

**B.Tech.**  
**IN**  
**ELECTRONICS & COMMUNICATION**  
**ENGINEERING**

**CURRICULUM AND SYLLABUS**

**(Applicable from 2024 onwards)**



**Department of Electronics & Communication Engineering**  
**NATIONAL INSTITUTE OF TECHNOLOGY MANIPUR**  
**Langol Road, Lamphelpat, Imphal, Manipur - 795004**

**COURSE STRUCTURE OF B.Tech. in ELECTRONICS AND COMMUNICATION ENGINEERING**

| Sl. No. | Course Components                           | No. of Course | Credits |
|---------|---------------------------------------------|---------------|---------|
| 1.      | Basic Science Courses (BSC)                 | 06            | 20      |
| 2.      | Engineering Science Courses (ESC)           | 07            | 26      |
| 3.      | Departmental Core Courses (DCC)             | 20            | 77      |
| 4.      | Departmental Elective Courses (DEC)         | 04            | 12      |
| 5.      | Open Elective Courses (OEC)                 | 02            | 06      |
| 6.      | Skill Enhancement Courses (SEC)             | 02            | 06      |
| 7.      | Ability Enhancement Mandatory Course (AEMC) | 04            | 11+8*   |
| 8.      | Value Addition Courses (VAC)                | 04            | 02      |
|         | <b>Total</b>                                | 51            | 160+8*  |

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**PROGRAMME STRUCTURE**  
**Semester I**

| Sl. No.      | Course Code | Course Name                       | Course Category | L  | T | P | Credits |
|--------------|-------------|-----------------------------------|-----------------|----|---|---|---------|
| 1.           | CH 1101     | Engineering Chemistry             | BSC-1           | 3  | 0 | 2 | 4       |
| 2.           | ME 1101     | Engineering Mechanics             | ESC-1           | 3  | 1 | 0 | 4       |
| 3.           | ME 1102     | Engineering Drawing               | ESC-2           | 1  | 2 | 0 | 3       |
| 4.           | MA 1101     | Engineering Mathematics-I         | BSC-2           | 3  | 0 | 0 | 3       |
| 5.           | PH 1101     | Engineering Physics-I             | BSC-3           | 3  | 0 | 2 | 4       |
| 6.           | HS 1101     | Professional Communication Skills | SEC-1           | 3  | 0 | 0 | 3       |
| 7.           | IC 1191     | Induction Programme*              | VAC-1           | 0  | 0 | 0 | 0       |
| 8.           | IC 1192     | Extra Academic Activity-I*        | VAC-2           | 0  | 0 | 0 | 0       |
| <b>Total</b> |             |                                   |                 | 16 | 3 | 4 | 21      |

**Semester II**

| Sl. No.      | Course Code | Course Name                  | Course Category | L  | T | P  | Credits |
|--------------|-------------|------------------------------|-----------------|----|---|----|---------|
| 1.           | CS 1201     | Introduction to Computing    | ESC-3           | 3  | 0 | 4  | 5       |
| 2.           | EE 1201     | Basic Electrical Engineering | ESC-4           | 3  | 0 | 2  | 4       |
| 3.           | MA 1201     | Engineering Mathematics-II   | BSC-4           | 3  | 0 | 0  | 3       |
| 4.           | EC 1201     | Basic Electronic Circuits    | ESC-5           | 3  | 0 | 2  | 4       |
| 5.           | CE 1201     | Environmental Engineering    | ESC-6           | 3  | 0 | 0  | 3       |
| 6.           | ME 1201     | Engineering Workshop         | ESC-7           | 1  | 0 | 4  | 3       |
| 7.           | IC 1291     | Extra Academic Activity-II*  | VAC-3           | 0  | 0 | 0  | 0       |
| <b>Total</b> |             |                              |                 | 16 | 0 | 12 | 22      |

\*Value Addition Courses (VAC) will be floated by Department of Humanities and Social Sciences (HSS).

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### Semester III

| Sl. No.      | Course Code | Course Name                                              | Course Category | L  | T | P | Credits |
|--------------|-------------|----------------------------------------------------------|-----------------|----|---|---|---------|
| 1.           | MA 2301     | Engineering Mathematics III                              | BSC-5           | 3  | 0 | 0 | 3       |
| 2.           | EC 2301     | Signals & Systems                                        | DCC-1           | 3  | 1 | 0 | 4       |
| 3.           | EC 2302     | Analog Communication                                     | DCC-2           | 3  | 0 | 2 | 4       |
| 4.           | EC 2303     | Analog Electronic Circuits                               | DCC-3           | 3  | 0 | 2 | 4       |
| 5.           | EC 2304     | Electronics and Electrical Measurement & Instrumentation | DCC-5           | 3  | 0 | 2 | 4       |
| 6.           | EE 2331     | Network Analysis and Synthesis                           | DCC-4           | 3  | 1 | 0 | 4       |
| <b>Total</b> |             |                                                          |                 | 18 | 2 | 6 | 23      |

### Semester IV

| Sl. No.      | Course Code | Course Name                           | Course Category | L  | T | P     | Credits |
|--------------|-------------|---------------------------------------|-----------------|----|---|-------|---------|
| 1.           | MA 2401     | Probability and Random Processes      | BSC-6           | 3  | 0 | 0     | 3       |
| 2.           | EC 2401     | Digital Electronics                   | DCC-6           | 3  | 0 | 2     | 4       |
| 3.           | EC 2402     | Digital Communication                 | DCC-7           | 3  | 0 | 2     | 4       |
| 4.           | EC 2403     | Introduction to Semiconductor Devices | DCC-8           | 3  | 1 | 0     | 4       |
| 5.           | EC 2404     | Digital Signal Processing             | DCC-10          | 3  | 0 | 2     | 4       |
| 6.           | EE 2431     | Control Systems                       | DCC-9           | 3  | 0 | 2     | 4       |
| 7.           | *EC2439     | Minor Project                         | AEMC-1          | 0  | 0 | 16    | 8       |
| <b>Total</b> |             |                                       |                 | 18 | 1 | 8+16* | 23+8*   |

\*NOTE: Minor Project (EC2439) is to be opted by the students who want to leave the program after IV Semester with UG Diploma in Electronics and Communication Engineering.

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### Semester V

| Sl. No. | Course Code | Course Name                                  | Course Category | L  | T | P | Credits |
|---------|-------------|----------------------------------------------|-----------------|----|---|---|---------|
| 1.      | EC 3501     | Introduction to Microprocessors              | DCC-11          | 3  | 0 | 2 | 4       |
| 2.      | EC 3502     | Electromagnetic Theory                       | DCC-12          | 3  | 0 | 0 | 3       |
| 3.      | EC 3503     | Artificial Neural Network & Its Applications | DCC-13          | 3  | 0 | 2 | 4       |
| 4.      | EC 3504     | IC Applications                              | DCC-14          | 3  | 0 | 2 | 4       |
| 5.      | EE 3531     | Industrial Electronics                       | DCC-15          | 3  | 0 | 0 | 3       |
| 6.      | EC 35XX     | Departmental Elective-I                      | DEC-1           | 3  | 0 | 0 | 3       |
|         |             | <b>Total</b>                                 |                 | 18 | 0 | 6 | 21      |

### Semester VI

| Sl. No. | Course Code | Course Name                                   | Course Category | L  | T | P | Credits |
|---------|-------------|-----------------------------------------------|-----------------|----|---|---|---------|
| 1.      | HS 3601     | Managerial Economics and Financial Accounting | SEC-2           | 3  | 0 | 0 | 3       |
| 1.      | EC 3601     | VLSI Design                                   | DCC-16          | 3  | 0 | 2 | 4       |
| 2.      | EC 3602     | Computer Networks                             | DCC-17          | 3  | 0 | 2 | 4       |
| 3.      | EC 3603     | Antenna and Wave Propagation                  | DCC-18          | 3  | 0 | 2 | 4       |
| 4.      | EC 36XX     | Departmental Elective-II                      | DEC-2           | 3  | 0 | 0 | 3       |
|         |             |                                               |                 |    |   |   |         |
|         |             | <b>Total</b>                                  |                 | 15 | 0 | 6 | 18      |

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### Semester VII

| Sl. No. | Course Code | Course Name                  | Course Category | L  | T | P  | Credits |
|---------|-------------|------------------------------|-----------------|----|---|----|---------|
| 1.      | EC 4701     | RF and Microwave Engineering | DCC-19          | 3  | 0 | 2  | 4       |
| 2.      | EC 4702     | Introduction to Photonics    | DCC-20          | 3  | 0 | 0  | 3       |
| 3.      | EC 47XX     | Departmental Elective-III    | DEC-3           | 3  | 0 | 0  | 3       |
| 4.      | EC 4738     | Internship/Summer Course     | VAC-4           | 0  | 0 | 4  | 2       |
| 5.      |             | Open Elective III            | OEC-3           | 3  | 0 | 0  | 3       |
| 6.      | EC 4739     | Project work-I               | AEMC-2          | 0  | 0 | 8  | 4       |
|         |             | <b>Total</b>                 |                 | 12 | 0 | 14 | 19      |

### Semester VIII

| Sl. No.                                                                          | Course Code | Course Name              | Course Category | L | T | P  | Credits |
|----------------------------------------------------------------------------------|-------------|--------------------------|-----------------|---|---|----|---------|
| 1.                                                                               | EC 48XX     | Departmental Elective-IV | DEC-4           | 3 | 0 | 0  | 3       |
| 2.                                                                               |             | Open Elective-IV         | OEC-4           | 3 | 0 | 0  | 3       |
| 3.                                                                               | EC 4835     | Seminar                  | AEMC-3          | 0 | 0 | 2  | 1       |
| 4.                                                                               | EC 4839     | Project Work-II          | AEMC-4          | 0 | 0 | 12 | 6       |
|                                                                                  |             | <b>Total</b>             |                 | 6 | 0 | 14 | 13      |
| <b>*For those students carrying out project work in Industries/Organizations</b> |             |                          |                 |   |   |    |         |
| 1.                                                                               | EC4840      | Industrial Project       |                 | 0 | 0 | 8  | 4       |
| 2.                                                                               | EC4841      | Project Seminar          |                 | 0 | 0 | 10 | 5       |
| 3.                                                                               | EC4842      | Comprehensive viva       |                 | 0 | 0 | 8  | 4       |
|                                                                                  |             | <b>Total</b>             |                 | 1 | 0 | 24 | 13      |

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**List of Basic Science Courses**

| Sl. No. | Course Code | Course Name                      | L | T | P | Credits |
|---------|-------------|----------------------------------|---|---|---|---------|
| 1.      | MA 1101     | Engineering Mathematics-I        | 3 | 0 | 0 | 3       |
| 2.      | CH 1101     | Engineering Chemistry            | 3 | 0 | 2 | 4       |
| 3.      | PH 1101     | Engineering Physics-I            | 3 | 0 | 2 | 4       |
| 4.      | MA 1201     | Engineering Mathematics-II       | 3 | 0 | 0 | 3       |
| 5.      | MA 2301     | Engineering Mathematics III      | 3 | 0 | 0 | 3       |
| 6.      | MA 2401     | Probability and Random Processes | 3 | 0 | 0 | 3       |
|         |             | <b>Total</b>                     |   |   |   | 20      |

**List of Engineering Science Courses**

| Sl. No. | Course Code | Course Name                  | L | T | P | Credits |
|---------|-------------|------------------------------|---|---|---|---------|
| 1.      | ME 1101     | Engineering Mechanics        | 3 | 1 | 0 | 4       |
| 2.      | ME 1149     | Engineering Drawing          | 0 | 1 | 4 | 3       |
| 3.      | CS 1201     | Introduction to Computing    | 3 | 0 | 4 | 5       |
| 4.      | EC 1201     | Basic Electronic Circuits    | 3 | 0 | 0 | 3       |
| 5.      | CE 1201     | Environmental Engineering    | 3 | 0 | 0 | 3       |
| 6.      | ME 1249     | Engineering Workshop         | 0 | 1 | 4 | 3       |
| 7.      | EE 1201     | Basic Electrical Engineering | 3 | 0 | 2 | 4       |
|         |             | <b>Total</b>                 |   |   |   | 25      |

**List of Skill Enhancement Courses**

| Sl. No. | Course Code | Course Name                                   | L | T | P | Credits |
|---------|-------------|-----------------------------------------------|---|---|---|---------|
| 1.      | HS 1101     | Professional Communication Skills             | 3 | 0 | 0 | 3       |
| 2.      | HS 3601     | Managerial Economics and Financial Accounting | 3 | 0 | 0 | 3       |
|         |             | <b>Total</b>                                  |   |   |   | 06      |

**List of Ability Enhancement Mandatory Course**

| Sl. No. | Course Code | Course Name     | L | T | P  | Credits |
|---------|-------------|-----------------|---|---|----|---------|
| 1.      | *EC2439     | Minor Project   | 0 | 0 | 16 | 8*      |
| 2.      | EC 4739     | Project work-I  | 0 | 0 | 8  | 4       |
| 3.      | EC 4835     | Seminar         | 0 | 0 | 2  | 1       |
| 4.      | EC 4839     | Project Work-II | 0 | 0 | 12 | 6       |
|         |             | <b>Total</b>    |   |   |    | 11+8*   |

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**List of Value Addition Courses**

| Sl. No. | Course Code | Course Name                | L | T | P | Credits |
|---------|-------------|----------------------------|---|---|---|---------|
| 1.      | IC 1191     | Induction Programme        |   |   |   | 0       |
| 2.      | IC 1192     | Extra Academic Activity-I  | 0 | 0 | 0 | 0       |
| 3.      | IC 1291     | Extra Academic Activity-II | 0 | 0 | 0 | 0       |
| 4.      | EC 4738     | Internship/ Summer Course  | 0 | 0 | 4 | 2       |
|         |             | <b>Total</b>               |   |   |   | 02      |

**List of Departmental Cores Courses**

| Sl. No. | Course Code | Course Name                                              | L | T | P | Credits |
|---------|-------------|----------------------------------------------------------|---|---|---|---------|
| 1.      | EC 2301     | Signals & Systems                                        | 3 | 1 | 0 | 4       |
| 2.      | EC 2302     | Analog Communication                                     | 3 | 0 | 2 | 4       |
| 3.      | EC 2303     | Analog Electronic Circuits                               | 3 | 0 | 2 | 4       |
| 4.      | EC2304      | Electronics and Electrical Measurement & Instrumentation | 3 | 0 | 2 | 4       |
| 5.      | EE 2331     | Network Analysis and Synthesis                           | 3 | 1 | 0 | 4       |
| 6.      | EC 2401     | Digital Electronics                                      | 3 | 0 | 2 | 4       |
| 7.      | EC 2402     | Digital Communication                                    | 3 | 0 | 2 | 4       |
| 8.      | EC 2403     | Introduction to Semiconductor Devices                    | 3 | 1 | 0 | 4       |
| 9.      | EC 2404     | Digital Signal Processing                                | 3 | 0 | 2 | 4       |
| 10.     | EE 2431     | Control Systems                                          | 3 | 0 | 2 | 4       |
| 11.     | EC 3501     | Introduction to Microprocessors                          | 3 | 0 | 2 | 4       |
| 12.     | EC 3502     | Electromagnetic Theory                                   | 3 | 0 | 0 | 3       |
| 13.     | EC 3503     | Artificial Neural Network & Its Applications             | 3 | 0 | 2 | 4       |
| 14.     | EC 3504     | IC Applications                                          | 3 | 0 | 2 | 4       |
| 15.     | EE 3531     | Industrial Electronics                                   | 3 | 0 | 0 | 3       |
| 16.     | EC 3601     | VLSI Design                                              | 3 | 0 | 2 | 4       |
| 17.     | EC 3602     | Computer Networks                                        | 3 | 0 | 2 | 4       |
| 18.     | EC 3603     | Antenna and Wave Propagation                             | 3 | 0 | 2 | 4       |
| 19.     | EC 4701     | RF and Microwave Engineering                             | 3 | 0 | 2 | 4       |
| 20.     | EC 4702     | Introduction to Photonics                                | 3 | 0 | 0 | 3       |
|         |             | <b>Total</b>                                             |   |   |   | 77      |

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**List of Departmental Electives**

| Sl. No. | Course Code | Course Name                                                  | L | T | P | Credits | Category     |
|---------|-------------|--------------------------------------------------------------|---|---|---|---------|--------------|
| 1.      | EC 3571     | Optical Fiber Communication                                  | 3 | 0 | 0 | 3       | Elective I   |
| 2.      | EC 3572     | Information Theory and Coding                                | 3 | 0 | 0 | 3       |              |
| 3.      | EC 3573     | Semiconductor Device Modelling                               | 3 | 0 | 0 | 3       |              |
| 4.      | EC 3574     | Wireless and Adhoc Networks                                  | 3 | 0 | 0 | 3       |              |
| 5.      | EC 3671     | Advanced Microprocessor                                      | 3 | 0 | 0 | 3       | Elective II  |
| 6.      | EC 3672     | Computer Organization and Architecture                       | 3 | 0 | 0 | 3       |              |
| 7.      | EC 3673     | Satellite Communication                                      | 3 | 0 | 0 | 3       |              |
| 8.      | EC 3674     | Introduction to Artificial Intelligence and Machine learning | 3 | 0 | 0 | 3       |              |
| 9.      | EC 3675     | VHDL and Verilog                                             | 3 | 0 | 0 | 3       | Elective III |
| 10.     | EC 4771     | Digital Image Processing                                     | 3 | 0 | 0 | 3       |              |
| 11.     | EC 4772     | Internet of Things                                           | 3 | 0 | 0 | 3       |              |
| 12.     | EC 4773     | Digital IC Design                                            | 3 | 0 | 0 | 3       |              |
| 13.     | EC 4774     | Embedded System                                              | 3 | 0 | 0 | 3       | Elective IV  |
| 14.     | EC 4775     | Low Power VLSI                                               | 3 | 0 | 0 | 3       |              |
| 15.     | EC 4871     | FPGA Based Physical Design                                   | 3 | 0 | 0 | 3       |              |
| 16.     | EC 4872     | Low Power Devices and System                                 | 3 | 0 | 0 | 3       |              |
| 17.     | EC 4873     | Semiconductor IC Technology                                  | 3 | 0 | 0 | 3       | Elective IV  |
| 18.     | EC 4874     | Radar Engineering                                            | 3 | 0 | 0 | 3       |              |
| 19.     | EC 4875     | Optimization Techniques                                      | 3 | 0 | 0 | 3       |              |

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**List of Open Electives**

| Sl. No. | Course Code | Course Name                                      | L | T | P | Credits | Elective Category |
|---------|-------------|--------------------------------------------------|---|---|---|---------|-------------------|
| 1.      | EC 4750     | Swayam NPTEL/ MOOCs courses                      | 3 | 0 | 0 | 3       | Elective I        |
| 2.      | EC 4751     | Introduction to Nano Science and Nano Technology | 3 | 0 | 0 | 3       |                   |
| 3.      | EC 4752     | Microelectronics and VLSI Technology             | 3 | 0 | 0 | 3       |                   |
| 4.      | EC 4753     | Modern Communication Technologies                | 3 | 0 | 0 | 3       |                   |
| 5.      | EC 4754     | Nano-Fabrication Techniques                      | 3 | 0 | 0 | 3       |                   |
| 6.      | EC 4755     | Wireless Sensor Networks                         | 3 | 0 | 0 | 3       |                   |
| 7.      | EC 4756     | RF Integrated Circuits                           | 3 | 0 | 0 | 3       |                   |
| 8.      | EC 4757     | Green Technologies                               | 3 | 0 | 0 | 3       |                   |
| 9.      | EC 4758     | Data Communication and Networking                | 3 | 0 | 0 | 3       |                   |
| 10.     | EC 4759     | Electronic Materials and their Applications      | 3 | 0 | 0 | 3       |                   |
| 11.     | EC 4850     | Swayam NPTEL/ MOOCs courses                      | 3 | 0 | 0 | 3       | Elective II       |
| 12.     | EC 4851     | Advanced Semiconductor Devices                   | 3 | 0 | 0 | 3       |                   |
| 13.     | EC 4852     | Image and Video Processing                       | 3 | 0 | 0 | 3       |                   |
| 14.     | EC 4853     | MEMS                                             | 3 | 0 | 0 | 3       |                   |
| 15.     | EC 4854     | 5G Communications and MIMO                       | 3 | 0 | 0 | 3       |                   |
| 16.     | EC 4855     | VLSI Physical Design                             | 3 | 0 | 0 | 3       |                   |
| 17.     | EC 4856     | Machine Learning and Pattern Recognition         | 3 | 0 | 0 | 3       |                   |
| 18.     | EC 4857     | Biophotonics                                     | 3 | 0 | 0 | 3       |                   |
| 19.     | EC 4858     | Hardware Description Language                    | 3 | 0 | 0 | 3       |                   |

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|---------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|--------------------------------------------|---------|----------------------|
| Course Code:<br>EC 1201                     |                                                                                                                                                      | Open Elective Course:<br>(Y/N)                                                                                                                                                                                                                                                                                                                                                                                               | Departmental Core Course: (Y/N)       | Departmental Elective Course: (Y/N)        |         |                      |
|                                             |                                                                                                                                                      | N                                                                                                                                                                                                                                                                                                                                                                                                                            | Y                                     | N                                          |         |                      |
| Type of Course                              |                                                                                                                                                      | Theory and Practical                                                                                                                                                                                                                                                                                                                                                                                                         |                                       |                                            |         |                      |
| Course Title                                |                                                                                                                                                      | Basic Electronic Circuits (EC1201)                                                                                                                                                                                                                                                                                                                                                                                           |                                       |                                            |         |                      |
| Course Objectives                           |                                                                                                                                                      | <ul style="list-style-type: none"><li>• This course will introduce students to the basic concepts underlying fundamental semiconductor devices like diode, BJT, MOSFETs.</li><li>• To familiarize students with the application of these devices in switching circuits, amplification and as operational amplifier.</li><li>• To learn the working of logic gates, combinational circuits and sequential circuits.</li></ul> |                                       |                                            |         |                      |
| Course Outcomes                             |                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                              |                                       | Cognitive Levels                           |         |                      |
| CO1                                         | To understand the working principle of diode, bipolar junction transistor (BJT), metal oxide semiconductor field effect transistor (MOSFET) devices. |                                                                                                                                                                                                                                                                                                                                                                                                                              |                                       | Knowledge/Comprehension (Level I/Level-II) |         |                      |
| CO2                                         | To analyse the models of diode, BJT, MOSFETs                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                              |                                       | Analysis (Level-IV)                        |         |                      |
| CO3                                         | To design the switching circuits and amplifier using diode, BJT, MOSFET devices                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                              |                                       | Application (Level-III)                    |         |                      |
| CO4                                         | To synthesize and evaluate combinational and sequential circuits.                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                              |                                       | Synthesis/Evaluation (Level-VI/Level-V)    |         |                      |
| Semester                                    |                                                                                                                                                      | VII                                                                                                                                                                                                                                                                                                                                                                                                                          |                                       | Summer                                     |         |                      |
| Contact Hours                               |                                                                                                                                                      | Lecture                                                                                                                                                                                                                                                                                                                                                                                                                      | Tutorial                              | Practical                                  | Credits | Total Teaching Hours |
|                                             |                                                                                                                                                      | 3                                                                                                                                                                                                                                                                                                                                                                                                                            | 0                                     | 2                                          | 4       | 48                   |
| Prerequisite course codes with course names |                                                                                                                                                      | Engineering Physics-I (PH1101)                                                                                                                                                                                                                                                                                                                                                                                               |                                       |                                            |         |                      |
| Text Books                                  |                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                              |                                       |                                            |         |                      |
| 1.                                          | Title                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                              | Electronic Devices and Circuit Theory |                                            |         |                      |
|                                             | Author                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                              | Robert L. Boylestad,                  |                                            |         |                      |
|                                             | Publisher                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                              | Prentice Hall                         |                                            |         |                      |
|                                             | Edition                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                              | 7 <sup>th</sup> Edition               |                                            |         |                      |
| 2.                                          | Title                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                              | Digital Design                        |                                            |         |                      |

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|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|----|
|                   | Author                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | M. Morris Mano and Michael D Ciletti                                                   |    |
|                   | Publisher                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Pearson                                                                                |    |
|                   | Edition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 5th Edition                                                                            |    |
| Reference Books   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                        |    |
| 1.                | Title                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Microelectronic Circuits                                                               |    |
|                   | Author                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Adel S Sedra and Kenneth C Smith                                                       |    |
|                   | Publisher                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Oxford University Press                                                                |    |
|                   | Edition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 7th Edition                                                                            |    |
| Course Contents   | <b>UNIT I: Introduction to Electronic Devices:</b><br>Passive devices, diode, bipolar junction transistor (BJT), metal oxide semiconductor field-effect transistor (MOSFET).<br>Diode: basic structure and operating principle, current-voltage characteristic, large and small signal models, iterative and graphical analysis; Diode Applications: rectifier circuits (half-wave and full-wave rectifiers, rectifiers with capacitor filter), voltage regulator (using Zener diode), clipper (limiter) circuits, clamper circuits                                          |                                                                                        | 12 |
|                   | <b>UNIT II: Bipolar Junction Transistor and their Applications:</b><br>Structure and modes of operation; n-p-n and p-n-p transistor in active mode, DC analysis of both transistor circuits; BJT as an amplifier, small-signal equivalent circuits, single-stage BJT amplifier (common-emitter mode); BJT as a switch; concepts of feedback amplifier<br>Operational Amplifier (Op Amp): ideal op amp; inverting amplifier, effect of finite gain, summing amplifier; non-inverting configuration, voltage follower; op amp applications like integrator and differentiator; |                                                                                        | 12 |
|                   | <b>UNIT III: Metal Oxide Semiconductor Field-Effect Transistors and their Applications:</b><br>Structure and physical operation of n-type and p-type MOSFET; DC analysis of MOSFET circuits; MOSFET as an amplifier, small-signal equivalent circuits, single-stage MOSFET amplifier (common source mode); MOSFET as a switch;                                                                                                                                                                                                                                               |                                                                                        | 12 |
|                   | <b>UNIT IV: Digital Electronics</b><br>Boolean algebra and rules of simplification; combinational circuits like adder, decoder, encoder, multiplexer and demultiplexer; sequential circuits like flip-flops, counters and shift registers                                                                                                                                                                                                                                                                                                                                    |                                                                                        | 12 |
|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                        |    |
| Course Assessment | Total Marks =100<br>Theory (75 Marks)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Evaluation will be done for 100 marks and 75% of the marks secured will be considered. |    |

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|  | <b>Practical (25 Marks)</b><br>Evaluation will be done for 50 marks and 50% of the marks secured will be considered. | <b>Continuous Evaluation 20%</b><br><b>Laboratory Examination 50%</b><br><b>Viva Voce 30%</b> |
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|                                       |                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |          |                                 |                                            |                                     |  |
|---------------------------------------|-------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---------------------------------|--------------------------------------------|-------------------------------------|--|
| Course Code:<br>EC 2301               |                                                                         | Open Elective Course:<br>(Y/N)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |          | Departmental Core Course: (Y/N) |                                            | Departmental Elective Course: (Y/N) |  |
|                                       |                                                                         | N                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |          | Y                               |                                            | N                                   |  |
| Type of Course                        |                                                                         | Theory Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |          |                                 |                                            |                                     |  |
| Course Title & Code                   |                                                                         | Signals & Systems (EC 2301)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |          |                                 |                                            |                                     |  |
| Course Objectives                     |                                                                         | <ul style="list-style-type: none"><li>● To understand the Classification and Representation of Signals and systems.</li><li>● To gain an understanding of systems (both continuous and discrete), including linear and time-invariant (LTI) systems, and their properties.</li><li>● To cover the fundamental concepts of sampling theory, aliasing, and reconstruction of signals from their samples.</li><li>● To analyse the impulse and step responses of systems and how these responses impact system behaviour.</li></ul> |          |                                 |                                            |                                     |  |
| Course Outcomes                       |                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |          |                                 | Cognitive Levels                           |                                     |  |
| CO1                                   | To analyze various types of signals and describe system characteristics |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |          |                                 | Analysis/Comprehension (Level IV/Level-II) |                                     |  |
| CO2                                   | To analyze systems that process signals.                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |          |                                 | Knowledge/Analysis (Level-I/Level-IV)      |                                     |  |
| CO3                                   | To perform time-domain analysis                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |          |                                 | Application/Analysis (Level-III/Level-IV)  |                                     |  |
| CO4                                   | To conduct frequency-domain analysis                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |          |                                 | Synthesis/Evaluation (Level-V/Level-VI)    |                                     |  |
| Semester                              |                                                                         | III                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |          |                                 | Summer                                     |                                     |  |
| Contact Hours                         |                                                                         | Lecture                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Tutorial | Practical                       | Credits                                    | Total Teaching Hours                |  |
|                                       |                                                                         | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 1        | 0                               | 4                                          | 48                                  |  |
| Prerequisite course codes with course |                                                                         | Engineering Mathematics-I(MA1101); Engineering Mathematics-II(MA1201)                                                                                                                                                                                                                                                                                                                                                                                                                                                            |          |                                 |                                            |                                     |  |

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| names           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                             |    |
| Text Books      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                             |    |
| 1.              | Title                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Fundamentals of Signals and Systems         |    |
|                 | Author                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Michael Roberts, Govind Sharma              |    |
|                 | Publisher                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | McGraw Hill Education                       |    |
|                 | Edition                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 2 <sup>nd</sup> Edition                     |    |
| 2.              | Title                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Signals and Systems                         |    |
|                 | Author                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | A.V. Oppenheim, A.S. Willsky and H.S. Nawab |    |
|                 | Publisher                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Prentice Hall of India                      |    |
|                 | Edition                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 2 <sup>nd</sup> Edition                     |    |
| Reference Books |                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                             |    |
| 1.              | Title                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Signals and Systems                         |    |
|                 | Author                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Barry Van Veen,Simon Haykin                 |    |
|                 | Publisher                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Wiley                                       |    |
|                 | Edition                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 2 <sup>nd</sup> Edition                     |    |
| Course Contents | UNIT I: Introduction: Definitions of signals and systems, standard signas-step, ramp, pulse, impulse, real and complex exponentials and sinusoids, classification of signals-continuous time and discrete time signals, Periodic and Aperiodic signals, Deterministic and Random Signals, Energy and Power Signals, classification of systems-CT systems and DT systems, linear and nonlinear, time-variant and time-invariant, causal and non-causal, stable and unstable. |                                             | 14 |
|                 | UNIT II: Linear Time Invariant Continuous Time Systems:Impulse response, continuous integrals, differential equation, Fourier and Laplace transforms in analysis of CT systems, systems connected in series/parallel                                                                                                                                                                                                                                                        |                                             | 10 |
|                 | UNIT III: Analysis of Continuous Time: Fourier Series for periodic signals-Fourier Transform-properties-Laplace transforms and properties                                                                                                                                                                                                                                                                                                                                   |                                             | 10 |
|                 | UNIT IV: Analysis of Discrete Time Signals&Linear Time Invariant Discrete Time Systems: Impulse response, difference equations, convolution sum, Discrete Fourier Transform and Z transform, analysis of Recursive and Non-recursive systems, DT systems connected in series and parallel, Baseband signals sampling-Fourier Transform of discrete time signals (DTFT), properties of DTFT, Z-transform and properties                                                      |                                             | 14 |
| Course          | Total Marks=100                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Continuous Evaluation 20%                   |    |

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| <b>Assessment</b> |  | Mid Semester 30%<br>End Semester 50% |
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| <b>Course Code:</b><br>EC 2302 |                                                                                                                                             | <b>Open Elective Course:</b><br>(Y/N)                                                                                                                                                                                                                                                                   |          | <b>Departmental Core Course:</b> (Y/N) |               | <b>Departmental Elective Course:</b> (Y/N)        |  |
|                                |                                                                                                                                             | N                                                                                                                                                                                                                                                                                                       |          | Y                                      |               | N                                                 |  |
| <b>Type of Course</b>          |                                                                                                                                             | Theory and Practical                                                                                                                                                                                                                                                                                    |          |                                        |               |                                                   |  |
| <b>Course Title &amp; Code</b> |                                                                                                                                             | Analog Communication (EC 2302)                                                                                                                                                                                                                                                                          |          |                                        |               |                                                   |  |
| <b>Course Objectives</b>       |                                                                                                                                             | <ul style="list-style-type: none"><li>● Familiarization with modulation and demodulation schemes for analog communications (AM, FM and PM).</li><li>● Understanding of Noise encountered during communication.</li><li>● Evaluation of the impact of noise on the various modulation schemes.</li></ul> |          |                                        |               |                                                   |  |
| <b>Course Outcomes</b>         |                                                                                                                                             |                                                                                                                                                                                                                                                                                                         |          |                                        |               | <b>Cognitive Levels</b>                           |  |
| <b>CO1</b>                     | Identify and understand different modulation and demodulation schemes for analog communications (AM, FM and PM).                            |                                                                                                                                                                                                                                                                                                         |          |                                        |               | Knowledge/<br>Comprehension<br>(Level I/Level-II) |  |
| <b>CO2</b>                     | Evaluate fundamental communication system parameters, such as bandwidth, power and signal to noise ratio, noise figure, sampling frequency. |                                                                                                                                                                                                                                                                                                         |          |                                        |               | Application<br>(Level-III)                        |  |
| <b>CO3</b>                     | Design analog communication systems to meet desired application requirements.                                                               |                                                                                                                                                                                                                                                                                                         |          |                                        |               | Analysis<br>(Level-IV)                            |  |
| <b>CO4</b>                     | Elucidate the design tradeoffs and performance of communications systems.                                                                   |                                                                                                                                                                                                                                                                                                         |          |                                        |               | Synthesis/ Evaluation<br>(Level-VI/Level-V)       |  |
| <b>Semester</b>                |                                                                                                                                             | <b>III</b>                                                                                                                                                                                                                                                                                              |          |                                        | <b>Summer</b> |                                                   |  |
| <b>Contact Hours</b>           |                                                                                                                                             | Lecture                                                                                                                                                                                                                                                                                                 | Tutorial | Practical                              | Credits       | Total Teaching Hours                              |  |
|                                |                                                                                                                                             | 3                                                                                                                                                                                                                                                                                                       | 0        | 2                                      | 4             | 36                                                |  |

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| Prerequisite course codes with course names |                                                                                                                                                                                                                                                                                                                                                              | Engineering Mathematics – II (MA 1201)               |    |
| Text Books                                  |                                                                                                                                                                                                                                                                                                                                                              |                                                      |    |
| 1.                                          | Title                                                                                                                                                                                                                                                                                                                                                        | Modern Digital and Analog Communication Systems      |    |
|                                             | Author                                                                                                                                                                                                                                                                                                                                                       | B.P.Lathi                                            |    |
|                                             | Publisher                                                                                                                                                                                                                                                                                                                                                    | Oxford University Press, New Delhi.                  |    |
|                                             | Edition                                                                                                                                                                                                                                                                                                                                                      | Latest edition                                       |    |
| 2.                                          | Title                                                                                                                                                                                                                                                                                                                                                        | An Introduction to Analog and Digital Communication, |    |
|                                             | Author                                                                                                                                                                                                                                                                                                                                                       | Symon Haykins                                        |    |
|                                             | Publisher                                                                                                                                                                                                                                                                                                                                                    | John Willy and Sons, New York                        |    |
|                                             | Edition                                                                                                                                                                                                                                                                                                                                                      | Latest Edition                                       |    |
| Reference Books                             |                                                                                                                                                                                                                                                                                                                                                              |                                                      |    |
| 1.                                          | Title                                                                                                                                                                                                                                                                                                                                                        | Communication Systems                                |    |
|                                             | Author                                                                                                                                                                                                                                                                                                                                                       | A. B. Carlson                                        |    |
|                                             | Publisher                                                                                                                                                                                                                                                                                                                                                    | McGraw Hill                                          |    |
|                                             | Edition                                                                                                                                                                                                                                                                                                                                                      | Latest Edition                                       |    |
| Course Contents                             | UNIT I: Signal Transmission<br>Signal transmission and filtering: response of LTI systems, transfer functions, distortionless transmission, linear and non linear distortions. Ideal filters, real filters and quadrature filters. Hilbert transform. Correlation and spectral density -correlation of power and energy signals, spectral density functions. |                                                      | 7  |
|                                             | UNIT II: Linear Continuous Wave Modulation<br>Linear CW modulation: bandpass systems and signals, AM, DSB signals and spectra. Tone modulation and phasor analysis. Modulators and transmitters. SSB and VSB signals and their spectra. Synchronous and                                                                                                      |                                                      | 13 |

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|                          | envelope detection. Exponential CW modulation: FM and PM signals, narrowband FM and PM. Tone, multitone and periodic modulation. Wideband FM, direct and indirect FM, capture effect, detection.                                                                                                                                                                                                                                                                                                                                                                                      |                                                                          |
|                          | <b>UNIT III: Probability and Noise</b><br>Probability and Random variables: principles, conditional probabilities and statistical independence. Random variables and probability functions. Statistical averages. Probability models: Binomial and Poisson distribution. Gaussian and Rayleigh PDF. Random processes: principles, ensemble averages and correlation functions. Stationary and Ergodic process. Noise: types, sources, frequency domain representation of noise, spectral components of noise, equivalent BW, additive white Gaussian noise and signal to noise ratio. | 11                                                                       |
|                          | <b>UNIT IV: Sequential Logic Circuits</b><br>Noise in CW modulation: system models, predetection S/N, quadrature components. Linear modulation with noise, synchronous and envelope detection, threshold effect.                                                                                                                                                                                                                                                                                                                                                                      | 5                                                                        |
| <b>Course Assessment</b> | Total Marks =100<br>Theory (80 Marks)<br>Evaluation will be done for 100 marks and 80% of the marks secured will be considered.                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50%        |
|                          | Practical (20 Marks)<br>Evaluation will be done for 50 marks and 40% of the marks secured will be considered.                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Continuous Evaluation 20%<br>Laboratory Examination 50%<br>Viva Voce 30% |

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| <b>Course Code:</b><br>EC 2303 | <b>Open Elective Course:</b><br>(Y/N) | <b>Departmental Core Course:</b> (Y/N) | <b>Departmental Elective Course:</b> (Y/N) |
|                                | N                                     | Y                                      | N                                          |
| <b>Type of Course</b>          | Theory and Practical                  |                                        |                                            |
| <b>Course Title &amp;</b>      | Analog Electronic Circuits (EC2303)   |                                        |                                            |

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| <b>Code</b>                                        |                                                                                          |                                                                                                                                                                                                                     |          |                                                 |               |                      |  |
| <b>Course Objectives</b>                           |                                                                                          | <ul style="list-style-type: none"><li>● To make the students understand the fundamentals of basic electronic circuits such as Diodes, BJTs and FETs.</li><li>● To introduce the PLL and its applications.</li></ul> |          |                                                 |               |                      |  |
| <b>Course Outcomes</b>                             |                                                                                          |                                                                                                                                                                                                                     |          | <b>Cognitive Levels</b>                         |               |                      |  |
| <b>CO1</b>                                         | Illustrate about diodes, rectifiers, and BJT and FET amplifiers.                         |                                                                                                                                                                                                                     |          | Knowledge/Comprehension (Level I/Level-II)      |               |                      |  |
| <b>CO2</b>                                         | Discuss biasing, low frequency models and frequency response for BJT and FET amplifiers. |                                                                                                                                                                                                                     |          | Knowledge/Comprehension (Level I/Level-II)      |               |                      |  |
| <b>CO3</b>                                         | Illustrate differential amplifiers and their characteristics.                            |                                                                                                                                                                                                                     |          | Knowledge/Comprehension (Level I/Level-II)      |               |                      |  |
| <b>CO4</b>                                         | Discuss feedback concepts, power amplifiers, and oscillator circuits.                    |                                                                                                                                                                                                                     |          | Knowledge/Comprehension (Level I/Level-II)      |               |                      |  |
| <b>Semester</b>                                    |                                                                                          | <b>III</b>                                                                                                                                                                                                          |          |                                                 | <b>Summer</b> |                      |  |
| <b>Contact Hours</b>                               |                                                                                          | Lecture                                                                                                                                                                                                             | Tutorial | Practical                                       | Credits       | Total Teaching Hours |  |
|                                                    |                                                                                          | 3                                                                                                                                                                                                                   | 0        | 2                                               | 4             | 36                   |  |
| <b>Prerequisite course codes with course names</b> |                                                                                          | Basic Electronics Circuit(EC 1201)                                                                                                                                                                                  |          |                                                 |               |                      |  |
| <b>Text Books</b>                                  |                                                                                          |                                                                                                                                                                                                                     |          |                                                 |               |                      |  |
| 1.                                                 | Title                                                                                    |                                                                                                                                                                                                                     |          | Microelectronic Circuits Theory and Application |               |                      |  |
|                                                    | Author                                                                                   |                                                                                                                                                                                                                     |          | Sedra and Smith                                 |               |                      |  |
|                                                    | Publisher                                                                                |                                                                                                                                                                                                                     |          | Oxford publication                              |               |                      |  |
|                                                    | Edition                                                                                  |                                                                                                                                                                                                                     |          | 7 <sup>th</sup> Edition                         |               |                      |  |

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| 2.              | Title                                                                                                                                                                                                                                                                                                                                                                                                                                    | Electronic Circuit Analysis and Design                            |
|                 | Author                                                                                                                                                                                                                                                                                                                                                                                                                                   | Donald A. Neamen                                                  |
|                 | Publisher                                                                                                                                                                                                                                                                                                                                                                                                                                | Irwin Publications                                                |
|                 | Edition                                                                                                                                                                                                                                                                                                                                                                                                                                  | 3 <sup>nd</sup> Edition                                           |
| Reference Books |                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                   |
| 1.              | Title                                                                                                                                                                                                                                                                                                                                                                                                                                    | Design with Operational Amplifiers and Analog Integrated Circuits |
|                 | Author                                                                                                                                                                                                                                                                                                                                                                                                                                   | Sergio Franco                                                     |
|                 | Publisher                                                                                                                                                                                                                                                                                                                                                                                                                                | Tata McGraw Hill Book Company                                     |
|                 | Edition                                                                                                                                                                                                                                                                                                                                                                                                                                  | 3 <sup>rd</sup> Edition                                           |
| Course Contents | <b>UNIT I:</b><br>Small signal equivalent circuits of diode, Simple diode circuits, clipping, clamping, rectifier, Voltage multiplier, Zener diode and voltage regulator. Review of BJT operation and its characteristics, need of biasing and different types of biasing circuits for BJT & FET, stability analysis, small signal Amplifier analysis of BJT & FET, estimation of voltage gain, input resistance, output resistance etc. |                                                                   |
|                 | <b>UNIT II:</b><br>Feedback concept, Feedback amplifier topologies, General characteristics of negative feedback amplifier, input and output resistance with negative feedback, Method of analysis of feedback amplifiers with practical examples. Definition of class A, B and C power amplifiers, Distortion analysis, Series fed and transformer coupled power amplifier, Push-pull amplifiers, Conversion efficiency                 |                                                                   |
|                 | <b>UNIT III:</b><br>Basic operation of differential Amplifier, Different configuration of differential Amplifier, Calculation of gain, impedance etc. Biasing of differential Amplifier, calculation of differential gain, common mode gain, CMRR.                                                                                                                                                                                       |                                                                   |
|                 | <b>UNIT IV:</b><br>Review of the basic concept for oscillation, Barkhausen criterion, LC Oscillators, RC phase shift oscillator and Wien bridge oscillator, Colpitts,                                                                                                                                                                                                                                                                    |                                                                   |

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|                          | Hartley and Crystal oscillator, PLL as negative feedback system, building blocks of PLL, applications of PLL                    |                                                                          |
| <b>Course Assessment</b> | Total Marks =100<br>Theory (75 Marks)<br>Evaluation will be done for 100 marks and 75% of the marks secured will be considered. | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50%        |
|                          | Practical (25 Marks)<br>Evaluation will be done for 50 marks and 50% of the marks secured will be considered.                   | Continuous Evaluation 20%<br>Laboratory Examination 50%<br>Viva Voce 30% |

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| Course Code:<br>EC 2304 | Open Elective Course:<br>(Y/N)<br>N                                                                                                                                                                                                                                                                                                                              | Departmental Core Course: (Y/N)<br>Y | Departmental Elective Course: (Y/N)<br>N   |
| Type of Course          | Theory and Practical                                                                                                                                                                                                                                                                                                                                             |                                      |                                            |
| Course Title & Code     | Electronics and Electrical Measurement & Instrumentation (EC 2304)                                                                                                                                                                                                                                                                                               |                                      |                                            |
| Course Objectives       | <ul style="list-style-type: none"> <li>To introduce Basic measurement techniques of Electronics and Electrical studies</li> <li>To Learn in detail the various measurement techniques.</li> <li>To learn handling of large volume of measurement data and interpretation.</li> <li>To learn new digital techniques of measurement and instrumentation</li> </ul> |                                      |                                            |
| Course Outcomes         |                                                                                                                                                                                                                                                                                                                                                                  |                                      | Cognitive Levels                           |
| CO1                     | To understand the basic fundamentals of electronics and electrical measurement and instrumentation in detail.                                                                                                                                                                                                                                                    |                                      | Knowledge/Comprehension (Level I/Level-II) |
| CO2                     | To understand and evaluate large volume large volume of measurement data and interpretation.                                                                                                                                                                                                                                                                     |                                      | Application (Level-III)                    |
| CO3                     | To understand various measurement and instrumentation techniques                                                                                                                                                                                                                                                                                                 |                                      | Analysis (Level-IV)                        |
| CO4                     | To implement measurement and/instrumentation for any industrial and laboratory requirements                                                                                                                                                                                                                                                                      |                                      | Synthesis/Evaluation (Level-VI/Level-V)    |
| Semester                | VI                                                                                                                                                                                                                                                                                                                                                               | Summer                               |                                            |

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| Contact Hours                               | Lecture                                                                                                                                                                                                                                                                                                   | Tutorial | Practical                                                              | Credits | Total Teaching Hours |
|                                             | 3                                                                                                                                                                                                                                                                                                         | 0        | 2                                                                      | 4       | 36                   |
| Prerequisite course codes with course names | Basic Electronic Circuits (EC 1201)                                                                                                                                                                                                                                                                       |          |                                                                        |         |                      |
| Text Books                                  |                                                                                                                                                                                                                                                                                                           |          |                                                                        |         |                      |
| 1.                                          | Title                                                                                                                                                                                                                                                                                                     |          | A course in Electrical and Electronic Measurements and Instrumentation |         |                      |
|                                             | Author                                                                                                                                                                                                                                                                                                    |          | A.K. Sawhney                                                           |         |                      |
|                                             | Publisher                                                                                                                                                                                                                                                                                                 |          | Dhanpat Rai & Co.                                                      |         |                      |
|                                             | Edition                                                                                                                                                                                                                                                                                                   |          | 19 <sup>th</sup> Revised Edition, 2011                                 |         |                      |
| 2.                                          | Title                                                                                                                                                                                                                                                                                                     |          | Electronic Measurements and Instrumentation                            |         |                      |
|                                             | Author                                                                                                                                                                                                                                                                                                    |          | RK Rajput                                                              |         |                      |
|                                             | Publisher                                                                                                                                                                                                                                                                                                 |          | S Chand                                                                |         |                      |
|                                             | Edition                                                                                                                                                                                                                                                                                                   |          | 2009                                                                   |         |                      |
| Reference Books                             |                                                                                                                                                                                                                                                                                                           |          |                                                                        |         |                      |
| 1.                                          | Title                                                                                                                                                                                                                                                                                                     |          | Electronic Instrumentation & Measurement                               |         |                      |
|                                             | Author                                                                                                                                                                                                                                                                                                    |          | David A Bell                                                           |         |                      |
|                                             | Publisher                                                                                                                                                                                                                                                                                                 |          | Oxford University Press                                                |         |                      |
|                                             | Edition                                                                                                                                                                                                                                                                                                   |          | 3 <sup>rd</sup> Edition, 2013                                          |         |                      |
| Course Contents                             | UNIT I: Introduction<br>Significance of Measurement, Methods of Measurement Classification of Instruments, Analog, Digital, and Smart Instruments                                                                                                                                                         |          |                                                                        |         | 7                    |
|                                             | UNIT II: Basic Measurement Techniques<br>Construction and principle of operation of Moving coil, Moving Iron, dynamometer, Wattmeter, Electro-static Instruments, Thermal and Rectifier type deflecting instruments, extension of instrument ranges using shunts, multipliers and instrument transformers |          |                                                                        |         | 7                    |
|                                             | UNIT III: Statistics in Measurement<br>Definition of accuracy, precision, Fidelity, speed of response, non-linearity, techniques of linearization, classification of errors                                                                                                                               |          |                                                                        |         | 7                    |

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|                   | UNIT IV: Measurement of Electronic and electrical quantities<br>Measurements of Resistances, AC Bridges, Measurement of power & Energy. Sensors & Transducers, Digital Instrumentation, Frequency domain instruments. | 15                                                                       |
| Course Assessment | Total Marks=100<br>Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50%                                                                                                                                  | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50%        |
|                   | Practical (25 Marks)<br>Evaluation will be done for 50 marks and 50% of the marks secured will be considered.                                                                                                         | Continuous Evaluation 20%<br>Laboratory Examination 50%<br>Viva Voce 30% |

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|--------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|--------------------------------------------|
| <b>Course Code:</b><br>EE 2331 | <b>Open Elective Course:</b><br>(Y/N)                                                                                                                                                                      | <b>Departmental Core Course:</b> (Y/N) | <b>Departmental Elective Course:</b> (Y/N) |
|                                | N                                                                                                                                                                                                          | Y                                      | N                                          |
| <b>Type of Course</b>          | Theory and Practical                                                                                                                                                                                       |                                        |                                            |
| <b>Course Title &amp; Code</b> | Network Analysis and Synthesis (EE 2331)                                                                                                                                                                   |                                        |                                            |
| <b>Course Objectives</b>       | <ul style="list-style-type: none"> <li>To introduce the fundamentals of network analysis using matrices</li> <li>To analyze two-port network and circuits</li> <li>To perform network synthesis</li> </ul> |                                        |                                            |
| <b>Course Outcomes</b>         |                                                                                                                                                                                                            |                                        | <b>Cognitive Levels</b>                    |
| <b>CO1</b>                     | To understand the various laws and theorems related to electric networks.                                                                                                                                  |                                        | Knowledge/Comprehension (Level-I/Level-II) |
| <b>CO2</b>                     | To apply the graph theory and network theorems in circuit analysis.                                                                                                                                        |                                        | Application (Level-III)                    |
| <b>CO3</b>                     | To analyse and evaluate the networks in transformed domain                                                                                                                                                 |                                        | Analysis/Evaluation (Level-IV/V)           |
| <b>CO4</b>                     | To analyse and synthesize the two port network functions.                                                                                                                                                  |                                        | Analysis/Synthesis (Level-IV/Level-VI)     |
| <b>Semester</b>                | <b>III</b>                                                                                                                                                                                                 |                                        | <b>Summer</b>                              |
| <b>Contact Hours</b>           | Lecture                                                                                                                                                                                                    | Tutorial                               | Practical Credits Total Teaching           |

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|----------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|--------------------------------|---|-----------|
|                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                    |   |                                |   | Hours     |
|                                                    | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 1 | 0                              | 4 | 48        |
| <b>Prerequisite course codes with course names</b> | Basic Electronic Circuits (EC 1201); Engineering Physics-I (PH1101)                                                                                                                                                                                                                                                                                                                                                                                |   |                                |   |           |
| <b>Text Books</b>                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                    |   |                                |   |           |
| 1.                                                 | Title                                                                                                                                                                                                                                                                                                                                                                                                                                              |   | Network Analysis               |   |           |
|                                                    | Author                                                                                                                                                                                                                                                                                                                                                                                                                                             |   | M.E. Van Valkenburg            |   |           |
|                                                    | Publisher                                                                                                                                                                                                                                                                                                                                                                                                                                          |   | Prentice Hall                  |   |           |
|                                                    | Edition                                                                                                                                                                                                                                                                                                                                                                                                                                            |   | 3 <sup>rd</sup> Edition        |   |           |
| 2.                                                 | Title                                                                                                                                                                                                                                                                                                                                                                                                                                              |   | Network Analysis and Synthesis |   |           |
|                                                    | Author                                                                                                                                                                                                                                                                                                                                                                                                                                             |   | Franklin F. Kuo                |   |           |
|                                                    | Publisher                                                                                                                                                                                                                                                                                                                                                                                                                                          |   | Wiley                          |   |           |
|                                                    | Edition                                                                                                                                                                                                                                                                                                                                                                                                                                            |   | 2 <sup>nd</sup> Edition        |   |           |
| <b>Reference Books</b>                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                    |   |                                |   |           |
| 1.                                                 | Title                                                                                                                                                                                                                                                                                                                                                                                                                                              |   | Engineering Circuit Analysis   |   |           |
|                                                    | Author                                                                                                                                                                                                                                                                                                                                                                                                                                             |   | W. H. Hayt and J E Kemmerly    |   |           |
|                                                    | Publisher                                                                                                                                                                                                                                                                                                                                                                                                                                          |   | TMH                            |   |           |
|                                                    | Edition                                                                                                                                                                                                                                                                                                                                                                                                                                            |   | 8 <sup>th</sup> Ed.            |   |           |
| <b>Course Contents</b>                             | <b>UNIT I:</b><br>Introduction: KCL, KVL, Network theorems: Superposition, Reciprocity, Thevenin's, Norton's, Millman's, Maximum Power Transfer theorems. And its application in the analysis of networks.                                                                                                                                                                                                                                         |   |                                |   | <b>12</b> |
|                                                    | <b>UNIT II:</b><br>Network Functions and Response Analysis: Concept of complex frequency, driving point and transfer functions for one port and two port network, poles & zeros of network functions, Restriction on Pole and Zero locations of network function, Impulse response and complete response, Time domain behavior form pole-zero plot                                                                                                 |   |                                |   | <b>12</b> |
|                                                    | <b>UNIT III:</b><br>Poly-Phase Circuits: Introduction to polyphase system, Generation of three-phase voltages, Interconnection of 3 phase sources and loads, Star-to-Delta and Delta-toStar transformation, Voltage, current and power in a star and delta connected system, three phase balanced and unbalanced circuits.Two Port networks: Two port parameters, relationships among different network parameters, inter connections of networks. |   |                                |   | <b>12</b> |

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|                          | <b>UNIT IV:</b><br>Network Synthesis: Realizability concept, Hurwitz property, positive realness, properties of positive real functions, properties of one port immittance functions and their synthesis, Foster and Cauer forms, RLC synthesis, Introduction to two port network synthesis. |                                                                          | <b>12</b> |
| <b>Course Assessment</b> | Total Marks =100<br>Theory (75 Marks)<br>Evaluation will be done for 100 marks and 75% of the marks secured will be considered.                                                                                                                                                              | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50%        |           |
|                          | Practical (25 Marks)<br>Evaluation will be done for 50 marks and 50% of the marks secured will be considered.                                                                                                                                                                                | Continuous Evaluation 20%<br>Laboratory Examination 50%<br>Viva Voce 30% |           |

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|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|-------------------------------------------|
| Course Code:<br>EC 2401 | Open Elective Course:<br>(Y/N)                                                                                                                                                                                                                                                                                      | Departmental Core Course:<br>(Y/N) | Departmental Elective Course:<br>(Y/N)    |
|                         | N                                                                                                                                                                                                                                                                                                                   | Y                                  | N                                         |
| Type of Course          | Theory and Practical                                                                                                                                                                                                                                                                                                |                                    |                                           |
| Course Title & Code     | Digital Electronics (EC2401)                                                                                                                                                                                                                                                                                        |                                    |                                           |
| Course Objectives       | <ul style="list-style-type: none"> <li>To introduce the concept of number system and logic gates</li> <li>To design the combinational and sequential logic circuits and to develop the characteristics of TTL/CMOS logic families.</li> <li>To understand memory devices such as SRAM/DRAM organization.</li> </ul> |                                    |                                           |
| Course Outcomes         |                                                                                                                                                                                                                                                                                                                     |                                    | Cognitive Levels                          |
| CO1                     | To acquire the basic knowledge of digital logic levels and application of knowledge to understand digital electronics circuits.                                                                                                                                                                                     |                                    | Knowledge(Level I)                        |
| CO2                     | To introduce the concept of digital and binary systems                                                                                                                                                                                                                                                              |                                    | Comprehension (Level-II)                  |
| CO3                     | To be able to design and analyse combinational logic circuits.                                                                                                                                                                                                                                                      |                                    | Application/Analysis (Level-III/Level-IV) |
| CO4                     | To be able to design and analyse sequential logic circuits.                                                                                                                                                                                                                                                         |                                    | Synthesis/Evaluation (Level-VI/Level-V)   |

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|---------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|------------------------------------------|---------|----------------------|--|
| Semester                                    | IV                                                                                                                                                                                                                                                                                                                                                                                                                                               |          |                                          | Winter  |                      |  |
| Contact Hours                               | Lecture                                                                                                                                                                                                                                                                                                                                                                                                                                          | Tutorial | Practical                                | Credits | Total Teaching Hours |  |
|                                             | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                | 0        | 2                                        | 4       | 36                   |  |
| Prerequisite course codes with course names | Basic Electronic Circuits (EC1201)<br>Engineering Physics-I (PH1101)                                                                                                                                                                                                                                                                                                                                                                             |          |                                          |         |                      |  |
| Text Books                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                  |          |                                          |         |                      |  |
| 1.                                          | Title                                                                                                                                                                                                                                                                                                                                                                                                                                            |          | Digital Electronics                      |         |                      |  |
|                                             | Author                                                                                                                                                                                                                                                                                                                                                                                                                                           |          | WH Gothmann                              |         |                      |  |
|                                             | Publisher                                                                                                                                                                                                                                                                                                                                                                                                                                        |          | PHI                                      |         |                      |  |
|                                             | Edition                                                                                                                                                                                                                                                                                                                                                                                                                                          |          | 2 <sup>nd</sup> Edition                  |         |                      |  |
| Reference Books                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                  |          |                                          |         |                      |  |
| 1.                                          | Title                                                                                                                                                                                                                                                                                                                                                                                                                                            |          | Digital Logic & Computer Design          |         |                      |  |
|                                             | Author                                                                                                                                                                                                                                                                                                                                                                                                                                           |          | M Morris Mano                            |         |                      |  |
|                                             | Publisher                                                                                                                                                                                                                                                                                                                                                                                                                                        |          | Pearson                                  |         |                      |  |
|                                             | Edition                                                                                                                                                                                                                                                                                                                                                                                                                                          |          | 5 <sup>th</sup> , 2011                   |         |                      |  |
| 2.                                          | Title                                                                                                                                                                                                                                                                                                                                                                                                                                            |          | Digital Design, Principles and Practices |         |                      |  |
|                                             | Author                                                                                                                                                                                                                                                                                                                                                                                                                                           |          | J. F. Wakerly                            |         |                      |  |
|                                             | Publisher                                                                                                                                                                                                                                                                                                                                                                                                                                        |          | Pearson Education                        |         |                      |  |
|                                             | Edition                                                                                                                                                                                                                                                                                                                                                                                                                                          |          | 4 <sup>th</sup> , 2005                   |         |                      |  |
| Course Contents                             | UNIT I: Number System and Boolean Algebra<br>Introduction to number systems, binary, Integer and floating-point-numbers, octal, hexadecimal and decimal number system and their conversion.<br>Arithmetic Operations: Binary addition & subtraction; 1's and 2's complement, subtraction using 2's complement; binary codes, addition and subtraction operations on binary-coded numbers; Algorithms for performing multiplication and division. |          |                                          |         | 9                    |  |
|                                             | UNIT II: Combinational Logic Circuits<br>Basic Logic Operations, AND, OR, NOR, NAND, EX-OR, EX-NOR Gates, Boolean expressions and their minimization using algebraic identities; Karnaugh map representation and minimization of Boolean functions using K-map; Don't care conditions, NAND and NOR logic implementations, two-level realizations using gates – AND-OR, OR-AND, NAND-NAND and NOR-NOR structures.                                |          |                                          |         | 15                   |  |

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|                   | Combinational Circuits using MSI Modules: Adders, subtractors, BCD arithmetic, serial adder, carry look-ahead adder, Multi-bit adder, Multiplexers, De-multiplexers, Decoders, Multiplexer-based realization of K-maps; Combinational circuit design using multiplexers and gates.                |                                                                          |   |
|                   | UNIT III: Sequential Logic Circuits<br>Latches and Flip-flops; Ripple counters using T flip-flops; Synchronous counters; Shift Registers; Ring and MLS counters; Sequence generator using J-K / D flip-flops, Finite state machines, propagation delay, setup and hold time, critical path delay. |                                                                          | 9 |
|                   | UNIT IV: Memories and Programmable Logic<br>ROM, SRAM, DRAM, PLA, PAL Logic Families: ROM, SRAM, DRAM, PLA, PAL                                                                                                                                                                                   |                                                                          | 3 |
| Course Assessment | Theory (75 Marks)<br>Evaluation will be done for 100 marks and 75% of the marks secured will be considered.                                                                                                                                                                                       | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50%        |   |
|                   | Practical (25 Marks)<br>Evaluation will be done for 50 marks and 50% of the marks secured will be considered.                                                                                                                                                                                     | Continuous Evaluation 20%<br>Laboratory Examination 50%<br>Viva Voce 30% |   |

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|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|----------------------------------------|
| Course Code:<br>EC 2402 | Open Elective Course:<br>(Y/N)                                                                                                                                                                                                                                                                                                          | Departmental Core<br>Course: (Y/N) | Departmental Elective<br>Course: (Y/N) |
|                         | N                                                                                                                                                                                                                                                                                                                                       | Y                                  | N                                      |
| Type of Course          | Theory and Practical                                                                                                                                                                                                                                                                                                                    |                                    |                                        |
| Course Title & Code     | Digital Communication (EC 2402)                                                                                                                                                                                                                                                                                                         |                                    |                                        |
| Course Objectives       | <ul style="list-style-type: none"> <li>To introduce the theory of sampling, its advantages and reconstruction techniques.</li> <li>To introduce the concept of Matched filters, their applications along with the concept of channel noise.</li> <li>To learn important aspects of information theory and concept of coding.</li> </ul> |                                    |                                        |

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| Course Outcomes                             |                                                                                         |                                                                         |                         |           | Cognitive Levels                           |                      |
|---------------------------------------------|-----------------------------------------------------------------------------------------|-------------------------------------------------------------------------|-------------------------|-----------|--------------------------------------------|----------------------|
| CO1                                         | Interpret and understand the building blocks of a typical digital communication system. |                                                                         |                         |           | Knowledge/Comprehension (Level I/Level-II) |                      |
| CO2                                         | Compute probability of error and hence the inter symbol interference from eye diagram.  |                                                                         |                         |           | Application (Level-III)                    |                      |
| CO3                                         | Derive expressions for the power spectrum of digital modulated signals.                 |                                                                         |                         |           | Analysis (Level-IV)                        |                      |
| CO4                                         | Design an encoder and decoder for a typical error control coding scheme.                |                                                                         |                         |           | Synthesis/Evaluation (Level-VI/Level-V)    |                      |
| Semester                                    |                                                                                         | IV                                                                      |                         |           | Winter                                     |                      |
| Contact Hours                               |                                                                                         | Lecture                                                                 | Tutorial                | Practical | Credits                                    | Total Teaching Hours |
|                                             |                                                                                         | 3                                                                       | 0                       | 2         | 4                                          | 36                   |
| Prerequisite course codes with course names |                                                                                         | Analog Communication (EC 2302); Probability and Random Process (MA2401) |                         |           |                                            |                      |
| Text Books                                  |                                                                                         |                                                                         |                         |           |                                            |                      |
| 1.                                          | Title                                                                                   |                                                                         | Digital Communications, |           |                                            |                      |
|                                             | Author                                                                                  |                                                                         | Simon Haykin            |           |                                            |                      |
|                                             | Publisher                                                                               |                                                                         | John Wiley and Sons     |           |                                            |                      |
|                                             | Edition                                                                                 |                                                                         | LatestEdition           |           |                                            |                      |
| 2.                                          | Title                                                                                   |                                                                         | Digital Communications, |           |                                            |                      |
|                                             | Author                                                                                  |                                                                         | Proakis ,               |           |                                            |                      |
|                                             | Publisher                                                                               |                                                                         | McGraw Hill             |           |                                            |                      |
|                                             | Edition                                                                                 |                                                                         | Latest Edition          |           |                                            |                      |

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| Reference Books |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                          |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| 1.              | Title                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Communication Systems, , |
|                 | Author                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | A. B. Carlson            |
|                 | Publisher                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | McGraw Hill              |
|                 | Edition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Latest Edition           |
| Course Contents | UNIT I: Sampling and Pulse Modulation<br>Sampling theorem, types. PAM, PPM, PDM and PCM systems. TDM and FDM systems and their comparison. Cross talk and guard times. Practical sampling and aliasing. Baseband digital transmission: digital PAM signals, transmission limitations. Power spectra and digital PAM, spectral shaping by precoding. Signal coding Techniques, PCM Generation and Reconstruction, Quantization Noise, Non-uniform Quantization and companding. DPCM, DM, ADM and ADPCM; Linear Predictive Coding. Transmission of base band signal over Band Limited system-RZ and NRZ format. |                          |
|                 | UNIT II: Matched Filter and Geometric Representation of Signals<br>Matched filter, Error rate due to Noise, ISI, Nyquist criteria for distortionless baseband binary transmission, Optimum Linear Receiver, Adaptive Equalization. Geometric representation of signals – Gram-Schmidt Orthogonalisation procedure, Vector Noise Channel, Likelihood functions, Maximum Likelihood decoding, Correlation receiver, Probability of Error, Frame patterns, Bit and Frame synchronization carrier recovery.                                                                                                       |                          |
|                 | UNIT III: Information Theory<br>Definition of information, Self and Mutual information, Entropy and Information rate. Discrete memoryless source and coding, Discrete channel capacity, Shannon-Hartley equation for channel capacity, Markov chains. Principles of Error Detection and Correction methods, Channel Coding – Linear Block Codes, Cyclic Codes, Convolutional Coding, Automatic request for retransmission systems.                                                                                                                                                                            |                          |
|                 | UNIT IV: Digital CW Modulation<br>Principles, Block schematics and Comparative Study of ASK, FSK and PSK systems, Introduction to Quadrature Carrier and M-ary systems,                                                                                                                                                                                                                                                                                                                                                                                                                                       |                          |

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|                   | Modems and standards, Modern Digital Communication Technologies- ISDN, BISDN etc. Cellular digital Radio, Spread Spectrum techniques and Personal communication Networks. |                                                                      |
| Course Assessment | Total Marks =100<br>Theory (75 Marks)<br>Evaluation will be done for 100 marks and 75% of the marks secured will be considered.                                           | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50%    |
|                   | Practical (25 Marks)<br>Evaluation will be done for 50 marks and 50% of the marks secured will be considered.                                                             | Continuous Evaluation 20%<br>Laboratory Examination<br>Viva Voce 30% |

|                         |                                                                                                                                                                                                                                                                                                                                                                             |                                      |                                            |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|--------------------------------------------|
| Course Code:<br>EC 2403 | Open Elective Course:<br>(Y/N)<br>N                                                                                                                                                                                                                                                                                                                                         | Departmental Core Course: (Y/N)<br>Y | Departmental Elective Course: (Y/N)<br>N   |
| Type of Course          | Theory Course                                                                                                                                                                                                                                                                                                                                                               |                                      |                                            |
| Course Title & Code     | Introduction to Semiconductor Devices (EC2403)                                                                                                                                                                                                                                                                                                                              |                                      |                                            |
| Course Objectives       | <ul style="list-style-type: none"> <li>This course aims to study the fundamentals of semiconductor devices and its applications.</li> <li>This course provides the detailed understanding of the physics, design, operation, and limitations of important solid state electronic and optoelectronic devices used by electrical and telecommunications engineers.</li> </ul> |                                      |                                            |
| Course Outcomes         |                                                                                                                                                                                                                                                                                                                                                                             |                                      | Cognitive Levels                           |
| CO1                     | To apply the basic laws of solid-state physics to understand the properties of semiconductor materials                                                                                                                                                                                                                                                                      |                                      | Knowledge/Comprehension (Level I/Level-II) |
| CO2                     | To analyse and model different types of semiconductor junctions, including homo junctions and heterojunctions.                                                                                                                                                                                                                                                              |                                      | Application/ Analysis (Level-III/Level-IV) |
| CO3                     | To analyse and model the physics of Metal-Oxide-Semiconductor systems and MOSFETs.                                                                                                                                                                                                                                                                                          |                                      | Analysis (Level-IV)                        |
| CO4                     | To evaluate the current, voltage, capacitance etc. characteristics of the semiconductor device.                                                                                                                                                                                                                                                                             |                                      | Synthesis/Evaluation (Level-VI/Level-V)    |
| Semester                | IV                                                                                                                                                                                                                                                                                                                                                                          | Winter                               |                                            |

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|---------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|-----------------------------------------------------|---------|----------------------|
| Contact Hours                               | Lecture                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Tutorial | Practical                                           | Credits | Total Teaching Hours |
|                                             | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 1        | 0                                                   | 4       | 48                   |
| Prerequisite course codes with course names | Basic Electronics Circuit (EC 1201)<br>Analog Electronic Circuits (EC2303)                                                                                                                                                                                                                                                                                                                                                                                                                        |          |                                                     |         |                      |
| Text Books                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |          |                                                     |         |                      |
| 1.                                          | Title                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |          | Solid State Electronic Devices                      |         |                      |
|                                             | Author                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |          | Ben G Streetman and S. K. Banerjee                  |         |                      |
|                                             | Publisher                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |          | Pearson                                             |         |                      |
|                                             | Edition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |          | 7 <sup>th</sup> Edition                             |         |                      |
| 2.                                          | Title                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |          | Semiconductor Physics and Devices- Basic Principles |         |                      |
|                                             | Author                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |          | Donald A. Neamen                                    |         |                      |
|                                             | Publisher                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |          | McGraw Hill                                         |         |                      |
|                                             | Edition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |          | 4th Edn., 2021.                                     |         |                      |
| Reference Books                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |          |                                                     |         |                      |
| 1.                                          | Title                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |          | Physics of Semiconductor Devices                    |         |                      |
|                                             | Author                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |          | Sm Sze                                              |         |                      |
|                                             | Publisher                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |          | John Wiley & Sons                                   |         |                      |
|                                             | Edition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |          | 3rd Edn., 2008                                      |         |                      |
| Course Contents                             | UNIT I: Introduction to Quantum Theory of Solids<br>Basic principles of quantum mechanics, Schrodinger equation and its applications, Atoms and formation of energy bands, electrical conduction in solids, density of states functions, bonding forces and energy bands in solids.<br>Semiconductor under Equilibrium: Charge carriers in semiconductors, carrier concentrations, dopant atoms and energy levels, intrinsic and extrinsic semiconductors; charge neutrality, Fermi energy level. |          |                                                     |         | 12                   |
|                                             | UNIT II: Semiconductor under non-equilibrium<br>Carrier transport, Carrier drift, diffusion, graded impurity distribution, Hall Effect, scattering in semiconductors, velocity- electric field relations, high field transport charge injection and quasi-Fermi levels. Non-Equilibrium Excess Carriers in Semiconductors: Carrier generation and recombination, characteristics of excess carriers, excess carrier lifetime, introduction to surface effects.                                    |          |                                                     |         | 12                   |

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|                   | <p>UNIT III: Semiconductor Junction</p> <p>P-N junction under equilibrium - Energy band diagram - Current under forward bias - Reverse bias - IV characteristics - Charge storage and transient behaviour - Junction capacitance - Junction break down - small signal model of P-N diode, Metal-Semiconductor contacts - non-rectifying (ohmic) contacts - Schottky diodes.</p> <p>Photonic Devices: Light emitting diodes, semiconductor lasers, photo detectors, solar cells, power devices etc.</p>                | 12                                                                               |
|                   | <p>UNIT IV: Field – Effect Transistors</p> <p>Metal-Oxide-Silicon System: Ideal MOS structure - Accumulation, Depletion, Inversion - Energy band diagram under bias - Threshold voltage - C-V characteristics - Effects of work function difference, Oxide and interface charges. MOSFET: Structure - Types - Threshold voltage - DC characteristics - Channel length modulation - Subthreshold conduction - Small signal models of MOSFET - Short channel effects (SCEs) - Introduction to advanced MOS devices.</p> | 12                                                                               |
| Course Assessment | Total Marks =100                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <p>Continuous Evaluation 20%</p> <p>Mid Semester 30%</p> <p>End Semester 50%</p> |

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| Course Code:<br>EC 2404 | Open Elective Course:<br>(Y/N)                                                                                                                                                                                                                                                                   | Departmental Core Course: (Y/N) | Departmental Elective Course: (Y/N)         |
|                         | N                                                                                                                                                                                                                                                                                                | Y                               | N                                           |
| Type of Course          | Theory and Practical                                                                                                                                                                                                                                                                             |                                 |                                             |
| Course Title & Code     | Digital Signal Processing (EC 2404)                                                                                                                                                                                                                                                              |                                 |                                             |
| Course Objectives       | <ul style="list-style-type: none"> <li>To introduce DTFT, Z- Transforms, DFT, FFT and its computation</li> <li>To introduce the design techniques for digital filters and its realization.</li> <li>To discuss word length issues, multi rate signal processing and DSP applications.</li> </ul> |                                 |                                             |
| Course Outcomes         |                                                                                                                                                                                                                                                                                                  |                                 | Cognitive Levels                            |
| CO1                     | To understand signal processing systems using basic concepts.                                                                                                                                                                                                                                    |                                 | Knowledge/Comprehension (Level I/ Level-II) |
| CO2                     | To identify the fundamentals of multi rate signal processing and its applications.                                                                                                                                                                                                               |                                 | Application (Level-III)                     |

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|---------------------------------------------|----------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----------------------------------------------------------------|-----------------------------------------|----------------------|----|
| CO3                                         | To specify and design FIR and IIR type digital filters.        |                                                                                                                                                                                              |          |                                                                | Analysis (Level-IV)                     |                      |    |
| CO4                                         | To compute DFT using FFT algorithms and derive DFT properties. |                                                                                                                                                                                              |          |                                                                | Synthesis/Evaluation (Level-VI/Level-V) |                      |    |
| Semester                                    |                                                                | V                                                                                                                                                                                            |          |                                                                | Summer                                  |                      |    |
| Contact Hours                               |                                                                | Lecture                                                                                                                                                                                      | Tutorial | Practical                                                      | Credits                                 | Total Teaching Hours |    |
|                                             |                                                                | 3                                                                                                                                                                                            | 0        | 2                                                              | 4                                       | 36                   |    |
| Prerequisite course codes with course names |                                                                | Signals and Systems (EC 2301)                                                                                                                                                                |          |                                                                |                                         |                      |    |
| Text Books                                  |                                                                |                                                                                                                                                                                              |          |                                                                |                                         |                      |    |
| 1.                                          |                                                                | Title                                                                                                                                                                                        |          | Digital signal processing:Principles, Algorithms, Applications |                                         |                      |    |
|                                             |                                                                | Author                                                                                                                                                                                       |          | Proakis, John G                                                |                                         |                      |    |
|                                             |                                                                | Publisher                                                                                                                                                                                    |          | Pearson Education India 2007.                                  |                                         |                      |    |
|                                             |                                                                | Edition                                                                                                                                                                                      |          | 4 <sup>rd</sup> Edition                                        |                                         |                      |    |
| 2.                                          |                                                                | Title                                                                                                                                                                                        |          | Discrete-time Signal processing                                |                                         |                      |    |
|                                             |                                                                | Author                                                                                                                                                                                       |          | Alan V Oppenheim and Ronald W Schafer                          |                                         |                      |    |
|                                             |                                                                | Publisher                                                                                                                                                                                    |          | Pearson.                                                       |                                         |                      |    |
|                                             |                                                                | Edition                                                                                                                                                                                      |          | 3 <sup>rd</sup> edition                                        |                                         |                      |    |
| Reference Books                             |                                                                |                                                                                                                                                                                              |          |                                                                |                                         |                      |    |
| 1.                                          |                                                                | Title                                                                                                                                                                                        |          | Understanding Digital Signal Processing                        |                                         |                      |    |
|                                             |                                                                | Author                                                                                                                                                                                       |          | Richard G Lyons                                                |                                         |                      |    |
|                                             |                                                                | Publisher                                                                                                                                                                                    |          | Pearson                                                        |                                         |                      |    |
|                                             |                                                                | Edition                                                                                                                                                                                      |          | 1 <sup>St</sup> Edition                                        |                                         |                      |    |
| Course Contents                             |                                                                | UNIT-I :Frequency Domain Analysis of Discrete Time Signal and System Review of Discrete-time Fourier Transform, Frequency response of discrete time systems, Z-Transform.                    |          |                                                                |                                         |                      | 9  |
|                                             |                                                                | UNIT II: Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT)<br>DFT, relationship of DFT to other transforms, FFT, DIT and DIF algorithms, Linear filtering using DFT and FFT. |          |                                                                |                                         |                      | 8  |
|                                             |                                                                | UNIT III: Filter Design Techniques and realization                                                                                                                                           |          |                                                                |                                         |                      | 11 |

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|                   | Frequency response of FIR filter, Design of FIR Digital filters, Window method, Park-McClellan's method, Frequency Sampling Method, Design of IIR Digital Filters, Butterworth, Chebyshev and Elliptic Approximations, Lowpass, Bandpass, Bandstop and High pass filters, Mapping formulas, Frequency transformations, Direct form realization of FIR and IIR systems, Lattice structure for FIR and IIR systems, Finite-word length effects. Limit cycle oscillations. |                                                                          |   |
|                   | UNIT IV: Multirate Signal Processing<br>Concepts, design of practical sampling rate converters, Decimators, interpolators. Polyphase decompositions.                                                                                                                                                                                                                                                                                                                    |                                                                          | 8 |
| Course Assessment | Total Marks =100<br>Theory (75 Marks)<br>Evaluation will be done for 100 marks and 75% of the marks secured will be considered.                                                                                                                                                                                                                                                                                                                                         | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50%        |   |
|                   | Practical (25 Marks)<br>Evaluation will be done for 50 marks and 50% of the marks secured will be considered.                                                                                                                                                                                                                                                                                                                                                           | Continuous Evaluation 20%<br>Laboratory Examination 50%<br>Viva Voce 30% |   |

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|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|-------------------------------------|
| Course Code:<br>EE 2431 | Open Elective Course:<br>(Y/N)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Departmental Core Course: (Y/N) | Departmental Elective Course: (Y/N) |
|                         | N                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Y                               | N                                   |
| Type of Course          | Theory and Practical                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                 |                                     |
| Course Title & Code     | Control Systems (EE2431)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                 |                                     |
| Course Objectives       | <ul style="list-style-type: none"> <li>To introduce different types of system and identify a set of algebraic equations to represent and model a complicated system into a more simplified form to interpret different physical and mechanical systems in terms of electrical system to construct equivalent electrical models for analysis.</li> <li>To employ time domain analysis to predict and diagnose transient performance parameters of the system for standard input functions and identify the needs of different types of controllers and compensator to ascertain the required dynamic response from the system</li> </ul> |                                 |                                     |

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|                                             |                                                                                                                                                                                                                                                                              | ● Formulate different types of analysis in frequency domain to explain the nature of stability of the system. |                                         |           |                                            |                      |
| Course Outcomes                             |                                                                                                                                                                                                                                                                              |                                                                                                               |                                         |           | Cognitive Levels                           |                      |
| CO1                                         | Categorize different types of system and identify a set of algebraic equations to represent and model a complicated system into a more simplified form.                                                                                                                      |                                                                                                               |                                         |           | Knowledge/Comprehension (Level I/Level-II) |                      |
| CO2                                         | Characterize any system in Laplace domain to illustrate different specification of the system using transfer function concept.                                                                                                                                               |                                                                                                               |                                         |           | Application (Level-III)                    |                      |
| CO3                                         | Analysis: Steady-state errors and error constants, Concepts and applications of P, PD, PI and PID types of control. Stability: Definition, Routh-Hurwitz criterion, Root locus techniques, Nyquist criterion, Bode plots, Relative stability, Gain margin and phase margins. |                                                                                                               |                                         |           | Analysis (Level-IV)                        |                      |
| CO4                                         | Compensation: Lead, Lag and lag-lead compensators, Design of compensating networks for specified control system performance.                                                                                                                                                 |                                                                                                               |                                         |           | Synthesis/Evaluation (Level-VI/Level-V)    |                      |
| Semester                                    |                                                                                                                                                                                                                                                                              | IV                                                                                                            |                                         | Winter    |                                            |                      |
| Contact Hours                               |                                                                                                                                                                                                                                                                              | Lecture                                                                                                       | Tutorial                                | Practical | Credits                                    | Total Teaching Hours |
|                                             |                                                                                                                                                                                                                                                                              | 3                                                                                                             | 0                                       | 2         | 4                                          | 36                   |
| Prerequisite course codes with course names |                                                                                                                                                                                                                                                                              | Signals and systems (EC 2301)                                                                                 |                                         |           |                                            |                      |
| Text Books                                  |                                                                                                                                                                                                                                                                              |                                                                                                               |                                         |           |                                            |                      |
| 1.                                          | Title                                                                                                                                                                                                                                                                        |                                                                                                               | ‘Control Systems Engineering’,          |           |                                            |                      |
|                                             | Author                                                                                                                                                                                                                                                                       |                                                                                                               | J. Nagrath, M. Gopal,                   |           |                                            |                      |
|                                             | Publisher                                                                                                                                                                                                                                                                    |                                                                                                               | New Age International Publishers, 2008. |           |                                            |                      |
|                                             | Edition                                                                                                                                                                                                                                                                      |                                                                                                               | 4 <sup>th</sup> Edition                 |           |                                            |                      |
| 2.                                          | Title                                                                                                                                                                                                                                                                        |                                                                                                               | ‘Modern Control Engineering’,           |           |                                            |                      |

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|                   | Author                                                                                                                                                                                                                                                                                                                                              | K. Ogata,                                                         |   |
|                   | Publisher                                                                                                                                                                                                                                                                                                                                           | Prentice Hall, 2010.                                              |   |
|                   | Edition                                                                                                                                                                                                                                                                                                                                             | 3 <sup>rd</sup> Edition                                           |   |
| Reference Books   |                                                                                                                                                                                                                                                                                                                                                     |                                                                   |   |
| 1.                | Title                                                                                                                                                                                                                                                                                                                                               | Automatic Control Systems                                         |   |
|                   | Author                                                                                                                                                                                                                                                                                                                                              | B. C. Kuo,                                                        |   |
|                   | Publisher                                                                                                                                                                                                                                                                                                                                           | 8/e, Wiley, 2002.                                                 |   |
|                   | Edition                                                                                                                                                                                                                                                                                                                                             | 3 <sup>rd</sup> Edition                                           |   |
| Course Contents   | UNIT I: SYSTEMS COMPONENTS AND THEIR REPRESENTATION<br>Control System: Terminology and Basic Structure-Feed forward and Feedback control theory-Electrical and Mechanical Transfer Function Models-Block diagram Models-Signal flow graphs models-DC and AC servo Systems-Synchronous -Multivariable control system.                                |                                                                   | 9 |
|                   | UNIT II: TIME RESPONSE ANALYSIS<br>Transient response-steady state response-Measures of performance of the standard first order and second order system-effect on an additional zero and an additional pole-steady error constant and system- type number-PID control-Analytical design for PD, PI, PID control systems                             |                                                                   | 9 |
|                   | UNIT III: FREQUENCY RESPONSE AND SYSTEM ANALYSIS<br>Closed loop frequency response-Performance specification in frequency domain-Frequency response of standard second order system- Bode Plot — Polar Plot- Nyquist plots-Design of compensators using Bode plots-Cascade lead compensation-Cascade lag compensation-Cascade lag-lead compensation |                                                                   | 9 |
|                   | UNIT IV: CONCEPTS OF STABILITY ANALYSIS<br>Concept of stability-Bounded — Input Bounded — Output stability-Routh stability criterion-Relative stability-Root locus concept-Guidelines for sketching root locus-Nyquist stability criterion.                                                                                                         |                                                                   | 9 |
| Course Assessment | Total Marks =100<br>Theory (75 Marks)<br>Evaluation will be done for 100 marks and 75% of the marks secured will be considered.                                                                                                                                                                                                                     | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50% |   |

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|  | <b>Practical (25 Marks)</b><br>Evaluation will be done for 50 marks and 50% of the marks secured will be considered. | <b>Continuous Evaluation 20%</b><br><b>Laboratory Examination 50%</b><br><b>Viva Voce 30%</b> |
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| Course Code:<br>EC 3501               |                                                                       | Open Elective Course:<br>(Y/N)                                                                                                                                                                                                                                                           |          | Departmental Core Course: (Y/N) |                                               | Departmental Elective Course: (Y/N) |                      |
|                                       |                                                                       | N                                                                                                                                                                                                                                                                                        |          | Y                               |                                               | N                                   |                      |
| Type of Course                        |                                                                       | Theory and Practical                                                                                                                                                                                                                                                                     |          |                                 |                                               |                                     |                      |
| Course Title & Code                   |                                                                       | Introduction to Microprocessors (EC3501)                                                                                                                                                                                                                                                 |          |                                 |                                               |                                     |                      |
| Course Objectives                     |                                                                       | <ul style="list-style-type: none"><li>● To make the students understand the basics of Microprocessor architectures(8085 and 8086)</li><li>● To understand the basics of interfacing, Memory Systems and I/Os</li><li>● To introduces the Microcontroller and its applications.</li></ul> |          |                                 |                                               |                                     |                      |
| Course Outcomes                       |                                                                       |                                                                                                                                                                                                                                                                                          |          | Cognitive Levels                |                                               |                                     |                      |
| CO1                                   | To understand the basics of Microprocessor.                           |                                                                                                                                                                                                                                                                                          |          |                                 | Knowledge/Comprehension<br>(Level I/Level-II) |                                     |                      |
| CO2                                   | Develop assembly language programs.                                   |                                                                                                                                                                                                                                                                                          |          |                                 | Synthesis/Evaluation<br>(Level-VI/Level-V)    |                                     |                      |
| CO3                                   | Learn about various I/O chips, different interrupts, and interfacing. |                                                                                                                                                                                                                                                                                          |          |                                 | Analysis (Level-IV)                           |                                     |                      |
| CO4                                   | To get familiar with microcontroller and its applications.            |                                                                                                                                                                                                                                                                                          |          |                                 | Application (Level-III)                       |                                     |                      |
| Semester                              |                                                                       | V                                                                                                                                                                                                                                                                                        |          |                                 | Summer                                        |                                     |                      |
| Contact Hours                         |                                                                       | Lecture                                                                                                                                                                                                                                                                                  | Tutorial |                                 | Practical                                     | Credits                             | Total Teaching Hours |
|                                       |                                                                       | 3                                                                                                                                                                                                                                                                                        | 0        |                                 | 2                                             | 4                                   | 36                   |
| Prerequisite course codes with course |                                                                       | Digital Electronics (EC 2401)                                                                                                                                                                                                                                                            |          |                                 |                                               |                                     |                      |

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| names           |                                                                                                                                                                        |                                                                        |   |
| Text Books      |                                                                                                                                                                        |                                                                        |   |
| 1.              | Title                                                                                                                                                                  | MicroprocessorArchitecture, Programming and Applications with the 8085 |   |
|                 | Author                                                                                                                                                                 | Ramesh Gaonkar                                                         |   |
|                 | Publisher                                                                                                                                                              | Prentice Hall                                                          |   |
|                 | Edition                                                                                                                                                                | 5 <sup>th</sup> Edition                                                |   |
| 2.              | Title                                                                                                                                                                  | The INTEL Microprocessors                                              |   |
|                 | Author                                                                                                                                                                 | Barry B. Brey                                                          |   |
|                 | Publisher                                                                                                                                                              | Pearson                                                                |   |
|                 | Edition                                                                                                                                                                | 8 <sup>th</sup> Edition                                                |   |
| Reference Books |                                                                                                                                                                        |                                                                        |   |
| 1.              | Title                                                                                                                                                                  | Computer Architecture, A Quantitative Approach                         |   |
|                 | Author                                                                                                                                                                 | John L. Hennessy David A. Patterson                                    |   |
|                 | Publisher                                                                                                                                                              | Elsevier                                                               |   |
|                 | Edition                                                                                                                                                                | 5 <sup>th</sup> Edition                                                |   |
| Course Contents | UNIT I:<br>Evolution of digital computer, evolution of microprocessor. Microprocessor architecture: 8-bit (8085) and 16-bit (8086).                                    |                                                                        | 5 |
|                 | UNIT II:<br>Addressing modes of microprocessors, instruction set of 8-bit (8085) and 16-bit microprocessors (8086)                                                     |                                                                        | 7 |
|                 | UNIT III:<br>Instruction cycle, timing diagram, Subroutine, assembly language programming. Types of memories and their organizations (RAM, ROM, stack, secondary etc.) |                                                                        | 9 |

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|                   | UNIT IV:<br>Interrupt, DMA, Principle of data transfer (synchronous and asynchronous). Serial data communication, RS-232 standard. Peripheral interface: PPI, DMA controller, interrupt controller, programmable timer, USART. Microcontroller(8051) and its applications . | 15                                                                       |
| Course Assessment | Total Marks =100<br>Theory (75 Marks)<br>Evaluation will be done for 100 marks and 75% of the marks secured will be considered.                                                                                                                                             | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50%        |
|                   | Practical (25 Marks)<br>Evaluation will be done for 50 marks and 50% of the marks secured will be considered.                                                                                                                                                               | Continuous Evaluation 20%<br>Laboratory Examination 50%<br>Viva Voce 30% |

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| Course Code:<br>EC 3502 | Open Elective Course:<br>(Y/N)<br>N                                                                                                                                                                                                                                                                                                                                                | Departmental Core Course:<br>(Y/N)<br>Y | Departmental Elective Course:<br>(Y/N)<br>N |
| Type of Course          | Theory Course                                                                                                                                                                                                                                                                                                                                                                      |                                         |                                             |
| Course Title & Code     | Electromagnetic Theory (EC3502)                                                                                                                                                                                                                                                                                                                                                    |                                         |                                             |
| Course Objectives       | <ul style="list-style-type: none"> <li>The intention of this course is to familiarize the students with concepts pertaining electric and magnetic fields and their applications.</li> <li>To correlate with the concept of vector calculus and real-time observation of the proposed course.</li> <li>To learn the field distribution inside and outside the materials.</li> </ul> |                                         |                                             |
| Course Outcomes         |                                                                                                                                                                                                                                                                                                                                                                                    |                                         | Cognitive Levels                            |
| CO1                     | To understand the various operations of vector calculus                                                                                                                                                                                                                                                                                                                            |                                         | Knowledge/Comprehension (Level I/Level-II)  |
| CO2                     | To understand the mathematics backgrounds the EM laws.                                                                                                                                                                                                                                                                                                                             |                                         | Application (Level-III)                     |
| CO3                     | To understand the electric and magnetic field distributions over the materials.                                                                                                                                                                                                                                                                                                    |                                         | Analysis (Level-IV)                         |

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| CO4                                         | To understand the propagation of waves in different mediums.                                                                                                                                                                                                                                                                                                                                     |                                                                        |          |                                           | Synthesis/Evaluation<br>(Level-VI/Level-V) |                      |
| Semester                                    |                                                                                                                                                                                                                                                                                                                                                                                                  | VII                                                                    |          |                                           | Summer                                     |                      |
| Contact Hours                               |                                                                                                                                                                                                                                                                                                                                                                                                  | Lecture                                                                | Tutorial | Practical                                 | Credits                                    | Total Teaching Hours |
|                                             |                                                                                                                                                                                                                                                                                                                                                                                                  | 3                                                                      | 0        | 0                                         | 3                                          | 36                   |
| Prerequisite course codes with course names |                                                                                                                                                                                                                                                                                                                                                                                                  | Engineering Physics – I (PH 1101); Engineering Mathematics-III(MA2301) |          |                                           |                                            |                      |
| Text Books                                  |                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                        |          |                                           |                                            |                      |
| 1.                                          | Title                                                                                                                                                                                                                                                                                                                                                                                            |                                                                        |          | Principle of Electromagnetics             |                                            |                      |
|                                             | Author                                                                                                                                                                                                                                                                                                                                                                                           |                                                                        |          | M.N.O. Sadiku and S.V. Kulkarni,          |                                            |                      |
|                                             | Publisher                                                                                                                                                                                                                                                                                                                                                                                        |                                                                        |          | Oxford                                    |                                            |                      |
|                                             | Edition                                                                                                                                                                                                                                                                                                                                                                                          |                                                                        |          | 6 <sup>th</sup> Edition                   |                                            |                      |
| 2.                                          | Title                                                                                                                                                                                                                                                                                                                                                                                            |                                                                        |          | Microwave Engineering                     |                                            |                      |
|                                             | Author                                                                                                                                                                                                                                                                                                                                                                                           |                                                                        |          | David. M. Pozar,                          |                                            |                      |
|                                             | Publisher                                                                                                                                                                                                                                                                                                                                                                                        |                                                                        |          | John Wiley                                |                                            |                      |
|                                             | Edition                                                                                                                                                                                                                                                                                                                                                                                          |                                                                        |          | 4 <sup>th</sup> Edition.                  |                                            |                      |
| Reference Books                             |                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                        |          |                                           |                                            |                      |
| 1.                                          | Title                                                                                                                                                                                                                                                                                                                                                                                            |                                                                        |          | Electromagnetic Waves                     |                                            |                      |
|                                             | Author                                                                                                                                                                                                                                                                                                                                                                                           |                                                                        |          | R.K. Shevgaonkar                          |                                            |                      |
|                                             | Publisher                                                                                                                                                                                                                                                                                                                                                                                        |                                                                        |          | Tata McGraw Hill                          |                                            |                      |
|                                             | Edition                                                                                                                                                                                                                                                                                                                                                                                          |                                                                        |          | 1 <sup>st</sup> Edition                   |                                            |                      |
| 2.                                          | Title                                                                                                                                                                                                                                                                                                                                                                                            |                                                                        |          | Electromagnetic waves & Radiating Systems |                                            |                      |
|                                             | Author                                                                                                                                                                                                                                                                                                                                                                                           |                                                                        |          | E.C. Jordan & K.G. Balmain                |                                            |                      |
|                                             | Publisher                                                                                                                                                                                                                                                                                                                                                                                        |                                                                        |          | Prentice Hall                             |                                            |                      |
|                                             | Edition                                                                                                                                                                                                                                                                                                                                                                                          |                                                                        |          | 2 <sup>nd</sup> Edition                   |                                            |                      |
| Course Contents                             | UNIT I: Vector Calculus<br>Basics of Vectors, Definition of potential difference and potential, Potential of point charge and system of charges. Potential gradient, Energy density in electrostatic field. Poisson’s and Laplace’s equations. Poynting Vector, Boundary conditions at Media Interface. Coordinate Systems and Transformation: Cartesian, Cylindrical and Spherical Coordinates. |                                                                        |          |                                           |                                            | 10                   |
|                                             | UNIT II: Electrostatic and Magnetostatic Fields                                                                                                                                                                                                                                                                                                                                                  |                                                                        |          |                                           |                                            | 12                   |

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|                   | Introduction, Electric Fields due to Continuous Charge Distributions, An Electric Dipole and Flux Lines, Energy Density in Electrostatic Fields, Maxwell's Equations for Static EM Fields, Gauss's law, Biot- Savart, Stoke's theorem and Amperes circuital laws and their applications. Significance of curl and divergence. Magnetic flux density, Scalar and Vector magnetic potential.                            |                                                                   |   |
|                   | UNIT III: Magnetics, Materials and Field Distributions<br>Properties of Materials, Convection and Conduction Currents, Polarization in Dielectrics, Dielectric Constant and Strength, Isotropic, and Homogeneous Dielectrics, A Magnetic Dipole, Magnetization in Materials, Classification of Magnetic Materials and Magnetic Boundary Conditions, Magnetic Energy, Force on Magnetic Materials, Current Continuity. |                                                                   | 8 |
|                   | UNIT IV: Wave Propagation Characteristics<br>Wave Propagation in Lossy Dielectrics, Plane Waves in Lossless Dielectrics, Free Space and in Good Conductors. Power and the Poynting Vector, Reflection of a Plane Wave at Normal Incidence and at Oblique Incidence.                                                                                                                                                   |                                                                   | 6 |
| Course Assessment | Total Marks=100                                                                                                                                                                                                                                                                                                                                                                                                       | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50% |   |

|                         |                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                 |                                            |
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| Course Code:<br>EC 3503 | Open Elective Course:<br>(Y/N)                                                                                                                                                                                                                                                                                                                                                                                                    | Departmental Core Course: (Y/N) | Departmental Elective Course: (Y/N)        |
|                         | N                                                                                                                                                                                                                                                                                                                                                                                                                                 | Y                               | N                                          |
| Type of Course          | Theory with Practical Course                                                                                                                                                                                                                                                                                                                                                                                                      |                                 |                                            |
| Course Title & Code     | Artificial Neural Networks and its Applications (EC3503)                                                                                                                                                                                                                                                                                                                                                                          |                                 |                                            |
| Course Objectives       | <ul style="list-style-type: none"> <li>To understand the theoretical foundations of artificial neural networks</li> <li>To understand different kinds of Neural Networks based on architectures and learning rules</li> <li>To understand the basic concept of deep neural networks (DNN) and its different kinds with working principle</li> <li>To understand the various tuning parameters and optimization methods</li> </ul> |                                 |                                            |
| Course Outcomes         |                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                 | Cognitive Levels                           |
| CO1                     | To understand the building blocks of a Convolution Neural Network, to design one from scratch.                                                                                                                                                                                                                                                                                                                                    |                                 | Knowledge/Comprehension (LevelII/Level-II) |

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| CO2                                         | To apply neural networks to real-world applications in fields such as image recognition, speech recognition, natural language processing, robotics, and healthcare |                                                                             |          |                                                                                  |         | Application (Level-III)                 |          |
| CO3                                         | To understand different types of pre-trained networks and to modify them for various applications.                                                                 |                                                                             |          |                                                                                  |         | Analysis (Level-IV)                     |          |
| CO4                                         | To evaluate the performance of neural network models using metrics such as accuracy, precision, recall, F1 score, and ROC curves                                   |                                                                             |          |                                                                                  |         | Synthesis/Evaluation (Level-VI/Level-V) |          |
| Semester                                    |                                                                                                                                                                    | VI                                                                          |          |                                                                                  | Winter  |                                         |          |
| Contact Hours                               |                                                                                                                                                                    | Lecture                                                                     | Tutorial | Practical                                                                        | Credits | Total                                   | Teaching |
|                                             |                                                                                                                                                                    | 3                                                                           | 0        | 2                                                                                | 4       | 36                                      | Hours    |
| Prerequisite course codes with course names |                                                                                                                                                                    | Engineering Mathematics-III(MA 2301),<br>Digital Signal Processing (EC2404) |          |                                                                                  |         |                                         |          |
| Text Books                                  |                                                                                                                                                                    |                                                                             |          |                                                                                  |         |                                         |          |
| 1.                                          |                                                                                                                                                                    | Title                                                                       |          | Computer Vision and Image Processing                                             |         |                                         |          |
|                                             |                                                                                                                                                                    | Author                                                                      |          | Adrian Low                                                                       |         |                                         |          |
|                                             |                                                                                                                                                                    | Publisher                                                                   |          | B.S. Publications, 2005.                                                         |         |                                         |          |
|                                             |                                                                                                                                                                    | Edition                                                                     |          | 2 <sup>nd</sup> Edition                                                          |         |                                         |          |
| 2.                                          |                                                                                                                                                                    | Title                                                                       |          | Neural Networks, Fuzzy Logis and Genetic Algorithms: Synthesis, and Applications |         |                                         |          |
|                                             |                                                                                                                                                                    | Author                                                                      |          | S. Rajasekaran, and G. A. Vijayalakshmi Pai                                      |         |                                         |          |
|                                             |                                                                                                                                                                    | Publisher                                                                   |          | Prentice Hall of India, 2007                                                     |         |                                         |          |
|                                             |                                                                                                                                                                    | Edition                                                                     |          | 1 <sup>st</sup> Edition                                                          |         |                                         |          |
| 3.                                          |                                                                                                                                                                    | Title                                                                       |          | Introduction to Neural Networks using MATLAB 6.0                                 |         |                                         |          |
|                                             |                                                                                                                                                                    | Author                                                                      |          | I. S.N.Sivanandam, S.Sumathi, S.N.Deepa,                                         |         |                                         |          |
|                                             |                                                                                                                                                                    | Publisher                                                                   |          | TMH, 2006                                                                        |         |                                         |          |
|                                             |                                                                                                                                                                    | Edition                                                                     |          | 1 <sup>st</sup> Edition                                                          |         |                                         |          |
| Reference Books                             |                                                                                                                                                                    |                                                                             |          |                                                                                  |         |                                         |          |
| 1.                                          |                                                                                                                                                                    | Title                                                                       |          | Foundations of Neural Networks, Fuzzy Systems, and Knowldge Engineering          |         |                                         |          |
|                                             |                                                                                                                                                                    | Author                                                                      |          | Nikola K. Kasabov                                                                |         |                                         |          |

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|                   | Publisher                                                                                                                                                                                                                                                                                                                                                                              | MIT Press, 1998         |                                                                           |
|                   | Edition                                                                                                                                                                                                                                                                                                                                                                                | 1 <sup>st</sup> Edition |                                                                           |
| Course Contents   | UNIT I: Essentials of Artificial Neural Networks (ANN):<br><br>Biological neurons and its working, Simulation of biological neurons to problem solving, Different ANNs architectures, Adaptive Networks – Feed Forward Networks (Back Propagation)– Supervised Learning Neural Networks, Radial Basis Function Networks, Reinforcement Learning, Unsupervised Learning Neural Network. |                         | 9                                                                         |
|                   | UNIT II: Convolutional Neural Network (CNN):<br>Basic structure of CNN, Analyzing different layers of CNN- Input Layer, Convolutional Layers (1D/2D), Batch Normalization Layers, Activation Layers, Fully Connected Layers, Optimization Methods-SGDM, ADAM; Building CNN from scratch.                                                                                               |                         | 9                                                                         |
|                   | UNIT III: Pre-trained Networks:<br>Google-Net, Res-Net, Alex-Net; Modifying structures of Pre-trained Networks with applications in object detection and semantic segmentation, Layer replacement and truncation;                                                                                                                                                                      |                         | 9                                                                         |
|                   | UNIT IV: Applications of ANN:<br>Transfer learning and Ensemble approach in signal modulation classification, signal (ECG, EEG) classification, Image Classification, super resolution, Segmentation, Noise Removal                                                                                                                                                                    |                         | 9                                                                         |
| Course Assessment | Theory (75 Marks)<br>Evaluation will be done for 100 marks and 75% of the marks secured will be considered.                                                                                                                                                                                                                                                                            |                         | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50%         |
|                   | Practical (25 Marks)<br>Evaluation will be done for 50 marks and 50% of the marks secured will be considered.                                                                                                                                                                                                                                                                          |                         | Continuous Evaluation 20%<br>Laboratory Examination 50%<br>Viva Voice 30% |

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| Course Code:<br>EC 3504 | Open Elective Course:<br>(Y/N) | Departmental Core<br>Course: (Y/N) | Departmental Elective<br>Course: (Y/N) |
|                         | N                              | Y                                  | N                                      |
| Type of Course          | Theory and Practical           |                                    |                                        |
| Course Title & Code     | IC Applications (EC 3504)      |                                    |                                        |

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| Course Objectives                           |                                                                                        | <ul style="list-style-type: none"><li>● To introduce Op-Amp basic characteristics, AC and DC parameters.</li><li>● To introduce Op-Amp linear as well as non-linear applications.</li><li>● To introduce the use of Op-Amp in designing various filters.</li></ul> |          |                                                                   |                                            |                      |
| Course Outcomes                             |                                                                                        |                                                                                                                                                                                                                                                                    |          |                                                                   | Cognitive Levels                           |                      |
| CO1                                         | To understand the Basics of Op-Amp and its parameters.                                 |                                                                                                                                                                                                                                                                    |          |                                                                   | Knowledge/Comprehension (Level I/Level-II) |                      |
| CO2                                         | To understand and design power amplifiers and oscillators using ICs                    |                                                                                                                                                                                                                                                                    |          |                                                                   | Application (Level-III)                    |                      |
| CO3                                         | To analyze the performance of IC amplifiers with respect to noise, bandwidth, and gain |                                                                                                                                                                                                                                                                    |          |                                                                   | Analysis (Level-IV)                        |                      |
| CO4                                         | To explore the basics of IC testing, debugging, and troubleshooting                    |                                                                                                                                                                                                                                                                    |          |                                                                   | Synthesis/Evaluation (Level-VI/Level-V)    |                      |
| Semester                                    |                                                                                        | VII                                                                                                                                                                                                                                                                |          |                                                                   | Summer                                     |                      |
| Contact Hours                               |                                                                                        | Lecture                                                                                                                                                                                                                                                            | Tutorial | Practical                                                         | Credits                                    | Total Teaching Hours |
|                                             |                                                                                        | 3                                                                                                                                                                                                                                                                  | 0        | 2                                                                 | 4                                          | 36                   |
| Prerequisite course codes with course names |                                                                                        | Introduction to Semiconductor Devices (EC2403)                                                                                                                                                                                                                     |          |                                                                   |                                            |                      |
| Text Books                                  |                                                                                        |                                                                                                                                                                                                                                                                    |          |                                                                   |                                            |                      |
| 1.                                          |                                                                                        | Title                                                                                                                                                                                                                                                              |          | Op-Amps and Linear Integrated Circuits                            |                                            |                      |
|                                             |                                                                                        | Author                                                                                                                                                                                                                                                             |          | Ramakant A. Gayakwad                                              |                                            |                      |
|                                             |                                                                                        | Publisher                                                                                                                                                                                                                                                          |          | Pearson                                                           |                                            |                      |
|                                             |                                                                                        | Edition                                                                                                                                                                                                                                                            |          | 2 <sup>nd</sup> Edition                                           |                                            |                      |
| 2.                                          |                                                                                        | Title                                                                                                                                                                                                                                                              |          | Design with Operational Amplifiers and Analog Integrated Circuits |                                            |                      |
|                                             |                                                                                        | Author                                                                                                                                                                                                                                                             |          | Sergei Franco                                                     |                                            |                      |
|                                             |                                                                                        | Publisher                                                                                                                                                                                                                                                          |          | McGraw-Hill                                                       |                                            |                      |
|                                             |                                                                                        | Edition                                                                                                                                                                                                                                                            |          | 2 <sup>nd</sup> Edition                                           |                                            |                      |
| Reference Books                             |                                                                                        |                                                                                                                                                                                                                                                                    |          |                                                                   |                                            |                      |
| 1.                                          |                                                                                        | Title                                                                                                                                                                                                                                                              |          | Integrated Electronics: Analog and Digital Circuits & Systems     |                                            |                      |
|                                             |                                                                                        | Author                                                                                                                                                                                                                                                             |          | Millman & Halkias                                                 |                                            |                      |

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|                   | Publisher                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | McGraw-Hill             |                                                                   |
|                   | Edition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1 <sup>st</sup> Edition |                                                                   |
| Course Contents   | UNIT I: Introduction to Operational Amplifiers<br>The Basic Operational Amplifier & Its Schematic Symbol, Block Diagram Representation of Op-Amp, Power Supply Requirements of an Op-Amp, Evolution of Op-Amp, Specification of a Typical Op-Amp (741).                                                                                                                                                                                                                                                                                                                                                        |                         | 9                                                                 |
|                   | UNIT II: The Practical Op-Amp<br>Input Offset Voltage, Input Bias Current, Input Offset Current, Total Output Offset Voltage, Thermal Drift, Error Voltage, Variation of Op-Amp Parameter with Temperature and Supply Voltage. Supply Voltage Rejection Ratio (SVRR), CMRR-Measurement of Op-Amp Parameters, Frequency Response Compensator Networks, Frequency Response of Internally Compensated Op-Amp and Non-Compensated Op-Amp, High Frequency Op-Amp Equivalent Circuit, Open Loop Voltage Gain as a Function of Frequency, Slew Rate, Causes of Slew Rates and Its Effects in Application.             |                         | 9                                                                 |
|                   | UNIT III: Operational Amplifier Configurations & Linear Applications<br>Open Loop Op-Amp Configurations - The Differential Amplifier, Inverting Amplifier, Non-Inverting Amplifier, Negative Feedback Configurations - Inverting and Non-Inverting Amplifiers, Voltage Followers & High Input Impedance Configuration, Differential Amplifiers, Closed Loop Frequency Response & Circuit Stability, Single Supply Operation of Op-Amp, Summing, Scaling and Averaging Amplifier, Voltage to Current & Current to Voltage Converters, Integrators & Differentiators, Logarithmic & Anti Logarithmic Amplifiers. |                         | 9                                                                 |
|                   | UNIT IV: Active Filters & Oscillators<br>Advantages of Active Filters, Classification of Filters, Response Characteristics of Butterworth, 73 Chebyshev, Causal Filters, First Order and Second Order Butterworth Filter- Low Pass and High Pass types. Band Pass & Band Reject Filters. Oscillator Principles, Types of Oscillators – Phase Shift, Weinbridge & Quadrature. Square Wave, Triangular Wave and Saw Tooth Wave Generators, Voltage-Controlled Oscillator.                                                                                                                                        |                         | 9                                                                 |
| Course Assessment | Total Marks =100<br>Theory (75 Marks)<br>Evaluation will be done for 100 marks and 75% of the marks secured will be considered.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                         | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50% |
|                   | Practical (25 Marks)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                         | Continuous Evaluation 20%                                         |

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|  | Evaluation will be done for 50 marks and 50% of the marks secured will be considered. | Laboratory Examination 50%<br>Viva Voce 30% |
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| Course Code:<br>EE 3531 | Open Elective Course:<br>(Y/N)<br>N                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Departmental Core Course: (Y/N)<br>Y | Departmental Elective Course: (Y/N)<br>N   |
| Type of Course          | Theory Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                      |                                            |
| Course Title & Code     | Industrial Electronics (EE3531)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                      |                                            |
| Course Objectives       | <ul style="list-style-type: none"> <li>To gain a comprehensive understanding of industrial automation and control systems, including their components, architectures, and functions</li> <li>To Identify and explain the operation of electronic components commonly used in industrial applications, such as diodes, transistors, thyristors, and integrated circuits</li> <li>To learn the principles and applications of power semiconductor devices, including diodes, thyristors (SCRs), MOSFETs, and IGBTs</li> <li>To understand power electronic circuits and their use in converting and controlling electrical power in industrial systems</li> </ul> |                                      |                                            |
| Course Outcomes         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                      | Cognitive Levels                           |
| CO1                     | Understanding of power electronic devices and circuits, including rectifiers, inverters, converters, and voltage regulators, as well as their applications in industrial settings                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                      | Knowledge/Comprehension (Level I/Level-II) |
| CO2                     | Understanding how industrial electronic components and systems integrate with broader industrial automation and control systems, including SCADA (Supervisory Control and Data Acquisition) systems and DCS (Distributed Control Systems)                                                                                                                                                                                                                                                                                                                                                                                                                       |                                      | Application (Level-III)                    |
| CO3                     | Proficiency in using electronic instruments for measuring and analyzing signals in industrial environments, including oscilloscopes, multi-meters, signal generators, and data acquisition systems                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                      | Analysis (Level-IV)                        |
| CO4                     | Ability to diagnose and troubleshoot faults in industrial electronic systems, as well as perform routine maintenance tasks to ensure system reliability and performance.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                      | Synthesis/Evaluation (Level-VI/Level-V)    |
| Semester                | VI                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Winter                               |                                            |

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|---------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---------------------------------------------------------|---------|----------------------|
| Contact Hours                               | Lecture                                                                                                                                                                                                                                                                                                                                                                                                                                | Tutorial | Practical                                               | Credits | Total Teaching Hours |
|                                             | 3                                                                                                                                                                                                                                                                                                                                                                                                                                      | 0        | 0                                                       | 3       | 36                   |
| Prerequisite course codes with course names | Analog Electronic Circuits (EC2303), Network Analysis and Synthesis (EE2331)                                                                                                                                                                                                                                                                                                                                                           |          |                                                         |         |                      |
| Text Books                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                        |          |                                                         |         |                      |
| 1.                                          | Title                                                                                                                                                                                                                                                                                                                                                                                                                                  |          | Power Electronics: Converters, Applications, and Design |         |                      |
|                                             | Author                                                                                                                                                                                                                                                                                                                                                                                                                                 |          | Ned Mohan, Tore M. Undeland, and William P. Robbins     |         |                      |
|                                             | Publisher                                                                                                                                                                                                                                                                                                                                                                                                                              |          | John Wiley and Sons                                     |         |                      |
|                                             | Edition                                                                                                                                                                                                                                                                                                                                                                                                                                |          | 3 <sup>rd</sup> Edition                                 |         |                      |
| 2.                                          | Title                                                                                                                                                                                                                                                                                                                                                                                                                                  |          | Fundamentals of Electrical Drives                       |         |                      |
|                                             | Author                                                                                                                                                                                                                                                                                                                                                                                                                                 |          | G.K. Dubey                                              |         |                      |
|                                             | Publisher                                                                                                                                                                                                                                                                                                                                                                                                                              |          | Narosa Publishing House                                 |         |                      |
|                                             | Edition                                                                                                                                                                                                                                                                                                                                                                                                                                |          | 2 <sup>nd</sup> Edition                                 |         |                      |
| Course Contents                             | UNIT I: General Introduction:<br>General Introduction of Power Electronics, Scope and Application, Power Semiconductor Devices- Power diodes; power transistors - SCRs - Triac - GTO; Power MOSFETs - IGBTs- Principles of operation and characteristics, device specifications and ratings, methods of turning on SCR- gate triggering circuit, methods of turning off SCR- commutation circuits; Protection and gate drive circuits. |          |                                                         |         | 9                    |
|                                             | UNIT II: Controlled Rectifiers:<br>Control rectifiers (AC to DC converter): Single phase converters- Principle of phase control, half wave-controlled rectifier load, fully controlled bridge converter, half controlled (semi) converter, Effect of single-phase full converter with source inductance, Dual converter, 3-phase half wave-controlled rectifier, 3-phase fully controlled bridge converter, 3-phase semi converter.    |          |                                                         |         | 9                    |
|                                             | UNIT III: Choppers and Inverters:<br>D.C. Choppers: Principle of operation, control techniques, step down chopper, buck, boost & buck-boost regulator, voltage commutated chopper, current commutated chopper. Inverter: Series inverter, parallel inverter, single phase bridge inverter, concept of VSI and CSI, 3-phase bridge inverter (120° and 180° conduction mode), concept of PWM inverter.                                   |          |                                                         |         | 9                    |

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|                   | <b>UNIT IV: AC Voltage Controllers:</b><br>Principle of on-off controller, Principle of phase control, Single-Phase bidirectional controllers with resistive loads, single-phase controllers with inductive loads, 3-phse half-wave controllers, 3-phse full-wave controllers; Cyclo converters: Single- phase cyclo-converters-mid-point type and bridge type cyclo converter, Three-phase cyclo-converters-Three-phase to single converter, Three-phase to three phase cyclo-converters-Mid-point and Bridge type<br>Applications: UPS, Zero voltage switch, Zero current switch. | 9                                                                 |
| Course Assessment | Total Mark=100                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50% |

|                         |                                                                          |                                                                                                                                                                                                                                      |                                    |                                            |         |                      |
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| Course Code:<br>EC 3601 |                                                                          | Open Elective Course:<br>(Y/N)                                                                                                                                                                                                       | Departmental Core<br>Course: (Y/N) | Departmental Elective<br>Course: (Y/N)     |         |                      |
|                         |                                                                          | N                                                                                                                                                                                                                                    | Y                                  | N                                          |         |                      |
| Type of Course          |                                                                          | Theory and Practical                                                                                                                                                                                                                 |                                    |                                            |         |                      |
| Course Title &<br>Code  |                                                                          | VLSI Design (EC 3601)                                                                                                                                                                                                                |                                    |                                            |         |                      |
| Course Objectives       |                                                                          | <ul style="list-style-type: none"><li>● To learn Basic CMOS circuits and CMOS Process technology</li><li>● To Design and Analyze Digital systems.</li><li>● To learn techniques of chip design using programmable devices.</li></ul> |                                    |                                            |         |                      |
| Course Outcomes         |                                                                          |                                                                                                                                                                                                                                      |                                    | Cognitive Levels                           |         |                      |
| CO1                     | To understand the fundamentals of various IC fabrication methods         |                                                                                                                                                                                                                                      |                                    | Knowledge/Comprehension (Level I/Level-II) |         |                      |
| CO2                     | To learn the fundamentals and design basic VLSI circuits                 |                                                                                                                                                                                                                                      |                                    | Application (Level-III)                    |         |                      |
| CO3                     | Express the Layout of simple MOS circuit using Lambda based design rules |                                                                                                                                                                                                                                      |                                    | Analysis (Level-IV)                        |         |                      |
| CO4                     | To implement/model VLSI Circuits using CAD tools                         |                                                                                                                                                                                                                                      |                                    | Synthesis/Evaluation (Level-VI/Level-V)    |         |                      |
| Semester                |                                                                          | V                                                                                                                                                                                                                                    |                                    | Winter                                     |         |                      |
| Contact Hours           |                                                                          | Lecture                                                                                                                                                                                                                              | Tutorial                           | Practical                                  | Credits | Total Teaching Hours |
|                         |                                                                          | 3                                                                                                                                                                                                                                    | 0                                  | 2                                          | 4       | 36                   |

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| Prerequisite course codes with course names | IC Applications (EC 3504),<br>Analog Electronic Circuits (EC 2304)                                                                                                                                                                                                                                   |                                                                                        |   |
| Text Books                                  |                                                                                                                                                                                                                                                                                                      |                                                                                        |   |
| 1.                                          | Title                                                                                                                                                                                                                                                                                                | Basic VLSI Design                                                                      |   |
|                                             | Author                                                                                                                                                                                                                                                                                               | Douglas AP, Kamran E.                                                                  |   |
|                                             | Publisher                                                                                                                                                                                                                                                                                            | PHI Learning                                                                           |   |
|                                             | Edition                                                                                                                                                                                                                                                                                              | 3 <sup>rd</sup> Edition ,2011                                                          |   |
| Reference Books                             |                                                                                                                                                                                                                                                                                                      |                                                                                        |   |
| 1.                                          | Title                                                                                                                                                                                                                                                                                                | Digital Integrated Circuits, Jan M. Rabaey, Anantha Chandrakasan, and Borivoje Nikolic |   |
|                                             | Author                                                                                                                                                                                                                                                                                               | Jan M. Rabaey, Anantha Chandrakasan, and Borivoje Nikolic                              |   |
|                                             | Publisher                                                                                                                                                                                                                                                                                            | Prentice Hall                                                                          |   |
|                                             | Edition                                                                                                                                                                                                                                                                                              | 2 <sup>nd</sup> Edition,2003                                                           |   |
| 2.                                          | Title                                                                                                                                                                                                                                                                                                | CMOS VLSI Design: Circuits and Systems Perspective                                     |   |
|                                             | Author                                                                                                                                                                                                                                                                                               | N Weste and D. Harris                                                                  |   |
|                                             | Publisher                                                                                                                                                                                                                                                                                            | Addison Wesley                                                                         |   |
|                                             | Edition                                                                                                                                                                                                                                                                                              | 4 <sup>th</sup> Edition, 2010                                                          |   |
| Course Contents                             | UNIT I: Introduction<br>Introduction to VLSI Design methodologies, VLSI Design flow, design hierarchy, concepts of regularity, modularity and locality, VLSI design styles, design quality, packaging technology, computer-aided design technology.                                                  |                                                                                        | 9 |
|                                             | UNIT II: MOSFET fabrication:<br>Basic steps of fabrication, CMOS p-well and n-well processes, layout design rules, BiCMOS fabrication process, Full-custom mask layout design.                                                                                                                       |                                                                                        | 9 |
|                                             | UNIT III:Basic VLSI Design<br>MOS Devices, CMOS Inverter, Combinational logic, layout, design rules, Manufacturing process, Simulation; CAD tools, Low Power design strategies<br>CMOS inverter - the dynamic view, Logic Styles; Dynamic CMOS logic, CMOS combinational, sequential logic circuits. |                                                                                        | 9 |

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|                   | UNIT IV: Circuit Realization<br>Circuit characterization and performance estimation: Resistance, capacitance estimation, Switching characteristics, Delay Models. Power Dissipation, Packaging, Scaling of MOS transistor dimensions. CMOS subsystem design (incrementor/ decrementor, shift register, comparator, etc.) | 9                                                                        |
| Course Assessment | Total Marks =100<br>Theory (75 Marks)<br>Evaluation will be done for 100 marks and 75% of the marks secured will be considered.                                                                                                                                                                                          | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50%        |
|                   | Practical (25 Marks)<br>Evaluation will be done for 50 marks and 50% of the marks secured will be considered.                                                                                                                                                                                                            | Continuous Evaluation 20%<br>Laboratory Examination 50%<br>Viva Voce 30% |

|                         |                                                                                                                                                                                                                                                                                                                                                                                                                 |                                      |                                            |
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| Course Code:<br>EC 3602 | Open Elective Course:<br>(Y/N)<br>N                                                                                                                                                                                                                                                                                                                                                                             | Departmental Core Course: (Y/N)<br>Y | Departmental Elective Course: (Y/N)<br>N   |
| Type of Course          | Theory and Practical                                                                                                                                                                                                                                                                                                                                                                                            |                                      |                                            |
| Course Title & Code     | Computer Networks (EC 3602)                                                                                                                                                                                                                                                                                                                                                                                     |                                      |                                            |
| Course Objectives       | <ul style="list-style-type: none"> <li>To introduce the fundamental concepts of computer networks, including the OSI model, TCP/IP suite, network layers, and addressing schemes.</li> <li>To learn about different network architectures including LANs, WANs, MANs and understand their design principles.</li> <li>To study various network topologies such as bus, star, ring, mesh, and hybrid.</li> </ul> |                                      |                                            |
| Course Outcomes         |                                                                                                                                                                                                                                                                                                                                                                                                                 |                                      | Cognitive Levels                           |
| CO1                     | To understand the issues and challenges at all levels of abstraction in the architecture of a computer network.                                                                                                                                                                                                                                                                                                 |                                      | Knowledge/Comprehension (Level I/Level-II) |
| CO2                     | To understand how to Develop networked applications.                                                                                                                                                                                                                                                                                                                                                            |                                      | Application (Level-III)                    |
| CO3                     | To realize protocols at different layers of a network hierarchy.                                                                                                                                                                                                                                                                                                                                                |                                      | Analysis (Level-IV)                        |

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| CO4                                         | To recognize network for real time application. |                                                                                                                                                                                                                                                    |          |                                          |         | Synthesis/Evaluation<br>(Level-VI/Level-V) |   |
| Semester                                    |                                                 | VII                                                                                                                                                                                                                                                |          |                                          | Summer  |                                            |   |
| Contact Hours                               |                                                 | Lecture                                                                                                                                                                                                                                            | Tutorial | Practical                                | Credits | Total Teaching Hours                       |   |
|                                             |                                                 | 3                                                                                                                                                                                                                                                  | 0        | 2                                        | 4       | 36                                         |   |
| Prerequisite course codes with course names |                                                 | Digital Communication (EC2402)                                                                                                                                                                                                                     |          |                                          |         |                                            |   |
| Text Books                                  |                                                 |                                                                                                                                                                                                                                                    |          |                                          |         |                                            |   |
| 1.                                          |                                                 | Title                                                                                                                                                                                                                                              |          | Computer networks                        |         |                                            |   |
|                                             |                                                 | Author                                                                                                                                                                                                                                             |          | A.S Tanenbaum                            |         |                                            |   |
|                                             |                                                 | Publisher                                                                                                                                                                                                                                          |          | Prentice Hall of India, New Delhi. 2001. |         |                                            |   |
|                                             |                                                 | Edition                                                                                                                                                                                                                                            |          | 3rd Ed.                                  |         |                                            |   |
| 2.                                          |                                                 | Title                                                                                                                                                                                                                                              |          | Data Communication and Networking        |         |                                            |   |
|                                             |                                                 | Author                                                                                                                                                                                                                                             |          | <u>Behrouz A. Forouzan</u>               |         |                                            |   |
|                                             |                                                 | Publisher                                                                                                                                                                                                                                          |          | McGraw Hill Education                    |         |                                            |   |
|                                             |                                                 | Edition                                                                                                                                                                                                                                            |          | 4 <sup>th</sup> Edition                  |         |                                            |   |
| Reference Books                             |                                                 |                                                                                                                                                                                                                                                    |          |                                          |         |                                            |   |
| 1.                                          |                                                 | Title                                                                                                                                                                                                                                              |          | Data and Computer communications         |         |                                            |   |
|                                             |                                                 | Author                                                                                                                                                                                                                                             |          | W.Stallings                              |         |                                            |   |
|                                             |                                                 | Publisher                                                                                                                                                                                                                                          |          | Prentice Hall of India, New Delhi.2001.  |         |                                            |   |
|                                             |                                                 | Edition                                                                                                                                                                                                                                            |          | 5 <sup>th</sup> Edition                  |         |                                            |   |
| Course Contents                             |                                                 | UNIT-I:Introduction Concepts<br>Applications of Networks, Network structure and architecture, The reference OSI reference model, services, Network Topology Design - Delay Analysis, Back Bone Design, Local Access Network Design, Physical Layer |          |                                          |         |                                            | 9 |
|                                             |                                                 | UNIT II: Physical Layer<br>Transmission Media, Switching methods, ISDN, Terminal Handling Medium Access sub layer: Medium Access sub layer - Channel Allocations, LAN 8 protocols - ALOHA protocols - Overview of IEEE standards - FDDI.           |          |                                          |         |                                            | 9 |

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|                   | UNIT III: Data Link Layer<br>Elementary Data Link Protocols, Sliding Window protocols, Error Handling. Network Layer: Point - to Point Networks, routing, Congestion control Internetworking 8 -TCP / IP, IP packet, IP address, IPv6.                                                                                          | 9                                                                         |
|                   | UNIT IV: Transport Layer, session, presentation and applications layer<br>Design issues, connection management, session Layer-Design issues, remote procedure call. Presentation Layer-Design issues, Data compression techniques, File Transfer, Access and Management, Electronic mail, Virtual Terminals, Other application. | 9                                                                         |
| Course Assessment | Total Marks =100<br>Theory (75 Marks)<br>Evaluation will be done for 100 marks and 75% of the marks secured will be considered.                                                                                                                                                                                                 | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50%         |
|                   | Practical (25 Marks)<br>Evaluation will be done for 50 marks and 50% of the marks secured will be considered.                                                                                                                                                                                                                   | Continuous Evaluation 20%<br>Laboratory Examination 50%<br>Viva Voice 30% |

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| Course Code:<br>EC 3603 | Open Elective Course:<br>(Y/N)<br>N                                                                                                                                                                                                                                                                                                                                                                | Departmental Core Course: (Y/N)<br>Y | Departmental Elective Course: (Y/N)<br>N   |
| Type of Course          | Theory and Practical                                                                                                                                                                                                                                                                                                                                                                               |                                      |                                            |
| Course Title & Code     | Antenna and Wave Propagation (EC3604)                                                                                                                                                                                                                                                                                                                                                              |                                      |                                            |
| Course Objectives       | <ul style="list-style-type: none"> <li>To introduce the practical idea on the different antenna parameters for real time knowledge.</li> <li>To improve the knowledge on the EM radiation techniques of various antennas and their maximum range of coverage</li> <li>To learn the EM wave transmission and receiving system in free space, sky wave and for ground wave communication.</li> </ul> |                                      |                                            |
| Course Outcomes         |                                                                                                                                                                                                                                                                                                                                                                                                    |                                      | Cognitive Levels                           |
| CO1                     | To understand the radiation techniques of various radiator.                                                                                                                                                                                                                                                                                                                                        |                                      | Knowledge/Comprehension (Level I/Level-II) |

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| CO2                                         | To design the various antenna and conforming the fundamental performance for various applications. |                                                                                                                                                                                                                                                                                          |          |                                      | Application<br>(Level-III)                 |                      |
| CO3                                         | To get clear idea about the design, performance and analysis.                                      |                                                                                                                                                                                                                                                                                          |          |                                      | Analysis<br>(Level-IV)                     |                      |
| CO4                                         | To understand the performance of the antenna as a wave radiator for various communication systems. |                                                                                                                                                                                                                                                                                          |          |                                      | Synthesis/Evaluation<br>(Level-VI/Level-V) |                      |
| Semester                                    |                                                                                                    | VI                                                                                                                                                                                                                                                                                       |          |                                      | Winter                                     |                      |
| Contact Hours                               |                                                                                                    | Lecture                                                                                                                                                                                                                                                                                  | Tutorial | Practical                            | Credits                                    | Total Teaching Hours |
|                                             |                                                                                                    | 3                                                                                                                                                                                                                                                                                        | 0        | 2                                    | 4                                          | 36                   |
| Prerequisite course codes with course names |                                                                                                    | Electromagnetic Theory (EC 3502)                                                                                                                                                                                                                                                         |          |                                      |                                            |                      |
| Text Books                                  |                                                                                                    |                                                                                                                                                                                                                                                                                          |          |                                      |                                            |                      |
| 1.                                          | Title                                                                                              |                                                                                                                                                                                                                                                                                          |          | Antennas                             |                                            |                      |
|                                             | Author                                                                                             |                                                                                                                                                                                                                                                                                          |          | J.D. Kraus                           |                                            |                      |
|                                             | Publisher                                                                                          |                                                                                                                                                                                                                                                                                          |          | Tata McGraw Hill                     |                                            |                      |
|                                             | Edition                                                                                            |                                                                                                                                                                                                                                                                                          |          | 2 <sup>nd</sup> Edition              |                                            |                      |
| 2.                                          | Title                                                                                              |                                                                                                                                                                                                                                                                                          |          | Antenna Theory - Analysis and Design |                                            |                      |
|                                             | Author                                                                                             |                                                                                                                                                                                                                                                                                          |          | C.A. Balanis                         |                                            |                      |
|                                             | Publisher                                                                                          |                                                                                                                                                                                                                                                                                          |          | John Wiley                           |                                            |                      |
|                                             | Edition                                                                                            |                                                                                                                                                                                                                                                                                          |          | 3 <sup>rd</sup> Edition              |                                            |                      |
| Reference Books                             |                                                                                                    |                                                                                                                                                                                                                                                                                          |          |                                      |                                            |                      |
| 1.                                          | Title                                                                                              |                                                                                                                                                                                                                                                                                          |          | Antennas and Radio Wave Propagation  |                                            |                      |
|                                             | Author                                                                                             |                                                                                                                                                                                                                                                                                          |          | R.E. Collins                         |                                            |                      |
|                                             | Publisher                                                                                          |                                                                                                                                                                                                                                                                                          |          | Tata McGraw Hill                     |                                            |                      |
|                                             | Edition                                                                                            |                                                                                                                                                                                                                                                                                          |          | 4 <sup>th</sup> Edition              |                                            |                      |
| 2.                                          | Title                                                                                              |                                                                                                                                                                                                                                                                                          |          | Broadband MicroStrip Antennas        |                                            |                      |
|                                             | Author                                                                                             |                                                                                                                                                                                                                                                                                          |          | G. Kumar and K.P. Roy                |                                            |                      |
|                                             | Publisher                                                                                          |                                                                                                                                                                                                                                                                                          |          | Artech House                         |                                            |                      |
|                                             | Edition                                                                                            |                                                                                                                                                                                                                                                                                          |          | 30 November 2002                     |                                            |                      |
| Course Contents                             |                                                                                                    | UNIT I: Fundamental concept of Antenna parameters<br>Physical concept of radiation, Radiation pattern, near and far-field regions, reciprocity, directivity and gain, effective aperture, polarization, input impedance, radiation resistance, radiating average power efficiency, Friis |          |                                      |                                            | 11                   |

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|                   | transmission equation, surface current distribution for finite dipoles.                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                          |
|                   | <p>UNIT II: Radiation Technique and Field distributions</p> <p>Infinitesimal dipole, Half Wave Dipole (<math>\lambda/2</math>), finite-length dipole and, (<math>\lambda/4</math>) monopole antenna. Concept of Smart Antennas, Characteristics of Loop antenna, Helical antenna Log-periodic, Yagi-Uda antenna and Horn Antenna. Basic characteristics and design of microstrip antennas: Planar monopole antenna, rectangular and circular patch antennas, feeding methods.</p> | 11                                                                                       |
|                   | <p>UNIT III: Array Antenna</p> <p>Two element array concept, array factor, N element linear array: uniform amplitude and spacing, End-fire array, broadside array and Binomial Array. Basic Concepts of Smart Antennas.</p>                                                                                                                                                                                                                                                       | 7                                                                                        |
|                   | <p>UNIT IV: Wave Propagation</p> <p>Concept of Ground wave propagation, Sky wave propagation and space wave propagation Duct propagation, Maximum Usable Frequency (MUF), Skip distance, Tropospheric Scatter propagation, Critical frequency, Fadings.</p>                                                                                                                                                                                                                       | 7                                                                                        |
| Course Assessment | <p>Total Marks =100</p> <p>Theory (75 Marks)</p> <p>Evaluation will be done for 100 marks and 75% of the marks secured will be considered.</p>                                                                                                                                                                                                                                                                                                                                    | <p>Continuous Evaluation 20%</p> <p>Mid Semester 30%</p> <p>End Semester 50%</p>         |
|                   | <p>Practical (25 Marks)</p> <p>Evaluation will be done for 50 marks and 50% of the marks secured will be considered.</p>                                                                                                                                                                                                                                                                                                                                                          | <p>Continuous Evaluation 20%</p> <p>Laboratory Examination 50%</p> <p>Viva Voice 30%</p> |

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| Course Code:<br>EC 4701 | Open Elective Course:<br>(Y/N)                                                                                                                                                                                | Departmental Core<br>Course: (Y/N) | Departmental Elective<br>Course: (Y/N) |
|                         | N                                                                                                                                                                                                             | Y                                  | N                                      |
| Type of Course          | Theory and Practical                                                                                                                                                                                          |                                    |                                        |
| Course Title & Code     | RF and Microwave Engineering (EC 4701)                                                                                                                                                                        |                                    |                                        |
| Course Objectives       | <ul style="list-style-type: none"> <li>To understand about the devices those are directly involve generating microwave signal.</li> <li>To understand the transmission process of X-band EM waves.</li> </ul> |                                    |                                        |

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|                                             |                                                                                                                                       | ● To improve the knowledge about the microwave signal amplification, division, addition and measurement techniques. |          |                                         |                                            |                      |
| Course Outcomes                             |                                                                                                                                       |                                                                                                                     |          | Cognitive Levels                        |                                            |                      |
| CO1                                         | Student should able to identify the basic microwave devices.                                                                          |                                                                                                                     |          |                                         | Knowledge/Comprehension (Level I/Level-II) |                      |
| CO2                                         | Student should able to differentiate microwave devices for different frequency bands application under the microwave frequency range. |                                                                                                                     |          |                                         | Application (Level-III)                    |                      |
| CO3                                         | Student should able to understand the working principle of the microwave devices.                                                     |                                                                                                                     |          |                                         | Analysis (Level-IV)                        |                      |
| CO4                                         | Student should able to implement the new microwave devices and also able to measure power and frequency bands                         |                                                                                                                     |          |                                         | Synthesis/Evaluation (Level-VI/Level-V)    |                      |
| Semester                                    |                                                                                                                                       | VII                                                                                                                 |          |                                         | Summer                                     |                      |
| Contact Hours                               |                                                                                                                                       | Lecture                                                                                                             | Tutorial | Practical                               | Credits                                    | Total Teaching Hours |
|                                             |                                                                                                                                       | 3                                                                                                                   | 0        | 2                                       | 4                                          | 36                   |
| Prerequisite course codes with course names |                                                                                                                                       | Antenna and Wave Propagation (EC3604)                                                                               |          |                                         |                                            |                      |
| Text Books                                  |                                                                                                                                       |                                                                                                                     |          |                                         |                                            |                      |
| 1.                                          | Title                                                                                                                                 |                                                                                                                     |          | Principle of Electromagnetics           |                                            |                      |
|                                             | Author                                                                                                                                |                                                                                                                     |          | M.N.O. Sadiku and S.V. Kulkarni,        |                                            |                      |
|                                             | Publisher                                                                                                                             |                                                                                                                     |          | Oxford                                  |                                            |                      |
|                                             | Edition                                                                                                                               |                                                                                                                     |          | 6 <sup>th</sup> Edition                 |                                            |                      |
| 2.                                          | Title                                                                                                                                 |                                                                                                                     |          | Microwave Engineering                   |                                            |                      |
|                                             | Author                                                                                                                                |                                                                                                                     |          | David. M. Pozar,                        |                                            |                      |
|                                             | Publisher                                                                                                                             |                                                                                                                     |          | John Wiley                              |                                            |                      |
|                                             | Edition                                                                                                                               |                                                                                                                     |          | 4 <sup>th</sup> Edition                 |                                            |                      |
| Reference Books                             |                                                                                                                                       |                                                                                                                     |          |                                         |                                            |                      |
| 1.                                          | Title                                                                                                                                 |                                                                                                                     |          | Fundamental of Microwave Engineering    |                                            |                      |
|                                             | Author                                                                                                                                |                                                                                                                     |          | R.E. Collins                            |                                            |                      |
|                                             | Publisher                                                                                                                             |                                                                                                                     |          | Wiley                                   |                                            |                      |
|                                             | Edition                                                                                                                               |                                                                                                                     |          | 2 <sup>nd</sup> Edition                 |                                            |                      |
| 2.                                          | Title                                                                                                                                 |                                                                                                                     |          | Microwave Devices and Circuits, Pearson |                                            |                      |

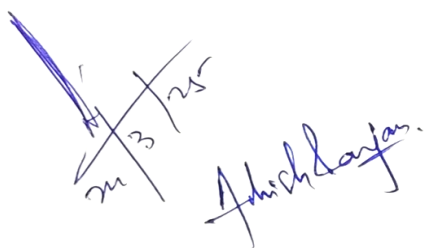
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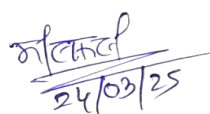
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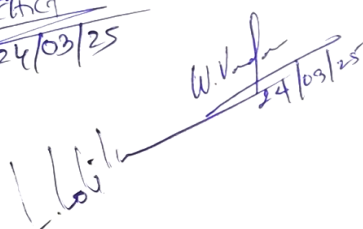
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|                   | Author                                                                                                                                                                                                                                                                                                                                                                 | S. Y. Liao                    |                                                                           |
|                   | Publisher                                                                                                                                                                                                                                                                                                                                                              | Pearson                       |                                                                           |
|                   | Edition                                                                                                                                                                                                                                                                                                                                                                | 3 <sup>rd</sup> Edition, 2003 |                                                                           |
| Course Contents   | UNIT I: Microwave Generation<br>A Short History of Microwave Engineering, IEEE standard microwave frequency bands and its applications, concept of microwave communication systems. Microwave Tubes: Klystron, TWT and Magnetron, Microwave Amplifier, Oscillators and Mixers design. Microwave Semiconductor Devices.                                                 |                               | 11                                                                        |
|                   | UNIT II: Fundamental Concepts OF Transmission line<br>Introduction, Transmission Line Parameters, The Loss-less, Distortion-less, Lossy Transmission Lines, Microstrip Transmission Lines. Plane Waves in a Lossless, Lossy and Good Conductor Mediums Applications of Transmission Lines: The Quarter-Wave Transformer, stubs, Smith Chart.                           |                               | 11                                                                        |
|                   | UNIT III: Microwave Waveguides and Applications<br>Introduction, Maxwell's Equation, EM wave equations, Rectangular Waveguides, Transverse Magnetic (TM) Modes, Transverse Electric (TE) Modes, Wave Propagation in the Guide, Power Transmission and Attenuation, scattering parameters., Directional Coupler, Power Divider, combiner, Attenuator, cavity resonator. |                               | 9                                                                         |
|                   | UNIT IV: Microwave Measurements<br>Power, Frequency and impedance measurement at microwave frequency, Network Analyzer and measurement of scattering parameters, Spectrum Analyzer and measurement of spectrum of a microwave signal.                                                                                                                                  |                               | 5                                                                         |
| Course Assessment | Total Marks =100<br>Theory (75 Marks)<br>Evaluation will be done for 100 marks and 75% of the marks secured will be considered.                                                                                                                                                                                                                                        |                               | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50%         |
|                   | Practical (25 Marks)<br>Evaluation will be done for 50 marks and 50% of the marks secured will be considered.                                                                                                                                                                                                                                                          |                               | Continuous Evaluation 20%<br>Laboratory Examination 50%<br>Viva Voice 30% |


  
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| Course Code:<br>EC 4702                     |                                                                                                                                                              | Open Elective Course:<br>(Y/N)                                                                                                                                                                                                                                                                                                                |          | Departmental Core<br>Course: (Y/N) |               | Departmental Elective<br>Course: (Y/N)            |  |
|                                             |                                                                                                                                                              | N                                                                                                                                                                                                                                                                                                                                             |          | Y                                  |               | N                                                 |  |
| Type of Course                              |                                                                                                                                                              | Theory Course                                                                                                                                                                                                                                                                                                                                 |          |                                    |               |                                                   |  |
| Course Title & Code                         |                                                                                                                                                              | Introduction to Photonics (EC4702)                                                                                                                                                                                                                                                                                                            |          |                                    |               |                                                   |  |
| Course Objectives                           |                                                                                                                                                              | <ul style="list-style-type: none"><li>• Learn the fundamental principles of photonics and light-matter interactions,</li><li>• Develop the ability to formulate problems related to photonic structures/processes and analyze them, and</li><li>• Understand processes that help to manipulate the fundamental properties of light.</li></ul> |          |                                    |               |                                                   |  |
| Course Outcomes                             |                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                               |          |                                    |               | Cognitive Levels                                  |  |
| CO1                                         | Defining and explaining the physics governing laser behavior and light matter interaction.Applying wave optics and diffraction theory to a range of problems |                                                                                                                                                                                                                                                                                                                                               |          |                                    |               | Knowledge/Compre<br>hension (Level<br>I/Level-II) |  |
| CO2                                         | Applying the principles of atomic physics to materials used in optics and photonics.Exploring the production and nature of light                             |                                                                                                                                                                                                                                                                                                                                               |          |                                    |               | Application<br>(Level-III)                        |  |
| CO3                                         | Learning the laws of reflection and refraction, theory of image formation,principles of wave optics (including interference, diffraction and polarization)   |                                                                                                                                                                                                                                                                                                                                               |          |                                    |               | Analysis<br>(Level-IV)                            |  |
| CO4                                         | Learning fundamentals of fiber optic theory, principles of lasers and laser safety,Learning the basics of holography                                         |                                                                                                                                                                                                                                                                                                                                               |          |                                    |               | Synthesis/Evaluatio<br>n (Level-VI/Level-<br>V)   |  |
| Semester                                    |                                                                                                                                                              | III/IV                                                                                                                                                                                                                                                                                                                                        |          |                                    | Summer/Winter |                                                   |  |
| Contact Hours                               |                                                                                                                                                              | Lecture                                                                                                                                                                                                                                                                                                                                       | Tutorial | Practical                          | Credits       | Total Teaching<br>Hours                           |  |
|                                             |                                                                                                                                                              | 3                                                                                                                                                                                                                                                                                                                                             | 0        | 0                                  | 3             | 36                                                |  |
| Prerequisite course codes with course names |                                                                                                                                                              | Engineering Mathematics-III(MA 2301); Basic Electronic Circuits (EC 1201)                                                                                                                                                                                                                                                                     |          |                                    |               |                                                   |  |
| Text Books                                  |                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                               |          |                                    |               |                                                   |  |
| 1.                                          |                                                                                                                                                              | Title                                                                                                                                                                                                                                                                                                                                         |          |                                    | Optics Edn    |                                                   |  |
|                                             |                                                                                                                                                              | Author                                                                                                                                                                                                                                                                                                                                        |          |                                    | E.Hecht       |                                                   |  |

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|                   | Publisher                                                                                                                                                                                                                                                                                                                                                                                               | Pearson2004                                                       |    |
|                   | Edition                                                                                                                                                                                                                                                                                                                                                                                                 | (4th Ed)                                                          |    |
| 2.                | Title                                                                                                                                                                                                                                                                                                                                                                                                   | Introduction to Optics, 2012                                      |    |
|                   | Author                                                                                                                                                                                                                                                                                                                                                                                                  | Frank L. Pedrotti, S.J., Leno M. Pedrotti, Leno S.Pedrotti,       |    |
|                   | Publisher                                                                                                                                                                                                                                                                                                                                                                                               | Pearson2012                                                       |    |
|                   | Edition                                                                                                                                                                                                                                                                                                                                                                                                 | (3rdEdition                                                       |    |
| Reference Books   |                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                   |    |
| 1.                | Title                                                                                                                                                                                                                                                                                                                                                                                                   | Optics                                                            |    |
|                   | Author                                                                                                                                                                                                                                                                                                                                                                                                  | Ajoy Ghatak,                                                      |    |
|                   | Publisher                                                                                                                                                                                                                                                                                                                                                                                               | Tata McGraw Hill, 2005                                            |    |
|                   | Edition                                                                                                                                                                                                                                                                                                                                                                                                 | 3rd edition                                                       |    |
| Course Contents   | UNIT I:Introduction; Different quantities associated with light; Properties of Light; Reflection; Refraction; Interference & Diffraction; Absorption & Scattering                                                                                                                                                                                                                                       |                                                                   | 6  |
|                   | UNIT II Properties of materials with respect to reflection, refraction, absorption and transmission of light; thermal, mechanical and chemical properties; Optical coatings and methods;                                                                                                                                                                                                                |                                                                   | 9  |
|                   | UNIT III Properties of materials with respect to reflection, refraction, absorption and transmission of light; thermal, mechanical and chemical properties; Optical coatings and methods;                                                                                                                                                                                                               |                                                                   | 9  |
|                   | UNIT IV Properties of materials with respect to reflection, refraction, absorption and transmission of light; thermal, mechanical and chemical properties; Optical coatings and methods;<br><br>Interaction of light waves; Interference; Young’s double slit experiment; Thin film interference; Diffraction Polarization; Formation & types of holograms Polarization; Formation & types of holograms |                                                                   | 12 |
| Course Assessment | Total Marks=100                                                                                                                                                                                                                                                                                                                                                                                         | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50% |    |

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|---------------------------------------------|---------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|------------------------------------|-----------|--------------------------------------------|----------------------|
| Course Code:<br>EC 3571                     |                                                                                 | Open Elective Course:<br>(Y/N)                                                                                                                                                                                                                                                                                         |          | Departmental Core<br>Course: (Y/N) |           | Departmental Elective<br>Course: (Y/N)     |                      |
|                                             |                                                                                 | N                                                                                                                                                                                                                                                                                                                      |          | N                                  |           | Y                                          |                      |
| Type of Course                              |                                                                                 | Theory Course                                                                                                                                                                                                                                                                                                          |          |                                    |           |                                            |                      |
| Course Title & Code                         |                                                                                 | Optical Fiber Communication (EC 3571)                                                                                                                                                                                                                                                                                  |          |                                    |           |                                            |                      |
| Course Objectives                           |                                                                                 | <ul style="list-style-type: none"><li>● To introduce basics of signal propagation through optical fibers.</li><li>● To introduce the fiber impairments, optical components and devices.</li><li>● To learn all design considerations of optical fiber systems.</li><li>● To learn about the optical sources.</li></ul> |          |                                    |           |                                            |                      |
| Course Outcomes                             |                                                                                 |                                                                                                                                                                                                                                                                                                                        |          |                                    |           | Cognitive Levels                           |                      |
| CO1                                         | To be able to recognize and classify the structures of Optical fiber and types. |                                                                                                                                                                                                                                                                                                                        |          |                                    |           | Knowledge/Comprehension (Level I/Level-II) |                      |
| CO2                                         | To discuss the channel impairments like losses and dispersion.                  |                                                                                                                                                                                                                                                                                                                        |          |                                    |           | Analysis (Level-IV)                        |                      |
| CO3                                         | Classify the Optical sources and detectors and to discuss their principle.      |                                                                                                                                                                                                                                                                                                                        |          |                                    |           | Application (Level-III)                    |                      |
| CO4                                         | Familiar with Design considerations of fiber optic systems.                     |                                                                                                                                                                                                                                                                                                                        |          |                                    |           | Synthesis/Evaluation (Level-VI/Level-V)    |                      |
| Semester                                    |                                                                                 | V                                                                                                                                                                                                                                                                                                                      |          |                                    | Summer    |                                            |                      |
| Contact Hours                               |                                                                                 | Lecture                                                                                                                                                                                                                                                                                                                | Tutorial |                                    | Practical | Credits                                    | Total Teaching Hours |
|                                             |                                                                                 | 3                                                                                                                                                                                                                                                                                                                      | 0        |                                    | 0         | 3                                          | 36                   |
| Prerequisite course codes with course names |                                                                                 | Electromagnetic Theory (EC 3502)                                                                                                                                                                                                                                                                                       |          |                                    |           |                                            |                      |
| Text Books                                  |                                                                                 |                                                                                                                                                                                                                                                                                                                        |          |                                    |           |                                            |                      |
| 1.                                          | Title                                                                           |                                                                                                                                                                                                                                                                                                                        |          | Optical Fiber Communications       |           |                                            |                      |
|                                             | Author                                                                          |                                                                                                                                                                                                                                                                                                                        |          | Gerd KeiserGerd Keiser             |           |                                            |                      |
|                                             | Publisher                                                                       |                                                                                                                                                                                                                                                                                                                        |          | McGraw-Hill Education, 2010        |           |                                            |                      |
|                                             | Edition                                                                         |                                                                                                                                                                                                                                                                                                                        |          | 4 <sup>th</sup> Edition            |           |                                            |                      |
| 2.                                          | Title                                                                           |                                                                                                                                                                                                                                                                                                                        |          | Introduction To Fiber Optics       |           |                                            |                      |

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|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|---|
|                   | Author                                                                                                                                                                                                                                                                                                     | ajoy ghatak, k. Thyagarajan                                       |   |
|                   | Publisher                                                                                                                                                                                                                                                                                                  | Cambridge University Press, 1998                                  |   |
|                   | Edition                                                                                                                                                                                                                                                                                                    | 1 <sup>st</sup> Edition                                           |   |
| Reference Books   |                                                                                                                                                                                                                                                                                                            |                                                                   |   |
| 1.                | Title                                                                                                                                                                                                                                                                                                      | Fiber Optic Communication Systems                                 |   |
|                   | Author                                                                                                                                                                                                                                                                                                     | G.P. Agrawal                                                      |   |
|                   | Publisher                                                                                                                                                                                                                                                                                                  | Wiley, 2002                                                       |   |
|                   | Edition                                                                                                                                                                                                                                                                                                    | 3 <sup>rd</sup> Edition                                           |   |
| 2.                | Title                                                                                                                                                                                                                                                                                                      | Optical Communication Systems                                     |   |
|                   | Author                                                                                                                                                                                                                                                                                                     | John Gowar                                                        |   |
|                   | Publisher                                                                                                                                                                                                                                                                                                  | Prentice Hall. 2001                                               |   |
|                   | Edition                                                                                                                                                                                                                                                                                                    | 2 <sup>nd</sup> Edition                                           |   |
| Course Contents   | UNIT I: Overview of Optical Fibers<br>Introduction to vector nature of light, propagation of light, Ray model, wave model.Optical Fibers: Structure, Types, Waveguiding. Step-index and graded index optical fibers. Modal analysis. Classification of modes. Single Mode Fibers.                          |                                                                   | 9 |
|                   | UNIT II: Signal Degradation In Optical Fibers<br>Attenuation. Pulse dispersion. Material and waveguide dispersion. Polarization Mode Dispersion. Absorption, scattering and bending losses. Dispersion Shifted Fibers, Dispersion Compensating Fibers.                                                     |                                                                   | 9 |
|                   | UNIT III: Optical Power Launching and Coupling<br>Source To Fiber Power Launching. Lensing schemes for coupling improvement. Fiber-to-fiber joints. Splicing techniques.Connectors. Optical fiber connectors.                                                                                              |                                                                   | 9 |
|                   | UNIT IV: Optical sources and Fiber Optics Systems<br>Laser fundamentals. Semiconductor Laser basics. LEDs. PIN and Avalanche photodiodes.Analog and digital modulation. Noise in detection process. Bit error rate. Optical receiver operation. Power Budget and Rise time Budget.Optical amplifiers. WDM. |                                                                   | 9 |
| Course Assessment | Total Marks=100                                                                                                                                                                                                                                                                                            | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50% |   |

|                         |                                |                                 |                                     |
|-------------------------|--------------------------------|---------------------------------|-------------------------------------|
| Course Code:<br>EC 3572 | Open Elective Course:<br>(Y/N) | Departmental Core Course: (Y/N) | Departmental Elective Course: (Y/N) |
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|---------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|--------------------------------------------|
|                                             | N                                                                                                                                                                                                                                                                                                                                                                                       | N                                | Y                                          |
| Type of Course                              | Theory Course                                                                                                                                                                                                                                                                                                                                                                           |                                  |                                            |
| Course Title & Code                         | Information Theory and Coding (EC3572)                                                                                                                                                                                                                                                                                                                                                  |                                  |                                            |
| Course Objectives                           | <ul style="list-style-type: none"><li>● To understand information theoretic behavior of a communication system.</li><li>● To understand various source coding techniques for data compression</li><li>● To understand various channel coding techniques and their capability.</li><li>● Build and understanding of fundamental concepts of data communication and networking.</li></ul> |                                  |                                            |
| Course Outcomes                             |                                                                                                                                                                                                                                                                                                                                                                                         |                                  | Cognitive Levels                           |
| CO1                                         | Summarize various theorems related to information channels                                                                                                                                                                                                                                                                                                                              |                                  | Knowledge/Comprehension (Level I/Level-II) |
| CO2                                         | Illustrate various encoding techniques related to information channels                                                                                                                                                                                                                                                                                                                  |                                  | Application (Level-III)                    |
| CO3                                         | Analyze information using various encoding techniques                                                                                                                                                                                                                                                                                                                                   |                                  | Analysis (Level-IV)                        |
| CO4                                         | Monitor performance of encoding techniques in the application of data transmission                                                                                                                                                                                                                                                                                                      |                                  | Synthesis/Evaluation (Level-VI/Level-V)    |
| Semester                                    | V                                                                                                                                                                                                                                                                                                                                                                                       |                                  | Summer                                     |
| Contact Hours                               | Lecture                                                                                                                                                                                                                                                                                                                                                                                 | Tutorial                         | Practical Credits Total Teaching Hours     |
|                                             | 3                                                                                                                                                                                                                                                                                                                                                                                       | 0                                | 0 3 36                                     |
| Prerequisite course codes with course names | Digital Communication (EC 2402)                                                                                                                                                                                                                                                                                                                                                         |                                  |                                            |
| Text Books                                  |                                                                                                                                                                                                                                                                                                                                                                                         |                                  |                                            |
| 1.                                          | Title                                                                                                                                                                                                                                                                                                                                                                                   | “Information and Coding Theory”, |                                            |

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|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|---|
|                 | Author                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | G. A. Jones and J. M. Jones,          |   |
|                 | Publisher                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Springer, 2000.                       |   |
|                 | Edition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 3 <sup>rd</sup> Edition               |   |
| 2.              | Title                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | “Introduction to Coding Theory”,      |   |
|                 | Author                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | J. H. van Lint,                       |   |
|                 | Publisher                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Springer, 1999.                       |   |
|                 | Edition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 3 <sup>rd</sup> Edition               |   |
| Reference Books |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                       |   |
| 1.              | Title                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | “Elements of Information Theory”, and |   |
|                 | Author                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Cover Thomas,                         |   |
|                 | Publisher                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Wiley 2006.                           |   |
|                 | Edition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 3 <sup>rd</sup> Edition               |   |
| Course Contents | UNIT 1:Definitions, Uniquely Decodable Codes, Instantaneous Codes, Krafts Inequality, McMillan’s Inequality, Optimal Codes, Binary Huffman Codes, r-ary Huffman codes, Information and Entropy, Properties of Entropy Function, Entropy and Average Word-Length, Shannon-Fano Coding, Shannon’s First Theorem, Information Channels, Binary Symmetric Channel, System Entropies, System Entropies for Binary Symmetric Channel, Extension of Shannon’s First Theorem to Information Channels, Mutual Information, Mutual Information for the Binary Symmetric Channel, Hamming Distance, Shannon’s Second (Fundamental) Theorem, Converse of Shannon’s Theorems. |                                       | 9 |
|                 | UNIT II: Review: Algebra, Krawtchouk Polynomials, Combinatorial Theory, Probability Theory. Linear Codes: Block Codes, Linear Codes, Hamming Codes, Majority Logic Coding, Weight Enumerators, The Lee Metric, Hadamard Codes, Golay Codes (Binary and Ternary), Reed Muller Codes, And Kerdock Codes.Bounds on Codes: Gilbert Bound, Upper Bound, Linear Programming Bounds, Hamming’s Sphere –Packing Bound, Gilbert Varshamov Bound, Hadamard Matrices and Codes. Cyclic Codes: Generator Matrix, Check polynomial, Zeros of                                                                                                                                  |                                       | 9 |

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|                   | UNIT III Cyclic Codes, BCH Codes, Reed-Solomon Codes, Quadratic Residue Codes, Generalized Reed-Muller Codes. Perfect Codes and Uniformly Packed Codes: Lloyd's Theorem, Characteristic Polynomial of a Code, Uniformly Packed Codes, Nonexistence Theorems.                                                                    | 9                                                                 |
|                   | UNIT IV Quaternary Codes, Binary Codes Derived from codes over $Z_4$ , Galois Rings over $Z_4$ , Cyclic Codes over $Z_4$ . Goppa Codes. Algebraic Curves, Divisors, Differentials on a Curve, Riemann – Roch Theorem, Codes from Algebraic Curves. Arithmetic Codes: AN Codes, Mandelbaum – Barrows Codes, Convolutional Codes. | 9                                                                 |
| Course Assessment | Total Marks=100                                                                                                                                                                                                                                                                                                                 | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50% |

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|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|--------------------------------------------|
| Course Code:<br>EC 3573 | Open Elective Course:<br>(Y/N)                                                                                                                                                                                          | Departmental Core<br>Course: (Y/N) | Departmental Elective<br>Course: (Y/N)     |
|                         | N                                                                                                                                                                                                                       | N                                  | Y                                          |
| Type of Course          | Theory Course                                                                                                                                                                                                           |                                    |                                            |
| Course Title & Code     | Semiconductor Device Modelling (EC3573)                                                                                                                                                                                 |                                    |                                            |
| Course Objectives       | <ul style="list-style-type: none"> <li>To introduce students to the physics of semiconductors.</li> <li>To provide students the insight useful for understanding new semiconductor devices and technologies.</li> </ul> |                                    |                                            |
| Course Outcomes         |                                                                                                                                                                                                                         |                                    | Cognitive Levels                           |
| CO1                     | To analyze MOS and its operation on the basis of physical operation                                                                                                                                                     |                                    | Knowledge/Comprehension (Level I/Level-II) |
| CO2                     | To develop a physics-based knowledge on the basic fundamentals in the course                                                                                                                                            |                                    | Application (Level-III)                    |
| CO3                     | To relate a 2nd order effect or deviation from ideal behavior in circuit level to device physics concept learnt in the course                                                                                           |                                    | Analysis (Level-IV)                        |
| CO4                     | To understand, articulate and demonstrate new ideas given in research literature of the field                                                                                                                           |                                    | Synthesis/Evaluation (Level-VI/Level-V)    |
| Semester                | V                                                                                                                                                                                                                       |                                    | Summer                                     |
| Contact Hours           | Lecture                                                                                                                                                                                                                 | Tutorial                           | Practical Credits Total Teaching Hours     |

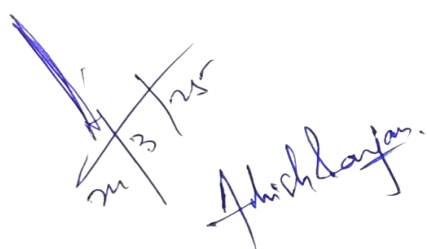
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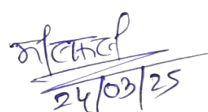
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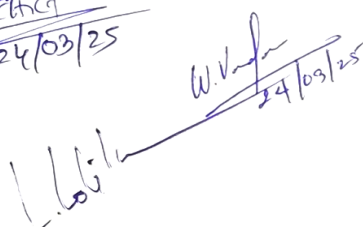
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|                                             |                                                                                                                                                                                                                                                           |                                               |   |   |    |
|---------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|---|---|----|
|                                             | 3                                                                                                                                                                                                                                                         | 0                                             | 0 | 3 | 36 |
| Prerequisite course codes with course names | Introduction to Semiconductor Devices(EC 2403)                                                                                                                                                                                                            |                                               |   |   |    |
| Text Books                                  |                                                                                                                                                                                                                                                           |                                               |   |   |    |
| 1.                                          | Title                                                                                                                                                                                                                                                     | Operation and Modeling of the MOS Transistor  |   |   |    |
|                                             | Author                                                                                                                                                                                                                                                    | Yannis Tsividis                               |   |   |    |
|                                             | Publisher                                                                                                                                                                                                                                                 | Oxford University Press                       |   |   |    |
|                                             | Edition                                                                                                                                                                                                                                                   | 3rd Edition                                   |   |   |    |
| 2.                                          | Title                                                                                                                                                                                                                                                     | MOSFET models for VLSI Circuit Simulation     |   |   |    |
|                                             | Author                                                                                                                                                                                                                                                    | N. Arora                                      |   |   |    |
|                                             | Publisher                                                                                                                                                                                                                                                 | Springer-Verlag                               |   |   |    |
|                                             | Edition                                                                                                                                                                                                                                                   | 1st Edition                                   |   |   |    |
| Reference Books                             |                                                                                                                                                                                                                                                           |                                               |   |   |    |
| 1.                                          | Title                                                                                                                                                                                                                                                     | Introduction to Semiconductor Device Modeling |   |   |    |
|                                             | Author                                                                                                                                                                                                                                                    | C. Snowden                                    |   |   |    |
|                                             | Publisher                                                                                                                                                                                                                                                 | World Scientific                              |   |   |    |
|                                             | Edition                                                                                                                                                                                                                                                   | 1986                                          |   |   |    |
| Course Contents                             | UNIT I: Two Terminal MOS Structure<br>Contact Potential: Overview, flat-band voltage, potential and charge balance, channel charge, accumulation, depletion, inversion, threshold voltage, small signal capacitances.                                     |                                               |   |   | 9  |
|                                             | UNIT II: Three Terminal MOS Structure<br>Effect of channel-body potential, body effect, inversion regions, contacting the inversion layer, region of inversion: approximate limits, threshold voltage, $V_{CB}$ control point of view, pinch-off voltage. |                                               |   |   | 9  |
|                                             | UNIT III: Four Terminal MOS Transistor<br>Complete charge-sheet model, simplified charge-sheet model, strong and weak inversion approximation to the channel current, effective surface mobility, field dependence of the surface mobility, breakdown.    |                                               |   |   | 9  |
|                                             | UNIT IV: Small Dimensional Effects<br>Long- and short-channel MOS transistor, carrier velocity saturation, channel length modulation, charge sharing, DIBL, threshold voltage rolls-                                                                      |                                               |   |   | 9  |









|                   |                                                                                                                                                                   |                                                                   |
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|                   | off, narrow channel effects, punch through, hot-carrier effects, GIDL, scaling: constant field and constant voltage scaling, non-scaling effects, modern scaling. |                                                                   |
| Course Assessment | Total Marks=100                                                                                                                                                   | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50% |

|                                             |                                                                                                                                               |                                                                                                                                                                                                                                                                                                                   |          |                                    |                          |                                            |  |
|---------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|------------------------------------|--------------------------|--------------------------------------------|--|
| Course Code:<br>EC 3574                     |                                                                                                                                               | Open Elective Course:<br>(Y/N)                                                                                                                                                                                                                                                                                    |          | Departmental Core<br>Course: (Y/N) |                          | Departmental Elective<br>Course: (Y/N)     |  |
|                                             |                                                                                                                                               | N                                                                                                                                                                                                                                                                                                                 |          | N                                  |                          | Y                                          |  |
| Type of Course                              |                                                                                                                                               | Theory Course                                                                                                                                                                                                                                                                                                     |          |                                    |                          |                                            |  |
| Course Title & Code                         |                                                                                                                                               | Wireless and Ad-hoc Network (EC3574)                                                                                                                                                                                                                                                                              |          |                                    |                          |                                            |  |
| Course Objectives                           |                                                                                                                                               | <ul style="list-style-type: none"><li>● To introduce fundamental principles of Ad-hoc Networks and comprehensive understanding of Ad-hoc network protocols.</li><li>● Outline current and emerging trends in Ad-hoc Wireless Networks.</li><li>● Analyze energy management in ad-hoc wireless networks.</li></ul> |          |                                    |                          |                                            |  |
| Course Outcomes                             |                                                                                                                                               |                                                                                                                                                                                                                                                                                                                   |          |                                    |                          | Cognitive Levels                           |  |
| CO1                                         | To understand concept of Ad-hoc Wireless Networks, Ad-hoc wireless Internet, issues in Ad-hoc wireless                                        |                                                                                                                                                                                                                                                                                                                   |          |                                    |                          | Knowledge/Comprehension (Level I/Level-II) |  |
| CO2                                         | To choose appropriate protocol for various applications                                                                                       |                                                                                                                                                                                                                                                                                                                   |          |                                    |                          | Application (Level-III)                    |  |
| CO3                                         | To design their own wireless network and examine security measures present at different levels and analyze energy consumption and management. |                                                                                                                                                                                                                                                                                                                   |          |                                    |                          | Analysis (Level-IV)                        |  |
| CO4                                         | To evaluate the existing network and improve its quality of service                                                                           |                                                                                                                                                                                                                                                                                                                   |          |                                    |                          | Synthesis/Evaluation (Level-VI/Level-V)    |  |
| Semester                                    |                                                                                                                                               | V                                                                                                                                                                                                                                                                                                                 |          |                                    | Summer                   |                                            |  |
| Contact Hours                               |                                                                                                                                               | Lecture                                                                                                                                                                                                                                                                                                           | Tutorial | Practical                          | Credits                  | Total Teaching Hours                       |  |
|                                             |                                                                                                                                               | 3                                                                                                                                                                                                                                                                                                                 | 0        | 0                                  | 3                        | 36                                         |  |
| Prerequisite course codes with course names |                                                                                                                                               | Digital Communication (EC2402)                                                                                                                                                                                                                                                                                    |          |                                    |                          |                                            |  |
| Text Books                                  |                                                                                                                                               |                                                                                                                                                                                                                                                                                                                   |          |                                    |                          |                                            |  |
| 1.                                          |                                                                                                                                               | Title                                                                                                                                                                                                                                                                                                             |          |                                    | Ad-hoc Wireless Networks |                                            |  |

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|                 | Author                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | C. Siva Ram Murthy & B. S. Manoj      |   |
|                 | Publisher                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Pearson Education, 2011               |   |
|                 | Edition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 2nd Edition                           |   |
| 2.              | Title                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Ad-hoc Wireless Networking            |   |
|                 | Author                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Xiuzhen Cheng, Xiao Hung, Ding-Zhu Du |   |
|                 | Publisher                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Kluwer Academic Publishers, 2004.     |   |
|                 | Edition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 1 <sup>st</sup> Edition               |   |
| Reference Books |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                       |   |
| 1.              | Title                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Ad-hoc Wireless Network               |   |
|                 | Author                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | OzanK. Tonguz and Gianguigi Ferrari   |   |
|                 | Publisher                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | John Wiley, 2007.                     |   |
|                 | Edition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 1 <sup>st</sup> Edition               |   |
| Course Contents | UNIT-I: Introduction to Ad-hoc Wireless Networks:<br>Introduction, Issues in Ad-hoc Wireless Networks, Ad-hoc Wireless Internet; MAC Protocols for Ad-hoc Wireless Networks: Introduction, Issues in Designing a MAC Protocol, Design Goals of MAC Protocols, Classification of MAC protocols, Contention-Based Protocols, Contention-Based Protocols with Reservation Mechanisms, Contention-Based Protocols with Scheduling Mechanisms, MAC Protocols that Use Directional Antennas. |                                       | 9 |
|                 | UNIT II: Routing Protocols for Ad-hoc Wireless Networks<br>Introduction, Issues in Designing a Routing Protocol for Ad-hoc Wireless Networks; Classification of Routing Protocols; Table Driven Routing Protocols; On-Demand Routing Protocols, Hybrid Routing Protocols, Hierarchical Routing Protocols and Power-Aware Routing Protocols.                                                                                                                                            |                                       | 9 |
|                 | UNIT III: Multicast Routing in Ad-hoc Wireless Networks<br>Introduction, Issues in Designing a Multicast Routing Protocol, Operation of Multicast Routing Protocols, An Architecture Reference Model for Multicast Routing Protocols, Classifications of Multicast Routing Protocols, Tree-Based Multicast Routing Protocols and Mesh-Based Multicast Routing Protocols                                                                                                                |                                       | 9 |
|                 | UNIT IV: Transport Layer and Security Protocols for Ad-hoc Networks<br>Introduction, Issues in Designing a Transport Layer Protocol; Design Goals of a Transport Layer Protocol; Classification of Transport Layer Solutions; TCP over Transport Layer Solutions; Other Transport Layer Protocols for Ad-hoc Networks; Security in Ad-hoc Wireless Networks, Issues and Challenges in Security Provisioning, Network Security Attacks, Key Management and Secure                       |                                       | 9 |

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|                   | Touting Ad-hoc Wireless Networks. Issues and Challenges in Providing QoS in Ad-hoc Wireless Networks, Classification of QoS Solutions, MAC Layer Solutions, Network Layer Solutions; Need for Energy Management in Ad-hoc Wireless Networks, Classification of Energy Management Schemes. |                                                                   |
| Course Assessment | Total Marks=100                                                                                                                                                                                                                                                                           | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50% |

|                         |                                                                                                                                                                                              |                                 |                                            |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|--------------------------------------------|
| Course Code:<br>EC 3671 | Open Elective Course:<br>(Y/N)                                                                                                                                                               | Departmental Core Course: (Y/N) | Departmental Elective Course: (Y/N)        |
|                         | N                                                                                                                                                                                            | N                               | Y                                          |
| Type of Course          | Theory Course                                                                                                                                                                                |                                 |                                            |
| Course Title & Code     | Advanced Microprocessor (EC3671)                                                                                                                                                             |                                 |                                            |
| Course Objectives       | <ul style="list-style-type: none"> <li>To make the students understand the basics of advanced Microprocessor(80286, 80386and 80586)</li> <li>To have knowledge of RISC Processors</li> </ul> |                                 |                                            |
| Course Outcomes         |                                                                                                                                                                                              |                                 | Cognitive Levels                           |
| CO1                     | To understand the basics of advanced Microprocessors.                                                                                                                                        |                                 | Knowledge/Comprehension (Level I/Level-II) |
| CO2                     | To analyze the internal architecture and addressing modes of 80286 and 80386.                                                                                                                |                                 | Application/Analysis (Level III/Level-IV)  |
| CO3                     | To evaluate the working of the Pentium Processor.                                                                                                                                            |                                 | Analysis/Evaluation (Level IV/Level-V)     |
| CO4                     | To evaluate the working and applications of RISC Processors.                                                                                                                                 |                                 | Evaluation/Synthesis (Level V/Level-VI)    |
| Semester                | VI                                                                                                                                                                                           |                                 | Winter                                     |
| Contact Hours           | Lecture                                                                                                                                                                                      | Tutorial                        | Practical Credits Total Teaching Hours     |

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|---------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|---|---|----|
|                                             | 3                                                                                                                                                                                                                 | 0                                              | 0 | 3 | 36 |
| Prerequisite course codes with course names | Introduction to Microprocessors(EC 3501)                                                                                                                                                                          |                                                |   |   |    |
| Text Books                                  |                                                                                                                                                                                                                   |                                                |   |   |    |
| 1.                                          | Title                                                                                                                                                                                                             | Advanced Microprocessors and Peripherals       |   |   |    |
|                                             | Author                                                                                                                                                                                                            | A.K. Ray and K.M. Bhurchandi                   |   |   |    |
|                                             | Publisher                                                                                                                                                                                                         | Tata Mcgraw Hill                               |   |   |    |
|                                             | Edition                                                                                                                                                                                                           | 3 <sup>rd</sup> Edition                        |   |   |    |
| 2.                                          | Title                                                                                                                                                                                                             | The INTEL Microprocessors                      |   |   |    |
|                                             | Author                                                                                                                                                                                                            | Barry B. Brey                                  |   |   |    |
|                                             | Publisher                                                                                                                                                                                                         | Pearson                                        |   |   |    |
|                                             | Edition                                                                                                                                                                                                           | 8 <sup>th</sup> Edition                        |   |   |    |
| Reference Books                             |                                                                                                                                                                                                                   |                                                |   |   |    |
| 1.                                          | Title                                                                                                                                                                                                             | Computer Architecture, A Quantitative Approach |   |   |    |
|                                             | Author                                                                                                                                                                                                            | John L. Hennessy David A. Patterson            |   |   |    |
|                                             | Publisher                                                                                                                                                                                                         | Elsevier                                       |   |   |    |
|                                             | Edition                                                                                                                                                                                                           | 5 <sup>th</sup> Edition                        |   |   |    |
| Course Contents                             | UNIT I:<br>Introduction to advanced microprocessors (16-bit, 32 bit & 64 bit), Internal Architecture of 80286.Signal description of 80286,Real addressing mode of 80286,80286 Bus Interface, Fetch Cycle of 80286 |                                                |   |   | 9  |
|                                             | UNIT II:<br>Salient features of 80386,Architecture and Signal description of 80386,Register Optimization of 80386, addressing mode of 80386,data types of 80386                                                   |                                                |   |   | 9  |

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|                   | UNIT III:<br>Salient features of 80586(Pentium),A few relevant concepts of computer architecture, System Architecture, Branch Prediction, Enhanced Instruction set of Pentium             | 9                                                                 |
|                   | UNIT IV:<br>A short history of RISC Processors, Hybrid Architecture—RISC and CISC Convergence, The Advantage of RISC ,Basic features of RISC Processors, Design issues of RISC Processors | 9                                                                 |
| Course Assessment | Total Marks=100                                                                                                                                                                           | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50% |

|                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                            |                                     |
|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|-------------------------------------|
| Course Code:<br>EC 3672 | Open Elective Course:<br>(Y/N)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Departmental Core Course: (Y/N)            | Departmental Elective Course: (Y/N) |
|                         | N                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | N                                          | Y                                   |
| Type of Course          | Theory Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                            |                                     |
| Course Title & Code     | Computer Organization and Architecture(EC 3672)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                            |                                     |
| Course Objectives       | <ul style="list-style-type: none"> <li>To gain a fundamental understanding of how computers are organized and the various components that make up a computer system.</li> <li>To cover aspects of CPU design including instruction sets, ALU operations, pipelines, and execution of machine-level instructions.</li> <li>To understand the different types of memory and storage, focusing on hierarchy, organization, management, and optimization techniques</li> <li>To understand how data paths and control paths are designed in microprocessors.</li> </ul> |                                            |                                     |
| Course Outcomes         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Cognitive Levels                           |                                     |
| CO1                     | To articulate the roles and functionalities of various computer components, such as CPUs, GPUs, memory, and storage devices.                                                                                                                                                                                                                                                                                                                                                                                                                                        | Knowledge/Comprehension (Level I/Level-II) |                                     |
| CO2                     | To apply knowledge of CPU Design.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Analysis (Level-IV)                        |                                     |
| CO3                     | To understand Memory Management.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Knowledge/Comprehension (Level I/Level-II) |                                     |

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| CO4                                         | To describe how parallel processing can be used to improve performance and the complexities it introduces into system design |                                                                                                                                                                                                                                                                         |          |           | Knowledge/Comprehension (Level I/Level-II) |                      |    |
| Semester                                    |                                                                                                                              | VI                                                                                                                                                                                                                                                                      |          |           | Winter                                     |                      |    |
| Contact Hours                               |                                                                                                                              | Lecture                                                                                                                                                                                                                                                                 | Tutorial | Practical | Credits                                    | Total Teaching Hours |    |
|                                             |                                                                                                                              | 3                                                                                                                                                                                                                                                                       | 0        | 0         | 3                                          | 36                   |    |
| Prerequisite course codes with course names |                                                                                                                              | Digital Electronics (EC2401); Introduction to Microprocessors (EC3501)                                                                                                                                                                                                  |          |           |                                            |                      |    |
| Text Books                                  |                                                                                                                              |                                                                                                                                                                                                                                                                         |          |           |                                            |                      |    |
| 1.                                          |                                                                                                                              | Title                                                                                                                                                                                                                                                                   |          |           | Computer Organization and Design           |                      |    |
|                                             |                                                                                                                              | Author                                                                                                                                                                                                                                                                  |          |           | D. A. Patterson, J. L. Hennessy            |                      |    |
|                                             |                                                                                                                              | Publisher                                                                                                                                                                                                                                                               |          |           | Morgan Kaufmann                            |                      |    |
|                                             |                                                                                                                              | Edition                                                                                                                                                                                                                                                                 |          |           | 4 <sup>th</sup> Edition                    |                      |    |
| 2.                                          |                                                                                                                              | Title                                                                                                                                                                                                                                                                   |          |           | Computer System Architecture               |                      |    |
|                                             |                                                                                                                              | Author                                                                                                                                                                                                                                                                  |          |           | M. Mano                                    |                      |    |
|                                             |                                                                                                                              | Publisher                                                                                                                                                                                                                                                               |          |           | Pearson, 1992                              |                      |    |
|                                             |                                                                                                                              | Edition                                                                                                                                                                                                                                                                 |          |           | 3rd Edition                                |                      |    |
| Reference Books                             |                                                                                                                              |                                                                                                                                                                                                                                                                         |          |           |                                            |                      |    |
| 1.                                          |                                                                                                                              | Title                                                                                                                                                                                                                                                                   |          |           | Computer Organization                      |                      |    |
|                                             |                                                                                                                              | Author                                                                                                                                                                                                                                                                  |          |           | C. Hamacher, Z. Vranesic, S. Zaky          |                      |    |
|                                             |                                                                                                                              | Publisher                                                                                                                                                                                                                                                               |          |           | McGraw Hill Education                      |                      |    |
|                                             |                                                                                                                              | Edition                                                                                                                                                                                                                                                                 |          |           | 6 <sup>th</sup> Edition                    |                      |    |
| Course Contents                             |                                                                                                                              | UNIT I: Functional units of a computer: CPU, memory, I/O;                                                                                                                                                                                                               |          |           |                                            |                      | 6  |
|                                             |                                                                                                                              | UNIT II: Instruction set architecture: Instruction format, addressing modes, ISAs for common CPUs and assembly languages;                                                                                                                                               |          |           |                                            |                      | 8  |
|                                             |                                                                                                                              | UNIT III: Data representation& Processor design: Signed number representation, fixed and floating point representations; Datapath components, control unit, pipelining, and hazards;                                                                                    |          |           |                                            |                      | 10 |
|                                             |                                                                                                                              | UNIT IV: Memory &Input-Output: Concept of hierarchical memory organization, cache memory, mapping functions and replacement algorithms, main memory organisation, virtual memory; I/O transfers - program controlled, interrupt driven and DMA, I/O devices - secondary |          |           |                                            |                      | 12 |

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|                   | storage; Introduction to multi-core architectures. |                                                                   |
| Course Assessment | Total Marks=100                                    | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50% |

|                                             |                                                                                                                              |                                                                                                                                                                                                                        |                                 |           |                                            |                      |
|---------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|-----------|--------------------------------------------|----------------------|
| Course Code:<br>EC 3673                     |                                                                                                                              | Open Elective Course:<br>(Y/N)                                                                                                                                                                                         | Departmental Core Course: (Y/N) |           | Departmental Elective Course: (Y/N)        |                      |
|                                             |                                                                                                                              | N                                                                                                                                                                                                                      | N                               |           | Y                                          |                      |
| Type of Course                              |                                                                                                                              | Theory Course                                                                                                                                                                                                          |                                 |           |                                            |                      |
| Course Title & Code                         |                                                                                                                              | Satellite Communication (EC3673)                                                                                                                                                                                       |                                 |           |                                            |                      |
| Course Objectives                           |                                                                                                                              | <ul style="list-style-type: none"><li>To introduce the Orbital Mechanism, earth station and satellite systems.</li><li>To impart knowledge about the satellite link design and satellite navigation systems.</li></ul> |                                 |           |                                            |                      |
| Course Outcomes                             |                                                                                                                              |                                                                                                                                                                                                                        |                                 |           | Cognitive Levels                           |                      |
| CO1                                         | To understand the orbital and functional principles of satellite communication systems                                       |                                                                                                                                                                                                                        |                                 |           | Knowledge/Comprehension (Level I/Level-II) |                      |
| CO2                                         | Architect, interpret, and select appropriate technologies for implementation of specified satellite communication systems    |                                                                                                                                                                                                                        |                                 |           | Application (Level-III)                    |                      |
| CO3                                         | Analyse and evaluate a satellite link and suggest enhancements to improve the link performance.                              |                                                                                                                                                                                                                        |                                 |           | Analysis (Level-IV)                        |                      |
| CO4                                         | Select an appropriate modulation, multiplexing, coding and multiple access schemes for a given satellite communication link. |                                                                                                                                                                                                                        |                                 |           | Synthesis/Evaluation (Level-VI/Level-V)    |                      |
| CO5                                         | Understand the Satellite based Navigation and different Systems.                                                             |                                                                                                                                                                                                                        |                                 |           | Knowledge/Comprehension (Level I/Level-II) |                      |
| Semester                                    |                                                                                                                              | VI                                                                                                                                                                                                                     |                                 |           | Winter                                     |                      |
| Contact Hours                               |                                                                                                                              | Lecture                                                                                                                                                                                                                | Tutorial                        | Practical | Credits                                    | Total Teaching Hours |
|                                             |                                                                                                                              | 3                                                                                                                                                                                                                      | 0                               | 0         | 3                                          | 36                   |
| Prerequisite course codes with course names |                                                                                                                              | Digital Communication(EC 2402)                                                                                                                                                                                         |                                 |           |                                            |                      |

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| Text Books      |                                                                                                                                                                                                                                                                                                                                                                                                                         |                                   |    |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|----|
| 1.              | Title                                                                                                                                                                                                                                                                                                                                                                                                                   | Satellite Communication           |    |
|                 | Author                                                                                                                                                                                                                                                                                                                                                                                                                  | D. Roddy                          |    |
|                 | Publisher                                                                                                                                                                                                                                                                                                                                                                                                               | McGraw- Hill, 2009                |    |
|                 | Edition                                                                                                                                                                                                                                                                                                                                                                                                                 | 4 <sup>th</sup> Edition           |    |
| 2.              | Title                                                                                                                                                                                                                                                                                                                                                                                                                   | Satellite Communication           |    |
|                 | Author                                                                                                                                                                                                                                                                                                                                                                                                                  | T. Pratt & C.W. Bostain           |    |
|                 | Publisher                                                                                                                                                                                                                                                                                                                                                                                                               | Wiley 2000.                       |    |
|                 | Edition                                                                                                                                                                                                                                                                                                                                                                                                                 | 1 <sup>st</sup> Edition           |    |
| Reference Books |                                                                                                                                                                                                                                                                                                                                                                                                                         |                                   |    |
| 1.              | Title                                                                                                                                                                                                                                                                                                                                                                                                                   | Design of Geosynchrone Spacecraft |    |
|                 | Author                                                                                                                                                                                                                                                                                                                                                                                                                  | B.N. Agrawal                      |    |
|                 | Publisher                                                                                                                                                                                                                                                                                                                                                                                                               | Prentice- Hall,1986.              |    |
|                 | Edition                                                                                                                                                                                                                                                                                                                                                                                                                 | 1 <sup>st</sup> Edition           |    |
| Course Contents | UNIT I: Orbital Mechanism<br>Satellite orbit and orbital equations, Kepler’s laws of planetary motion, Locating satellite in the orbit, Locating satellite with respect to earth, Look angle calculation, Coverage angle and slant range, Orbital perturbations, Satellite launching, Orbital effects in communication subsystem performance                                                                            |                                   | 8  |
|                 | UNIT II: Satellites<br>Satellite subsystems, Attitude and orbit control system, Telemetry tracking command and monitoring, Power system, communication subsystem, Satellite antennas. Earth station antenna types, Antenna gain, Antenna gain to noise temperature ratio, G/T measurement,                                                                                                                              |                                   | 10 |
|                 | UNIT III: Satellite Link Design<br>Basic link analysis, Interference analysis, Terrestrial interference, Inter modulation interference, Inter-symbol interference and rain induced attenuation, Uplink power control, system availability, System design for link without frequency reuse and system design for link with frequency reuse. Frequency division multiple access, FDM-FM-FDMA, Single channel per carrier. |                                   | 10 |
|                 | UNIT IV: Satellite based Navigation System<br>Principle of measuring signal transit time, Basic principles of satellite navigation, Signal travel time Determining position, The effect and correction of time error, Functional segments of GPS, Improved GPS:                                                                                                                                                         |                                   | 8  |

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|                   | DGPS, SBAS, A-GPS and HSGPS. |                                                                   |
| Course Assessment | Total Marks=100              | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50% |

|                                       |                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                 |           |                                                |                         |
|---------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|-----------|------------------------------------------------|-------------------------|
| Course Code:<br>EC 3674               |                                                                                                                                                                                                            | Open Elective Course:<br>(Y/N)                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Departmental Core Course: (Y/N) |           | Departmental Elective Course: (Y/N)            |                         |
|                                       |                                                                                                                                                                                                            | N                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | N                               |           | Y                                              |                         |
| Type of Course                        |                                                                                                                                                                                                            | Theory Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                 |           |                                                |                         |
| Course Title & Code                   |                                                                                                                                                                                                            | Introduction To Artificial Intelligence and Machine Learning (EC3674)                                                                                                                                                                                                                                                                                                                                                                                                                   |                                 |           |                                                |                         |
| Course Objectives                     |                                                                                                                                                                                                            | <ul style="list-style-type: none"><li>● To understand the theoretical foundations along with the ethics of AI</li><li>● To recognize and analyze Machine Learning-based AI problems along with ethical implications</li><li>● To understand the basic concept of deep neural networks (DNN) and its different kinds with working principle</li><li>● To apply ML techniques to solve real-world problems from various domains such as healthcare, social computing, economics</li></ul> |                                 |           |                                                |                         |
| Course Outcomes                       |                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                 |           | Cognitive Levels                               |                         |
| CO1                                   | To understand the basic concepts of AI with its working principle.                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                 |           | Knowledge/Comprehe<br>nsion (Level I/Level-II) |                         |
| CO2                                   | To apply AI and ML techniques to solve problems in diverse application areas, such as image recognition, natural language processing, recommendation systems, autonomous vehicles, healthcare, and finance |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                 |           | Application (Level-III)                        |                         |
| CO3                                   | To understand the role of learning parameters and optimization techniques in the overall performance of an ML algorithm                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                 |           | Analysis (Level-IV)                            |                         |
| CO4                                   | To evaluate the performance of ML algorithms in signal and image processing applications                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                 |           | Synthesis/Evaluation<br>(Level-VI/Level-V)     |                         |
| Semester                              |                                                                                                                                                                                                            | VI                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                 |           | Winter                                         |                         |
| Contact Hours                         |                                                                                                                                                                                                            | Lecture                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Tutorial                        | Practical | Credits                                        | Total Teaching<br>Hours |
|                                       |                                                                                                                                                                                                            | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 0                               | 0         | 3                                              | 36                      |
| Prerequisite course codes with course |                                                                                                                                                                                                            | Engineering Mathematics-III (MA2301), Digital Signal Processing (EC3503),                                                                                                                                                                                                                                                                                                                                                                                                               |                                 |           |                                                |                         |

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| names           |                                                                                                                                                                                                                                                                           |                                                         |
| Text Books      |                                                                                                                                                                                                                                                                           |                                                         |
| 1.              | Title                                                                                                                                                                                                                                                                     | Machine Learning Yearning                               |
|                 | Author                                                                                                                                                                                                                                                                    | Adrew Ng                                                |
|                 | Publisher                                                                                                                                                                                                                                                                 | FREE EBOOK                                              |
|                 | Edition                                                                                                                                                                                                                                                                   |                                                         |
| 2.              | Title                                                                                                                                                                                                                                                                     | Artificial Intelligence                                 |
|                 | Author                                                                                                                                                                                                                                                                    | Elain Rich, and Kevin Knight                            |
|                 | Publisher                                                                                                                                                                                                                                                                 | Tata McGraw-Hill, 1993                                  |
|                 | Edition                                                                                                                                                                                                                                                                   | 2 <sup>st</sup> Edition                                 |
| 3.              | Title                                                                                                                                                                                                                                                                     | Introduction to Neural Networks using MATLAB 6.0        |
|                 | Author                                                                                                                                                                                                                                                                    | 2. S.N.Sivanandam, S.Sumathi, S.N.Deepa,                |
|                 | Publisher                                                                                                                                                                                                                                                                 | TMH, 2006                                               |
|                 | Edition                                                                                                                                                                                                                                                                   | 1 <sup>st</sup> Edition                                 |
| Reference Books |                                                                                                                                                                                                                                                                           |                                                         |
| 1.              | Title                                                                                                                                                                                                                                                                     | Foundations of Machine Learning                         |
|                 | Author                                                                                                                                                                                                                                                                    | Mehryar Mohri, Afshin Rostamizadeh, and Ameet Talwalkar |
|                 | Publisher                                                                                                                                                                                                                                                                 | MIT Press, 2018, FREE EBOOK                             |
|                 | Edition                                                                                                                                                                                                                                                                   | 2 <sup>nd</sup> Edition                                 |
| Course Contents | UNIT I: Introduction to Artificial Intelligence:<br>Definition and history of artificial intelligence, Goals and Applications of AI, Types of AI: Narrow AI, General AI, Ethical Considerations in AI                                                                     | 9                                                       |
|                 | UNIT II: Problem Solving and Search Algorithms:<br>Problem Solving Agents, State space Search, Uninformed Search Algorithms: Breath First Search (BFS), Depth First Search (DFS);<br>Heuristic Search Algorithms: Hill Climbing                                           | 9                                                       |
|                 | UNIT III: Machine Learning Fundamentals:<br>Introduction to machine learning, Types of machine learning: Supervised, Unsupervised, Reinforcement Learning, Basic Concepts: Features, Labels, Training, testing, Evaluation Metrics: Accuracy, Precision, Recall, F1 Score | 9                                                       |

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|                   | UNIT IV: Neural Networks and deep Learning:<br>Introduction to artificial neural networks (ANN). Perceptron. Multilayer Perceptron (MLP), Training Neural Networks: Back-Propogation, Introduction to Deep Learning, Convolutional Neural Networks (CNNs) for image classification, Recurrent Neural Networks (RNNs) for sequence data, Applications of deep learning: Computer Vision, Natural Language Processing | 9                                                                 |
| Course Assessment | Total Marks=100                                                                                                                                                                                                                                                                                                                                                                                                     | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50% |

|                         |                                                                                                                                                                                                                              |                                 |                                            |
|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|--------------------------------------------|
| Course Code:<br>EC 3675 | Open Elective Course:<br>(Y/N)                                                                                                                                                                                               | Departmental Core Course: (Y/N) | Departmental Elective Course: (Y/N)        |
|                         | N                                                                                                                                                                                                                            | N                               | Y                                          |
| Type of Course          | Theory Course                                                                                                                                                                                                                |                                 |                                            |
| Course Title & Code     | VHDL and Verilog (EC3675)                                                                                                                                                                                                    |                                 |                                            |
| Course Objectives       | <ul style="list-style-type: none"> <li>To make the students understand HDL for designing digital circuits and systems.</li> <li>To debug and simulate digital circuits and Systems described in VHDL and Verilog.</li> </ul> |                                 |                                            |
| Course Outcomes         |                                                                                                                                                                                                                              |                                 | Cognitive Levels                           |
| CO1                     | Understand HDL for describing Hardware.                                                                                                                                                                                      |                                 | Knowledge/Comprehension (Level I/Level-II) |
| CO2                     | Develop programs to design and implement the given combinational and sequential circuits.                                                                                                                                    |                                 | Analysis (Level-IV)                        |
| CO3                     | Use software to debug and simulate digital circuits and systems described in VHDL and Verilog.                                                                                                                               |                                 | Synthesis/Evaluation (Level-VI/Level-V)    |
| CO4                     | Describe the test bench for the given application in VHDL and                                                                                                                                                                |                                 | Application                                |

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|                                             | Verilog.                                                                                                                              |                              |          |                                              |         | (Level-III)          |  |
| Semester                                    |                                                                                                                                       | VI                           |          |                                              | Winter  |                      |  |
| Contact Hours                               |                                                                                                                                       | Lecture                      | Tutorial | Practical                                    | Credits | Total Teaching Hours |  |
|                                             |                                                                                                                                       | 3                            | 0        | 0                                            | 3       | 36                   |  |
| Prerequisite course codes with course names |                                                                                                                                       | Digital Electronics(EC 2401) |          |                                              |         |                      |  |
| Text Books                                  |                                                                                                                                       |                              |          |                                              |         |                      |  |
| 1.                                          | Title                                                                                                                                 |                              |          | HDL Programming (VHDL and Verilog)           |         |                      |  |
|                                             | Author                                                                                                                                |                              |          | Nazeih M.Botros- John                        |         |                      |  |
|                                             | Publisher                                                                                                                             |                              |          | Weily India Pvt. Ltd                         |         |                      |  |
|                                             | Edition                                                                                                                               |                              |          | 2008                                         |         |                      |  |
| 2.                                          | Title                                                                                                                                 |                              |          | Fundamentals of HDL                          |         |                      |  |
|                                             | Author                                                                                                                                |                              |          | Cyril P.R. Pearson/Sanguin                   |         |                      |  |
|                                             | Publisher                                                                                                                             |                              |          | Pearson Education India                      |         |                      |  |
|                                             | Edition                                                                                                                               |                              |          | 2010                                         |         |                      |  |
| Reference Books                             |                                                                                                                                       |                              |          |                                              |         |                      |  |
| 1.                                          | Title                                                                                                                                 |                              |          | Advanced digital design with the Verilog HDL |         |                      |  |
|                                             | Author                                                                                                                                |                              |          | Michel D. Ciletti                            |         |                      |  |
|                                             | Publisher                                                                                                                             |                              |          | Pearson                                      |         |                      |  |
|                                             | Edition                                                                                                                               |                              |          | 2 <sup>nd</sup>                              |         |                      |  |
| Course Contents                             | UNIT I:<br>Introduction to Hardware Description Languages (HDL), History of VHDL, Pro's and Con's of VHDL,VHDL Flow elements:-Entity. |                              |          |                                              |         | 9                    |  |

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|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|---|
|                   | Architecture, configuration, package, library, Data Types, operators, VHDL Modeling: -Data flow, Behavioral, Structural                                                                                                                                                                                                             |                                                                   |   |
|                   | UNIT II:<br>Variables, Signals and constants, Arrays, Synthesis and Simulation of MUX, DEMUX, DECODER ,ENCODER, Flip-Flop, Counter, Shift Register, MOORE ,MEALY Machines. Test bench and its applications                                                                                                                          |                                                                   | 9 |
|                   | UNIT III:<br>Generics, Generate statements ,VHDL functions, VHDL procedures, Packages and libraries, File Processing, Examples of File Processing                                                                                                                                                                                   |                                                                   | 9 |
|                   | UNIT IV:<br>Introduction to Verilog, Brief comparison of VHDL and Verilog, Structure of Verilog module, Operators, Data types, Modules, ports, vectors - Structural and data flow modelling, hierarchical structure, testbenches, examples - Blocking and Non- blocking assignments - Combinational and sequential circuit modeling |                                                                   | 9 |
| Course Assessment | Total Marks=100                                                                                                                                                                                                                                                                                                                     | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50% |   |

|                         |                                                                                                                                                                                                                                                                                                     |                                 |                                     |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|-------------------------------------|
| Course Code:<br>EC 4771 | Open Elective Course:<br>(Y/N)                                                                                                                                                                                                                                                                      | Departmental Core Course: (Y/N) | Departmental Elective Course: (Y/N) |
|                         | N                                                                                                                                                                                                                                                                                                   | N                               | Y                                   |
| Type of Course          | Theory Course                                                                                                                                                                                                                                                                                       |                                 |                                     |
| Course Title & Code     | Digital Image Processing (EC4771)                                                                                                                                                                                                                                                                   |                                 |                                     |
| Course Objectives       | <ul style="list-style-type: none"> <li>To study the image fundamentals and mathematical transforms necessary for image processing.</li> <li>To study the image enhancement techniques</li> <li>To study image restoration procedures.</li> <li>To study the image compression procedures</li> </ul> |                                 |                                     |
| Course Outcomes         | Cognitive Levels                                                                                                                                                                                                                                                                                    |                                 |                                     |

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|---------------------------------------------|-----------------------------------------------|------------------------------|---------------------------------------|-------------------------------------------|---------|----------------------|--|
| CO1                                         | Introduction to image mathematical model      |                              |                                       | Knowledge/Comprehension (LevelI/Level-II) |         |                      |  |
| CO2                                         | Various method for analysis of image          |                              |                                       | Application (Level-III)                   |         |                      |  |
| CO3                                         | Analyze the different types of transformation |                              |                                       | Analysis (Level-IV)                       |         |                      |  |
| CO4                                         | Relation of image related to neural network   |                              |                                       | Synthesis/Evaluation (Level-VI/Level-V)   |         |                      |  |
| Semester                                    |                                               | VII                          |                                       |                                           | Summer  |                      |  |
| Contact Hours                               |                                               | Lecture                      | Tutorial                              | Practical                                 | Credits | Total Teaching Hours |  |
|                                             |                                               | 3                            | 0                                     | 0                                         | 3       | 36                   |  |
| Prerequisite course codes with course names |                                               | Signals and System (EC 2301) |                                       |                                           |         |                      |  |
| Text Books                                  |                                               |                              |                                       |                                           |         |                      |  |
| 1.                                          | Title                                         |                              | 1. Digital Image Processing,          |                                           |         |                      |  |
|                                             | Author                                        |                              | Rafael C. Gonzalez, Richard E. Woods, |                                           |         |                      |  |
|                                             | Publisher                                     |                              | Pearson Education/PHI, 2000.          |                                           |         |                      |  |
|                                             | Edition                                       |                              | Second Edition,                       |                                           |         |                      |  |
| 2.                                          | Title                                         |                              | Digital Image Processing ,            |                                           |         |                      |  |
|                                             | Author                                        |                              | W.K.Pratt                             |                                           |         |                      |  |
|                                             | Publisher                                     |                              | John Wiley & sons, Inc. 2006.         |                                           |         |                      |  |
|                                             | Edition                                       |                              | 3 <sup>rd</sup> Edition               |                                           |         |                      |  |
| Reference Books                             |                                               |                              |                                       |                                           |         |                      |  |
| 1.                                          | Title                                         |                              | Digital Image Processing,             |                                           |         |                      |  |
|                                             | Author                                        |                              | K. R. Castleman                       |                                           |         |                      |  |
|                                             | Publisher                                     |                              | Pearson, 2006.                        |                                           |         |                      |  |

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|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|
|                   | Edition                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 4 <sup>th</sup> Edition                                           |
| Course Contents   | UNIT I: Two-dimensional mathematical preliminaries, 2D transforms - DFT, DCT, KLT, SVD.                                                                                                                                                                                                                                                                                                                                                                                       | 9                                                                 |
|                   | UNIT II: Image Enhancement - Histogram equalization and specification techniques, Noise distributions, Spatial averaging, Directional Smoothing, Median, Geometric mean, Harmonic mean, Contraharmonic mean filters, Homomorphic filtering, Color image enhancement. Image restoration - Degradation model, Unconstrained restoration - Lagrange multiplier and Constrained restoration, Inverse filtering-removal of blur caused by uniform linear motion, Wiener filtering, | 9                                                                 |
|                   | UNIT III: Geometric transformations-spatial transformations. Image segmentation - Edge detection, Edge linking via Hough transform – Thresholding - Region based segmentation – Region growing – Region splitting and Merging – Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm-Segmentation by K-Means Algorithm.                                                                                            | 9                                                                 |
|                   | UNIT IV : Digit Recognition using Convolutional Neural network. Compression - Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, Vector Quantization, Transform coding, JPEG standard, MPEG. Image. Morphology - Preliminaries, dilation, erosion, open and closing, hit or miss transformation, basic morphologic algorithms.                                                                                                          | 9                                                                 |
| Course Assessment | Total Marks=100                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50% |

|                         |                                                                                                                                                                                                              |                                    |                                        |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|----------------------------------------|
| Course Code:<br>EC 4772 | Open Elective Course:<br>(Y/N)                                                                                                                                                                               | Departmental Core<br>Course: (Y/N) | Departmental Elective<br>Course: (Y/N) |
|                         | N                                                                                                                                                                                                            | N                                  | Y                                      |
| Type of Course          | Theory Course                                                                                                                                                                                                |                                    |                                        |
| Course Title & Code     | Internet of Things(EC 4772)                                                                                                                                                                                  |                                    |                                        |
| Course Objectives       | <ul style="list-style-type: none"> <li>To introduce Internet of Things (IOT) and its applications in modern world</li> <li>To learn in detail the various methods for implementation of IOT based</li> </ul> |                                    |                                        |

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|                                             |                                                                        | systems                                                                                                                                                                                                    |          |                                                                    |                                         |                      |
|                                             |                                                                        | <ul style="list-style-type: none"><li>● To learn various communication techniques employed in IOT based systems</li><li>● To implement IOT based systems, with proper security measure for users</li></ul> |          |                                                                    |                                         |                      |
| Course Outcomes                             |                                                                        |                                                                                                                                                                                                            |          | Cognitive Levels                                                   |                                         |                      |
| CO1                                         | To understand the fundamentals of IOT, its applications and importance |                                                                                                                                                                                                            |          |                                                                    | Knowledge/Comprehnson (Level/Level-II)  |                      |
| CO2                                         | To understand various methods for implementation of IOT systems        |                                                                                                                                                                                                            |          |                                                                    | Application (Level-III)                 |                      |
| CO3                                         | To design IOT based sub-systems and systems for various applications   |                                                                                                                                                                                                            |          |                                                                    | Analysis (Level-IV)                     |                      |
| CO4                                         | To implement IOT based systems, with proper security measure for users |                                                                                                                                                                                                            |          |                                                                    | Synthesis/Evaluation (Level-VI/Level-V) |                      |
| Semester                                    |                                                                        | VII                                                                                                                                                                                                        |          |                                                                    | Summer                                  |                      |
| Contact Hours                               |                                                                        | Lecture                                                                                                                                                                                                    | Tutorial | Practical                                                          | Credits                                 | Total Teaching Hours |
|                                             |                                                                        | 3                                                                                                                                                                                                          | 0        | 0                                                                  | 3                                       | 36                   |
| Prerequisite course codes with course names |                                                                        | Digital Communication (EC2402),Introduction to Microprocessors (EC3501)                                                                                                                                    |          |                                                                    |                                         |                      |
| Text Books                                  |                                                                        |                                                                                                                                                                                                            |          |                                                                    |                                         |                      |
| 1.                                          | Title                                                                  |                                                                                                                                                                                                            |          | Internet of Things (For Engineering Students)                      |                                         |                      |
|                                             | Author                                                                 |                                                                                                                                                                                                            |          | Dr. Jaikaran Singh Dr. Kalpana Rai Dr. Rajesh Kumar Rai            |                                         |                      |
|                                             | Publisher                                                              |                                                                                                                                                                                                            |          | Nitya Publications                                                 |                                         |                      |
|                                             | Edition                                                                |                                                                                                                                                                                                            |          | 1 <sup>st</sup> Edition, 2020                                      |                                         |                      |
| Reference Books                             |                                                                        |                                                                                                                                                                                                            |          |                                                                    |                                         |                      |
| 1.                                          | Title                                                                  |                                                                                                                                                                                                            |          | Fundamentals of Internet of Things: For Students and Professionals |                                         |                      |
|                                             | Author                                                                 |                                                                                                                                                                                                            |          | F. John Dian                                                       |                                         |                      |
|                                             | Publisher                                                              |                                                                                                                                                                                                            |          | Wiley                                                              |                                         |                      |
|                                             | Edition                                                                |                                                                                                                                                                                                            |          | 1 <sup>st</sup> Edition,2023                                       |                                         |                      |
| 2.                                          | Title                                                                  |                                                                                                                                                                                                            |          | Internet of Things A to Z: Technologies and Applications           |                                         |                      |

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|                   | Author                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Qusay F. Hassan                                                   |  |
|                   | Publisher                                                                                                                                                                                                                                                                                                                                                                                                                                                | Wiley                                                             |  |
|                   | Edition                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 1 <sup>st</sup> Edition, 2018                                     |  |
| Course Contents   | UNIT I: Introduction<br>Concepts and Definitions of The Internet of Things (IOT), structure of IOT, IOT enabling technologies, architecture, major component of IOT(Hardware & Software), communication and networking protocols,wired and wireless communication.IOT services and applications.                                                                                                                                                         | 6                                                                 |  |
|                   | UNIT II:IOT Platforms<br>Micro-controllers, Real-time systems and embedded softwareOS and Drivers (End Device Program), Hardware & Software Requirements. Basics of Networking, Communication protocols, Sensor Networks                                                                                                                                                                                                                                 | 8                                                                 |  |
|                   | UNIT III: Implementation of IOT<br>Interoperability in IoT, Introduction to Arduino Programming: Integration of Sensors and Actuators with Arduino, Introduction to Python programming, Introduction to Raspberry Pi, Implementation of IoT with Raspberry Pi, Introduction to SDN, SDN for IoT, Data Handling and Analytics, Cloud Computing, Sensor-Cloud, Fog Computing, Smart Cities and Smart Homes, Connected Vehicles, Smart Grid, Industrial IoT | 11                                                                |  |
|                   | UNIT IV: IOT Security<br>Attack, Defense, and Network Robustness of Internet of Things, Malware Propagation and Control in Internet of Things, Privacy Preservation Data Dissemination, Trust, and Trust Models for the IoT, Authentication in IoT Computational Security for the IoT, Security Protocols for IoT Access Networks, Security Testing                                                                                                      | 11                                                                |  |
| Course Assessment | Total Marks=100                                                                                                                                                                                                                                                                                                                                                                                                                                          | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50% |  |

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|-------------------------|---------------------------------------------------------------------------------------------------------------------------|------------------------------------|----------------------------------------|
| Course Code:<br>EC 4773 | Open Elective Course:<br>(Y/N)                                                                                            | Departmental Core<br>Course: (Y/N) | Departmental Elective<br>Course: (Y/N) |
|                         | N                                                                                                                         | N                                  | Y                                      |
| Type of Course          | Theory Course                                                                                                             |                                    |                                        |
| Course Title & Code     | Digital IC Design (EC4773)                                                                                                |                                    |                                        |
| Course Objectives       | <ul style="list-style-type: none"> <li>To introduce the transistor level design of all digital building blocks</li> </ul> |                                    |                                        |

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|                                             |                                                                                                                    | common to all CMOS microprocessors, network processors, digital backend of all wireless systems etc.,<br><br>● To introduce the principles and design methodology in terms of the dominant circuit choices, constraints and performance measures.<br><br>● To learn all important issues related to size, speed and power consumption. |          |                                                  |                                            |                      |
| Course Outcomes                             |                                                                                                                    |                                                                                                                                                                                                                                                                                                                                        |          | Cognitive Levels                                 |                                            |                      |
| CO1                                         | To understand the power dissipated in the circuit.                                                                 |                                                                                                                                                                                                                                                                                                                                        |          |                                                  | Knowledge/Comprehension (Level I/Level-II) |                      |
| CO2                                         | To design a circuit to performed a certain functionality with specified speed.                                     |                                                                                                                                                                                                                                                                                                                                        |          |                                                  | Application (Level-III)                    |                      |
| CO3                                         | To identify the critical path of a combinational Circuit                                                           |                                                                                                                                                                                                                                                                                                                                        |          |                                                  | Analysis (Level-IV)                        |                      |
| CO4                                         | To convert a combinational block to pipelined circuit and calculate the maximum frequency of the designed circuit. |                                                                                                                                                                                                                                                                                                                                        |          |                                                  | Synthesis/Evaluation (Level-VI/Level-V)    |                      |
| Semester                                    |                                                                                                                    | VII                                                                                                                                                                                                                                                                                                                                    |          |                                                  | Summer                                     |                      |
| Contact Hours                               |                                                                                                                    | Lecture                                                                                                                                                                                                                                                                                                                                | Tutorial | Practical                                        | Credits                                    | Total Teaching Hours |
|                                             |                                                                                                                    | 3                                                                                                                                                                                                                                                                                                                                      | 0        | 0                                                | 3                                          | 36                   |
| Prerequisite course codes with course names |                                                                                                                    | IC Applications(EC 3504)                                                                                                                                                                                                                                                                                                               |          |                                                  |                                            |                      |
| Text Books                                  |                                                                                                                    |                                                                                                                                                                                                                                                                                                                                        |          |                                                  |                                            |                      |
| 1.                                          | Title                                                                                                              |                                                                                                                                                                                                                                                                                                                                        |          | Digital Integrated Circuit: A design perspective |                                            |                      |
|                                             | Author                                                                                                             |                                                                                                                                                                                                                                                                                                                                        |          | J. M. Rabaey, A. Chandrakasan, B. Nikolic        |                                            |                      |
|                                             | Publisher                                                                                                          |                                                                                                                                                                                                                                                                                                                                        |          | Pearson Education, Delhi-2005                    |                                            |                      |
|                                             | Edition                                                                                                            |                                                                                                                                                                                                                                                                                                                                        |          | 2 <sup>nd</sup> Edition                          |                                            |                      |
| 2.                                          | Title                                                                                                              |                                                                                                                                                                                                                                                                                                                                        |          | CMOS VLSI Design                                 |                                            |                      |
|                                             | Author                                                                                                             |                                                                                                                                                                                                                                                                                                                                        |          | Weste, Neil HE, and David Money Harris           |                                            |                      |
|                                             | Publisher                                                                                                          |                                                                                                                                                                                                                                                                                                                                        |          | Pearson/Addison Wesley, 2010. Geiger             |                                            |                      |
|                                             | Edition                                                                                                            |                                                                                                                                                                                                                                                                                                                                        |          | 1 <sup>st</sup> Edition                          |                                            |                      |
| Reference Books                             |                                                                                                                    |                                                                                                                                                                                                                                                                                                                                        |          |                                                  |                                            |                      |
| 1.                                          | Title                                                                                                              |                                                                                                                                                                                                                                                                                                                                        |          | Low power design methodologies                   |                                            |                      |

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|                   | Author                                                                                                                                                                                                                                                                                                                                                                                      | J. M. Rabaey., and MassoudPedram, eds                             |   |
|                   | Publisher                                                                                                                                                                                                                                                                                                                                                                                   | Springer Science & Business Media, 2012                           |   |
|                   | Edition                                                                                                                                                                                                                                                                                                                                                                                     | 1 <sup>st</sup> Edition                                           |   |
| Course Contents   | UNIT I: MOS Transistor Principles and CMOS Inverter<br>Introduction, MOS Capacitor Threshold Voltage, MOS (FET) Transistor, Short Channel Transistor, CMOS Inverter Construction, Voltage Transfer Characteristics, Load line Analysis, Noise Margin Analysis, Pass Transistor, Inverter: Transient Response, Dynamic Power, Short Circuit Power, Leakage Power and Transistor Stacks       |                                                                   | 9 |
|                   | UNIT II: Combinational Logic Circuits<br>Implementing any Boolean Logic Function, Gate Sizing, Logic Gate Capacitance, Gate Delay, Parasitic Delay, Gate Delay with Load Capacitance, Path Delay Calculation and Optimization, Psuedo NMOS Logic, Domino Logic and Weak Keeper, Transmission Gate Logic, Gate Sizing for Large Circuits.                                                    |                                                                   | 9 |
|                   | UNIT III: Arithmetic Building Blocks<br>Ripple Adder Introduction, Full Adder Circuit Implementation, Full Adder Optimization, Carry Select Adder, Two's Complement Arithmetic, Array Multiplier: Timing Analysis, Carry Save Multiplier: Signed Multiplication.                                                                                                                            |                                                                   | 9 |
|                   | UNIT IV: Sequential Logic Circuits<br>Introduction to Pipelining, Time Borrowing, Master Slave Flip Flop, Flip-Flop Timing Parameters, Alternate Circuit Implementation, Clock Overlap, C2MOS Flip Flop, Flip Flop Characterization, Max and Min Delay of Flip Flop Based Systems, Flip Flop Min Delay Constraints, Latch – Max and Min Delay Constraints, Latch-Timing Analysis with Skew. |                                                                   | 9 |
| Course Assessment | Total Marks=100                                                                                                                                                                                                                                                                                                                                                                             | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50% |   |

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|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|----------------------------------------|
| Course Code:<br>EC 4774 | Open Elective Course:<br>(Y/N)                                                                                                                   | Departmental Core<br>Course: (Y/N) | Departmental Elective<br>Course: (Y/N) |
|                         | N                                                                                                                                                | N                                  | Y                                      |
| Type of Course          | Theory Course                                                                                                                                    |                                    |                                        |
| Course Title & Code     | Embedded System (EC 4774)                                                                                                                        |                                    |                                        |
| Course Objectives       | <ul style="list-style-type: none"> <li>To write, test, and debug embedded software, using appropriate programming languages and tools</li> </ul> |                                    |                                        |

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|                                             |                                                      | <ul style="list-style-type: none"><li>• To implement and configure a real-time operating system for task management, synchronization, and communication in embedded systems, understanding the trade-offs between different scheduling algorithms and RTOS features.</li><li>• To undertake and complete projects that require them to design, implement, and integrate both the software and hardware components of an embedded system, meeting specified requirements and constraints.</li></ul> |          |                                            |         |                      |
| Course Outcomes                             |                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |          | Cognitive Levels                           |         |                      |
| CO1                                         | To impart foundational knowledge of embedded systems |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |          | Knowledge/Comprehension (Level I/Level-II) |         |                      |
| CO2                                         | To develop programming proficiency                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |          | Knowledge (Level-I)                        |         |                      |
| CO3                                         | To provide hands-on hardware experience              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |          | Analysis (Level-IV)                        |         |                      |
| CO4                                         | To foster system design and integration skills       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |          | Synthesis/Evaluation (Level-VI/Level-V)    |         |                      |
| Semester                                    |                                                      | VII                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |          | Summer                                     |         |                      |
| Contact Hours                               |                                                      | Lecture                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Tutorial | Practical                                  | Credits | Total Teaching Hours |
|                                             |                                                      | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 0        | 0                                          | 3       | 36                   |
| Prerequisite course codes with course names |                                                      | Introduction to Microprocessors(EC3501)                                                                                                                                                                                                                                                                                                                                                                                                                                                            |          |                                            |         |                      |
| Text Books                                  |                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |          |                                            |         |                      |
| 1.                                          |                                                      | Title                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |          | An Embedded Software Primer                |         |                      |
|                                             |                                                      | Author                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |          | David Simon                                |         |                      |
|                                             |                                                      | Publisher                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |          | Pearson India                              |         |                      |
|                                             |                                                      | Edition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |          | 1 <sup>st</sup> Edition                    |         |                      |
| 2.                                          |                                                      | Title                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |          | The Art of Designing Embedded Systems      |         |                      |
|                                             |                                                      | Author                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |          | Jack Ganssle                               |         |                      |
|                                             |                                                      | Publisher                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |          | Newnes                                     |         |                      |
|                                             |                                                      | Edition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |          | 2 <sup>nd</sup> Edition                    |         |                      |
| Reference Books                             |                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |          |                                            |         |                      |
| 1.                                          |                                                      | Title                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |          | Introduction to Embedded Systems           |         |                      |
|                                             |                                                      | Author                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |          | Shibu K V                                  |         |                      |

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|                   | Publisher                                                                                                                                                                                                                                                                                                              | McGraw Hill Education India                                       |    |
|                   | Edition                                                                                                                                                                                                                                                                                                                | 2 <sup>nd</sup> Edition                                           |    |
| Course Contents   | UNIT I: Embedded systems overview: CPU vs DSP vs PLC vs GPU vs ARM, Cortex A8 and A9, SoC memory subsystems, ADC and DAC interfacing, Multi-standard I/Os, GPIOs, high-speed transceivers; CMOS, LVDS, LVPECL signaling Serial interfacing: SPI, RS232, RS485, I2C, UART, CAN, USB, HDMI, ARM architecture (cortex A8) |                                                                   | 18 |
|                   | UNIT II: Embedded software: process, scheduling; fork and exec, process – child and parent, process id, spawning new process, inter process communication, boot sequence,                                                                                                                                              |                                                                   | 5  |
|                   | UNIT III: Operating system: BIOS, ROM, shell, DOS, UEFI boot, file system, Inode based file systems, POSIX standard Inodes, Flash memory-based file systems, device drivers, Watchdog timers                                                                                                                           |                                                                   | 4  |
|                   | UNIT IV: Introduction to Zynq 7000 series SoC: Processing system (PS), Programmable logic (PL) – FPGA, DSP, RAM; general purpose AXI ports, high-performance AXI ports, timers, memory interfaces, clocking between PS and PL                                                                                          |                                                                   | 9  |
| Course Assessment | Total Marks=100                                                                                                                                                                                                                                                                                                        | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50% |    |

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| Course Code:<br>EC 4775 | Open Elective Course:<br>(Y/N)                                                                                                                                                                                                                | Departmental Core<br>Course: (Y/N) | Departmental Elective<br>Course: (Y/N)     |
|                         | N                                                                                                                                                                                                                                             | N                                  | Y                                          |
| Type of Course          | Theory Course                                                                                                                                                                                                                                 |                                    |                                            |
| Course Title & Code     | Low power VLSI (EC4775)                                                                                                                                                                                                                       |                                    |                                            |
| Course Objectives       | <ul style="list-style-type: none"> <li>● Preliminaries on Power dissipation</li> <li>● Fundamentals of low-power circuits.</li> <li>● Basic synthesis, design and testing for low-power circuits.</li> <li>● Basics of SRAM memory</li> </ul> |                                    |                                            |
| Course Outcomes         |                                                                                                                                                                                                                                               |                                    | Cognitive Levels                           |
| CO1                     | Able to understand the basics of Power Dissipation.                                                                                                                                                                                           |                                    | Knowledge/Comprehension (Level I/Level-II) |
| CO2                     | Able to understand the basics of Power Dissipation and low-                                                                                                                                                                                   |                                    | Application                                |

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|---------------------------------------------|------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|------------------------------------|---------|--------------------------------------------|----------|---|
|                                             | power circuit design.                                                                          |                                                                                                                                                                                                                                                                                                                                                                       |          |                                    |         | (Level-III)                                |          |   |
| CO3                                         | Able to acquire knowledge on SRAM.                                                             |                                                                                                                                                                                                                                                                                                                                                                       |          |                                    |         | Analysis<br>(Level-IV)                     |          |   |
| CO4                                         | Able to learn circuit-level optimization and design low-power circuits at the submicron level. |                                                                                                                                                                                                                                                                                                                                                                       |          |                                    |         | Synthesis/Evaluation<br>(Level-VI/Level-V) |          |   |
| Semester                                    |                                                                                                | VII                                                                                                                                                                                                                                                                                                                                                                   |          |                                    | Summer  |                                            |          |   |
| Contact Hours                               |                                                                                                | Lecture                                                                                                                                                                                                                                                                                                                                                               | Tutorial | Practical                          | Credits | Total                                      | Teaching |   |
|                                             |                                                                                                | 3                                                                                                                                                                                                                                                                                                                                                                     | 0        | 0                                  | 3       | 36                                         | Hours    |   |
| Prerequisite course codes with course names |                                                                                                | VLSI Design (EC3601)                                                                                                                                                                                                                                                                                                                                                  |          |                                    |         |                                            |          |   |
| Text Books                                  |                                                                                                |                                                                                                                                                                                                                                                                                                                                                                       |          |                                    |         |                                            |          |   |
| 1.                                          |                                                                                                | Title                                                                                                                                                                                                                                                                                                                                                                 |          | Low Power CMOS VLSI Circuit Design |         |                                            |          |   |
|                                             |                                                                                                | Author                                                                                                                                                                                                                                                                                                                                                                |          | K. Roy and S. C. Prasad,           |         |                                            |          |   |
|                                             |                                                                                                | Publisher                                                                                                                                                                                                                                                                                                                                                             |          | John Wiley and Sons                |         |                                            |          |   |
|                                             |                                                                                                | Edition                                                                                                                                                                                                                                                                                                                                                               |          | 3 <sup>rd</sup> Edition            |         |                                            |          |   |
| 2.                                          |                                                                                                | Title                                                                                                                                                                                                                                                                                                                                                                 |          | Low Power Design Essentials        |         |                                            |          |   |
|                                             |                                                                                                | Author                                                                                                                                                                                                                                                                                                                                                                |          | Jan Rabaey                         |         |                                            |          |   |
|                                             |                                                                                                | Publisher                                                                                                                                                                                                                                                                                                                                                             |          | Springer Publications              |         |                                            |          |   |
|                                             |                                                                                                | Edition                                                                                                                                                                                                                                                                                                                                                               |          | 1 <sup>st</sup> Edition            |         |                                            |          |   |
| Reference Books                             |                                                                                                |                                                                                                                                                                                                                                                                                                                                                                       |          |                                    |         |                                            |          |   |
| 1.                                          |                                                                                                | Title                                                                                                                                                                                                                                                                                                                                                                 |          | Low-Power CMOS Design              |         |                                            |          |   |
|                                             |                                                                                                | Author                                                                                                                                                                                                                                                                                                                                                                |          | Chandrakasan and R. Brodersen      |         |                                            |          |   |
|                                             |                                                                                                | Publisher                                                                                                                                                                                                                                                                                                                                                             |          | IEEE Press                         |         |                                            |          |   |
|                                             |                                                                                                | Edition                                                                                                                                                                                                                                                                                                                                                               |          | 1 <sup>st</sup> Edition            |         |                                            |          |   |
| Course Contents                             |                                                                                                | UNIT I: POWER DISSIPATION IN CMOS<br>Sources of Power Dissipation – Physics of Power Dissipation in MOSFET Devices: The MIS Structure, Long Channel MOSFET,Submicron MOSFET, Gate Induced Drain Leakage– Power Dissipation in CMOS: Short Circuit Dissipation, Dynamic Dissipation, Load Capacitance– Low Power VLSI Design: Limits – Principles of Low Power Design. |          |                                    |         |                                            |          | 9 |
|                                             |                                                                                                | UNIT II: DESIGN AND SYNTHESIS OF LOW POWER CIRCUITS:<br>Transistor and Gate Sizing: Sizing an Inverter Chain, Transistor and Gate Sizing for Dynamic Power Reduction, Transistor Sizingfor Leakage Power                                                                                                                                                              |          |                                    |         |                                            |          | 9 |

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|                   | Reduction - Network Restructuring and Reorganization: Transistor Network Restructuring, Transistor Network Partitioning and Reorganization - Special Latches and Flip-flops: Self-gating Flip-flop, Varieties of Boolean Functions, Adjustable Device Threshold Voltage. Synthesis: Behavioral Level Transforms, Logic Level Optimization for Low power, Circuit Level Optimization. |                                                                   |   |
|                   | UNIT III: LOW POWER STATIC RAM ARCHITECTURES<br>Organization of a Static RAM, MOS Static RAM Memory cell, Banked Organization of SRAMs, Reducing Voltage Swings on Bit Lines, Reducing Power in Write Driver Circuits, Reducing Power in Sense Amplifier Circuits, The Method for Achieving Low Core Voltages from a Single Supply.                                                  |                                                                   | 9 |
|                   | UNIT IV: DESIGN AND TEST OF LOW-VOLTAGE CMOS CIRCUITS<br>Circuit Design style, Leakage Current in Deep Sub Micro-Meter Transistors, Deep Sub Micro-meter Device Design Issues, Low Voltage Circuit Design Techniques, Designing Deep Sub Micro-Meter ICs with Elevated Intrinsic Leakage, Multiple Supply Voltages.                                                                  |                                                                   | 9 |
| Course Assessment | Total Marks=100                                                                                                                                                                                                                                                                                                                                                                      | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50% |   |

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| Course Code:<br>EC 4871 | Open Elective Course:<br>(Y/N)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Departmental Core Course: (Y/N) | Departmental Elective Course: (Y/N) |
|                         | N                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | N                               | Y                                   |
| Type of Course          | Theory Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                 |                                     |
| Course Title & Code     | FPGA Based Physical Design (EC 4871)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                 |                                     |
| Course Objectives       | <ul style="list-style-type: none"> <li>To describe the internal architecture of FPGAs, including logic blocks, interconnects, and I/O blocks.</li> <li>To gain proficiency in using hardware description languages (HDLs) like VHDL or Verilog for FPGA design.</li> <li>To have capacity of creating complex digital designs and simulating them to verify functionality and performance.</li> <li>To understand the principles of floorplanning, partitioning, and the physical implementation of designs on FPGA platforms.</li> </ul> |                                 |                                     |
| Course Outcomes         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Cognitive Levels                |                                     |

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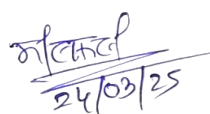
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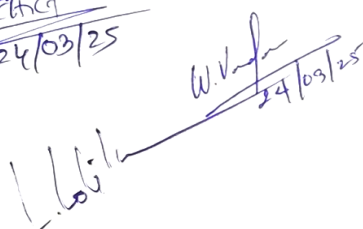
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|---------------------------------------------|---------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----------------------------------------------------------------------|---------|----------------------|---|
| CO1                                         | To understand FPGA architecture and its components.                       |                                                                                                                                                                          |          | Knowledge/Comprehension (Level I/Level-II)                           |         |                      |   |
| CO2                                         | To apply FPGA design methodologies for efficient hardware implementation. |                                                                                                                                                                          |          | Analysis (Level-IV)                                                  |         |                      |   |
| CO3                                         | To optimize FPGA designs for speed, area, and power consumption           |                                                                                                                                                                          |          | Analysis (Level-IV)                                                  |         |                      |   |
| CO4                                         | To implement and troubleshoot complex digital systems on FPGAs.           |                                                                                                                                                                          |          | Synthesis/Evaluation (Level-VI/Level-V)                              |         |                      |   |
| Semester                                    |                                                                           | VIII                                                                                                                                                                     |          |                                                                      | Winter  |                      |   |
| Contact Hours                               |                                                                           | Lecture                                                                                                                                                                  | Tutorial | Practical                                                            | Credits | Total Teaching Hours |   |
|                                             |                                                                           | 3                                                                                                                                                                        | 0        | 0                                                                    | 3       | 36                   |   |
| Prerequisite course codes with course names |                                                                           | Digital Electronics (EC2401)                                                                                                                                             |          |                                                                      |         |                      |   |
| Text Books                                  |                                                                           |                                                                                                                                                                          |          |                                                                      |         |                      |   |
| 1.                                          |                                                                           | Title                                                                                                                                                                    |          | FPGA Prototyping by VHDL Examples: Xilinx MicroBlaze MCS SoC         |         |                      |   |
|                                             |                                                                           | Author                                                                                                                                                                   |          | Pong P. Chu                                                          |         |                      |   |
|                                             |                                                                           | Publisher                                                                                                                                                                |          | Wiley                                                                |         |                      |   |
|                                             |                                                                           | Edition                                                                                                                                                                  |          | 2 <sup>nd</sup> Edition                                              |         |                      |   |
| 2.                                          |                                                                           | Title                                                                                                                                                                    |          | Advanced FPGA Design: Architecture, Implementation, and Optimization |         |                      |   |
|                                             |                                                                           | Author                                                                                                                                                                   |          | Steve Kilts                                                          |         |                      |   |
|                                             |                                                                           | Publisher                                                                                                                                                                |          | Wiley-IEEE Press                                                     |         |                      |   |
|                                             |                                                                           | Edition                                                                                                                                                                  |          | 1 <sup>st</sup> Edition                                              |         |                      |   |
| Reference Books                             |                                                                           |                                                                                                                                                                          |          |                                                                      |         |                      |   |
| 1.                                          |                                                                           | Title                                                                                                                                                                    |          | Designing with Xilinx FPGAs: Using Vivado                            |         |                      |   |
|                                             |                                                                           | Author                                                                                                                                                                   |          | Sanjay Churiwala                                                     |         |                      |   |
|                                             |                                                                           | Publisher                                                                                                                                                                |          | Springer International Publishing                                    |         |                      |   |
|                                             |                                                                           | Edition                                                                                                                                                                  |          | 1 <sup>st</sup> Edition                                              |         |                      |   |
| Course Contents                             |                                                                           | UNIT I: Introduction to FPGAs: Overview of FPGA technology and applications, FPGA architecture: Logic blocks, interconnects, I/O blocks, Comparison with ASICs and CPLDs |          |                                                                      |         |                      | 6 |

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|                   | UNIT III: FPGA Design Flow& HDL for FPGA Design: Design entry: Schematic-based vs. HDL-based, Simulation and verification, Synthesis, place and route, Timing analysis and constraint management, Review of VHDL/Verilog, Advanced HDL techniques for FPGA, Behavioral vs. structural modelling, Testbenches and simulation                                                                                                                                             | 12                                                                |
|                   | UNIT III: Logic Optimization and Implementation: Logic optimization techniques, Mapping designs to FPGA architecture, Resource sharing and pipelining, Clock domain crossing techniques                                                                                                                                                                                                                                                                                 | 6                                                                 |
|                   | UNIT IV: Physical Design and Layout &Advanced FPGA Features, Real-World Applications and Case Studies: Floorplanning and partitioning, Power analysis and optimization, Thermal analysis and heat dissipation, Signal integrity issues and solutions, Embedded processors in FPGAs, High-speed serial interfaces, Memory interfaces and DSP blocks, IoT devices, Automotive applications, Aerospace and defence systems, Image processing and machine learning on FPGAs | 12                                                                |
| Course Assessment | Total Marks=100                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50% |

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| Course Code:<br>EC 4872 | Open Elective Course:<br>(Y/N)<br>N                                                                                                                                                                                                                                                                          | Departmental Core Course: (Y/N)<br>N | Departmental Elective Course: (Y/N)<br>Y   |
| Type of Course          | Theory Course                                                                                                                                                                                                                                                                                                |                                      |                                            |
| Course Title & Code     | Low Power Devices and Systems (EC4872)                                                                                                                                                                                                                                                                       |                                      |                                            |
| Course Objectives       | <ul style="list-style-type: none"> <li>To introduce basic of low power technique in MOS and CMOS circuits.</li> <li>To introduce the power minimization in different strategies such as scaling, voltage technique, physical levels.</li> <li>To learn various architecture for low power design.</li> </ul> |                                      |                                            |
| Course Outcomes         |                                                                                                                                                                                                                                                                                                              |                                      | Cognitive Levels                           |
| CO1                     | To understand the fundamentals low power for MOS and CMOS circuits in details.                                                                                                                                                                                                                               |                                      | Knowledge/Comprehension (Level I/Level-II) |
| CO2                     | To design the various level and approaches for low power consumption and its technique.                                                                                                                                                                                                                      |                                      | Application (Level-III)                    |
| CO3                     | To analysis the process/management for its lower power                                                                                                                                                                                                                                                       |                                      | Analysis                                   |

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|                                             | consumption.                                                                                                                                                                                                                                                                                                                                                                 |                       |          |                                                  |         | (Level-IV)                                 |
| CO4                                         | To evaluate the architecture for low power systems.                                                                                                                                                                                                                                                                                                                          |                       |          |                                                  |         | Synthesis/Evaluation<br>(Level-VI/Level-V) |
| Semester                                    |                                                                                                                                                                                                                                                                                                                                                                              | VIII                  |          |                                                  | Winter  |                                            |
| Contact Hours                               |                                                                                                                                                                                                                                                                                                                                                                              | Lecture               | Tutorial | Practical                                        | Credits | Total Teaching Hours                       |
|                                             |                                                                                                                                                                                                                                                                                                                                                                              | 3                     | 0        | 0                                                | 3       | 36                                         |
| Prerequisite course codes with course names |                                                                                                                                                                                                                                                                                                                                                                              | VLSI Design (EC 3601) |          |                                                  |         |                                            |
| Text Books                                  |                                                                                                                                                                                                                                                                                                                                                                              |                       |          |                                                  |         |                                            |
| 1.                                          | Title                                                                                                                                                                                                                                                                                                                                                                        |                       |          | Power system stability and control               |         |                                            |
|                                             | Author                                                                                                                                                                                                                                                                                                                                                                       |                       |          | P.Kundur                                         |         |                                            |
|                                             | Publisher                                                                                                                                                                                                                                                                                                                                                                    |                       |          | McGraw-Hill                                      |         |                                            |
|                                             | Edition                                                                                                                                                                                                                                                                                                                                                                      |                       |          | 1993                                             |         |                                            |
| 2.                                          | Title                                                                                                                                                                                                                                                                                                                                                                        |                       |          | Electric Power Systems                           |         |                                            |
|                                             | Author                                                                                                                                                                                                                                                                                                                                                                       |                       |          | B.M. Weddy and B.J Cory and John Wiely and Sarma |         |                                            |
|                                             | Publisher                                                                                                                                                                                                                                                                                                                                                                    |                       |          | John Wiely and Sons                              |         |                                            |
|                                             | Edition                                                                                                                                                                                                                                                                                                                                                                      |                       |          | Fourth Edition, 2002                             |         |                                            |
| Reference Books                             |                                                                                                                                                                                                                                                                                                                                                                              |                       |          |                                                  |         |                                            |
| 1.                                          | Title                                                                                                                                                                                                                                                                                                                                                                        |                       |          | Digital Integrated Ciecuit                       |         |                                            |
|                                             | Author                                                                                                                                                                                                                                                                                                                                                                       |                       |          | Jan M. Rabaey                                    |         |                                            |
|                                             | Publisher                                                                                                                                                                                                                                                                                                                                                                    |                       |          | Pearson Education                                |         |                                            |
|                                             | Edition                                                                                                                                                                                                                                                                                                                                                                      |                       |          | 2 <sup>nd</sup> Edition,2003                     |         |                                            |
| Course Contents                             | UNIT I: Basics of MOS circuit<br>Basic of MOS circuit, sources of power dissipation, supply voltage scaling approaches, switch activity and switched capacitance minimization approaches leakage power minimization approaches                                                                                                                                               |                       |          |                                                  |         | 9                                          |
|                                             | UNIT II: Low power in CMOS circuit through various angles<br>Power dissipation in CMOS circuit, physical bounds on low power ,power estimation on different abstraction levels, methods and tools for power estimation ,strategies for power optimization, influence of supply voltage scaling and threshold voltage power consumption, multiple threshold voltage technique |                       |          |                                                  |         | 9                                          |

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|                   | UNIT III: Technique low power Devices<br>Delay balancing to minimize glitches, synthesis of state machines, energy recovery in CMOS circuit, power management gating the clock, power down and synchronism algorithm for low power and algorithm transformations on different abstractions level and data dependency | 9                                                                 |
|                   | UNIT IV: Various design architecture for low power<br>Architectures for low power, arithmetic for low power, system partitioning programming for low lower consumption. Software design for low power.                                                                                                               | 9                                                                 |
| Course Assessment | Total Marks=100                                                                                                                                                                                                                                                                                                      | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50% |

|                         |                                                                                              |                                                                                                                                                                                                                                                                       |          |                                 |         |                                           |  |
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| Course Code:<br>EC 4873 |                                                                                              | Open Elective Course:<br>(Y/N)                                                                                                                                                                                                                                        |          | Departmental Core Course: (Y/N) |         | Departmental Elective Course: (Y/N)       |  |
|                         |                                                                                              | N                                                                                                                                                                                                                                                                     |          | N                               |         | Y                                         |  |
| Type of Course          |                                                                                              | Theory Course                                                                                                                                                                                                                                                         |          |                                 |         |                                           |  |
| Course Title & Code     |                                                                                              | Semiconductor IC Technology (EC4873)                                                                                                                                                                                                                                  |          |                                 |         |                                           |  |
| Course Objectives       |                                                                                              | <ul style="list-style-type: none"><li>● To introduce the concept of Semiconductor fundamentals fabrication steps by steps.</li><li>● To design and fabricate semiconductor-based device</li><li>● To understand fabrication principles and their synthesis.</li></ul> |          |                                 |         |                                           |  |
| Course Outcomes         |                                                                                              |                                                                                                                                                                                                                                                                       |          |                                 |         | Cognitive Levels                          |  |
| CO1                     | To understand the fundamentals of semiconductor fabrication procedure in detail.             |                                                                                                                                                                                                                                                                       |          |                                 |         | Knowledge (Level I)                       |  |
| CO2                     | To fabricate a semiconductor-based device for different efficient application.               |                                                                                                                                                                                                                                                                       |          |                                 |         | Comprehension (Level-II)                  |  |
| CO3                     | To analysis the fabricated based device in terms of current, voltage, power dissipation etc. |                                                                                                                                                                                                                                                                       |          |                                 |         | Application/Analysis (Level-III/Level-IV) |  |
| CO4                     | To evaluate the IC technology for electrical testing, packaging and its future trends.       |                                                                                                                                                                                                                                                                       |          |                                 |         | Synthesis/Evaluation (Level-VI/Level-V)   |  |
| Semester                |                                                                                              | VIII                                                                                                                                                                                                                                                                  |          |                                 | Winter  |                                           |  |
| Contact Hours           |                                                                                              | Lecture                                                                                                                                                                                                                                                               | Tutorial | Practical                       | Credits | Total Teaching Hours                      |  |
|                         |                                                                                              | 3                                                                                                                                                                                                                                                                     | 0        | 0                               | 3       | 36                                        |  |

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|---------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|----|
| Prerequisite course codes with course names | Introduction to Semiconductor Devices (EC 2403)                                                                                                                                                                                                                                                                                                                                                                                                                                |                                          |    |
| Text Books                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                          |    |
| 1.                                          | Title                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Fundamental of Semiconductor fabrication |    |
|                                             | Author                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | G.S May and S.M Sze.                     |    |
|                                             | Publisher                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Wiley education                          |    |
|                                             | Edition                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 2004                                     |    |
| Reference Books                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                          |    |
| 1.                                          | Title                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | VLSI Technology                          |    |
|                                             | Author                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | S.M Sze                                  |    |
|                                             | Publisher                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 2nt Edition                              |    |
|                                             | Edition                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | TMH, 2004                                |    |
| 2.                                          | Title                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Fundamentals of Microfabrication         |    |
|                                             | Author                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | M.J Madou                                |    |
|                                             | Publisher                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | CRC Press                                |    |
|                                             | Edition                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 2 <sup>nd</sup> Edition, 2011            |    |
| Course Contents                             | UNIT I: Historical perspective and overview of semiconductor devices<br>Historical perspective, processing overview, semiconductor substrate-crystal structure, crystal growth, czochralski growth, float zone growth, crystal defects, characterization and evaluation of crystals, basic properties of silicon wafers                                                                                                                                                        |                                          | 9  |
|                                             | UNIT II: Basic wafer fabrication steps<br>Epitaxy, thermal oxidation of silicon, Clean Rooms, Wafer Cleaning, wafer fabrication and its steps- Lithography, Wet and Dry Etching, Thin film deposition, Diffusion, Ion Implantation, Metallization.                                                                                                                                                                                                                             |                                          | 12 |
|                                             | UNIT III: Process integration of different passive components<br>Process Integration: Passive components, MOS Process Integration, Bipolar Process Integration: Basic MOS Device Considerations, MOS Transistor Layout and Design Rules, Complementary MOS (CMOS) Technology, The Junction-Isolated Structure, Current Gain, Transit Time, Base width, Breakdown Voltages,Low Voltage/Low-Power CMOS/Bi CMOS Processes., MOSFET Technology, MESFET Technology, MEMS Technology |                                          | 9  |
|                                             | UNIT IV: Testing and its future trends                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                          | 6  |

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|                   | IC Manufacturing: Electrical Testing, Packaging, Yield, Future trends and Challenges: Challenges for integration, system on chip. |                                                                   |
| Course Assessment | Total Marks=100                                                                                                                   | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50% |

|                                       |                                                                                                                                                                                                                                                                                                                                  |                                    |                                            |         |                      |
|---------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|--------------------------------------------|---------|----------------------|
| Course Code:<br>EC 4874               | Open Elective Course:<br>(Y/N)                                                                                                                                                                                                                                                                                                   | Departmental Core<br>Course: (Y/N) | Departmental Elective<br>Course: (Y/N)     |         |                      |
|                                       | N                                                                                                                                                                                                                                                                                                                                | N                                  | Y                                          |         |                      |
| Type of Course                        | Theory Course                                                                                                                                                                                                                                                                                                                    |                                    |                                            |         |                      |
| Course Title & Code                   | Radar Engineering (EC 4874)                                                                                                                                                                                                                                                                                                      |                                    |                                            |         |                      |
| Course Objectives                     | <ul style="list-style-type: none"><li>● To introduce the scenario of radar system and its implementation advantages.</li><li>● To understand the different types of clutters in radar communication.</li><li>● To learn transmission, reception, display process and precaution need to take for radar communications.</li></ul> |                                    |                                            |         |                      |
| Course Outcomes                       |                                                                                                                                                                                                                                                                                                                                  |                                    | Cognitive Levels                           |         |                      |
| CO1                                   | Student should able to identify different type of radar technology.                                                                                                                                                                                                                                                              |                                    | Knowledge/Comprehension (Level I/Level-II) |         |                      |
| CO2                                   | To understand the different IEEE standard microwave frequency bands for radar applications.                                                                                                                                                                                                                                      |                                    | Application (Level-III)                    |         |                      |
| CO3                                   | To identify the installation, transmission and reception of radar signals.                                                                                                                                                                                                                                                       |                                    | Analysis (Level-IV)                        |         |                      |
| CO4                                   | Student should able to understand how the radar is used in communication system.                                                                                                                                                                                                                                                 |                                    | Synthesis/Evaluation (Level-VI/Level-V)    |         |                      |
| Semester                              | VII                                                                                                                                                                                                                                                                                                                              |                                    | Summer                                     |         |                      |
| Contact Hours                         | Lecture                                                                                                                                                                                                                                                                                                                          | Tutorial                           | Practical                                  | Credits | Total Teaching Hours |
|                                       | 3                                                                                                                                                                                                                                                                                                                                | 0                                  | 0                                          | 3       | 36                   |
| Prerequisite course codes with course | Antenna and Wave Propagation (EC3603)                                                                                                                                                                                                                                                                                            |                                    |                                            |         |                      |

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| names           |                                                                                                                                                                                                                                                                                                                          |                                                          |
| Text Books      |                                                                                                                                                                                                                                                                                                                          |                                                          |
| 1.              | Title                                                                                                                                                                                                                                                                                                                    | Introduction Radar Systems                               |
|                 | Author                                                                                                                                                                                                                                                                                                                   | M.I. Skolnik                                             |
|                 | Publisher                                                                                                                                                                                                                                                                                                                | Tata McGraw Hill                                         |
|                 | Edition                                                                                                                                                                                                                                                                                                                  | 4 <sup>th</sup> Edition                                  |
| 2.              | Title                                                                                                                                                                                                                                                                                                                    | Radar Engineering and Fundamentals and Navigational Aids |
|                 | Author                                                                                                                                                                                                                                                                                                                   | G.S.N. Raju                                              |
|                 | Publisher                                                                                                                                                                                                                                                                                                                | I.K. International                                       |
|                 | Edition                                                                                                                                                                                                                                                                                                                  | 1 <sup>st</sup> Edition                                  |
| Reference Books |                                                                                                                                                                                                                                                                                                                          |                                                          |
| 1.              | Title                                                                                                                                                                                                                                                                                                                    | Understanding Radar Systems                              |
|                 | Author                                                                                                                                                                                                                                                                                                                   | S. Kingsley and S. Quegan                                |
|                 | Publisher                                                                                                                                                                                                                                                                                                                | SciTech                                                  |
|                 | Edition                                                                                                                                                                                                                                                                                                                  | 1 <sup>st</sup> Edition                                  |
| 2.              | Title                                                                                                                                                                                                                                                                                                                    | Introduction to Radar Systems                            |
|                 | Author                                                                                                                                                                                                                                                                                                                   | Merrill I. Skolnik                                       |
|                 | Publisher                                                                                                                                                                                                                                                                                                                | TMH Special                                              |
|                 | Edition                                                                                                                                                                                                                                                                                                                  | 2 <sup>nd</sup> Edition                                  |
| Course Contents | UNIT I: Fundamental concept of Various Radar<br>Introduction, Radar block Diagram and Operation, Radar and Radar Equation, Doppler Effect, CW Radar, FM - CW radar, altimeter, Multiple Frequency Radar, Pulse Radar, MTI and Pulse Doppler Radar, Tracking Radar, RADAR System Design, Prediction of Range Performance. |                                                          |
|                 | UNIT II: Radar Clutter<br>Introduction to Radar Clutter, Surface-Clutter Radar Equations, Sea Clutter, Detection of Targets in Sea Clutter, Land Clutter Detection of Targets in Land Clutter, Effects of Weather on Radar Detection of Targets in Precipitation                                                         |                                                          |
|                 | UNIT III: Detection of Radar Signals in Noise<br>Introduction, Matched Filter, Response, detection Characteristics and Derivation, Correlation detection, detection criterion, Matched Filter, Low Noise Front-Ends, Detector Characteristics, Advantages and Limitations Navigational Aids.                             |                                                          |
|                 | UNIT IV: Receivers, Displays, and Duplexer                                                                                                                                                                                                                                                                               |                                                          |
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|                   | Noise Figure and Noise Temperature, Mixture, Displays – types, Duplexers-Branch and Balanced Types, Introduction to Phased Arrays Antennas: Basic Concepts, Radiation Pattern, Beam Steering and Beam Width changes, phase shifter, Applications, Advantages and Limitations. |                                                                   |
| Course Assessment | Total Marks=100                                                                                                                                                                                                                                                               | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50% |

|                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                 |                                            |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|--------------------------------------------|
| Course Code:<br>EC 4875 | Open Elective Course:<br>(Y/N)                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Departmental Core Course: (Y/N) | Departmental Elective Course: (Y/N)        |
|                         | N                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | N                               | Y                                          |
| Type of Course          | Theory Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                 |                                            |
| Course Title & Code     | Optimization Techniques (EC4875)                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                 |                                            |
| Course Objectives       | <ul style="list-style-type: none"> <li>To understand the working principle of optimization techniques</li> <li>To understand optimization problem formulations, including objective functions and constraints</li> <li>To analyze the mathematical properties of optimization problems, such as convexity, linearity, and constraint qualifications</li> <li>To explore optimization applications in scientific research, such as parameter estimation, experimental design, and data fitting</li> </ul> |                                 |                                            |
| Course Outcomes         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                 | Cognitive Levels                           |
| CO1                     | To understand various optimization algorithms, including linear and nonlinear optimization, convex optimization, and metaheuristic algorithms.                                                                                                                                                                                                                                                                                                                                                           |                                 | Knowledge/Comprehension (Level I/Level-II) |
| CO2                     | Implement optimization algorithms using appropriate programming languages and software tools.                                                                                                                                                                                                                                                                                                                                                                                                            |                                 | Application (Level-III)                    |
| CO3                     | Analyze optimization problems to determine their mathematical properties, such as convexity and linearity.                                                                                                                                                                                                                                                                                                                                                                                               |                                 | Analysis (Level-IV)                        |
| CO4                     | To evaluate the performance of the neural networks in signal and image processing applications using various optimization techniques.                                                                                                                                                                                                                                                                                                                                                                    |                                 | Synthesis/Evaluation (Level-VI/Level-V)    |
| Semester                | VII                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                 | Summer                                     |
| Contact Hours           | Lecture                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Tutorial                        | Practical Credits Total Teaching Hours     |

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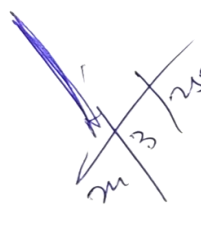
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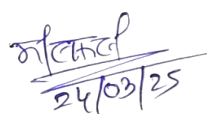
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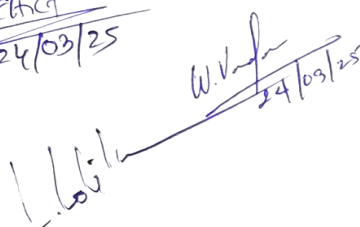
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|---------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|---|---|----|
|                                             | 3                                                                                                                                                                                                                                                                                                                                                                           | 0                                             | 0 | 3 | 36 |
| Prerequisite course codes with course names | Engineering Mathematics-III (MA2301)                                                                                                                                                                                                                                                                                                                                        |                                               |   |   |    |
| Text Books                                  |                                                                                                                                                                                                                                                                                                                                                                             |                                               |   |   |    |
| 1.                                          | Title                                                                                                                                                                                                                                                                                                                                                                       | An introduction to optimization               |   |   |    |
|                                             | Author                                                                                                                                                                                                                                                                                                                                                                      | Chong E.K., and Zak S.H.                      |   |   |    |
|                                             | Publisher                                                                                                                                                                                                                                                                                                                                                                   | Wiley-Inter science Publication, 2001.        |   |   |    |
|                                             | Edition                                                                                                                                                                                                                                                                                                                                                                     | 2 <sup>nd</sup> Edition                       |   |   |    |
| 2.                                          | Title                                                                                                                                                                                                                                                                                                                                                                       | Introduction to Operations Research           |   |   |    |
|                                             | Author                                                                                                                                                                                                                                                                                                                                                                      | Frederick S. Hillier, and Gerald J. Lieberman |   |   |    |
|                                             | Publisher                                                                                                                                                                                                                                                                                                                                                                   | Mc Graw Hill Higher Education                 |   |   |    |
|                                             | Edition                                                                                                                                                                                                                                                                                                                                                                     | 9 <sup>th</sup> Edition                       |   |   |    |
| Reference Books                             |                                                                                                                                                                                                                                                                                                                                                                             |                                               |   |   |    |
| 1.                                          | Title                                                                                                                                                                                                                                                                                                                                                                       | Linear and Nonlinear Programming              |   |   |    |
|                                             | Author                                                                                                                                                                                                                                                                                                                                                                      | Luenberger D.G., and Ye Y.                    |   |   |    |
|                                             | Publisher                                                                                                                                                                                                                                                                                                                                                                   | Springer                                      |   |   |    |
|                                             | Edition                                                                                                                                                                                                                                                                                                                                                                     | 3 <sup>rd</sup> Edition                       |   |   |    |
| 2.                                          | Title                                                                                                                                                                                                                                                                                                                                                                       | Numerical Optimization                        |   |   |    |
|                                             | Author                                                                                                                                                                                                                                                                                                                                                                      | Nocedel J., and Wright S.                     |   |   |    |
|                                             | Publisher                                                                                                                                                                                                                                                                                                                                                                   | Springer (2006)                               |   |   |    |
|                                             | Edition                                                                                                                                                                                                                                                                                                                                                                     |                                               |   |   |    |
| Course Contents                             | UNIT I: Introduction to Optimization:<br>Definition of optimization; Types of optimization problems-linear, nonlinear, discrete, continuous; Applications of optimization in various fields - engineering, economics, operations research; optimization terminology and concepts-objective function, decision variables, constraints, feasible solutions, optimal solutions |                                               |   |   | 9  |
|                                             | UNIT II: Unconstrained Optimization:<br>One-dimensional optimization techniques-brute force search, golden section search, bisection method; Multidimensional optimization techniques-gradient-based methods, Newton's method, quasi-Newton methods; Convergence analysis; Line Search Methods; Conjugate Gradient Methods; Trust Region Methods                            |                                               |   |   | 9  |







|                   |                                                                                                                                                                                                                                                                                      |                                                                   |   |
|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|---|
|                   | UNIT III: Constrained Optimization:<br>Types of Constraints-Equality and Inequality Constraints; Karush-Kuhn-Tucker (KKT) condition; Lagrange Multipliers; Penalty function Methods; Barrier function methods; Sequential Quadratic programming (SQP); Interior-point methods        |                                                                   | 9 |
|                   | UNIT IV: Nonlinear programming methods:<br>Gradient descent methods-Gradient descent (GD), stochastic gradient descent (SGD), Adam; Metaheuristic techniques- Genetic algorithms (GA), Particle swarm optimization (PSO), Ant Colony optimization (ACO), Differential evolution (DE) |                                                                   | 9 |
| Course Assessment | Total Marks=100                                                                                                                                                                                                                                                                      | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50% |   |

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| Course Code:<br>EC 4751 | Open Elective Course:<br>(Y/N)                                                                                                                                                                                                                                                                                                                                                                                                                              | Departmental Core Course: (Y/N) | Departmental Elective Course: (Y/N)        |
|                         | Y                                                                                                                                                                                                                                                                                                                                                                                                                                                           | N                               | N                                          |
| Type of Course          | Theory Course                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                 |                                            |
| Course Title & Code     | Introduction to Nano Science and Nano Technology (EC 4751)                                                                                                                                                                                                                                                                                                                                                                                                  |                                 |                                            |
| Course Objectives       | <ul style="list-style-type: none"> <li>To understand the fundamental principles and concepts of nanoscience and nanotechnology.</li> <li>To familiarize students with the synthesis, characterization, and manipulation of nanomaterials.</li> <li>To explore the various applications of nanotechnology in different fields.</li> <li>To develop critical thinking and problem-solving skills in the context of nanoscience and nanotechnology.</li> </ul> |                                 |                                            |
| Course Outcomes         |                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                 | Cognitive Levels                           |
| CO1                     | To identify types of nanomaterials and to understand the basic principles of nanotechnology and nanoscience.                                                                                                                                                                                                                                                                                                                                                |                                 | Knowledge/Comprehension (Level I/Level-II) |

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| CO2                                         | To analyze properties of nanomaterials.                                           |                                                                                                                                                                                                                                                                                                                                |          |                                                        |               | Analysis (Level IV)     |   |
| CO3                                         | To design experiments and communicate findings                                    |                                                                                                                                                                                                                                                                                                                                |          |                                                        |               | Synthesis (Level VI)    |   |
| CO4                                         | To characterize nanomaterials and solve problems using nanotechnology principles. |                                                                                                                                                                                                                                                                                                                                |          |                                                        |               | Application (Level III) |   |
| CO5                                         | To evaluate applications and critique scientific literature.                      |                                                                                                                                                                                                                                                                                                                                |          |                                                        |               | Evaluation (Level V)    |   |
| Semester                                    |                                                                                   | III/IV                                                                                                                                                                                                                                                                                                                         |          |                                                        | Summer/Winter |                         |   |
| Contact Hours                               |                                                                                   | Lecture                                                                                                                                                                                                                                                                                                                        | Tutorial | Practical                                              | Credits       | Total Teaching Hours    |   |
|                                             |                                                                                   | 3                                                                                                                                                                                                                                                                                                                              | 0        | 0                                                      | 3             | 36                      |   |
| Prerequisite course codes with course names |                                                                                   | Basic Electronics Circuit (EC 1201), Engineering Physics-I (PH1101), Engineering Chemistry (CH 1101)                                                                                                                                                                                                                           |          |                                                        |               |                         |   |
| Text Books                                  |                                                                                   |                                                                                                                                                                                                                                                                                                                                |          |                                                        |               |                         |   |
| 1.                                          |                                                                                   | Title                                                                                                                                                                                                                                                                                                                          |          | Introduction to Nanotechnology                         |               |                         |   |
|                                             |                                                                                   | Author                                                                                                                                                                                                                                                                                                                         |          | Charles P. Poole Jr. and Frank J. Owens                |               |                         |   |
|                                             |                                                                                   | Publisher                                                                                                                                                                                                                                                                                                                      |          | Wiley, 2012                                            |               |                         |   |
|                                             |                                                                                   | Edition                                                                                                                                                                                                                                                                                                                        |          | 3 <sup>rd</sup> Edition                                |               |                         |   |
| 2.                                          |                                                                                   | Title                                                                                                                                                                                                                                                                                                                          |          | Nanotechnology: Understanding Small Systems            |               |                         |   |
|                                             |                                                                                   | Author                                                                                                                                                                                                                                                                                                                         |          | Ben Rogers, Jesse Adams, and Sumita Pennathur          |               |                         |   |
|                                             |                                                                                   | Publisher                                                                                                                                                                                                                                                                                                                      |          | CRC Press, 2012                                        |               |                         |   |
|                                             |                                                                                   | Edition                                                                                                                                                                                                                                                                                                                        |          | 3 <sup>rd</sup> Edition                                |               |                         |   |
| Reference Books                             |                                                                                   |                                                                                                                                                                                                                                                                                                                                |          |                                                        |               |                         |   |
| 1.                                          |                                                                                   | Title                                                                                                                                                                                                                                                                                                                          |          | Nanomaterials: Synthesis, Properties, and Applications |               |                         |   |
|                                             |                                                                                   | Author                                                                                                                                                                                                                                                                                                                         |          | A.S. Edelstein and R.C. Cammarata                      |               |                         |   |
|                                             |                                                                                   | Publisher                                                                                                                                                                                                                                                                                                                      |          | CRC Press, 2017                                        |               |                         |   |
|                                             |                                                                                   | Edition                                                                                                                                                                                                                                                                                                                        |          | 2 <sup>nd</sup> Edition                                |               |                         |   |
| Course Contents                             |                                                                                   | UNIT I: Introduction to Nanoscience and Nanotechnology<br>Definition and scope of nanoscience and nanotechnology, Historical development and milestones, Importance and potential impact of nanotechnology, Quantum mechanics and its relevance to nanoscale phenomena, Size-dependent properties, Surface effects and quantum |          |                                                        |               |                         | 9 |

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|                   | confinement.                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                   |   |
|                   | <b>UNIT II: Synthesis of Nanomaterials</b><br>Top-down vs. bottom-up approaches, Chemical vapor deposition (CVD), Sol-gel synthesis, Self-assembly techniques, Characterization Techniques, Scanning electron microscopy (SEM), Transmission electron microscopy (TEM), Atomic force microscopy (AFM), X-ray diffraction (XRD), Spectroscopic techniques (UV-Vis, FTIR, Raman).                                    |                                                                   | 9 |
|                   | <b>UNIT III: Nanomaterials and Nanodevices</b><br>Carbon-based nanomaterials (graphene, carbon nanotubes, fullerenes), Metal nanoparticles, Semiconductor nanoparticles (quantum dots), Polymer nanocomposites, Nanoelectronics, Nanophotonics, Nanomechanical devices, Nanosensors and biosensors.                                                                                                                |                                                                   | 9 |
|                   | <b>UNIT IV: Applications in Electronics, Medicine and Energy</b><br>Nanoscale transistors and integrated circuits, Nanomaterials for flexible electronics, Nanoelectromechanical systems (NEMS), Drug delivery systems, Nanomedicine and cancer therapy, Diagnostic techniques using nanoparticles, Nanomaterials for energy storage (batteries, supercapacitors), Photovoltaic devices, Catalysis and fuel cells. |                                                                   | 9 |
| Course Assessment | Total Marks=100                                                                                                                                                                                                                                                                                                                                                                                                    | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50% |   |

|                         |                                                                                                                                                                                                                                                                                                                                                                             |                                 |                                     |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|-------------------------------------|
| Course Code:<br>EC 4752 | Open Elective Course:<br>(Y/N)                                                                                                                                                                                                                                                                                                                                              | Departmental Core Course: (Y/N) | Departmental Elective Course: (Y/N) |
|                         | Y                                                                                                                                                                                                                                                                                                                                                                           | N                               | N                                   |
| Type of Course          | Theory Course                                                                                                                                                                                                                                                                                                                                                               |                                 |                                     |
| Course Title & Code     | Microelectronics and VLSI Technology (EC 4752)                                                                                                                                                                                                                                                                                                                              |                                 |                                     |
| Course Objectives       | <ul style="list-style-type: none"> <li>To understand the principles of microelectronics and semiconductor devices.</li> <li>To learn about the fabrication processes used in VLSI technology.</li> <li>To gain hands-on experience in designing and simulating integrated circuits.</li> <li>To explore advanced topics in VLSI technology and its applications.</li> </ul> |                                 |                                     |
| Course Outcomes         | Cognitive Levels                                                                                                                                                                                                                                                                                                                                                            |                                 |                                     |

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| CO1                                         | To understand the overview of semiconductor materials and devices.                    |                                                                                                                          |          |                                                      |               | Knowledge/Comprehension (Level I/Level-II) |   |
| CO2                                         | To design and implement basic VLSI Circuits and simulate applying testing techniques. |                                                                                                                          |          |                                                      |               | Application (Level-III)                    |   |
| CO3                                         | To optimize VLSI designs.                                                             |                                                                                                                          |          |                                                      |               | Evaluation (Level-V)                       |   |
| CO4                                         | To analyse the VLSI device characteristics and research trends.                       |                                                                                                                          |          |                                                      |               | Analysis (Level- IV)                       |   |
| CO5                                         | To develop layouts for VLSI circuits.                                                 |                                                                                                                          |          |                                                      |               | Synthesis (Level VI)                       |   |
| Semester                                    |                                                                                       | III (or) IV                                                                                                              |          |                                                      | Summer/Winter |                                            |   |
| Contact Hours                               |                                                                                       | Lecture                                                                                                                  | Tutorial | Practical                                            | Credits       | Total Teaching Hours                       |   |
|                                             |                                                                                       | 3                                                                                                                        | 0        | 0                                                    | 3             | 36                                         |   |
| Prerequisite course codes with course names |                                                                                       | Basic Electronic Circuits (EC 1201); Engineering Physics-I (PH1101)                                                      |          |                                                      |               |                                            |   |
| Text Books                                  |                                                                                       |                                                                                                                          |          |                                                      |               |                                            |   |
| 1.                                          |                                                                                       | Title                                                                                                                    |          | Microelectronics: Circuit Analysis and Design        |               |                                            |   |
|                                             |                                                                                       | Author                                                                                                                   |          | Donald A. Neamen                                     |               |                                            |   |
|                                             |                                                                                       | Publisher                                                                                                                |          | McGraw Hill Education, 2018                          |               |                                            |   |
|                                             |                                                                                       | Edition                                                                                                                  |          | 5 <sup>th</sup> Edition                              |               |                                            |   |
| 2.                                          |                                                                                       | Title                                                                                                                    |          | CMOS VLSI Design: A Circuits and Systems Perspective |               |                                            |   |
|                                             |                                                                                       | Author                                                                                                                   |          | Neil H. E. Weste and David Money Harris              |               |                                            |   |
|                                             |                                                                                       | Publisher                                                                                                                |          | Pearson Education, 2010                              |               |                                            |   |
|                                             |                                                                                       | Edition                                                                                                                  |          | 4 <sup>th</sup> Edition                              |               |                                            |   |
| Reference Books                             |                                                                                       |                                                                                                                          |          |                                                      |               |                                            |   |
| 1.                                          |                                                                                       | Title                                                                                                                    |          | VLSI Technology                                      |               |                                            |   |
|                                             |                                                                                       | Author                                                                                                                   |          | S.M. Sze and Kwok K. Ng                              |               |                                            |   |
|                                             |                                                                                       | Publisher                                                                                                                |          | McGraw Hill Education, 2003                          |               |                                            |   |
|                                             |                                                                                       | Edition                                                                                                                  |          | 2 <sup>nd</sup> Edition                              |               |                                            |   |
| Course                                      |                                                                                       | UNIT I: Introduction to Microelectronics and VLSI Overview of semiconductor materials and device technologies, Evolution |          |                                                      |               |                                            | 9 |

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| Contents          | of integrated circuits and VLSI technology, Scaling trends and challenges in semiconductor manufacturing.                                                                                                                                                                                                                                                                                                                                                                           |                                                                   |   |
|                   | <b>UNIT II: Semiconductor Fabrication Processes</b><br>Semiconductor basics: crystal structure, energy bands, carrier transport, PN junctions and diodes, MOSFET operation and characteristics, Bipolar junction transistors (BJTs), Semiconductor wafer fabrication: crystal growth, wafer preparation, Photolithography and patterning, Deposition techniques: thermal oxidation, chemical vapor deposition (CVD), physical vapor deposition (PVD), Etching and doping processes. |                                                                   | 9 |
|                   | <b>UNIT III: CMOS Technology, Circuit Simulation and Modeling</b><br>Complementary Metal-Oxide-Semiconductor (CMOS) technology, CMOS process flow and fabrication steps, Layout design rules and design for manufacturability (DFM), Introduction to SPICE (Simulation Program with Integrated Circuit Emphasis), Device modeling and parameter extraction, Circuit simulation techniques: DC, transient, and AC analysis.                                                          |                                                                   | 9 |
|                   | <b>UNIT IV: VLSI Design Methodologies</b><br>Overview of VLSI design flow, RTL (Register-Transfer Level) design and synthesis, Logic optimization and technology mapping, Floorplanning and placement techniques, Static timing analysis (STA), Timing closure and timing-driven design, Design rule checking (DRC) and layout versus schematic (LVS) verification.                                                                                                                 |                                                                   | 9 |
| Course Assessment | Total Marks=100                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50% |   |

|                         |                                                                                                                                                                                                                                                                                                                             |                                 |                                     |
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| Course Code:<br>EC 4753 | Open Elective Course:<br>(Y/N)                                                                                                                                                                                                                                                                                              | Departmental Core Course: (Y/N) | Departmental Elective Course: (Y/N) |
|                         | Y                                                                                                                                                                                                                                                                                                                           | N                               | N                                   |
| Type of Course          | Theory Course                                                                                                                                                                                                                                                                                                               |                                 |                                     |
| Course Title & Code     | Modern Communication Technologies (EC 4753)                                                                                                                                                                                                                                                                                 |                                 |                                     |
| Course Objectives       | <ul style="list-style-type: none"> <li>Familiarization with EM waves and their propagation through transmission lines.</li> <li>Understanding of modulation and demodulation schemes for analog and pulse modulation.</li> <li>Evaluation of the cellular communication in enhancing the capacity of the system.</li> </ul> |                                 |                                     |

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| Course Outcomes                             |                                                                                                                          |                                                                                                                                                           |                                   |           | Cognitive Levels                                  |                      |   |
|---------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|-----------|---------------------------------------------------|----------------------|---|
| CO1                                         | Comprehension of EM waves and their propagation mechanism.                                                               |                                                                                                                                                           |                                   |           | Knowledge/<br>Comprehension<br>(Level I/Level-II) |                      |   |
| CO2                                         | Understand the transmission lines and their properties.                                                                  |                                                                                                                                                           |                                   |           | Application<br>(Level-III)                        |                      |   |
| CO3                                         | Understand different modulation and demodulation schemes for analog communications (AM, FM and PM) and pulse Modulation. |                                                                                                                                                           |                                   |           | Analysis<br>(Level-IV)                            |                      |   |
| CO4                                         | Importance of cellular communication and its role in improving capacity.                                                 |                                                                                                                                                           |                                   |           | Synthesis/ Evaluation<br>(Level-VI/Level-V)       |                      |   |
| Semester                                    |                                                                                                                          | III/IV                                                                                                                                                    |                                   |           | Summer/Winter                                     |                      |   |
| Contact Hours                               |                                                                                                                          | Lecture                                                                                                                                                   | Tutorial                          | Practical | Credits                                           | Total Teaching Hours |   |
|                                             |                                                                                                                          | 3                                                                                                                                                         | 0                                 | 0         | 3                                                 | 36                   |   |
| Prerequisite course codes with course names |                                                                                                                          | Engineering Mathematics – II (MA 1201), Engineering Physics-I (PH1101); Basic Electronic Circuits (EC1201)                                                |                                   |           |                                                   |                      |   |
| Text Books                                  |                                                                                                                          |                                                                                                                                                           |                                   |           |                                                   |                      |   |
| 1.                                          |                                                                                                                          | Title                                                                                                                                                     | Electronic Communication Systems  |           |                                                   |                      |   |
|                                             |                                                                                                                          | Author                                                                                                                                                    | G.Kennedy and Bernard Davis       |           |                                                   |                      |   |
|                                             |                                                                                                                          | Publisher                                                                                                                                                 | Tata McGraw Hill                  |           |                                                   |                      |   |
|                                             |                                                                                                                          | Edition                                                                                                                                                   | Latest edition                    |           |                                                   |                      |   |
| 2.                                          |                                                                                                                          | Title                                                                                                                                                     | Electronics Communication Systems |           |                                                   |                      |   |
|                                             |                                                                                                                          | Author                                                                                                                                                    | Dennis Roody and John Coolen      |           |                                                   |                      |   |
|                                             |                                                                                                                          | Publisher                                                                                                                                                 | PHI                               |           |                                                   |                      |   |
|                                             |                                                                                                                          | Edition                                                                                                                                                   | Latest Edition                    |           |                                                   |                      |   |
| Reference Books                             |                                                                                                                          |                                                                                                                                                           |                                   |           |                                                   |                      |   |
| 1.                                          |                                                                                                                          | Title                                                                                                                                                     | Communication Systems             |           |                                                   |                      |   |
|                                             |                                                                                                                          | Author                                                                                                                                                    | A. B. Carlson                     |           |                                                   |                      |   |
|                                             |                                                                                                                          | Publisher                                                                                                                                                 | McGraw Hill                       |           |                                                   |                      |   |
|                                             |                                                                                                                          | Edition                                                                                                                                                   | Latest Edition                    |           |                                                   |                      |   |
| Course Contents                             |                                                                                                                          | UNIT I: EM Waves<br>Introduction to EM waves and their spectrum. Principles of Radiation. Types of EM wave propagation –Ground wave, Sky wave, Space wave |                                   |           |                                                   |                      | 8 |

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|                   | propagation. Structure of Ionosphere, Skip distance, Radio horizon, skip zone.                                                                                                                                                                                                                                                                         |                                                                   |
|                   | UNIT II: Transmission Lines<br>Introduction to Transmission lines –Twisted pair wires, coaxial cables and Wave guides                                                                                                                                                                                                                                  | 8                                                                 |
|                   | UNIT III: Modulations<br>Principles of Amplitude, Frequency and phase Modulation Techniques                                                                                                                                                                                                                                                            | 10                                                                |
|                   | UNIT IV: Cellular Communication<br>Limitations of conventional mobile system. Cellular communication: introduction, frequency reuse, cluster size, cellular system architecture, mobile station, base station, MSC, channel assignment strategies, call handover strategies, interference and system capacity, improving capacity in cellular systems. | 10                                                                |
| Course Assessment | Theory (100 Marks)                                                                                                                                                                                                                                                                                                                                     | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50% |

|                         |                                                                                                                                                                                                                                                                                                                    |                                      |                                            |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|--------------------------------------------|
| Course Code:<br>EC 4754 | Open Elective Course:<br>(Y/N)<br>Y                                                                                                                                                                                                                                                                                | Departmental Core Course: (Y/N)<br>N | Departmental Elective Course: (Y/N)<br>N   |
| Type of Course          | Theory Course                                                                                                                                                                                                                                                                                                      |                                      |                                            |
| Course Title & Code     | Nanofabrication Techniques (EC 4754)                                                                                                                                                                                                                                                                               |                                      |                                            |
| Course Objectives       | <ul style="list-style-type: none"> <li>To introduce chip manufacturing process, FEOL and BEOL concepts.</li> <li>To introduce the basic of photolithography, Deposition, Oxidation, Testing and yield during chip manufacturing.</li> <li>To learn various process/steps of chip manufacturing process.</li> </ul> |                                      |                                            |
| Course Outcomes         |                                                                                                                                                                                                                                                                                                                    |                                      | Cognitive Levels                           |
| CO1                     | To understand the basic fundamentals of chip manufacturing process in detail.                                                                                                                                                                                                                                      |                                      | Knowledge/Comprehension (Level I/Level-II) |
| CO2                     | To implement the basic of photolithography, Deposition, Oxidation, Testing and yield during chip manufacturing.                                                                                                                                                                                                    |                                      | Application (Level-III)                    |
| CO3                     | To analysis the mechanism of manufacturing process for chip.                                                                                                                                                                                                                                                       |                                      | Analysis (Level-IV)                        |
| CO4                     | To evaluate the process/steps done during nanofabrication                                                                                                                                                                                                                                                          |                                      | Synthesis/Evaluation                       |

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|---------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|----------|-------------------------------------------------------------|--------------------|----------------------|
|                                             | technique.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                      |          |                                                             | (Level-VI/Level-V) |                      |
| Semester                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | III/IV                                                               |          |                                                             | Summer             |                      |
| Contact Hours                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Lecture                                                              | Tutorial | Practical                                                   | Credits            | Total Teaching Hours |
|                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 3                                                                    | 0        | 0                                                           | 3                  | 36                   |
| Prerequisite course codes with course names |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Basic Electronic Circuits (EC 1201); Engineering Physics-I (PH 1101) |          |                                                             |                    |                      |
| Text Books                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                      |          |                                                             |                    |                      |
| 1.                                          | Title                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                      |          | The Science and Engineering of Microelectronics Fabrication |                    |                      |
|                                             | Author                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                      |          | S.A Campbell                                                |                    |                      |
|                                             | Publisher                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                      |          | Oxford University Press                                     |                    |                      |
|                                             | Edition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                      |          | 2 <sup>nd</sup> Edition ,2001                               |                    |                      |
| 2.                                          | Title                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                      |          | VLSI Technology                                             |                    |                      |
|                                             | Author                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                      |          | C.Y. Chang and S.M Sze                                      |                    |                      |
|                                             | Publisher                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                      |          | McGraw-Hill                                                 |                    |                      |
|                                             | Edition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                      |          | 1996                                                        |                    |                      |
| Reference Books                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                      |          |                                                             |                    |                      |
| 1.                                          | Title                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                      |          | Introduction to Microelectronics Fabrication                |                    |                      |
|                                             | Author                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                      |          | Richard C. Jaeger                                           |                    |                      |
|                                             | Publisher                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                      |          | Prentice Hill                                               |                    |                      |
|                                             | Edition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                      |          | 2 <sup>nd</sup> Edition,2001                                |                    |                      |
| Course Contents                             | UNIT I: Introduction<br>Review of Chip Manufacturing Process, FEOL and BEOL concepts                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                      |          |                                                             |                    | 9                    |
|                                             | UNIT II: Photolithography, Deposition, Material Removal:<br>Lithography basics, Wavelength, Layout and Optical Proximity Correction (OPC), Mask making, Phase shift mask, Lithography details, Production issues including depth of focus, misalignment: Physical and Chemical Vapour Deposition (PVD & CVD) basics, Electrochemical deposition; Plasma and wet etching, Chemical Mechanical Polishing (CMP) basics, Dishing, Erosion, Issues in Shallow Trench Isolation, Oxide Polish and Copper Polish, Post CMP issues |                                                                      |          |                                                             |                    | 9                    |
|                                             | UNIT III: FEOL, Diffusion and Ion implantation, Oxidation<br>Semiconductor electron band structure, band gap MOS capacitor, MOS                                                                                                                                                                                                                                                                                                                                                                                            |                                                                      |          |                                                             |                    | 9                    |

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|                   | transistor structure for enhancement mode devices, Transistor fabrication, MOS transistor operation: Implantation basics, Constant source and limited source diffusion, Diffusion vs. ion implantation, Mechanism and Models, Equipment, relevant issues; Process Types, Details of thermal oxidation, Models, relevant issues; |                                                                   |
|                   | UNIT IV: Process Integration, Testing and Yield<br>BEOL Issues, Cu vs. Al metallization, oxide vs. low-k integration, MEMS; Scribe line Test (for process evaluation), Functional Test (for product evaluation), Yield Models, process and design modifications for yield optimization.                                         | 9                                                                 |
| Course Assessment | Total Marks=100                                                                                                                                                                                                                                                                                                                 | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50% |

|                         |                                                                                    |                                                                                                                                                                                                                                   |                                    |           |                                             |                      |
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| Course Code:<br>EC 4755 |                                                                                    | Open Elective<br>Course: (Y/N)                                                                                                                                                                                                    | Departmental Core<br>Course: (Y/N) |           | Departmental Elective<br>Course: (Y/N)      |                      |
|                         |                                                                                    | Y                                                                                                                                                                                                                                 | N                                  |           | N                                           |                      |
| Type of Course          |                                                                                    | Theory Course                                                                                                                                                                                                                     |                                    |           |                                             |                      |
| Course Title & Code     |                                                                                    | Wireless Sensor Networks (EC 4755)                                                                                                                                                                                                |                                    |           |                                             |                      |
| Course Objectives       |                                                                                    | <ul style="list-style-type: none"><li>• To familiarize with wireless sensors.</li><li>• To understand the communication among the sensor nodes.</li><li>• To learn the applications and simulations of sensor networks.</li></ul> |                                    |           |                                             |                      |
| Course Outcomes         |                                                                                    |                                                                                                                                                                                                                                   |                                    |           | Cognitive Levels                            |                      |
| CO1                     | Understand challenges and technologies for wireless networks                       |                                                                                                                                                                                                                                   |                                    |           | Knowledge/Comprehension (Level I/ Level-II) |                      |
| CO2                     | Understand architecture and sensors                                                |                                                                                                                                                                                                                                   |                                    |           | Application (Level-III)                     |                      |
| CO3                     | Describe the communication, energy efficiency, computing, storage and transmission |                                                                                                                                                                                                                                   |                                    |           | Analysis (Level-IV)                         |                      |
| CO4                     | Explain the concept of programming the in WSN environment                          |                                                                                                                                                                                                                                   |                                    |           | Synthesis/Evaluation (Level-VI/Level-V)     |                      |
| Semester                |                                                                                    | III/IV                                                                                                                                                                                                                            |                                    |           | Summer/Winter                               |                      |
| Contact Hours           |                                                                                    | Lecture                                                                                                                                                                                                                           | Tutorial                           | Practical | Credits                                     | Total Teaching Hours |
|                         |                                                                                    | 3                                                                                                                                                                                                                                 | 0                                  | 0         | 3                                           | 36                   |

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| Prerequisitecourse codes with course names |                                                                                                                                                                                                                                                       | Engineering Mathematics-III (EC 2301); Modern Communication Technologies (EC2353) |   |
| Text Books                                 |                                                                                                                                                                                                                                                       |                                                                                   |   |
| 1.                                         | Title                                                                                                                                                                                                                                                 | Protocols And Architectures for Wireless Sensor Networks                          |   |
|                                            | Author                                                                                                                                                                                                                                                | Holger Karl & Andreas Willig                                                      |   |
|                                            | Publisher                                                                                                                                                                                                                                             | John Wiley                                                                        |   |
|                                            | Edition                                                                                                                                                                                                                                               | Latest                                                                            |   |
| 2.                                         | Title                                                                                                                                                                                                                                                 | Wireless Sensor Networks- An Information Processing Approach                      |   |
|                                            | Author                                                                                                                                                                                                                                                | Feng Zhao & Leonidas J.Guibas                                                     |   |
|                                            | Publisher                                                                                                                                                                                                                                             | Elsevier                                                                          |   |
|                                            | Edition                                                                                                                                                                                                                                               | Latest                                                                            |   |
| Reference Books                            |                                                                                                                                                                                                                                                       |                                                                                   |   |
| 1.                                         | Title                                                                                                                                                                                                                                                 | Fundamentals of Wireless Sensor Networks - Theory and Practice                    |   |
|                                            | Author                                                                                                                                                                                                                                                | Waltenegus Dargie , Christian Poellabauer                                         |   |
|                                            | Publisher                                                                                                                                                                                                                                             | John Wiley & Sons                                                                 |   |
|                                            | Edition                                                                                                                                                                                                                                               | Latest                                                                            |   |
| 2.                                         | Title                                                                                                                                                                                                                                                 | Wireless Sensor Networks Technology, Protocols, and Applications                  |   |
|                                            | Author                                                                                                                                                                                                                                                | Kazem Sohraby, Daniel Minoli, & Taieb Znati                                       |   |
|                                            | Publisher                                                                                                                                                                                                                                             | John Wiley                                                                        |   |
|                                            | Edition                                                                                                                                                                                                                                               | Latest                                                                            |   |
| Course Contents                            | UNIT – I: OVERVIEW OF WIRELESS SENSOR NETWORKS: Single - Node Architecture - Hardware Components - Network Characteristics-unique constraints and challenges, Enabling Technologies for Wireless Sensor Networks - Types of wireless sensor networks. |                                                                                   | 9 |

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|                   | UNIT – II: ARCHITECTURES: Network Architecture - Sensor Networks - Scenarios - Design Principle, Physical Layer and Transceiver Design Considerations, Optimization Goals and Figures of Merit, Gateway Concepts, Operating Systems and Execution Environments - introduction to Tiny OS and nesC - Internet to WSN Communication.                                      | 9 |
|                   | UNIT – III: NETWORKING SENSORS: MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols and Wakeup Concepts – SMAC, - B-MAC Protocol, IEEE 802.15.4 standard and ZigBee, the Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols Energy - Efficient Routing, Geographic Routing. | 9 |
|                   | UNIT – IV: INFRASTRUCTURE ESTABLISHMENT: Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control. Sensor Node Hardware – Berkeley Motes, Programming Challenges.                                                                                                                                                   | 9 |
| Course Assessment | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50%                                                                                                                                                                                                                                                                                                       |   |

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|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|----------------------------------------|
| Course Code:<br>EC4756 | Open Elective Course:<br>(Y/N)                                                                                                                                                                                                                                                                                | Departmental Core<br>Course: (Y/N) | Departmental Elective<br>Course: (Y/N) |
|                        | Y                                                                                                                                                                                                                                                                                                             | N                                  | N                                      |
| Type of Course         | Theory Course                                                                                                                                                                                                                                                                                                 |                                    |                                        |
| Course Title &<br>Code | RF Integrated Circuits (EC 4756)                                                                                                                                                                                                                                                                              |                                    |                                        |
| Course Objectives      | <ul style="list-style-type: none"> <li>To introduce the high frequency circuits and its implementation.</li> <li>To understand the different types of circuits for RF communication.</li> <li>To learn the design process of transmitted, low noise amplifier, receiver and mixer RF applications.</li> </ul> |                                    |                                        |
| Course Outcomes        |                                                                                                                                                                                                                                                                                                               |                                    | Cognitive Levels                       |

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| CO1                                         | Student should able to identify different type of high frequency RF modules.                             |                                                                        |          |                                      | Knowledge/Comprehension (Level I/Level-II) |                      |
| CO2                                         | To understand the different types of RF integrated circuit boards for wireless system.                   |                                                                        |          |                                      | Application (Level-III)                    |                      |
| CO3                                         | To identify the active and passive devices of the RF system.                                             |                                                                        |          |                                      | Analysis (Level-IV)                        |                      |
| CO4                                         | Student should able to understand how the all active and passive devices are work together in RF system. |                                                                        |          |                                      | Synthesis/Evaluation (Level-VI/Level-V)    |                      |
| Semester                                    |                                                                                                          | V/VI                                                                   |          | Summer/Winter                        |                                            |                      |
| Contact Hours                               |                                                                                                          | Lecture                                                                | Tutorial | Practical                            | Credits                                    | Total Teaching Hours |
|                                             |                                                                                                          | 3                                                                      | 0        | 0                                    | 3                                          | 36                   |
| Prerequisite course codes with course names |                                                                                                          | Engineering Physics-I (PH 1101); Engineering Mathematics-III (EC 2301) |          |                                      |                                            |                      |
| Text Books                                  |                                                                                                          |                                                                        |          |                                      |                                            |                      |
| 1.                                          |                                                                                                          | Title                                                                  |          | RF Microelectronics                  |                                            |                      |
|                                             |                                                                                                          | Author                                                                 |          | B. Razavi                            |                                            |                      |
|                                             |                                                                                                          | Publisher                                                              |          | Pearson                              |                                            |                      |
|                                             |                                                                                                          | Edition                                                                |          | 2 <sup>nd</sup> Edition              |                                            |                      |
| 2.                                          |                                                                                                          | Title                                                                  |          | Microwave Engineering                |                                            |                      |
|                                             |                                                                                                          | Author                                                                 |          | David. M. Pozar,                     |                                            |                      |
|                                             |                                                                                                          | Publisher                                                              |          | John Wiley                           |                                            |                      |
|                                             |                                                                                                          | Edition                                                                |          | 4 <sup>th</sup> Edition              |                                            |                      |
| Reference Books                             |                                                                                                          |                                                                        |          |                                      |                                            |                      |
| 1.                                          |                                                                                                          | Title                                                                  |          | Fundamental of Microwave Engineering |                                            |                      |
|                                             |                                                                                                          | Author                                                                 |          | R.E. Collins                         |                                            |                      |
|                                             |                                                                                                          | Publisher                                                              |          | Wiley                                |                                            |                      |

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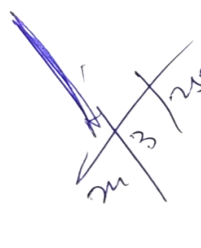
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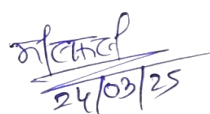
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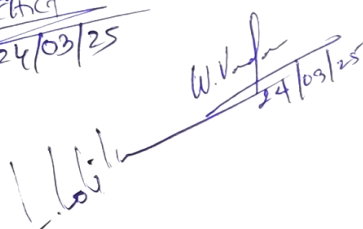
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|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|-------------------------------------------------------------------|
|                   | Edition                                                                                                                                                                                                                                                                                                                                             | 2 <sup>nd</sup> Edition              |                                                                   |
| 2.                | Title                                                                                                                                                                                                                                                                                                                                               | Antenna Theory - Analysis and Design |                                                                   |
|                   | Author                                                                                                                                                                                                                                                                                                                                              | C.A. Balanis                         |                                                                   |
|                   | Publisher                                                                                                                                                                                                                                                                                                                                           | John Wiley                           |                                                                   |
|                   | Edition                                                                                                                                                                                                                                                                                                                                             | 3 <sup>rd</sup> Edition              |                                                                   |
| Course Contents   | <b>UNIT I: Fundamentals of RF circuits and systems:</b><br>Review of Transmission line Theory, terminated transmission lines, smith chart, impedance matching, Microstrip and Coplanar waveguide implementations, microwave network analysis, ABCD parameters, S parameters, X parameters.                                                          |                                      | 9                                                                 |
|                   | <b>UNIT II: Transmitter and Receiver architectures:</b><br>Passive RLC network, Behavior of passive components and networks, resonant structures using distributed transmission lines, power dividers, couplers and filters; CRLH transmission line based components.                                                                               |                                      | 8                                                                 |
|                   | <b>UNIT III: Low Noise Amplifiers and CMOS:</b><br>Basics of high frequency amplifier design, biasing techniques, simultaneous tuning of 2 port circuits, noise and distortion, linearity, noise and large signal performance, <i>CMOS RFIC</i> : Review of MOSFET, RF transistor layout, CMOS process, Capacitors, Varactors, Resistors, Inductors |                                      | 10                                                                |
|                   | <b>UNIT IV: Power Amplifiers, Mixers, Oscillators:</b><br>Basics and Class A, B, C, D, E, F and other configurations, Power combining, Linearity improvement techniques, Specifications, NL system as a mixer, Active mixers, Passive mixers, Power amplifier design,                                                                               |                                      | 8                                                                 |
| Course Assessment | Total Marks=100                                                                                                                                                                                                                                                                                                                                     |                                      | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50% |


  
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| Course Code:<br>EC 4757                     |                                                                                                         | Open Elective Course:<br>(Y/N)                                                                                                                                                                                                                                                                                                                                                                            |          | Departmental Core Course: (Y/N) |                                                         | Departmental Elective Course: (Y/N)        |  |
|                                             |                                                                                                         | Y                                                                                                                                                                                                                                                                                                                                                                                                         |          | N                               |                                                         | N                                          |  |
| Type of Course                              |                                                                                                         | Theory Course                                                                                                                                                                                                                                                                                                                                                                                             |          |                                 |                                                         |                                            |  |
| Course Title & Code                         |                                                                                                         | Green Technologies (EC 4757)                                                                                                                                                                                                                                                                                                                                                                              |          |                                 |                                                         |                                            |  |
| Course Objectives                           |                                                                                                         | <ul style="list-style-type: none"><li>To familiarize with the concept of Green Computing and Green IT infrastructure for making computing and information system environment sustainable.</li><li>To encourage optimized software and hardware designs for development of Green IT Storage, Communication and Services.</li><li>To highlight useful approaches to embrace green IT initiatives.</li></ul> |          |                                 |                                                         |                                            |  |
| Course Outcomes                             |                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                           |          |                                 |                                                         | Cognitive Levels                           |  |
| CO1                                         | To learn the basic of green IT by hardware, software, network communication and data center operations. |                                                                                                                                                                                                                                                                                                                                                                                                           |          |                                 |                                                         | Knowledge/Comprehension (Level I/Level-II) |  |
| CO2                                         | To design the development of Green IT storage infrastructure.                                           |                                                                                                                                                                                                                                                                                                                                                                                                           |          |                                 |                                                         | Application (Level-III)                    |  |
| CO3                                         | To understand the strategies, frameworks, processes and management of green IT.                         |                                                                                                                                                                                                                                                                                                                                                                                                           |          |                                 |                                                         | Analysis (Level-IV)                        |  |
| CO4                                         | To evaluate the different approaches against Green Technologies.                                        |                                                                                                                                                                                                                                                                                                                                                                                                           |          |                                 |                                                         | Synthesis/Evaluation (Level-VI/Level-V)    |  |
| Semester                                    |                                                                                                         | V/VI                                                                                                                                                                                                                                                                                                                                                                                                      |          |                                 | Summer/Winter                                           |                                            |  |
| Contact Hours                               |                                                                                                         | Lecture                                                                                                                                                                                                                                                                                                                                                                                                   | Tutorial | Practical                       | Credits                                                 | Total Teaching Hours                       |  |
|                                             |                                                                                                         | 3                                                                                                                                                                                                                                                                                                                                                                                                         | 0        | 0                               | 3                                                       | 36                                         |  |
| Prerequisite course codes with course names |                                                                                                         | Introduction to Computing (CS 1201)                                                                                                                                                                                                                                                                                                                                                                       |          |                                 |                                                         |                                            |  |
| Text Books                                  |                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                           |          |                                 |                                                         |                                            |  |
| 1.                                          |                                                                                                         | Title                                                                                                                                                                                                                                                                                                                                                                                                     |          |                                 | Green Communications: Principles, Concepts and Practice |                                            |  |
|                                             |                                                                                                         | Author                                                                                                                                                                                                                                                                                                                                                                                                    |          |                                 | Samdanis J                                              |                                            |  |

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|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|
|                 | Publisher                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Wiley                                                                |
|                 | Edition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                      |
| 2.              | Title                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Green IT for Sustainable Business Practice: An ISEB Foundation Guide |
|                 | Author                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Mark G. O'Neill                                                      |
|                 | Publisher                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | The Chartered Institute for IT                                       |
|                 | Edition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 2010                                                                 |
| Reference Books |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                      |
| 1.              | Title                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Green IT                                                             |
|                 | Author                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Deepak Shikarpur                                                     |
|                 | Publisher                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Vishwkarma Publications                                              |
|                 | Edition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 2014                                                                 |
| Course Contents | <b>UNIT I: Green IT Overview, Green Devices and Hardware, Green Software</b><br>Introduction, Environmental Concerns and Sustainable Development, Environmental Impacts of IT, Green I, Holistic Approach to Greening IT, Greening IT, Applying IT for Enhancing Environmental Sustainability, Green IT Standards and Eco-Labelling of IT, Enterprise Green IT Strategy, Green Washing, Green IT: Burden or Opportunity? Introduction of Green Devices and Hardware, Life Cycle of a Device or Hardware, Reuse, Recycle and Dispose. Green Software: Introduction, Processor Power States, Energy-Saving Software Techniques. | 9                                                                    |
|                 | <b>UNIT II: Green Data Centers, Green Data Storage Green Networks and Communications</b><br>Data Centers and Associated Energy Challenges, Data Centre IT Infrastructure, Data Centre Facility Infrastructure: Implications for Energy Efficiency, IT Infrastructure Management, and Green Data Centre Metrics. Introduction of Green Data Storage, Storage Media Power Characteristics, Energy Management Techniques for Hard Disks, System-Level Energy Management. Introduction of Green Networks and Communications, Objectives of Green Network Protocols, Green Network Protocols and Standards.                        | 9                                                                    |
|                 | <b>UNIT III: Sustainable Information Systems and Green Metrics, Enterprise Green IT Readiness</b><br>Introduction, Multilevel Sustainable Information, Sustainability Hierarchy Models, Product Level Information, Individual Level Information,                                                                                                                                                                                                                                                                                                                                                                              | 9                                                                    |

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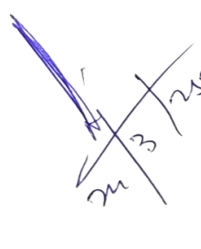
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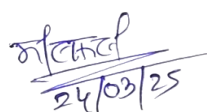
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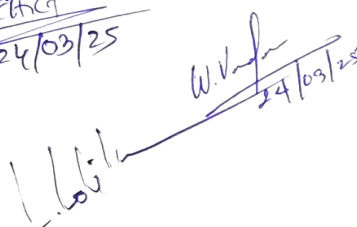
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|                   | functional Level Information, Organizational Level Information, Measuring the Maturity of Sustainable ICT, Introduction of Enterprise Green IT readiness, Readiness and Capability, Development of the G-Readiness Framework, Measuring an Organization's G-Readiness.                                                                                                                                                                                                                                            |                                                                   |
|                   | <b>UNIT IV: Sustainable IT Services: Creating a Framework for Service Innovation, Green Enterprises and the Role of IT</b><br>Introduction, Factors Driving the Development of Sustainable IT, Sustainable IT Services (SITS), SITS Strategic Framework, Introduction of Green Enterprises and the Role of IT: Organizational and Enterprise, Greening, Information Systems in Greening Enterprises, Greening the Enterprise: IT Usage and Hardware, Inter-organizational Enterprise Activities and Green Issues. | 9                                                                 |
| Course Assessment | Total Marks=100                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50% |

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| <b>Course Code:</b><br>EC 4758 | <b>Open Elective Course:</b><br>(Y/N)                                                                                                                                                                                                                            | <b>Departmental Core Course:</b> (Y/N) | <b>Departmental Elective Course:</b> (Y/N) |
|                                | Y                                                                                                                                                                                                                                                                | N                                      | N                                          |
| <b>Type of Course</b>          | Theory Course                                                                                                                                                                                                                                                    |                                        |                                            |
| <b>Course Title &amp; Code</b> | Data Communication and Networking (EC4758)                                                                                                                                                                                                                       |                                        |                                            |
| <b>Course Objectives</b>       | <ul style="list-style-type: none"> <li>To gain comprehensive knowledge about the layered communication architectures (OSI and TCP/IP) and its functionalities.</li> <li>Understand the switching concept and different types of switching techniques.</li> </ul> |                                        |                                            |
| <b>Course Outcomes</b>         |                                                                                                                                                                                                                                                                  |                                        | <b>Cognitive Levels</b>                    |
| CO1                            | Obtain insight about basic network theory and layered communication architectures                                                                                                                                                                                |                                        | Knowledge/Comprehension (Level I/Level-II) |
| CO2                            | Analyze the shortest path over which data can be transmitted, and design a routing mechanism for secure transmission of data from sender to the receiver.                                                                                                        |                                        | Analysis (Level-IV)                        |
| CO3                            | Provide solutions to various problems in network theory.                                                                                                                                                                                                         |                                        | Application (Level-III)                    |


  
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| CO4                                         | Design a network topology with the available networking elements and can implement a routing protocol ensuring the error free transmission of data. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |          |                                            | Synthesis/Evaluation (Level-VI/Level-V) |                      |   |
| Semester                                    |                                                                                                                                                     | V/VI                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |          |                                            | Summer/Winter                           |                      |   |
| Contact Hours                               |                                                                                                                                                     | Lecture                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Tutorial | Practical                                  | Credits                                 | Total Teaching Hours |   |
|                                             |                                                                                                                                                     | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 0        | 0                                          | 3                                       | 36                   |   |
| Prerequisite course codes with course names |                                                                                                                                                     | Modern Communication Technologies (EC2353); EngineeringPhysics-I (PH1101)                                                                                                                                                                                                                                                                                                                                                                                                                                       |          |                                            |                                         |                      |   |
| Text Books                                  |                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |          |                                            |                                         |                      |   |
| 1.                                          |                                                                                                                                                     | Title                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |          | Data and Computer Communication            |                                         |                      |   |
|                                             |                                                                                                                                                     | Author                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |          | W. Stallings                               |                                         |                      |   |
|                                             |                                                                                                                                                     | Publisher                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |          | Pearson Education, 2007                    |                                         |                      |   |
|                                             |                                                                                                                                                     | Edition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |          | 8 <sup>th</sup> Edition                    |                                         |                      |   |
| 2.                                          |                                                                                                                                                     | Title                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |          | Computer Networks                          |                                         |                      |   |
|                                             |                                                                                                                                                     | Author                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |          | Andrew S. Tanenbaum and David J. Wetherall |                                         |                      |   |
|                                             |                                                                                                                                                     | Publisher                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |          | Prentice Hall, 2010                        |                                         |                      |   |
|                                             |                                                                                                                                                     | Edition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |          | 5 <sup>st</sup> Edition                    |                                         |                      |   |
| Reference Books                             |                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |          |                                            |                                         |                      |   |
| 1.                                          |                                                                                                                                                     | Title                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |          | Data Communication and Networking          |                                         |                      |   |
|                                             |                                                                                                                                                     | Author                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |          | Behrouz A. Forouzan                        |                                         |                      |   |
|                                             |                                                                                                                                                     | Publisher                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |          | McGraw Hill Education,2017                 |                                         |                      |   |
|                                             |                                                                                                                                                     | Edition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |          | 4 <sup>st</sup> Edition                    |                                         |                      |   |
| Course Contents                             |                                                                                                                                                     | UNIT I: Introduction to Data Communication<br>Goals and Applications of Networks, Wireless Network, Interfaces and services. Reference Models: The OSI reference model, TCP/IP reference model. Network Hardware and software. Digital signaling and encoding techniques, Data Rate Limit, Transmission Impairments, Line Coding, Block Coding, Sampling, Transmission Mode, Modulation of Digital Data, Telephone Modems, Modulation of Analog Signal, FDM, WDM, TDM, Guided Media, Unguided Media, Switching. |          |                                            |                                         |                      | 9 |
|                                             |                                                                                                                                                     | UNIT II: Data Link Layer<br>Data Link Layer Design Issues, Services Provided to Network Layers, Framing, Error Control, Flow Control, Error Detection and Correction,                                                                                                                                                                                                                                                                                                                                           |          |                                            |                                         |                      | 8 |

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|                   | Elementary Data Link Protocols, An Unrestricted Simplex Protocol, A Simplex Stop-and-Wait Protocol, Simplex Protocol for a Noisy Channel, Sliding Window Protocols, A protocol using go-back-N, A Protocol using Selective Repeat, Example Data Link Protocol-HDLC, PPP.                                                                                                                                                                                                                                                                                                                 |                                                                   |    |
|                   | <b>UNIT III: Medium Access Control</b><br>Random access, ALOHA, Slotted ALOHA, CSMA, CSMA CD, Scheduling approaches to medium access control, reservation systems, polling, token-passing rings, comparisons, Delay performance of MAC: Performance of channelization with bursty traffic, performance of polling and token ring, random access and CSMA/CD. Local area networks: LAN protocols, Ethernet, token ring, wireless LAN and IEEE 802.11 standard.                                                                                                                            |                                                                   | 8  |
|                   | <b>UNIT IV: Packet Switching Networks and TCP/IP</b><br>Packet network topology, datagrams and virtual circuit, routing in packet networks, Shortest-path routing, ATM networks, traffic management at packet level, traffic management at flow level, traffic management at the flow-aggregate level. Architecture and protocol, IP packet, addressing, subnet, IP routing, CIDR, address resolution, reverse address resolution, fragmentation and reassembly, ICMP, IPv6, UDP, Transmission control protocol, internet routing protocols, multicast routing, DHCP, NAT and mobile IP. |                                                                   | 11 |
| Course Assessment | Total Marks=100                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50% |    |

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| <b>Course Code:</b><br>EC 4759 | <b>Open Elective Course:</b><br>(Y/N)                                                                                                                                                                                                                                               | <b>Departmental Core Course:</b> (Y/N) | <b>Departmental Elective Course:</b> (Y/N) |
|                                | N                                                                                                                                                                                                                                                                                   | N                                      | Y                                          |
| <b>Type of Course</b>          | Theory Course                                                                                                                                                                                                                                                                       |                                        |                                            |
| <b>Course Title &amp; Code</b> | <b>Electronics Materials and their Applications (EC 4759)</b>                                                                                                                                                                                                                       |                                        |                                            |
| <b>Course Objectives</b>       | <ul style="list-style-type: none"> <li>To impart knowledge of different electronics materials and various components used in electronics industries.</li> <li>To describes suitability and characteristics of various electronics components for different applications.</li> </ul> |                                        |                                            |
| <b>Course Outcomes</b>         |                                                                                                                                                                                                                                                                                     |                                        | <b>Cognitive Levels</b>                    |
| <b>CO1</b>                     | To learn about the conducting materials, magnetic materials, insulating materials, semiconductor and electronics components.                                                                                                                                                        |                                        | Knowledge/Comprehension (Level             |

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|                                             |                                                                                              |                                                                                                                                                                                                                                                                                                                                              |          |                             |               | I/Level-II)                                |   |
| CO2                                         | To design the development of electronics-based device in an efficient application.           |                                                                                                                                                                                                                                                                                                                                              |          |                             |               | Application<br>(Level-III)                 |   |
| CO3                                         | To understand the strategies, frameworks, processes and management of electronics materials. |                                                                                                                                                                                                                                                                                                                                              |          |                             |               | Analysis<br>(Level-IV)                     |   |
| CO4                                         | To evaluate the different approaches against electronics materials.                          |                                                                                                                                                                                                                                                                                                                                              |          |                             |               | Synthesis/Evaluation<br>(Level-VI/Level-V) |   |
| Semester                                    |                                                                                              | VII/VIII                                                                                                                                                                                                                                                                                                                                     |          |                             | Summer/Winter |                                            |   |
| Contact Hours                               |                                                                                              | Lecture                                                                                                                                                                                                                                                                                                                                      | Tutorial | Practical                   | Credits       | Total Teaching Hours                       |   |
|                                             |                                                                                              | 3                                                                                                                                                                                                                                                                                                                                            | 0        | 0                           | 3             | 36                                         |   |
| Prerequisite course codes with course names |                                                                                              | Engineering Physics-I (PH1101)                                                                                                                                                                                                                                                                                                               |          |                             |               |                                            |   |
| Text Books                                  |                                                                                              |                                                                                                                                                                                                                                                                                                                                              |          |                             |               |                                            |   |
| 1.                                          |                                                                                              | Title                                                                                                                                                                                                                                                                                                                                        |          | Electronics Engg. Materials |               |                                            |   |
|                                             |                                                                                              | Author                                                                                                                                                                                                                                                                                                                                       |          | Rains & bhattacharya        |               |                                            |   |
|                                             |                                                                                              | Publisher                                                                                                                                                                                                                                                                                                                                    |          | Khanna                      |               |                                            |   |
|                                             |                                                                                              | Edition                                                                                                                                                                                                                                                                                                                                      |          |                             |               |                                            |   |
| 2.                                          |                                                                                              | Title                                                                                                                                                                                                                                                                                                                                        |          | Electronics Engg. Materials |               |                                            |   |
|                                             |                                                                                              | Author                                                                                                                                                                                                                                                                                                                                       |          | M.L Gupta                   |               |                                            |   |
|                                             |                                                                                              | Publisher                                                                                                                                                                                                                                                                                                                                    |          | Khanna                      |               |                                            |   |
|                                             |                                                                                              | Edition                                                                                                                                                                                                                                                                                                                                      |          | 2020                        |               |                                            |   |
| Reference Books                             |                                                                                              |                                                                                                                                                                                                                                                                                                                                              |          |                             |               |                                            |   |
| 1.                                          |                                                                                              | Title                                                                                                                                                                                                                                                                                                                                        |          | Applied Electronics         |               |                                            |   |
|                                             |                                                                                              | Author                                                                                                                                                                                                                                                                                                                                       |          | R.S Sedha and S. Chand      |               |                                            |   |
|                                             |                                                                                              | Publisher                                                                                                                                                                                                                                                                                                                                    |          |                             |               |                                            |   |
|                                             |                                                                                              | Edition                                                                                                                                                                                                                                                                                                                                      |          | 2014                        |               |                                            |   |
| Course Contents                             |                                                                                              | UNIT I: CONDUCTING MATERIALS:<br>Electronic properties of solids, band theory, resistivity - factors affecting resistivity, temperature co-eff. of resistance, thermal conductivity, properties and applications of -copper, aluminum, nickel, silver, tungsten, manganese, tantalum, brass &bronze and resistive alloys. Superconductivity. |          |                             |               |                                            | 9 |
|                                             |                                                                                              | UNIT II: MAGNETIC MATERIALS:                                                                                                                                                                                                                                                                                                                 |          |                             |               |                                            | 9 |

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|-------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|--------------------------------------------|
|                               | Introduction of magnetic materials, classification of magnetic materials, magnetization curve and magnetic properties, Hysteresis loss and eddy current loss- methods to reduce eddy current losses, soft and hard magnetic materials, properties and uses of magnetic steel and steel alloys, Ferrites & powdered core- their construction, characteristics and uses, Choice of material for transformer core, armature of motors, loud speakers, submarine communication, long distance telephone lines, current transformers, audio-frequency transformers, moving iron instruments, TV tubes.                                                                                                                                                                                                                 |                                                                   |                                            |
|                               | <b>UNIT III: INSULATING MATERIALS:</b><br>Classification of insulating materials on the basis of operating temperatures, Electrical and chemical properties of insulating materials (Insulation resistance, dielectric strength, dielectric constant, dielectric loss and chemical resistance), Common insulating material: Ceramic, glass, paper, mica, rubber, plastics-thermosetting and thermoplastic materials, PTFE, FRP (Fiber Reinforced Plastic), their important properties and applications.                                                                                                                                                                                                                                                                                                           |                                                                   | 9                                          |
|                               | <b>UNIT IV: SEMICONDUCTORS AND ELECTRONICS COMPONENTS</b><br>Qualitative discussion of semiconductors, electrical properties of silicon and germanium, intrinsic semiconductors, trivalent and pentavalent impurities, extrinsic semiconductors, formation of P and N type semiconductors, P-N junction, construction and use of common electronic components, resistors - carbon composition, carbon film, cracked carbon, metal oxide film, wire-wound, variable resistors, capacitors - paper, silvered paper, mica, silvered mica, ceramic plastic foil, electrolytic, variable resistor, inductors - fixed and variable inductors, Relays - electromagnetic and reed relay, Chokes - A.F and R.F chokes, Printed circuit board and its fabrication, Piezo electric crystal - Principle, cat. & applications. |                                                                   | 9                                          |
| <b>Course Assessment</b>      | Total Marks=100                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50% |                                            |
|                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                   |                                            |
| <b>Course Code:</b><br>EC4851 | <b>Open Elective Course: (Y/N)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>Departmental Course: (Y/N)</b>                                 | <b>Core</b>                                |
|                               | Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | N                                                                 |                                            |
|                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                   | <b>Departmental Elective Course: (Y/N)</b> |
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|----------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---------------------------------------------|----------------------|----------------------|
| <b>Type of Course</b>                              |                                                                                                                        | Theory Course                                                                                                                                                                                                                                                                                                                                                             |          |                                             |                      |                      |
| <b>Course Title &amp; Code</b>                     |                                                                                                                        | Advanced Semiconductor Devices (EC 4851)                                                                                                                                                                                                                                                                                                                                  |          |                                             |                      |                      |
| <b>Course Objectives</b>                           |                                                                                                                        | <ul style="list-style-type: none"><li>To understand the importance of device miniaturization and problems related to the scaling down of device dimensions.</li><li>To analyze the short channels effects of the devices.</li><li>To investigate the advantages of architectural modifications of devices such as SOI device technology, multi-gate device etc.</li></ul> |          |                                             |                      |                      |
| <b>Course Outcomes</b>                             |                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                           |          | <b>Cognitive Levels</b>                     |                      |                      |
| <b>CO1</b>                                         | To understand the fundamental rules of scaling and power crisis problem.                                               |                                                                                                                                                                                                                                                                                                                                                                           |          | Knowledge/Comprehensi on (Level I/Level-II) |                      |                      |
| <b>CO2</b>                                         | To analyze the impact of gate oxide scaling on the device characteristics.                                             |                                                                                                                                                                                                                                                                                                                                                                           |          | Application (Level-III)                     |                      |                      |
| <b>CO3</b>                                         | Todemonstrate the SOI device Technology considering fully depleted and partially depleted case.                        |                                                                                                                                                                                                                                                                                                                                                                           |          | Analysis (Level-IV)                         |                      |                      |
| <b>CO4</b>                                         | To illustrate the multigate device physics and to evaluate the benchmarking of analog and digital models and layouting |                                                                                                                                                                                                                                                                                                                                                                           |          | Synthesis/Evaluation (Level-VI/Level-V)     |                      |                      |
| <b>Semester</b>                                    |                                                                                                                        | <b>VII/VIII</b>                                                                                                                                                                                                                                                                                                                                                           |          |                                             | <b>Summer/Winter</b> |                      |
| <b>Contact Hours</b>                               |                                                                                                                        | Lecture                                                                                                                                                                                                                                                                                                                                                                   | Tutorial | Practical                                   | Credits              | Total Teaching Hours |
|                                                    |                                                                                                                        | 3                                                                                                                                                                                                                                                                                                                                                                         | 0        | 0                                           | 3                    | 36                   |
| <b>Prerequisite course codes with course names</b> |                                                                                                                        | Engineering Physics-I (PH101); Microelectronics and VLSI Technology (EC2352)                                                                                                                                                                                                                                                                                              |          |                                             |                      |                      |
| <b>Text Books</b>                                  |                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                           |          |                                             |                      |                      |
| <b>1.</b>                                          |                                                                                                                        | <b>Title</b>                                                                                                                                                                                                                                                                                                                                                              |          | Nano-CMOS Circuit and Physical Design       |                      |                      |
|                                                    |                                                                                                                        | <b>Author</b>                                                                                                                                                                                                                                                                                                                                                             |          | B. Wong, A. Mittal, Y. Cao, G. Starr        |                      |                      |
|                                                    |                                                                                                                        | <b>Publisher</b>                                                                                                                                                                                                                                                                                                                                                          |          | Wiley Interscience.                         |                      |                      |
|                                                    |                                                                                                                        | <b>Edition</b>                                                                                                                                                                                                                                                                                                                                                            |          | 2004                                        |                      |                      |
| <b>2.</b>                                          |                                                                                                                        | <b>Title</b>                                                                                                                                                                                                                                                                                                                                                              |          | Solid State Electronic Devices              |                      |                      |
|                                                    |                                                                                                                        | <b>Author</b>                                                                                                                                                                                                                                                                                                                                                             |          | Ben G. Streetman                            |                      |                      |
|                                                    |                                                                                                                        | <b>Publisher</b>                                                                                                                                                                                                                                                                                                                                                          |          | Pearson                                     |                      |                      |

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|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|
|                        | <b>Edition</b>                                                                                                                                                                                                                                                                                                                                                                                                                        | 7 <sup>th</sup> Edition                  |
| <b>Reference Books</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                          |
| <b>1.</b>              | <b>Title</b>                                                                                                                                                                                                                                                                                                                                                                                                                          | FinFETs and Other Multi-Gate Transistors |
|                        | <b>Author</b>                                                                                                                                                                                                                                                                                                                                                                                                                         | J.P. Colinge                             |
|                        | <b>Publisher</b>                                                                                                                                                                                                                                                                                                                                                                                                                      | Springer                                 |
|                        | <b>Edition</b>                                                                                                                                                                                                                                                                                                                                                                                                                        | 2010                                     |
| <b>2.</b>              | <b>Title</b>                                                                                                                                                                                                                                                                                                                                                                                                                          | Nano-CMOS Gate Dielectric Engineering    |
|                        | <b>Author</b>                                                                                                                                                                                                                                                                                                                                                                                                                         | Hei Wong                                 |
|                        | <b>Publisher</b>                                                                                                                                                                                                                                                                                                                                                                                                                      | CRC                                      |
|                        | <b>Edition</b>                                                                                                                                                                                                                                                                                                                                                                                                                        | 2011                                     |
| <b>Course Contents</b> | <b>UNIT I: Fundamentals of Semiconductor Device Physics</b><br>History of Si technology, Review of CMOS scaling. Problems with traditional geometric scaling. Power crisis. Review of basic quantum mechanics. Mobility enhancement techniques. Review of stress and strain, how it affects band structure of silicon. Types and realization of stress elements. Problems with stress elements.                                       | <b>9</b>                                 |
|                        | <b>UNIT II: High-K Gate Dielectric and process</b><br>Gate oxide scaling trend. Urgency to switch gate dielectric material. High K material selection. Fermi level pinning Process integration of high K gate dielectrics and metal gates multi-gate transistors. Ways of realization. Fabrication issues and integration challenges.                                                                                                 | <b>9</b>                                 |
|                        | <b>UNIT III: Silicon-on-Insulator (SOI) Devices</b><br>Basic principle of MOSFETs, Introduction to classical planer bulk MOSFETs, VMOS devices. Introduction to SOI Technology, radiation hardness capability. Partially depleted SOI MOSFET, Fully depleted SOI MOSFET. Single gate SOI MOSFET, Double Gate SOI MOSFET, kink effect, Floating Body effect, Applications of SOI MOSFET, Comparison with Classical planer bulk MOSFET. | <b>9</b>                                 |

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|                          | <b>UNIT IV: Multi-gate CMOS devices and CMOS compatible memory devices</b><br>Introduction to FinFETs, Ways of realization, Fabrication issues and integration challenges. Analog and digital benchmarking of models. Layout dependent effects. Test structures used for characterization, Variations and how it can affect scaling. Basics of sub wavelength lithography. Design for manufacturability. |                                                                   | <b>9</b> |
| <b>Course Assessment</b> | Total Marks=100                                                                                                                                                                                                                                                                                                                                                                                          | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50% |          |

| Course Code:<br>EC 4852        | Open Elective Course:<br>(Y/N)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Departmental Core Course: (Y/N) | Departmental Elective Course: (Y/N)           |
|--------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|-----------------------------------------------|
|                                | Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | N                               | N                                             |
| <b>Type of Course</b>          | Theory Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                 |                                               |
| <b>Course Title &amp; Code</b> | Image and Video Processing (EC 4852)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                 |                                               |
| <b>Course Objectives</b>       | <ul style="list-style-type: none"> <li>To understand the basic principles and concepts underlying digital image and video processing comprising pixel representation, colour spaces, and image/video formats</li> <li>Acquire proficiency in a variety of image and video processing techniques, such as filtering, compression, segmentation, feature extraction, and object detection</li> <li>To Learn to analyze and interpret processed images and videos, including understanding motion, detecting objects, tracking features, and extracting meaningful information from visual data</li> <li>To Learn techniques for evaluating the performance of image and video processing algorithms, as well as optimizing them for efficiency, accuracy, and scalability</li> </ul> |                                 |                                               |
| <b>Course Outcomes</b>         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                 | <b>Cognitive Levels</b>                       |
| <b>CO1</b>                     | To understand the fundamental concepts in digital image and video processing                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                 | Knowledge/Comprehension<br>(Level I/Level-II) |

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|---------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|---------------|-----------------------------------------|
| CO2                                         | To be proficient in applying various image and video processing techniques such as enhancement, segmentation, and transformation to manipulate and improve visual data    |                                    |                                                                                                                                                                        |           |               | Application (Level-III)                 |
| CO3                                         | To be able to implement algorithms for image and video processing using programming languages such as Python, MATLAB, or C/C++                                            |                                    |                                                                                                                                                                        |           |               | Analysis (Level-IV)                     |
| CO4                                         | To be capable of developing applications that involve image and video processing, such as video stabilization, object tracking, facial recognition, and augmented reality |                                    |                                                                                                                                                                        |           |               | Synthesis/Evaluation (Level-VI/Level-V) |
| Semester                                    |                                                                                                                                                                           | VII/VIII                           |                                                                                                                                                                        |           | Summer/Winter |                                         |
| Contact Hours                               |                                                                                                                                                                           | Lecture                            | Tutorial                                                                                                                                                               | Practical | Credits       | Total Teaching Hours                    |
|                                             |                                                                                                                                                                           | 3                                  | 0                                                                                                                                                                      | 0         | 3             | 36                                      |
| Prerequisite course codes with course names |                                                                                                                                                                           | Engineering Mathematics-I (MA1101) |                                                                                                                                                                        |           |               |                                         |
| Text Books                                  |                                                                                                                                                                           |                                    |                                                                                                                                                                        |           |               |                                         |
| 1.                                          |                                                                                                                                                                           | Title                              | Digital ImageProcessing, <a href="http://www.imageprocessingplace.com/DIP-3E/dip3e_main_page.htm/">http://www.imageprocessingplace.com/DIP-3E/dip3e_main_page.htm/</a> |           |               |                                         |
|                                             |                                                                                                                                                                           | Author                             | R. C. Gonzalez and R. E. Woods                                                                                                                                         |           |               |                                         |
|                                             |                                                                                                                                                                           | Publisher                          | Prentice Hall, 2008                                                                                                                                                    |           |               |                                         |
|                                             |                                                                                                                                                                           | Edition                            | 3 <sup>rd</sup> Edition                                                                                                                                                |           |               |                                         |
| 2.                                          |                                                                                                                                                                           | Title                              | Video Processing and Communications, <a href="http://eeweb.poly.edu/~yao/videobook/">http://eeweb.poly.edu/~yao/videobook/</a>                                         |           |               |                                         |
|                                             |                                                                                                                                                                           | Author                             | Y. Wang, J. Ostermann, and Y.Q.Zhang                                                                                                                                   |           |               |                                         |
|                                             |                                                                                                                                                                           | Publisher                          | Prentice Hall, 2002                                                                                                                                                    |           |               |                                         |
|                                             |                                                                                                                                                                           | Edition                            | 1 <sup>st</sup> Edition                                                                                                                                                |           |               |                                         |
| Reference Books                             |                                                                                                                                                                           |                                    |                                                                                                                                                                        |           |               |                                         |

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| <b>1.</b>                | <b>Title</b>                                                                                                                                                                                                                                                                                                                   | Computer Vision: Algorithms and Applications, <a href="http://szeliski.org/Book/">http://szeliski.org/Book/</a> |          |
|                          | <b>Author</b>                                                                                                                                                                                                                                                                                                                  | Richard Szeliski                                                                                                |          |
|                          | <b>Publisher</b>                                                                                                                                                                                                                                                                                                               |                                                                                                                 |          |
|                          | <b>Edition</b>                                                                                                                                                                                                                                                                                                                 | 2 <sup>nd</sup> Edition                                                                                         |          |
| <b>Course Contents</b>   | <b>UNIT I: Basic Requirements</b><br>Colour image capture, representation, and manipulation; Colour space; 2D transforms - DFT, DCT, KLT, and SVD, Overview of video processing concepts and applications, Basics terminology: frames, resolution, aspect ratio, frame rate, codecs, containers, introduction to video formats |                                                                                                                 | <b>9</b> |
|                          | <b>UNIT II: Enhancement and Restoration</b><br>Contrast Enhancement, Image Enhancement - Histogram equalization and specification techniques, Sharpening and Edge Detection, segmentation, frequency domain interpretation of linear convolution, Degradation model, Types of Noises, Spatial domain filtering                 |                                                                                                                 | <b>9</b> |
|                          | <b>UNIT III: Compression</b><br>Compression - Need for data compression, Huffman, Run Length Encoding, shift codes, Arithmetic coding, Vector Quantization, Transform coding, JPEG standard, MPEG. Principles of video compression, lossy and lossless compression, Common Video Codecs                                        |                                                                                                                 | <b>9</b> |
|                          | <b>UNIT IV: Motion Analysis</b><br>Object Detection and tracking, Motion representation and Estimation, Object tracking in video sequences                                                                                                                                                                                     |                                                                                                                 | <b>9</b> |
| <b>Course Assessment</b> | Total Marks=100                                                                                                                                                                                                                                                                                                                | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50%                                               |          |

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|--------------------------------|---------------------------------------|----------------------------------------|--------------------------------------------|
| <b>Course Code:</b><br>EC 4853 | <b>Open Elective Course:</b><br>(Y/N) | <b>Departmental Core Course:</b> (Y/N) | <b>Departmental Elective Course:</b> (Y/N) |
|                                | Y                                     | N                                      | N                                          |
| <b>Type of Course</b>          | Theory Course                         |                                        |                                            |

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|---------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|----------|------------------------------------------------|---------|----------------------|
| Course Title & Code                         | MEMS (EC 4853)                                                                                                                                                                                                                                                                                                                                           |                                                                                |          |                                                |         |                      |
| Course Objectives                           | <ul style="list-style-type: none"><li>To impart knowledge about the need and applications of microsystem in engineering.</li><li>To introduce the fundamental concepts relevant to fabrication and machining process of MEMS sensors and actuators.</li><li>To enable the students to understand the various sensing and actuation mechanisms.</li></ul> |                                                                                |          |                                                |         |                      |
| Course Outcomes                             |                                                                                                                                                                                                                                                                                                                                                          |                                                                                |          | Cognitive Levels                               |         |                      |
| CO1                                         | Identify structural and sacrificial materials for MEMS.                                                                                                                                                                                                                                                                                                  |                                                                                |          | Knowledge/Comprehension (Level I/Level-II)     |         |                      |
| CO2                                         | Describe the fabrication steps in designing of various MEMS parts.                                                                                                                                                                                                                                                                                       |                                                                                |          | Analysis (Level-IV)                            |         |                      |
| CO3                                         | Apply principles for the design of Sensor and actuators                                                                                                                                                                                                                                                                                                  |                                                                                |          | Application (Level-III)                        |         |                      |
| CO4                                         | Characterize MEMS devices for different applications in various fields of engineering.                                                                                                                                                                                                                                                                   |                                                                                |          | Synthesis/Evaluation (Level-VI/Level-V)        |         |                      |
| Semester                                    |                                                                                                                                                                                                                                                                                                                                                          | VII/VIII                                                                       |          | Summer/Winter                                  |         |                      |
| Contact Hours                               |                                                                                                                                                                                                                                                                                                                                                          | Lecture                                                                        | Tutorial | Practical                                      | Credits | Total Teaching Hours |
|                                             |                                                                                                                                                                                                                                                                                                                                                          | 3                                                                              | 0        | 0                                              | 3       | 36                   |
| Prerequisite course codes with course names |                                                                                                                                                                                                                                                                                                                                                          | Microelectronics and VLSI Technology (EC 2352); Engineering Physics-I (PH1101) |          |                                                |         |                      |
| Text Books                                  |                                                                                                                                                                                                                                                                                                                                                          |                                                                                |          |                                                |         |                      |
| 1.                                          |                                                                                                                                                                                                                                                                                                                                                          | Title                                                                          |          | MEMS                                           |         |                      |
|                                             |                                                                                                                                                                                                                                                                                                                                                          | Author                                                                         |          | N. P. Mahalik                                  |         |                      |
|                                             |                                                                                                                                                                                                                                                                                                                                                          | Publisher                                                                      |          | Tata McGraw Hill, 2007                         |         |                      |
|                                             |                                                                                                                                                                                                                                                                                                                                                          | Edition                                                                        |          | 1 <sup>nd</sup> Edition                        |         |                      |
| 2.                                          |                                                                                                                                                                                                                                                                                                                                                          | Title                                                                          |          | Introductory MEMS Fabrication and Applications |         |                      |
|                                             |                                                                                                                                                                                                                                                                                                                                                          | Author                                                                         |          | T. M. Adams and R. A. Layton                   |         |                      |
|                                             |                                                                                                                                                                                                                                                                                                                                                          | Publisher                                                                      |          | Springer Science & Business Media, 2010        |         |                      |
|                                             |                                                                                                                                                                                                                                                                                                                                                          | Edition                                                                        |          | 1 <sup>st</sup> Edition                        |         |                      |

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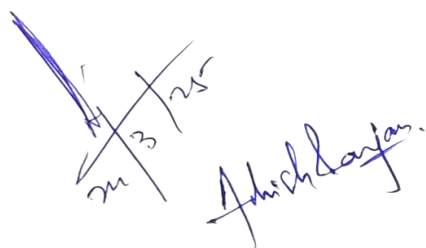
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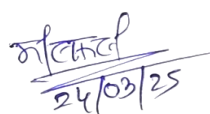
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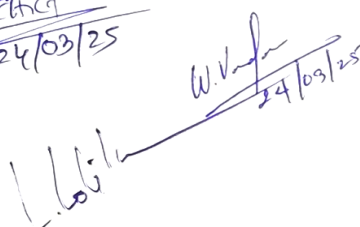
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| Reference Books          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                   |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|
| 1.                       | <b>Title</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Analysis and Design Principles of MEMS Devices                    |
|                          | <b>Author</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Minhang Bao                                                       |
|                          | <b>Publisher</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Elsevier Science Ltd, 2005                                        |
|                          | <b>Edition</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 1 <sup>st</sup> Edition                                           |
| <b>Course Contents</b>   | <b>UNIT I: Introduction</b><br>Introduction to MEMS and Microsystems, MEMS Materials, Structural and Sacrificial Materials, Properties of Silicon, Polymers, Ceramics, and Composites, Basic Modeling of Elements in Electrical and Mechanical Systems. Introduction of layout, Simulation Tools, Packaging and Various Characterization Techniques for MEMS Devices                                                                                                                                                                                                                                                                                                                                                                                                                     | 8                                                                 |
|                          | <b>UNIT II: MEMS Fabrication</b><br>Silicon Growth, Additive Techniques: Oxidation, Physical Vapor Deposition, Chemical Vapor Deposition, Thin Film Deposition, Photolithography, Etching, Bulk and Surface, Micromachining, Etch Stop Technique and Microstructure, Microstereolithography LIGA, and Wafer Bonding.                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 9                                                                 |
|                          | <b>UNIT III: Microsensors and Microactuators</b><br>Basic Modeling Elements in Mechanical, Electrical and Thermal Systems, Types of Beams: Fixed-Free (Cantilevers), Fixed-Fixed (Bridges), Fixed-Guided beams, Electrostatic sensing and Actuation: Parallel plate capacitor, Applications of parallel plate capacitors: Inertial sensor, Pressure sensor, Flow sensor, Parallel plate Actuators, Piezoresistive Sensors: Origin and Expressions of Piezoresistivity, Piezoresistive Sensor Materials, Applications of Piezoresistive Sensors, Piezoelectric Sensing and Actuation, Thermal Sensing and Actuation: Sensors and Actuators based on Thermal Expansion, Thermocouples, Thermoresistors, Shape Memory Alloy, Applications: Inertial sensors, Flow sensors, Infrared sensors | 12                                                                |
|                          | <b>UNIT IV: MEMS Applications</b><br>MEMS in consumer electronics, Automotive MEMS, Biomedical MEMS, Aerospace and defense applications, Environmental and industrial monitoring                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 7                                                                 |
| <b>Course Assessment</b> | Total Marks=100                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50% |


  
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| <b>Course Code:</b><br>EC 4854                     |                                                                      | <b>Open Elective Course:</b><br>(Y/N)                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                 | <b>Departmental Core Course:</b> (Y/N) |                      | <b>Departmental Elective Course:</b> (Y/N)      |  |
|                                                    |                                                                      | Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                 | N                                      |                      | N                                               |  |
| <b>Type of Course</b>                              |                                                                      | Theory Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                 |                                        |                      |                                                 |  |
| <b>Course Title &amp; Code</b>                     |                                                                      | 5G Communications and MIMO(EC 4854)                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                 |                                        |                      |                                                 |  |
| <b>Course Objectives</b>                           |                                                                      | <ul style="list-style-type: none"><li>● To understand the principles and challenges of 5G wireless communication systems.</li><li>● To study the fundamentals of MIMO technology and its applications in 5G networks.</li><li>● To analyze advanced techniques such as massive MIMO, beam forming, and mmWave communication.</li><li>● To explore real-world implementations and standards of 5G networks.</li><li>● To gain hands-on experience through simulations and practical exercises</li></ul> |                 |                                        |                      |                                                 |  |
| <b>Course Outcomes</b>                             |                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                 |                                        |                      | <b>Cognitive Levels</b>                         |  |
| <b>CO1</b>                                         | To understand the principles of 5G Communication and MIMO Technology |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                 |                                        |                      | Knowledge (Level I)<br>Comprehension (Level II) |  |
| <b>CO2</b>                                         | To analyze the different access techniques.                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                 |                                        |                      | Application/Analysis (Level III/Level- IV)      |  |
| <b>CO3</b>                                         | To evaluate advanced MIMO systems and MIMO channels.                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                 |                                        |                      | Evaluate (Level-V)                              |  |
| <b>CO4</b>                                         | To design and simulate 5G communication systems.                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                 |                                        |                      | Synthesis (Level- VI)                           |  |
| <b>Semester</b>                                    |                                                                      | <b>VII/VIII</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                 |                                        | <b>Summer/Winter</b> |                                                 |  |
| <b>Contact Hours</b>                               |                                                                      | <b>Lecture</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>Tutorial</b> | <b>Practical</b>                       | <b>Credits</b>       | <b>Total Teaching Hours</b>                     |  |
|                                                    |                                                                      | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 0               | 0                                      | 3                    | 36                                              |  |
| <b>Prerequisite course codes with course names</b> |                                                                      | Modern Communication Technologies (EC2353)                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |                                        |                      |                                                 |  |
| <b>Text Books</b>                                  |                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                 |                                        |                      |                                                 |  |

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|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|---|
| 1.              | Title                                                                                                                                                                                                                                                                                                                                                                            | 5G NR: The Next Generation Wireless Access Technology                       |   |
|                 | Author                                                                                                                                                                                                                                                                                                                                                                           | Erik Dahlman, Stefan Parkvall, and Johan Skold                              |   |
|                 | Publisher                                                                                                                                                                                                                                                                                                                                                                        | Academic Press, 2018                                                        |   |
|                 | Edition                                                                                                                                                                                                                                                                                                                                                                          | 1 <sup>st</sup> Edition                                                     |   |
| 2.              | Title                                                                                                                                                                                                                                                                                                                                                                            | Massive MIMO Networks: Spectral, Energy, and Hardware Efficiency            |   |
|                 | Author                                                                                                                                                                                                                                                                                                                                                                           | Emil Bjornson, Jakob Hoydis, and Luca Sanguinetti                           |   |
|                 | Publisher                                                                                                                                                                                                                                                                                                                                                                        | Cambridge University Press, 2017                                            |   |
|                 | Edition                                                                                                                                                                                                                                                                                                                                                                          | 1 <sup>st</sup> Edition                                                     |   |
| Reference Books |                                                                                                                                                                                                                                                                                                                                                                                  |                                                                             |   |
| 1.              | Title                                                                                                                                                                                                                                                                                                                                                                            | Millimeter Wave Wireless Communications                                     |   |
|                 | Author                                                                                                                                                                                                                                                                                                                                                                           | Theodore S. Rappaport, Robert W. Heath Jr, Robert Daniels and James Murdock |   |
|                 | Publisher                                                                                                                                                                                                                                                                                                                                                                        | Prentice Hall, 2014                                                         |   |
|                 | Edition                                                                                                                                                                                                                                                                                                                                                                          | 1 <sup>st</sup> Edition                                                     |   |
| Course Contents | <b>UNIT I: Introduction to 5G Communications</b><br>Evolution of wireless communication systems (1G to 5G), Key features and requirements of 5G networks, use cases and applications of 5G technology<br>Wireless Channel Modeling, Path loss models (free-space, log-distance, etc.), Fading channels (Rayleigh, Rician, Nakagami), Small-scale and large-scale fading effects. |                                                                             | 9 |
|                 | <b>UNIT II: Multiple Access Techniques</b><br>Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA), Orthogonal Frequency Division Multiple Access (OFDMA), Code Division Multiple Access (CDMA).                                                                                                                                                      |                                                                             | 9 |
|                 | <b>UNIT III: MIMO Systems and MIMO Channel Models</b><br>Introduction to MIMO technology,Spatial multiplexing and diversity techniques, Channel capacity and spatial degrees of freedom, SISO, SIMO, MISO, and MIMO channel models, Correlation and capacity analysis, Channel state information (CSI) estimation.                                                               |                                                                             | 9 |
|                 | <b>UNIT IV: Massive MIMO and Beamforming and Antenna Arrays</b><br>Principles of massive MIMO technology, Benefits and challenges of massive MIMO systems, Precoding and beamforming techniques,                                                                                                                                                                                 |                                                                             | 9 |
|                 |                                                                                                                                                                                                                                                                                                                                                                                  |                                                                             |   |

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|                          | Beamforming fundamentals, Analog and digital beamforming techniques, Beamforming in mmWave communication. Characteristics and challenges of mmWave communication, Beamforming and beam steering at mmWave frequencies, Channel modeling and propagation characteristics. |                                                                   |
| <b>Course Assessment</b> | Total Marks=100                                                                                                                                                                                                                                                          | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50% |

|                                                    |                                                                                                                        |                                                                                                                                                                                                                 |                 |                                        |                      |                                            |  |
|----------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|----------------------------------------|----------------------|--------------------------------------------|--|
| <b>Course Code:</b><br>EC 4855                     |                                                                                                                        | <b>Open Elective Course:</b><br>(Y/N)                                                                                                                                                                           |                 | <b>Departmental Core Course:</b> (Y/N) |                      | <b>Departmental Elective Course:</b> (Y/N) |  |
|                                                    |                                                                                                                        | N                                                                                                                                                                                                               |                 | N                                      |                      | Y                                          |  |
| <b>Type of Course</b>                              |                                                                                                                        | Theory Course                                                                                                                                                                                                   |                 |                                        |                      |                                            |  |
| <b>Course Title &amp; Code</b>                     |                                                                                                                        | VLSI Physical Design (EC4855)                                                                                                                                                                                   |                 |                                        |                      |                                            |  |
| <b>Course Objectives</b>                           |                                                                                                                        | <ul style="list-style-type: none"><li>● To introduce to the physical design automation, floor planning, placement and routing.</li><li>● To perform static timing analysis for low power VLSI design.</li></ul> |                 |                                        |                      |                                            |  |
| <b>Course Outcomes</b>                             |                                                                                                                        |                                                                                                                                                                                                                 |                 |                                        |                      | <b>Cognitive Levels</b>                    |  |
| <b>CO1</b>                                         | To partition a given logic circuits using CAD tools to meet the cost function and other constraints.                   |                                                                                                                                                                                                                 |                 |                                        |                      | Knowledge/Comprehension (Level I/Level-II) |  |
| <b>CO2</b>                                         | To solve the floor planning and placement issues in circuit layout using appropriate CAD tools.                        |                                                                                                                                                                                                                 |                 |                                        |                      | Application (Level-III)                    |  |
| <b>CO3</b>                                         | Toanalyse the physical design requirements and find the most appropriate routing path for the modules inside the chip. |                                                                                                                                                                                                                 |                 |                                        |                      | Analysis (Level-IV)                        |  |
| <b>CO4</b>                                         | To be able to carry out all the physical verification (such as DRC rules, LVS, ERC etc.) of the layout designed.       |                                                                                                                                                                                                                 |                 |                                        |                      | Synthesis/Evaluation (Level-VI/Level-V)    |  |
| <b>Semester</b>                                    |                                                                                                                        | <b>VII/VIII</b>                                                                                                                                                                                                 |                 |                                        | <b>Summer/Winter</b> |                                            |  |
| <b>Contact Hours</b>                               |                                                                                                                        | <b>Lecture</b>                                                                                                                                                                                                  | <b>Tutorial</b> | <b>Practical</b>                       | <b>Credits</b>       | <b>Total Teaching Hours</b>                |  |
|                                                    |                                                                                                                        | 3                                                                                                                                                                                                               | 0               | 0                                      | 3                    | 36                                         |  |
| <b>Prerequisite course codes with course names</b> |                                                                                                                        | Microelectronics and VLSI Technology (EC 2352)                                                                                                                                                                  |                 |                                        |                      |                                            |  |
| <b>Text/Reference Books</b>                        |                                                                                                                        |                                                                                                                                                                                                                 |                 |                                        |                      |                                            |  |

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|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|---|
| 1.                       | <b>Title</b>                                                                                                                                                                                                                          | An Introduction to Physical VLSI Design                           |   |
|                          | <b>Author</b>                                                                                                                                                                                                                         | M. Sarrafzadeh & C.K Wong                                         |   |
|                          | <b>Publisher</b>                                                                                                                                                                                                                      | McGraw-Hill Series                                                |   |
|                          | <b>Edition</b>                                                                                                                                                                                                                        | 1996                                                              |   |
| 2.                       | <b>Title</b>                                                                                                                                                                                                                          | Principles of CMOS VLSI Design.                                   |   |
|                          | <b>Author</b>                                                                                                                                                                                                                         | Neil Weste & K Eshraghian                                         |   |
|                          | <b>Publisher</b>                                                                                                                                                                                                                      | Pearson                                                           |   |
|                          | <b>Edition</b>                                                                                                                                                                                                                        | 2nd Edition                                                       |   |
| <b>Course Contents</b>   | <b>UNIT I: Introduction</b><br>Design representation, VLSI Design Styles, VLSI Design Automation, partitioning, floor planning, floor planning algorithms, Pin assignment, placement, grid routing, global routing, detailed routing. |                                                                   | 9 |
|                          | <b>UNIT II: Timing Analysis</b><br>Clock design, clock network synthesis, power and ground routing, time closure, time driven placement, time driven routing.                                                                         |                                                                   | 9 |
|                          | <b>UNIT III: Physical Synthesis</b><br>Physical synthesis, performance driven design flow, interconnect modelling, design rule check, layout compaction, testing, fault model.                                                        |                                                                   | 9 |
|                          | <b>UNIT IV: Test Pattern Generation</b><br>Test pattern generation, design for testability, boundary scan standard, built-in self-test, low power design, techniques to reduce power, gate level design for low power.                |                                                                   | 9 |
| <b>Course Assessment</b> | Total Marks: 100                                                                                                                                                                                                                      | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50% |   |

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| <b>Course Code:</b><br>EC 4856 | <b>Open Elective Course:</b><br>(Y/N)                                                                                                                                                                                      | <b>Departmental Core Course:</b> (Y/N) | <b>Departmental Elective Course:</b> (Y/N) |
|                                | Y                                                                                                                                                                                                                          | N                                      | N                                          |
| <b>Type of Course</b>          | Theory Course                                                                                                                                                                                                              |                                        |                                            |
| <b>Course Title &amp; Code</b> | Machine Learning and Pattern Recognition(EC 4856)                                                                                                                                                                          |                                        |                                            |
| <b>Course Objectives</b>       | <ul style="list-style-type: none"> <li>To understand the theoretical underpinnings of machine learning and pattern recognition.</li> <li>To familiarize with machine learning algorithms with their theoretical</li> </ul> |                                        |                                            |

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|                                             | foundations and practical implementation. <ul style="list-style-type: none"><li>To explore the various topics in machine learning such as CNNs, RNNs and GANs.</li><li>To develop critical thinking and problem-solving skills in the context of machine learning and pattern recognition.</li></ul> |                                                                         |          |                                                    |         |                      |
| Course Outcomes                             |                                                                                                                                                                                                                                                                                                      |                                                                         |          | Cognitive Levels                                   |         |                      |
| CO1                                         | To understand the foundational concepts, algorithms, and techniques in machine learning and pattern recognition.                                                                                                                                                                                     |                                                                         |          | Knowledge/Comprehension (Level I/Level-II)         |         |                      |
| CO2                                         | To be able to implement various machine learning algorithms.                                                                                                                                                                                                                                         |                                                                         |          | Application (Level-III)                            |         |                      |
| CO3                                         | To critically analyze the performance of machine learning models, select appropriate evaluation metrics, and make informed decisions for model improvement and optimization.                                                                                                                         |                                                                         |          | Analysis (Level-IV)                                |         |                      |
| CO4                                         | To evaluate the merits and demerits of existing machine learning and pattern recognition methods in different contexts.                                                                                                                                                                              |                                                                         |          | Evaluation/Syntheses(Level-V/Level-VI)             |         |                      |
| Semester                                    |                                                                                                                                                                                                                                                                                                      | VII/VIII                                                                |          | Summer/Winter                                      |         |                      |
| Contact Hours                               |                                                                                                                                                                                                                                                                                                      | Lecture                                                                 | Tutorial | Practical                                          | Credits | Total Teaching Hours |
|                                             |                                                                                                                                                                                                                                                                                                      | 3                                                                       | 0        | 0                                                  | 3       | 36                   |
| Prerequisite course codes with course names |                                                                                                                                                                                                                                                                                                      | Introduction to Computing (CS1201); Engineering Mathematics-II (MA1201) |          |                                                    |         |                      |
| Text Books                                  |                                                                                                                                                                                                                                                                                                      |                                                                         |          |                                                    |         |                      |
| 1.                                          |                                                                                                                                                                                                                                                                                                      | Title                                                                   |          | Deep Learning                                      |         |                      |
|                                             |                                                                                                                                                                                                                                                                                                      | Author                                                                  |          | Ian Goodfellow, Yoshua Bengio, and Aaron Courville |         |                      |
|                                             |                                                                                                                                                                                                                                                                                                      | Publisher                                                               |          | Springer, 2006                                     |         |                      |
|                                             |                                                                                                                                                                                                                                                                                                      | Edition                                                                 |          | 1 <sup>st</sup> Edition                            |         |                      |
| Reference Books                             |                                                                                                                                                                                                                                                                                                      |                                                                         |          |                                                    |         |                      |
| 1.                                          |                                                                                                                                                                                                                                                                                                      | Title                                                                   |          | Pattern Recognition and Machine Learning           |         |                      |
|                                             |                                                                                                                                                                                                                                                                                                      | Author                                                                  |          | Christopher M. Bishop                              |         |                      |
|                                             |                                                                                                                                                                                                                                                                                                      | Publisher                                                               |          | MIT Press, 2016                                    |         |                      |
|                                             |                                                                                                                                                                                                                                                                                                      | Edition                                                                 |          | 1 <sup>st</sup> Edition                            |         |                      |

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| <b>Course Contents</b>   | <b>UNIT I: Introduction to Machine Learning</b><br>Overview of Machine Learning, Types of Machine Learning: Supervised, Unsupervised, Reinforcement Learning, Basics of Python for Machine Learning, Introduction to NumPy and Pandas.                                                                                                                                | <b>9</b>                                                          |
|                          | <b>UNIT II: Supervised Learning and Unsupervised</b><br>Linear Regression, Logistic Regression, Decision Trees and Ensemble Learning (Random Forests, Gradient Boosting), Evaluation Metrics for Classification and Regression, K-Means Clustering, Hierarchical Clustering, Principal Component Analysis (PCA), t-Distributed Stochastic Neighbor Embedding (t-SNE). | <b>9</b>                                                          |
|                          | <b>UNIT III: Deep Learning Basics and Convolutional Neural Networks</b><br>Introduction to Neural Networks, Activation Functions, Optimization Algorithms (Gradient Descent, Adam), Backpropagation Algorithm<br>Architecture of CNNs, Convolutional Layers, Pooling Layers, CNN Applications: Image Classification, Object Detection.                                | <b>9</b>                                                          |
|                          | <b>UNIT IV: Introduction to Pattern Recognition</b><br>Introduction to Pattern recognition, feature extraction and selection, pattern classification techniques, applications of pattern recognition.                                                                                                                                                                 | <b>9</b>                                                          |
| <b>Course Assessment</b> | Total Marks: 100                                                                                                                                                                                                                                                                                                                                                      | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50% |

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| <b>Course Code:</b><br>EC 4857 | <b>Open Elective Course:</b><br>(Y/N)                                                                                                                                                                                                                  | <b>Departmental Core Course:</b> (Y/N) | <b>Departmental Elective Course:</b> (Y/N) |
|                                | N                                                                                                                                                                                                                                                      | N                                      | Y                                          |
| <b>Type of Course</b>          | Theory Course                                                                                                                                                                                                                                          |                                        |                                            |
| <b>Course Title &amp; Code</b> | Biophotonics (EC4857)                                                                                                                                                                                                                                  |                                        |                                            |
| <b>Course Objectives</b>       | <ul style="list-style-type: none"> <li>To impart knowledge about the emerging field of Biophotonics.</li> <li>To understand the application of Optical based Technologies in the field of biosensing, imaging, cell manipulation and so on.</li> </ul> |                                        |                                            |
| <b>Course Outcomes</b>         |                                                                                                                                                                                                                                                        |                                        | <b>Cognitive Levels</b>                    |
| <b>CO1</b>                     | Able to understand the basics of Biophotonics.                                                                                                                                                                                                         |                                        | Knowledge/Comprehension (Level I/Level-II) |
| <b>CO2</b>                     | Able to understand the basics of Biosensors and Applications of                                                                                                                                                                                        |                                        | Application                                |

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|                                             | Bioimaging.                                             |                                                                                                                                                                                                                                                                                                                                                             |          |                               |               | (Level-III)                                |   |
| CO3                                         | Able to acquire knowledge on Biosensing and Bioimaging. |                                                                                                                                                                                                                                                                                                                                                             |          |                               |               | Analysis<br>(Level-IV)                     |   |
| CO4                                         | Able to learn about Bioscience and Photonics.           |                                                                                                                                                                                                                                                                                                                                                             |          |                               |               | Synthesis/Evaluation<br>(Level-VI/Level-V) |   |
| Semester                                    |                                                         | VII/VIII                                                                                                                                                                                                                                                                                                                                                    |          |                               | Summer/Winter |                                            |   |
| Contact Hours                               |                                                         | Lecture                                                                                                                                                                                                                                                                                                                                                     | Tutorial | Practical                     | Credits       | Total Teaching Hours                       |   |
|                                             |                                                         | 3                                                                                                                                                                                                                                                                                                                                                           | 0        | 0                             | 3             | 36                                         |   |
| Prerequisite course codes with course names |                                                         | Engineering Physics-I (PH 1101)                                                                                                                                                                                                                                                                                                                             |          |                               |               |                                            |   |
| Text Books                                  |                                                         |                                                                                                                                                                                                                                                                                                                                                             |          |                               |               |                                            |   |
| 1.                                          |                                                         | Title                                                                                                                                                                                                                                                                                                                                                       |          | Introduction to Biophotonics  |               |                                            |   |
|                                             |                                                         | Author                                                                                                                                                                                                                                                                                                                                                      |          | Paras N. Prasad               |               |                                            |   |
|                                             |                                                         | Publisher                                                                                                                                                                                                                                                                                                                                                   |          | John Wiley and Sons           |               |                                            |   |
|                                             |                                                         | Edition                                                                                                                                                                                                                                                                                                                                                     |          | 1 <sup>st</sup> Edition       |               |                                            |   |
| 2.                                          |                                                         | Title                                                                                                                                                                                                                                                                                                                                                       |          | Fundamentals of Photonics     |               |                                            |   |
|                                             |                                                         | Author                                                                                                                                                                                                                                                                                                                                                      |          | Bahaa Saleh                   |               |                                            |   |
|                                             |                                                         | Publisher                                                                                                                                                                                                                                                                                                                                                   |          | John Wiley and Sons           |               |                                            |   |
|                                             |                                                         | Edition                                                                                                                                                                                                                                                                                                                                                     |          | 3 <sup>rd</sup> Edition       |               |                                            |   |
| Reference Books                             |                                                         |                                                                                                                                                                                                                                                                                                                                                             |          |                               |               |                                            |   |
| 1.                                          |                                                         | Title                                                                                                                                                                                                                                                                                                                                                       |          | Biomedical Photonics Handbook |               |                                            |   |
|                                             |                                                         | Author                                                                                                                                                                                                                                                                                                                                                      |          | T. Vo-Dinh ed.                |               |                                            |   |
|                                             |                                                         | Publisher                                                                                                                                                                                                                                                                                                                                                   |          | CRC Press Optics              |               |                                            |   |
|                                             |                                                         | Edition                                                                                                                                                                                                                                                                                                                                                     |          | 1 <sup>st</sup> Edition       |               |                                            |   |
| Course Contents                             |                                                         | UNIT I: LIGHT AND MATTER<br>Basics of Structure and Function of Living Materials, Process of Light Interaction with Matter, Light – Matter Interaction, Fundamental Nature of Light.                                                                                                                                                                        |          |                               |               |                                            | 9 |
|                                             |                                                         | UNIT II: INTERACTION OF LIGHT WITH CELLS AND TISSUES<br>Interaction of Light with Cells and Tissues- Components that Interact with Light, Light Absorption in Cells, Light Induced Cellular Processes, Interaction of Light with Tissues- Absorption, Scattering, Tissue Optical Properties, Light Induced Processes in Tissue, Radiative Transport Theory. |          |                               |               |                                            | 9 |

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|                          | <b>UNIT III: OPTICAL SPECTROSCOPY&amp; PRINCIPLES OF LASER</b><br>Optical Spectroscopy: Fluorescence Spectroscopy, Raman Spectroscopy, CARS, Fluorescence Detection and Quantification of Nucleic Acids, Proteins and Cells, Optical Activity and Circular Dichroism. Laser: Types of Light Sources, Basic Principles of Lasers, Lasers Relevant to Biophotonics.                                                                                                                                                                                                                                                                                                                   |                                                                   | 9 |
|                          | <b>UNIT IV: BIOIMAGING AND OPTICAL BIOSENSORS: PRINCIPLES, TECHNIQUES AND APPLICATIONS</b><br>Optical Imaging- Background and Need for Optical Imaging, Different Optical Imaging Techniques, Microscopy –Simple, Compound, Fluorescence Microscopy, Confocal Microscopy, Optical Tomography, Fluorescence Resonance Energy Transfer (FRET), Fluorescence Life Time Imaging (FLIM). Applications of Bioimaging- Endogenous and Exogenous Fluorophores, Tissue Imaging, In Vivo Imaging. Optical Diagnostic Technique, Light for Therapy and Treatment, Optical Tweezer, Laser Scissor. Optical Biosensing- Principle, Fiber Optic Biosensors, Surface Plasmon Resonance Biosensors. |                                                                   | 9 |
| <b>Course Assessment</b> | Total Marks=100                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50% |   |

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|--------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|--------------------------------------------|
| <b>Course Code:</b><br>EC 4858 | <b>Open Elective Course:</b><br>(Y/N)                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>Departmental Core Course:</b> (Y/N) | <b>Departmental Elective Course:</b> (Y/N) |
|                                | Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | N                                      | N                                          |
| <b>Type of Course</b>          | Theory Course                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                        |                                            |
| <b>Course Title &amp; Code</b> | Hardware Description Language(EC 4858)                                                                                                                                                                                                                                                                                                                                                                                                                              |                                        |                                            |
| <b>Course Objectives</b>       | <ul style="list-style-type: none"> <li>● To understand the fundamental principles and concepts of nanoscience and nanotechnology.</li> <li>● To familiarize students with the synthesis, characterization, and manipulation of nanomaterials.</li> <li>● To explore the various applications of nanotechnology in different fields.</li> <li>● To develop critical thinking and problem-solving skills in the context of nanoscience and nanotechnology.</li> </ul> |                                        |                                            |
| <b>Course Outcomes</b>         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                        | <b>Cognitive Levels</b>                    |

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|---------------------------------------------|---------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---------------------------------------------------------|--------------------------------------------|----------------------|
| CO1                                         | To understand the basic requirements of Hardware Description Language.                                              |                                                                                                                                                                                                                                                                                              |          |                                                         | Knowledge/Comprehension (Level I/Level-II) |                      |
| CO2                                         | To design combinational and sequential circuits and use of HDLs in practical applications like FPGA programming.    |                                                                                                                                                                                                                                                                                              |          |                                                         | Application (Level-III)                    |                      |
| CO3                                         | To analyse the HDL codes and perform timing analysis.                                                               |                                                                                                                                                                                                                                                                                              |          |                                                         | Analysis (Level-IV)                        |                      |
| CO4                                         | To design and evaluate complex systems, develop testbenches and integrate modules to form complete digital systems, |                                                                                                                                                                                                                                                                                              |          |                                                         | Synthesis/Evaluation (Level-VI/Level-V)    |                      |
| Semester                                    |                                                                                                                     | VII/VIII                                                                                                                                                                                                                                                                                     |          |                                                         | Summer/Winter                              |                      |
| Contact Hours                               |                                                                                                                     | Lecture                                                                                                                                                                                                                                                                                      | Tutorial | Practical                                               | Credits                                    | Total Teaching Hours |
|                                             |                                                                                                                     | 3                                                                                                                                                                                                                                                                                            | 0        | 0                                                       | 3                                          | 36                   |
| Prerequisite course codes with course names |                                                                                                                     | Basic Electronic Circuits (EC 1201)                                                                                                                                                                                                                                                          |          |                                                         |                                            |                      |
| Text Books                                  |                                                                                                                     |                                                                                                                                                                                                                                                                                              |          |                                                         |                                            |                      |
| 1.                                          |                                                                                                                     | Title                                                                                                                                                                                                                                                                                        |          | Digital Design and Computer Architecture                |                                            |                      |
|                                             |                                                                                                                     | Author                                                                                                                                                                                                                                                                                       |          | David Money Harris and Sarah L. Harris                  |                                            |                      |
|                                             |                                                                                                                     | Publisher                                                                                                                                                                                                                                                                                    |          | Morgan Kaufmann, 2012                                   |                                            |                      |
|                                             |                                                                                                                     | Edition                                                                                                                                                                                                                                                                                      |          | 2 <sup>nd</sup> Edition                                 |                                            |                      |
| 2.                                          |                                                                                                                     | Title                                                                                                                                                                                                                                                                                        |          | Digital Design: With an Introduction to the Verilog HDL |                                            |                      |
|                                             |                                                                                                                     | Author                                                                                                                                                                                                                                                                                       |          | M. Morris Mano and Michael D. Ciletti                   |                                            |                      |
|                                             |                                                                                                                     | Publisher                                                                                                                                                                                                                                                                                    |          | Pearson Education, 2017                                 |                                            |                      |
|                                             |                                                                                                                     | Edition                                                                                                                                                                                                                                                                                      |          | 6 <sup>th</sup> Edition                                 |                                            |                      |
| Reference Books                             |                                                                                                                     |                                                                                                                                                                                                                                                                                              |          |                                                         |                                            |                      |
| 1.                                          |                                                                                                                     | Title                                                                                                                                                                                                                                                                                        |          | VHDL for Digital Design                                 |                                            |                      |
|                                             |                                                                                                                     | Author                                                                                                                                                                                                                                                                                       |          | Frank Vahid and Roman Lysecky                           |                                            |                      |
|                                             |                                                                                                                     | Publisher                                                                                                                                                                                                                                                                                    |          | Wiley, 2007                                             |                                            |                      |
|                                             |                                                                                                                     | Edition                                                                                                                                                                                                                                                                                      |          | 1 <sup>st</sup> Edition                                 |                                            |                      |
| Course Contents                             |                                                                                                                     | UNIT I: Introduction to HDLs (Verilog and VHDL)<br>Overview of digital design and electronic systems, Role and importance of HDLs in digital design, Comparison of Verilog and VHDL, Verilog syntax and structure<br>Data types and variables, Module instantiation and hierarchical design, |          |                                                         |                                            | 9                    |

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|                          | VHDL syntax and structure, Entity-architecture modeling, Data types and signal declarations.                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                   |
|                          | <b>UNIT II: Combinational and Sequential Logic Design</b><br>Modeling combinatorial circuits in Verilog and VHDL, Operators and expressions<br>Case and if-else statements, Introduction to sequential circuits, Modeling flip-flops and latches, Finite State Machine (FSM) design.                                                                                                                                                                                                                                                                     | 9                                                                 |
|                          | <b>UNIT III: Behavioral Modeling and Advanced Modeling Techniques</b><br>Behavioral modeling techniques in Verilog and VHDL, Procedural blocks and assignments, Modeling delays and timing constraints, Parameterized modules and generics, Generate statements and loop constructs, User-defined data types and functions.                                                                                                                                                                                                                              | 9                                                                 |
|                          | <b>UNIT IV: Testbenches, Simulation, Synthesis and Optimization</b><br>Writing testbenches for HDL designs, Simulation tools and environments (e.g., ModelSim, Xilinx Vivado), Verification techniques and test coverage, Synthesis flow and process, Optimizing HDL code for area and timing constraints, Timing analysis and constraints. FPGA architecture and design flow, Synthesizing HDL designs for FPGAs, Hardware description for ASIC implementation, High Level Synthesis (HLS) and design abstraction, Emerging trends in HDL-based design. | 9                                                                 |
| <b>Course Assessment</b> | Total Marks=100                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50% |

|                                |                                                                                                                                                                                                                    |                                        |                                            |
|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|--------------------------------------------|
| <b>Course Code:</b><br>EC 2331 | <b>Open Elective Course:</b><br>(Y/N)                                                                                                                                                                              | <b>Departmental Core Course:</b> (Y/N) | <b>Departmental Elective Course:</b> (Y/N) |
|                                | N                                                                                                                                                                                                                  | Y                                      | N                                          |
| <b>Type of Course</b>          | Theory and Practical                                                                                                                                                                                               |                                        |                                            |
| <b>Course Title &amp; Code</b> | Analog Circuit Theory (EC2331)                                                                                                                                                                                     |                                        |                                            |
| <b>Course Objectives</b>       | <ul style="list-style-type: none"> <li>To make the students understand the fundamentals of basic electronic circuits such as Diodes, BJTs and FETs.</li> <li>To introduce the PLL and its applications.</li> </ul> |                                        |                                            |

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| Course Outcomes                             |                                                                                          |                                     |                                                 | Cognitive Levels                           |         |                      |
|---------------------------------------------|------------------------------------------------------------------------------------------|-------------------------------------|-------------------------------------------------|--------------------------------------------|---------|----------------------|
| CO1                                         | Illustrate about diodes, rectifiers, and BJT and FET amplifiers.                         |                                     |                                                 | Knowledge/Comprehension (Level I/Level-II) |         |                      |
| CO2                                         | Discuss biasing, low frequency models and frequency response for BJT and FET amplifiers. |                                     |                                                 | Knowledge/Comprehension (Level I/Level-II) |         |                      |
| CO3                                         | Illustrate differential amplifiers and their characteristics.                            |                                     |                                                 | Knowledge/Comprehension (Level I/Level-II) |         |                      |
| CO4                                         | Discuss feedback concepts, power amplifiers, and oscillator circuits.                    |                                     |                                                 | Knowledge/Comprehension (Level I/Level-II) |         |                      |
| Semester                                    |                                                                                          | III                                 |                                                 | Summer                                     |         |                      |
| Contact Hours                               |                                                                                          | Lecture                             | Tutorial                                        | Practical                                  | Credits | Total Teaching Hours |
|                                             |                                                                                          | 3                                   | 0                                               | 2                                          | 4       | 36                   |
| Prerequisite course codes with course names |                                                                                          | Basic Electronics Circuit (EC 1201) |                                                 |                                            |         |                      |
| Text Books                                  |                                                                                          |                                     |                                                 |                                            |         |                      |
| 1.                                          | Title                                                                                    |                                     | Microelectronic Circuits Theory and Application |                                            |         |                      |
|                                             | Author                                                                                   |                                     | Sedra and Smith                                 |                                            |         |                      |
|                                             | Publisher                                                                                |                                     | Oxford publication                              |                                            |         |                      |
|                                             | Edition                                                                                  |                                     | 7 <sup>th</sup> Edition                         |                                            |         |                      |
| 2.                                          | Title                                                                                    |                                     | Electronic Circuit Analysis and Design          |                                            |         |                      |
|                                             | Author                                                                                   |                                     | Donald A. Neamen                                |                                            |         |                      |
|                                             | Publisher                                                                                |                                     | Irwin Publications                              |                                            |         |                      |
|                                             | Edition                                                                                  |                                     | 3 <sup>nd</sup> Edition                         |                                            |         |                      |
| Reference Books                             |                                                                                          |                                     |                                                 |                                            |         |                      |

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| 1.                       | Title                                                                                                                                                                                                                                                                                                                                                                                                                                    | Design with Operational Amplifiers and Analog Integrated Circuits |   |
|                          | Author                                                                                                                                                                                                                                                                                                                                                                                                                                   | Sergio Franco                                                     |   |
|                          | Publisher                                                                                                                                                                                                                                                                                                                                                                                                                                | Tata McGraw Hill Book Company                                     |   |
|                          | Edition                                                                                                                                                                                                                                                                                                                                                                                                                                  | 3 <sup>rd</sup> Edition                                           |   |
| <b>Course Contents</b>   | <b>UNIT I:</b><br>Small signal equivalent circuits of diode, Simple diode circuits, clipping, clamping, rectifier, Voltage multiplier, Zener diode and voltage regulator. Review of BJT operation and its characteristics, need of biasing and different types of biasing circuits for BJT & FET, stability analysis, small signal Amplifier analysis of BJT & FET, estimation of voltage gain, input resistance, output resistance etc. |                                                                   | 9 |
|                          | <b>UNIT II:</b><br>Feedback concept, Feedback amplifier topologies, General characteristics of negative feedback amplifier, input and output resistance with negative feedback, Method of analysis of feedback amplifiers with practical examples. Definition of class A, B and C power amplifiers, Distortion analysis, Series fed and transformer coupled power amplifier, Push-pull amplifiers, Conversion efficiency                 |                                                                   | 9 |
|                          | <b>UNIT III:</b><br>Basic operation of differential Amplifier, Different configuration of differential Amplifier, Calculation of gain, impedance etc. Biasing of differential Amplifier, calculation of differential gain, common mode gain, CMRR.                                                                                                                                                                                       |                                                                   | 9 |
|                          | <b>UNIT IV:</b><br>Review of the basic concept for oscillation, Barkhausen criterion, LC Oscillators, RC phase shift oscillator and Wien bridge oscillator, Colpitts, Hartley and Crystal oscillator, PLL as negative feedback system, building blocks of PLL, applications of PLL                                                                                                                                                       |                                                                   | 9 |
| <b>Course Assessment</b> | Total Marks =100<br>Theory (75 Marks)<br>Evaluation will be done for 100 marks and 75% of the marks secured will be considered.                                                                                                                                                                                                                                                                                                          | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50% |   |

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|  | <b>Practical (25 Marks)</b><br>Evaluation will be done for 50 marks and 50% of the marks secured will be considered. | Continuous Evaluation 20%<br>Laboratory Examination 50%<br>Viva Voce 30% |
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|---------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---------------------------------|---------|-------------------------------------------|--|
| Course Code:<br>EC 2431                     |                                                                                                                                 | Open Elective Course:<br>(Y/N)                                                                                                                                                                                                                                                                                        |          | Departmental Core Course: (Y/N) |         | Departmental Elective Course: (Y/N)       |  |
|                                             |                                                                                                                                 | N                                                                                                                                                                                                                                                                                                                     |          | Y                               |         | N                                         |  |
| Type of Course                              |                                                                                                                                 | Theory and Practical                                                                                                                                                                                                                                                                                                  |          |                                 |         |                                           |  |
| Course Title & Code                         |                                                                                                                                 | Digital Electronics & Computer Organization (EC2431)                                                                                                                                                                                                                                                                  |          |                                 |         |                                           |  |
| Course Objectives                           |                                                                                                                                 | <ul style="list-style-type: none"><li>● To introduce the concept of number system and logic gates</li><li>● To design the combinational and sequential logic circuits and to develop the characteristics of TTL/CMOS logic families.</li><li>● To understand memory devices such as SRAM/DRAM organization.</li></ul> |          |                                 |         |                                           |  |
| Course Outcomes                             |                                                                                                                                 |                                                                                                                                                                                                                                                                                                                       |          |                                 |         | Cognitive Levels                          |  |
| CO1                                         | To acquire the basic knowledge of digital logic levels and application of knowledge to understand digital electronics circuits. |                                                                                                                                                                                                                                                                                                                       |          |                                 |         | Knowledge (Level I)                       |  |
| CO2                                         | To introduce the concept of digital and binary systems                                                                          |                                                                                                                                                                                                                                                                                                                       |          |                                 |         | Comprehension (Level-II)                  |  |
| CO3                                         | To be able to design and analyse combinational logic circuits.                                                                  |                                                                                                                                                                                                                                                                                                                       |          |                                 |         | Application/Analysis (Level-III/Level-IV) |  |
| CO4                                         | To be able to design and analyse sequential logic circuits.                                                                     |                                                                                                                                                                                                                                                                                                                       |          |                                 |         | Synthesis/Evaluation (Level-VI/Level-V)   |  |
| Semester                                    |                                                                                                                                 | IV                                                                                                                                                                                                                                                                                                                    |          |                                 | Winter  |                                           |  |
| Contact Hours                               |                                                                                                                                 | Lecture                                                                                                                                                                                                                                                                                                               | Tutorial | Practical                       | Credits | Total Teaching Hours                      |  |
|                                             |                                                                                                                                 | 3                                                                                                                                                                                                                                                                                                                     | 0        | 2                               | 4       | 36                                        |  |
| Prerequisite course codes with course names |                                                                                                                                 | Basic Electronic Circuits (EC1201)<br>Engineering Physics-I (PH1101)                                                                                                                                                                                                                                                  |          |                                 |         |                                           |  |
| Text Books                                  |                                                                                                                                 |                                                                                                                                                                                                                                                                                                                       |          |                                 |         |                                           |  |

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| 1.              | Title                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Digital Electronics                      |
|                 | Author                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | WH Gothmann                              |
|                 | Publisher                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | PHI                                      |
|                 | Edition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 2 <sup>nd</sup> Edition                  |
| Reference Books |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                          |
| 1.              | Title                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Digital Logic & Computer Design          |
|                 | Author                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | M Morris Mano                            |
|                 | Publisher                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Pearson                                  |
|                 | Edition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 5 <sup>th</sup> , 2011                   |
| 2.              | Title                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Digital Design, Principles and Practices |
|                 | Author                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | J. F. Wakerly                            |
|                 | Publisher                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Pearson Education                        |
|                 | Edition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 4 <sup>th</sup> , 2005                   |
| Course Contents | UNIT I: Number System and Boolean Algebra<br>Introduction to number systems, binary, Integer and floating-point-numbers, octal, hexadecimal and decimal number system and their conversion.<br>Arithmetic Operations: Binary addition & subtraction; 1's and 2's complement, subtraction using 2's complement; binary codes, addition and subtraction operations on binary-coded numbers; Algorithms for performing multiplication and division.                                                                                                                                                                                                                                                        | 9                                        |
|                 | UNIT II: Combinational Logic Circuits<br>Basic Logic Operations, AND, OR, NOR, NAND, EX-OR, EX-NOR Gates, Boolean expressions and their minimization using algebraic identities; Karnaugh map representation and minimization of Boolean functions using K-map; Don't care conditions, NAND and NOR logic implementations, two-level realizations using gates – AND-OR, OR-AND, NAND-NAND and NOR-NOR structures.<br>Combinational Circuits using MSI Modules: Adders, subtractors, BCD arithmetic, serial adder, carry look-ahead adder, Multi-bit adder, Multiplexers, De-multiplexers, Decoders, Multiplexer-based realization of K-maps; Combinational circuit design using multiplexers and gates. | 9                                        |
|                 | UNIT III: Sequential Logic Circuits<br>Latches and Flip-flops; Ripple counters using T flip-flops; Synchronous counters; Shift Registers; Ring and MLS counters; Sequence generator using J-K / D flip-flops, Finite state machines, propagation delay, setup and hold time, critical path delay.                                                                                                                                                                                                                                                                                                                                                                                                       | 9                                        |

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|                   | UNIT IV: Memories and Programmable Logic<br>ROM, SRAM, DRAM, PLA, PAL Logic Families: ROM, SRAM, DRAM, PLA, PAL | 9                                                                        |
| Course Assessment | Theory (75 Marks)<br>Evaluation will be done for 100 marks and 75% of the marks secured will be considered.     | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50%        |
|                   | Practical (25 Marks)<br>Evaluation will be done for 50 marks and 50% of the marks secured will be considered.   | Continuous Evaluation 20%<br>Laboratory Examination 50%<br>Viva Voce 30% |

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|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|--------------------------------------------|
| Course Code:<br>EC 3531 | Open Elective Course:<br>(Y/N)<br>N                                                                                                                                                                                                                                                                                                                                                | Departmental Core Course: (Y/N)<br>Y | Departmental Elective Course: (Y/N)<br>N   |
| Type of Course          | Theory Course                                                                                                                                                                                                                                                                                                                                                                      |                                      |                                            |
| Course Title & Code     | Electromagnetic Field Theory (EC3531)                                                                                                                                                                                                                                                                                                                                              |                                      |                                            |
| Course Objectives       | <ul style="list-style-type: none"> <li>The intention of this course is to familiarize the students with concepts pertaining electric and magnetic fields and their applications.</li> <li>To correlate with the concept of vector calculus and real-time observation of the proposed course.</li> <li>To learn the field distribution inside and outside the materials.</li> </ul> |                                      |                                            |
| Course Outcomes         |                                                                                                                                                                                                                                                                                                                                                                                    |                                      | Cognitive Levels                           |
| CO1                     | To understand the various operations of vector calculus                                                                                                                                                                                                                                                                                                                            |                                      | Knowledge/Comprehension (Level-I/Level-II) |
| CO2                     | To understand the mathematics backgrounds the EM laws.                                                                                                                                                                                                                                                                                                                             |                                      | Application (Level-III)                    |
| CO3                     | To understand the electric and magnetic field distributions over the materials.                                                                                                                                                                                                                                                                                                    |                                      | Analysis (Level-IV)                        |
| CO4                     | To understand the propagation of waves in different mediums.                                                                                                                                                                                                                                                                                                                       |                                      | Synthesis/Evaluation (Level-VI/Level-V)    |
| Semester                | VII                                                                                                                                                                                                                                                                                                                                                                                |                                      | Summer                                     |
| Contact Hours           | Lecture                                                                                                                                                                                                                                                                                                                                                                            | Tutorial                             | Practical Credits Total Teaching Hours     |

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|---------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|---|---|----|
|                                             | 3                                                                                                                                                                                                                                                                                                                                                                                                                                             | 0                                         | 0 | 3 | 36 |
| Prerequisite course codes with course names | Engineering Physics – I (PH 1101); Engineering Mathematics-III(MA2301)                                                                                                                                                                                                                                                                                                                                                                        |                                           |   |   |    |
| Text Books                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                           |   |   |    |
| 1.                                          | Title                                                                                                                                                                                                                                                                                                                                                                                                                                         | Principle of Electromagnetics             |   |   |    |
|                                             | Author                                                                                                                                                                                                                                                                                                                                                                                                                                        | M.N.O. Sadiku and S.V. Kulkarni,          |   |   |    |
|                                             | Publisher                                                                                                                                                                                                                                                                                                                                                                                                                                     | Oxford                                    |   |   |    |
|                                             | Edition                                                                                                                                                                                                                                                                                                                                                                                                                                       | 6 <sup>th</sup> Edition                   |   |   |    |
| 2.                                          | Title                                                                                                                                                                                                                                                                                                                                                                                                                                         | Microwave Engineering                     |   |   |    |
|                                             | Author                                                                                                                                                                                                                                                                                                                                                                                                                                        | David. M. Pozar,                          |   |   |    |
|                                             | Publisher                                                                                                                                                                                                                                                                                                                                                                                                                                     | John Wiley                                |   |   |    |
|                                             | Edition                                                                                                                                                                                                                                                                                                                                                                                                                                       | 4 <sup>th</sup> Edition.                  |   |   |    |
| Reference Books                             |                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                           |   |   |    |
| 1.                                          | Title                                                                                                                                                                                                                                                                                                                                                                                                                                         | Electromagnetic Waves                     |   |   |    |
|                                             | Author                                                                                                                                                                                                                                                                                                                                                                                                                                        | R.K. Shevgaonkar                          |   |   |    |
|                                             | Publisher                                                                                                                                                                                                                                                                                                                                                                                                                                     | Tata McGraw Hill                          |   |   |    |
|                                             | Edition                                                                                                                                                                                                                                                                                                                                                                                                                                       | 1 <sup>st</sup> Edition                   |   |   |    |
| 2.                                          | Title                                                                                                                                                                                                                                                                                                                                                                                                                                         | Electromagnetic waves & Radiating Systems |   |   |    |
|                                             | Author                                                                                                                                                                                                                                                                                                                                                                                                                                        | E.C. Jordan & K.G. Balmain                |   |   |    |
|                                             | Publisher                                                                                                                                                                                                                                                                                                                                                                                                                                     | Prentice Hall                             |   |   |    |
|                                             | Edition                                                                                                                                                                                                                                                                                                                                                                                                                                       | 2 <sup>nd</sup> Edition                   |   |   |    |
| Course Contents                             | UNIT I: Vector Calculus<br>Basics of Vectors, Definition of potential difference and potential, Potential of point charge and system of charges. Potential gradient, Energy density in electrostatic field. Poisson’s and Laplace’s equations. Poynting Vector, Boundary conditions at Media Interface. Coordinate Systems and Transformation: Cartesian, Cylindrical and Spherical Coordinates.                                              |                                           |   |   | 10 |
|                                             | UNIT II: Electrostatic and Magnetostatic Fields<br>Introduction, Electric Fields due to Continuous Charge Distributions, An Electric Dipole and Flux Lines, Energy Density in Electrostatic Fields, Maxwell's Equations for Static EM Fields, Gauss’s law, Biot- Savart, Stoke’s theorem and Amperes circuital laws and their applications. Significance of curl and divergence. Magnetic flux density, Scalar and Vector magnetic potential. |                                           |   |   | 12 |

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|                   | UNIT III: Magnetics, Materials and Field Distributions<br>Properties of Materials, Convection and Conduction Currents, Polarization in Dielectrics, Dielectric Constant and Strength, Isotropic, and Homogeneous Dielectrics, A Magnetic Dipole, Magnetization in Materials, Classification of Magnetic Materials and Magnetic Boundary Conditions, Magnetic Energy, Force on Magnetic Materials, Current Continuity. | 8                                                                 |
|                   | UNIT IV: Wave Propagation Characteristics<br>Wave Propagation in Lossy Dielectrics, Plane Waves in Lossless Dielectrics, Free Space and in Good Conductors. Power and the Poynting Vector, Reflection of a Plane Wave at Normal Incidence and at Oblique Incidence.                                                                                                                                                   | 6                                                                 |
| Course Assessment | Total Marks=100                                                                                                                                                                                                                                                                                                                                                                                                       | Continuous Evaluation 20%<br>Mid Semester 30%<br>End Semester 50% |

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Anish Dasjan.

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