B. Tech.

IN

COMPUTER SCIENCE & ENGINEERING

CURRICULUM AND SYLLABUS

(Applicable from 2024 onwards)

Department of Computer Science & Engineering
NATIONAL INSTITUTE OF TECHNOLOGY MANIPUR
Langol Road, Lamphelpat, Imphal, Manipur - 795004

Vision of the Institute

Towards a knowledge hub of excellence in education, research, Innovation, and entrepreneurship, nurturing skilled professionals committed to sustainable ecosystems.

Mission of the Institute

- To impart quality education in engineering technology and allied fields to produce competent and ethical professionals.
- To foster a culture of research and innovation that addresses emerging challenges and contributes to technological growth.
- To promote entrepreneurship and leadership skills for developing sustainable solutions, socio-economic growth and global wellbeing.

Vision of the Department

To be a knowledge provider in the fields of Computer Science and Engineering for welfare of mankind by catering to the ever changing industrial demands and societal needs.

Mission of the Department

- To impart quality engineering education to the students through state of art technology in Computer science and engineering.
- To contribute to society by carrying out quality research and development in frontier areas of Computer science and engineering.
- To make the students ready for the industrial environment by establishing laboratories in collaboration with reputed industries.

Program: Bachelor of Technology in Computer Science and Engineering

PEO No.	Program Educational Objectives (PEOs) Statements
PEO1	Evolve as globally competent computer professionals, researchers and entrepreneurs possessing collaborative and leadership skills, for developing innovative solutions in multidisciplinary domains.
PEO2	Excel as socially committed computer engineers having mutual respect, effective communication skills, high ethical values and empathy for the needs of society.
PEO3	Involve in lifelong learning to foster sustainable development in the emerging areas of technology.

Program Articulation Matrix

Mission Statement	PEO1	PEO2	PEO3
To impart quality engineering education to the students through state-of-the-art technology in Computer Science and Engineering.	3	2	3
To contribute to society by carrying out quality research and development in frontier areas of Computer Science and Engineering.	2	2	1
To make the students ready for the industrial environment by establishing laboratories in collaboration with industries.	2	3	2

1 – Low 2 – Medium 3 – High

Program: Bachelor of Technology in Computer Science and Engineering

Program Outcomes (POs)

PO1:	Engineering knowledge: Apply the knowledge of mathematics, natural science, computing, engineering fundamentals, and an engineering specialization as specified in WK1 to WK4 respectively to develop the solution of complex engineering problems.
PO2:	Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
PO3:	Design/Development of Solutions: Design solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)
PO4:	Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8)
PO5:	Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)
PO6:	The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact and sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7)
PO7:	Ethics: Apply ethical principles and commit to professional ethics, human values, and diversity and inclusion; adhere to national and international laws. (WK9)
PO8:	Individual and Collaborative Team Work: Function effectively as an individual, and as a member or leader in diverse/multidisciplinary teams.
PO9:	Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences.
PO10:	Project Management and Finance: Apply knowledge and understanding of the engineering and management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
PO11:	Life-Long Learning: Recognize the need for, and have the preparation and ability for (i). independent and life-long learning, (ii). adaptability to new and emerging technologies and (iii). critical thinking in the broadest context of technological change. (WK8)

Program Specific Outcomes (PSOs)

PSO1:	Professional Skills: Attain the ability to design and develop hardware and software based systems, evaluate and recognize potential risks and provide creative solutions.
PSO2:	Successful Career and Entrepreneurship: Gain knowledge in diverse areas of Computer Science and experience an environment conducive in cultivating skills for successful career, entrepreneurship and higher studies.

COURSE STRUCTURE OF B.Tech. in COMPUTER SCIENCE AND ENGINEERING

Sl. No.	Course Components	No. of Course	Credits
1.	Basic Science Course (BSC)	7	23
2.	Engineering Science Course (ESC)	7	26
3.	Departmental Core Courses (DCC)	17	69
4.	Departmental Elective Courses (DEC)	5	15
5.	Open Elective Course (OEC)	2	6
6.	Skill Enhancement Courses (SEC)	2	6
7.	Ability Enhancement Mandatory Course (AEMC)	4	13
8.	Value Addition Courses (VAC)	6	2
	Total	50	160

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.	ME1101	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	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
		Total		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 Electronics 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
		Total		16	0	12	22

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

Semester III

Sl. No.	Course Code	Course Name	Course Category	L	T	P	Credits
1.	MA2301	Engineering Mathematics III	BSC-5	3	0	0	3
2.	CS2301	Data Structures	DCC-1	3	0	3	4.5
3.	CS2302	Discrete Structures	DCC-2	3	0	0	3
4.	CS2303	Digital Logic Design	DCC-3	3	0	3	4.5
5.	HS2301	Managerial Economics & Financial Accounting	SEC-2	3	0	0	3
6.	CS2304	Programming in Python	DCC-4	3	0	2	4
7.	SA2391	NCC/NSO	VAC-4	0	0	2	0
		Total		**18**	**0**	**10**	**22**

Semester IV

Sl. No.	Course Code	Course Name	Course Category	L	T	P	Credits
1.	CS2401	Formal Languages and Automata Theory	DCC-5	3	1	0	4
2.	CS2402	Design and Analysis of Algorithms	DCC-6	3	0	3	4.5
3.	CS2403	Computer Organization and Architecture	DCC-7	3	0	2	4
4.	MA2401	Probability and Random Processes	BSC-6	3	0	0	3
5.	CS2404	Object Oriented Programming	DCC-8	3	0	3	4.5
6.	SA2491	NCC/NSO	VAC-5	0	0	2	0
		Total		**15**	**1**	**10**	**20**

Semester V

Sl. No.	Course Code	Course Name	Course Category	L	T	P	Credits
1.	MA3501	Optimization Techniques	BSC-7	3	0	0	3
2.	CS3501	Software Engineering	DCC-9	3	0	0	3
3.	CS3502	Operating Systems	DCC-10	3	0	3	4.5
4.	CS3503	Compiler Design	DCC-11	3	0	3	4.5
5.	CS3504	Data Communication	DCC-12	3	0	0	3
6.	CS35XX	Department Elective - I	DEC-1	3	0	0	3
		Total		**18**	**0**	**6**	**21**

Semester VI

Sl. No.	Course Code	Course Name	Course Category	L	T	P	Credits
1.	CS3601	Database Management Systems	DCC-13	3	0	3	4.5
2.	CS3602	Computer Networks	DCC-14	3	0	3	4.5
3.	CS3603	Artificial Intelligence	DCC-15	3	0	0	3
4.	CS36XX	Department Elective - II	DEC-2	3	0	0	3
5.	CS36XX	Department Elective - III	DEC-3	3	0	0	3
6.	CS3639	Minor Project	AEMC-1	0	0	4	2
		Total		15	0	10	20

Semester VII

Sl. No.	Course Code	Course Name	Course Category	L	T	P	Credits
1.	CS4701	Computer Graphics	DCC-16	3	0	3	4.5
2.	CS4702	Machine Learning	DCC-17	3	0	3	4.5
3.	CS47XX	Department Elective - IV	DEC-4	3	0	0	3
4.	OEC	Open Elective Course - I	OEC-1	3	0	0	3
5.	CS4739	Project - I	AEMC-2	0	0	8	4
6.	CS4738	Internship	VAC-6	0	0	4	2
		Total		12	0	18	21

Semester VIII

Sl. No.	Course Code	Course Name	Course Category	L	T	P	Credits
1.	CS4800	Departmental Elective - V	DEC-5	3	0	0	3
2.	OEC	Open Elective course - II	OEC-2	3	0	0	3
3.	CS4835	Seminar	AEMC-3	0	0	2	1
4.	CS4839	Project - II	AEMC-4	0	0	12	6
		Total		6	0	14	13
For those students carrying out project work in Industries/Organizations							
1.	CS4840	Industrial Project		0	0	8	4
2.	CS4841	Project Seminar		0	0	10	5
3.	CS4842	Comprehensive Viva		0	0	8	4
		Total		0	0	26	13

List of Basic Science Courses

Sl. No.	Course Code	Course Name	Course Category	L	T	P	Credits
1.	CH 1101	Engineering Chemistry	BSC-1	3	0	2	4
2.	MA 1101	Engineering Mathematics-I	BSC-2	3	0	0	3
3.	PH 1101	Engineering Physics-I	BSC-3	3	0	2	4
4.	MA 1201	Engineering Mathematics-II	BSC-4	3	0	0	3
5.	MA2301	Engineering Mathematics III	BSC-5	3	0	0	3
6.	MA2401	Probability and Random Processes	BSC-6	3	0	0	3
7.	MA3501	Optimization Techniques	BSC-7	3	0	0	3
		Total		21	0	4	23

List of Engineering Science Courses

Sl. No.	Course Code	Course Name	Course Category	L	T	P	Credits
1.	ME1101	Engineering Mechanics	ESC-1	3	1	0	4
2.	ME 1102	Engineering Drawing	ESC-2	1	2	0	3
3.	CS 1201	Introduction to Computing	ESC-3	3	0	4	5
4.	EE 1201	Basic Electrical Engineering	ESC-4	3	0	2	4
5.	EC 1201	Basic Electronics Circuits	ESC-5	3	0	2	4
6.	CE 1201	Environmental Engineering	ESC-6	3	0	0	3
7.	ME 1201	Engineering Workshop	ESC-7	1	0	4	3
		Total		17	3	12	26

List of Skill Enhancement Courses

Sl. No.	Course Code	Course Name	Course Category	L	T	P	Credits
1.	HS 1101	Communication Skills	SEC-1	3	0	0	3
2.	HS2301	Managerial Economics & Financial Accounting	SEC-2	3	0	0	3
		Total		6			6

List of Ability Enhancement Mandatory Course

Sl. No.	Course Code	Course Name	Course Category	L	T	P	Credits
1.	CS3639	Minor Project	AEMC-1	0	0	4	2
2.	CS4739	Project - I	AEMC-2	0	0	8	4
3.	CS4835	Seminar	AEMC-3	0	0	2	1
4.	CS4839	Project - II	AEMC-4	0	0	12	6
		Total		0	0	26	13

List of Value Addition Courses

Sl. No.	Course Code	Course Name	Course Category	L	T	P	Credits
1.	IC 1191	Induction Programme*	VAC-1	0	0	0	0
2.	IC 1192	Extra Academic Activity-I*	VAC-2	0	0	0	0
3.	IC 1291	Extra Academic Activity-II*	VAC-3	0	0	0	0
4.	SA2391	NCC/NSO	VAC-4	0	0	2	0
5.	SA2491	NCC/NSO	VAC-5	0	0	2	0
6.	CS4738	Internship	VAC-6	0	0	4	2
		Total		0	0	8	2

List of Department Cores Courses

Sl. No.	Course Code	Course Name	Course Category	L	T	P	Credits
1.	CS2301	Data Structures	DCC-1	3	0	3	4.5
2	CS2302	Discrete Structures	DCC-2	3	0	0	3
3	CS2303	Digital Logic Design	DCC-3	3	0	3	4.5
4	CS2304	Programming in Python	DCC-4	3	0	2	4
5	CS2401	Formal Languages and Automata Theory	DCC-5	3	1	0	4
6	CS2402	Design and Analysis of Algorithms	DCC-6	3	0	3	4.5
7	CS2403	Computer Organization and Architecture	DCC-7	3	0	2	4
8	CS2404	Object Oriented Programming	DCC-8	3	0	3	4.5
9	CS3501	Software Engineering	DCC-9	3	0	0	3
10	CS3502	Operating Systems	DCC-10	3	0	3	4.5
11	CS3503	Compiler Design	DCC-11	3	0	3	4.5
12.	CS3504	Data Communication	DCC-12	3	0	0	3
13.	CS3601	Database Management Systems	DCC-13	3	0	3	4.5
14.	CS3602	Computer Networks	DCC-14	3	0	3	4.5
15.	CS3603	Artificial Intelligence	DCC-15	3	0	0	3
16.	CS4701	Computer Graphics	DCC-16	3	0	3	4.5
17.	CS4702	Machine Learning	DCC-17	3	0	3	4.5
		Total		51	2	34	69

List of Department Electives

Sl. No.	Course Code	Course Name	L	T	P	Credits	Category
1.	CS3571	Digital Image Processing	3	0	0	3	Elective-I
2.	CS3572	Computational geometry	3	0	0	3	
3	CS3573	Computational Systems Biology	3	0	0	3	
4.	CS3574	Multimedia systems	3	0	0	3	
5.	CS3575	Logic in computer science	3	0	0	3	
6.	CS3500	SWAYAM/NPTEL Courses	3	0	0	3	
7.	CS3671	Human computer interaction	3	0	0	3	Elective-II
8.	CS3672	Algorithmic Game Theory	3	0	0	3	
9	CS3673	Graph Theory	3	0	0	3	
10.	CS3674	Pattern recognition	3	0	0	3	
11	CS3675	Learning with Kernels	3	0	0	3	
12	CS3676	Advanced Computer Architecture	3	0	0	3	
13	CS3677	Formal methods for system verification	3	0	0	3	
14	CS3678	Distributed systems	3	0	0	3	
15	CS3600	SWAYAM/NPTEL Courses	3	0	0	3	
16.	CS3679	Computation number theory & cryptography	3	0	0	3	Elective-III
17.	CS3681	Wireless sensor networks	3	0	0	3	
18	CS3682	Parallel Algorithms	3	0	0	3	
19	CS3683	Functional & logic programming	3	0	0	3	

20	CS3684	Semantics for programming languages	3	0	0	3	
21	CS3685	Steganography	3	0	0	3	
22	CS3686	Data Mining	3	0	0	3	
23	CS3687	Optimization methods	3	0	0	3	
24	CS3688	Information transmission & security	3	0	0	3	
25	CS3610	SWAYAM/NPTEL Courses	3	0	0	3	
26	CS4771	Speech Processing	3	0	0	3	Elective-IV
27	CS4772	Information Storage and Retrieval	3	0	0	3	
28	CS4773	Natural Language Processing	3	0	0	3	
29	CS4774	Principles of Robotics	3	0	0	3	
30	CS4775	Internet of Things	3	0	0	3	
31	CS4776	Digital Watermarking	3	0	0	3	
32	CS4777	Big Data	3	0	0	3	
33	CS4778	Intelligent Systems And Interfaces	3	0	0	3	
34	CS4779	Web development technologies	3	0	0	3	
35	CS4781	Advanced operating systems	3	0	0	3	
36	CS4782	Computer and Network Security	3	0	0	3	
37	CS4700	Ethical Hacking	3	0	0	3	
38	CS4710	SWAYAM/NPTEL Courses	3	0	0	3	
39	CS4800	SWAYAM/NPTEL Courses	3	0	0	3	Elective-V

List of Open Electives

Sl. No.	Course Code	Course Name	L	T	P	Credits	Category
1.	CS4751	SWAYAM / NPTEL Courses	3	0	0	3	Elective-I
2.	CS4752	The Joy of Computing using Python	3	0	0	3	
3.	CS4753	Machine Learning	3	0	0	3	
4.	CS4851	SWAYAM / NPTEL Courses	3	0	0	3	Elective-II
6.	CS4852	Artificial Intelligence	3	0	0	3	

12.0 Syllabi

CS2301	DATA STRUCTURES	L-T-P-C 3-0-3-4.5

Course Outcomes

Upon successful completion of this course, students will be able to:

CO1: apply asymptotic analysis techniques to evaluate the time and space complexity of algorithms.

CO2: implement and manipulate fundamental data structures (arrays, linked lists, stacks, queues, binary trees) and perform operations such as traversal, insertion, and deletion.

CO3:develop and compare algorithms for searching and sorting in terms of efficiency.

CO4: utilize advanced data structures like priority queues, balanced search trees, and hashing methods to solve computational problems effectively.

CO5: analyze and apply graph algorithms (BFS, DFS), string data structures (suffix arrays, tries), and randomized structures (skip lists) to real-world applications.

Mapping of course outcomes with program outcomes:

High – 3 Medium -2 Low - 1

PO PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PSO1	PSO2
CO1	3	2	–	1	2	–	–	–	1	–	1	2	1
CO2	2	–	2	1	2	–	–	1	1	–	–	2	1
CO3	2	2	–	2	2	–	–	1	1	–	–	1	2
CO4	2	2	2	–	2	1	–	1	–	1	–	2	1
CO5	2	2	–	2	2	–	–	1	1	–	2	2	1
Average	**2.2**	**1.6**	**0.8**	**1.2**	**2**	**0.2**	**0.0**	**0.8**	**0.8**	**0.2**	**0.6**	**1.8**	**1.2**

Prerequisite: CS1201

Syllabus :

Performance of algorithms: space and time complexity, asymptotics; Fundamental Data structures: linked lists, arrays, matrices, stacks, queues, binary trees, tree traversals; Algorithms for sorting and searching: linear search, binary search, insertion-sort, selection sort, bubble-sort, quicksort, mergesort, heapsort, shellsort; Priority Queues: lists, heaps, binomial heaps, Fibonacci heaps; Graphs: representations, depth first search, breadth first search; Hashing: separate chaining, linear probing, quadratic probing; Search Trees: binary search trees, red-black trees, AVL trees, splay trees, B-trees; Strings: suffix arrays, tries; Randomized data structures: skip lists.

Texts :

1. T H Cormen, C E Leiserson, R L Rivest and C Stein, Introduction to Algorithms, MIT Press, 2001.
2. M A Weiss, Data Structures and Problem Solving Using Java, Addison-Wesley, 1997.

References :

1. A M Tannenbaum, Y Langsam and M J Augenstein, Data Structures Using C++, Prentice Hall India, 1996.
2. A H Aho, J E Hopcroft and J Ullman, Data Structures and Algorithms, Addison-Wesley, 1987.
3. Robert Sedgewick, Algorithms in C++ Parts 1-4, Pearson Education, Third Edition, 1998.
4. Robert Sedgewick, Algorithms in C++ Part 5, Pearson Education, Third Edition, 2002

CS2302	DISCRETE STRUCTURES	L-T-P-C 3-0-0-3

Course Outcomes (COs)

CO1: Apply set theory, logic, and proof techniques to analyze mathematical and computational problems.
CO2: Solve problems in number theory using classical algorithms and identify patterns in special numerical sequences.
CO3: Use combinatorial techniques and generating functions to model and solve counting problems.
CO4: Analyze the properties of graphs and apply graph-theoretical techniques to solve problems involving connectivity, matchings, and colouring.
CO5: Understand and apply algebraic structures including groups, rings, fields, and Boolean algebras in abstract problem-solving contexts

CO/PO mapping with PSO

High – 3 Medium -2 Low - 1

CO/Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	2	1	-	-	-	1	1	-	2	3
CO2	3	3	3	2	1	-	-	-	1	1	-	3	3
CO3	3	3	3	2	1	-	-	-	1	1	-	3	3
CO4	3	3	3	3	1	-	-	-	1	1	-	3	3
CO5	3	3	3	2	1	-	-	-	1	1	-	3	3

Prerequisite: NIL
Syllabus:
Set theory: sets, relations, functions, countability; Logic: formulae, interpretations, methods of proof, soundness and completeness in propositional and predicate logic; Number theory: division algorithm, Euclid's algorithm, fundamental theorem of arithmetic, Chinese remainder theorem, special numbers like Catalan, Fibonacci, harmonic and Stirling; Combinatorics: permutations, combinations, partitions, recurrences, generating functions; Graph Theory: paths, connectivity, subgraphs, isomorphism, trees, complete graphs, bipartite graphs, matchings,

colourability, planarity, digraphs; Algebraic Structures: semigroups, groups, subgroups, homomorphisms, rings, integral domains, fields, lattices and Boolean algebras.

Texts :
1. C L Liu, Elements of Discrete Mathematics, 2/e, Tata McGraw-Hill, 2000
2. R C Penner, Discrete Mathematics: Proof Techniques and Mathematical Structures, World Scientific, 1999.

References :
1. R L Graham, D E Knuth, and O Patashnik, Concrete Mathematics, 2/e, Addison-Wesley, 1994.
2. K H Rosen, Discrete Mathematics & its Applications, 6/e, Tata McGraw-Hill, 2007.
3. J L Hein, Discrete Structures, Logic, and Computability, 3/e, Jones and Bartlett, 2010.
4. N Deo, Graph Theory, Prentice Hall of India, 1974.
5. S Lipschutz and M L Lipson, Schaum's Outline of Theory and Problems of Discrete Mathematics, 2/e, Tata McGraw-Hill, 1999.
6. J P Tremblay and R P Manohar, Discrete Mathematics with Applications to Computer Science, Tata McGraw-Hill, 1997.

CS2303	DIGITAL LOGIC DESIGN	L-T-P-C 3-0-3-4.5

CO1: The student should be able to apply Boolean algebra and minimization techniques to simplify and implement combinational circuits.

CO2: The student should be able to design and analyze combinational logic circuits using decoders, multiplexers, ROMs, PLAs

CO3: The student should be able to construct and compare sequential circuits using latches, flip-flops, and memory elements

CO4: The student should be able to develop state diagrams, ASM charts, and synthesize sequential circuits.

CO5: The student should be able to evaluate modern digital design trends.

Mapping of CO- PO and PSO

High – 3 Medium -2 Low - 1

CO/Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	3	2	2	1	1	-	-	-	-	-	1	2
CO2	3	3	3	2	2	-	-	-	-	-	1	3
CO3	3	3	2	2	1	-	-	-	-	-	1	3
CO4	3	3	3	3	2	-	1	1	1	1	2	2
CO5	2	2	2	2	3	1	1	1	1	2	3	1
Average	2.8	2.6	2.4	2	1.8	0.2	0.4	0.4	0.4	0.6	1.6	2.2

Prerequisite: NIL

Syllabus:

Boolean Algebra and switching functions; Minimization and realization using logic gates, ROMs, PLAs, multiplexers; Circuits for code conversion; Flip-flops, registers, counters; Finite state model: State tables

CS2303	DIGITAL LOGIC DESIGN	L-T-P-C 3-0-3-4.5

and diagrams; State minimization; Excitation functions of memory elements; Synthesis of synchronous sequential circuits; Representation and synthesis using ASM charts; Incompletely specified machines; Specification and synthesis of asynchronous sequential machines; Current trends in digital design: ASIC, FPGA, etc.; Number representation: fixed and floating point; Addition, subtraction, multiplication and division of numbers.

Texts :

1. M. Morris Mano and M. D. Ciletti, Digital Design, 4/e, Pearson Education, 2007.
2. R. H. Katz and G. Boriello, Contemporary Logic Design, 2/e, Prentice Hall of India, 2009.

References :

1. A. P. Malvino, D. P. Leach and G.Saha, Digital Principles and Applications, 7/e, McGraw Hill, 2010.
2. Z. Kohavi and N. Jha, Switching and Finite Automata Theory, 3/e, Cambridge University Press, 2010.
3. S. C. Lee, Digital Circuits and Logic Design, Prentice Hall of India, 2006.
4. J. F. Wakerly, Digital Design Principles and Practices, 4/e, Prentice Hall of India, 2008.

CS2304	PROGRAMMING IN PYTHON	L-T-P-C 3-0-2-4

Course Outcomes

After completing this course the student will be able to:

CO1: Write programs using built-in data types of Python.

CO2: Implement arrays and user defined functions in Python.

CO3. Solve problems spanning multiple disciplines using suitable programming constructs in Python.

CO4: Solve problems spanning multiple disciplines using the concepts of object oriented programming in Python.

CO5: Have basic understanding on the working of Pandas Library, Matplotlib, and Numpy

Mapping of course outcomes with program outcomes:

High – 3 Medium -2 Low - 1

CO/Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO12
CO1	3	2			3				1		2	3	2
CO2	3	2	2		3						2	3	2
CO3	2	3	3	2	2	1		1			3	3	2

CS2304	PROGRAMMING IN PYTHON	L-T-P-C 3-0-2-4

CO4	2	2	3	2	2		1	2		1	3	3	3
CO5	2		1	3				1	1	3	3	3	3

Prerequisite: CS1201

Syllabus: Introduction to algorithms - Variables, expressions, and statements, Conditional execution - Chained conditionals, Nested conditionals, Functions - Built-in functions, Parameters and arguments, Iterations and Ranges - Updating variables, The while statement, For Loops, Loop patterns, Collections in Python - Dictionaries, Lists, Tuples, Regular Expressions, File Operations, Module system in python, Object-oriented programming – Inheritance, Method overriding Data hiding, Basic Pandas and Numpy processing of data

Texts :

1. Luciano Ramalho , Fluent Python, O'Reilly Media, 2nd Edition, 2022

2. Charles R. Severance, Python for Everybody, Shroff Publishers, 2017, Link: http://do1.dr-chuck.com/pythonlearn/EN_us/pythonlearn.pdf

References :

1. Mark Lutz, Learning Python, O'Reilly Media, 2013

2. Reema Thareja, PYTHON PROGRAMMING 2E, OXFORD, 2023

3. Allen Downey, Jeffrey Elkner, Learning with Python, 2015

4. R. Nageswara Rao, Core Python Programming. 2021

CS2401	FORMAL LANGUAGES AND AUTOMATA THEORY	L-T-P-C 3-1-0-4

CO1: The student should be able to apply the fundamentals of formal languages, grammars, and automata theory to describe and classify computational problems.

CS2401	FORMAL LANGUAGES AND AUTOMATA THEORY	L-T-P-C 3-1-0-4

CO2: The student should be able to understand the concept of abstract machines and their power to recognize the languages.

CO3: The student should be able to analyze context-free languages and design pushdown automata to recognize them.

CO4: The student should be able to compare context-sensitive, recursive enumerable languages, and evaluate their computational models such as linear bounded automata and Turing machines.

CO5: The student should be able to assess decidability and undecidability issues of formal languages to determine the solvability of computational problems.

Mapping of CO- PO and PSO

High – 3 Medium -2 Low - 1

CO/Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1
CO1	3	2	1	1	2	-	-	-	-	-	2	3
CO2	3	2	2	1	2	-	-	-	-	-	2	3
CO3	3	3	2	2	2	-	-	1	-	-	2	3
CO4	3	3	2	2	3	-	-	-	-	-	3	3
CO5	3	3	2	2	3	1	1	-	-	-	3	3
Average	3	2.6	1.8	1.6	2.4	0.2	0.2	0.2	-	-	2.4	3

Prerequisite: NIL

Syllabus:

Alphabets, languages, grammars; Finite automata: regular languages, regular expressions; Context -free languages: pushdown automata, DCFLs; Context sensitive languages: linear bounded automata; Turing machines: recursively enumerable languages; Operations on formal languages and their properties; Chomsky hierarchy; Decision questions on languages.

Texts :

1. J. E. Hopcroft, R. Motwani and J. D. Ullman, Introduction to Automata Theory, Languages and Computation, 2/e, Pearson Education, 2000.

References :

1. M. Sipser, Introduction to the Theory of Computation, Thomson, 2004.
2. H. R. Lewis, C. H. Papadimitriou, Elements of the Theory of Computation, Pearson Education Asia, 2001.

CS2401	FORMAL LANGUAGES AND AUTOMATA THEORY	L-T-P-C 3-1-0-4
3. D. C. Kozen, Automata and Computability, Springer-Verlag, 1997.		

CS2402	DESIGN AND ANALYSIS OF ALGORITHMS	L-T-P-C 3-0-3-4.5

Course Outcomes

CO1: effectively analyse algorithm efficiency using asymptotic notations and determine lower bounds for computational problems like sorting.

CO2: proficiently design and apply algorithms using core paradigms such as greedy, divide-and-conquer, dynamic programming, backtracking, and branch-and-bound.

CO3: implement and utilize various graph algorithms for connectivity, shortest paths, minimum spanning trees, and network flow, including the Disjoint Set Union data structure.

CO4: solve string matching problems and comprehend the theoretical implications of NP-completeness within computational complexity.

CO5: understand and differentiate between approximate and randomized algorithms, recognizing their roles in addressing complex computational challenges.

Mapping of course outcomes with program outcomes:

High – 3 Medium -2 Low - 1

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	–	–	1	–	–	–	–	–	–	1	–
CO2	2	2	3	–	1	–	–	–	–	–	–	2	–
CO3	2	2	3	–	2	–	–	–	–	–	–	2	–
CO4	2	3	2	–	–	–	–	–	–	–	–	2	–
CO5	2	2	2	–	–	–	–	–	–	–	–	2	1
Average	2	2	2	–	–	–	–	–	–	–	–	2	1

Prerequisite: CS2301 and CS2302

Syllabus:

Models of Computation: space and time complexity measures, lower and upper bounds; Design techniques: the greedy method, divide-and-conquer, dynamic programming, backtracking, branch and bound; Lower bound for sorting; Selection; Graph Algorithms: connectivity, strong connectivity,

CS2402	DESIGN AND ANALYSIS OF ALGORITHMS	L-T-P-C 3-0-3-4.5
biconnectivity, topological sort, shortest paths, minimum spanning trees, network flow; The disjoint set union problem; String matching; NP-completeness; Introduction to approximate algorithms and Randomized algorithms.		
Texts : 1. T H Cormen, C E Leiserson, R L Rivest and C Stein, Introduction to Algorithms, MIT Press, 2001. 2. Jon Kleinberg and Eva Tardos, Algorithm Design, Addison Wesley, 2005.		
References : 1. A Aho, J E Hopcroft and J D Ullman, The Design and Analysis of Computer Algorithms, Addison-Wesley, 1974. 2. S Sahni, Data Structures, Algorithms and Applications in C++, McGraw-Hill, 2001. 3. M T Goodrich and R Tamassia, Algorithm Design: Foundations, Analysis and Internet Examples, John Wiley & Sons, 2001.		

CS2403	COMPUTER ORGANIZATION AND ARCHITECTURE	L-T-P-C 3-0-3-4.5

Course Outcomes

CO1: Understand the basics of instruction sets and their impact on processor design.

CO2: Demonstrate an understanding of the design of the functional units of a digital computer system.

CO3: Evaluate cost performance and design trade-offs in designing and constructing a computer processor including memory.

CO4: Design a pipeline for consistent execution of instructions with minimum hazards.

CO5: Manipulate representations of numbers stored in digital computers.

Mapping of course outcomes with program outcomes:

High – 3 Medium -2 Low - 1

PO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO1	PS O2
CS2403.1	3	2	-	-	2	-	-	-	-	-	-	2	-
CS2403.2	3	2	-	-	2	-	-	-	-	-	-	2	-
CS2403.3	2	3	2	2	-	2	-	-	-	-	-	2	2
CS2403.4	3	2	2	-	2	-	-	-	-	-	-	3	-
CS2403.5	3	-	-	-	-	-	-	-	-	-	-	2	-
Average	2.8	1.8	0.8	0.4	1.2	0.4	0	0	0	0	0	2.2	0.4

Prerequisite: CS2303

Syllabus:

Arithmetic and Logic Unit; Memory Organization; Instruction sets; RISC and CISC paradigms; Various addressing modes; Assembly language programming; Instruction interpretation: micro-operations and their RTL specification; CPU design: Hardwired and Microprogrammed; I/O transfer techniques: Program controlled, Interrupt controlled and DMA; Introduction to computer buses, peripherals and current trends in architecture.

Texts :

1. William Stallings, Computer Organization and Architecture: Designing for Performance, 8/e, Pearson Education India. 2010.

CS2403	COMPUTER ORGANIZATION AND ARCHITECTURE	L-T-P-C 3-0-3-4.5
2. D. A. Patterson and J. L. Hennessy, Computer Organization and Design, 4/e, Morgan Kaufmann, 2008.		
References : 1. A. S. Tanenbaum, Structured Computer Organization, 5/e, Prentice Hall of India, 2009. 2. V. C. Hamacher, Z. G. Vranesic and S. G. Zaky, Computer Organization, 5/e, McGraw Hill, 2002. 3. J. L. Hennessy and D. A. Patterson, Computer Architecture: A Quantitative Approach, 4/e, Morgan Kaufmann, 2006. 4. D. V. Hall, Microprocessors and Interfacing, 2/e, McGraw Hall, 2006.		

CS2404	OBJECT ORIENTED PROGRAMMING	L-T-P-C 3-0-3-4.5

Course Outcomes

CO1 – Understand the core principles and constructs of object-oriented programming.

CO2 –Apply inheritance and polymorphism to develop modular and reusable code.

CO3 – Implement encapsulation, abstraction, and robust error handling

CO4 – Develop programs using file handling, templates/generics of C++.

CO5 – Build real-world applications using advanced OOP concepts and tools.

Mapping of course outcomes with program outcomes:

High – 3 Medium -2 Low - 1

P O CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CS1201.1	3	2	1	1	2	1	1	1	1	1	2	2	2
CS1201.2	3	2	2	1	3	1	1	2	1	1	2	3	2
CS1201.3	3	2	2	2	3	1	2	2	1	1	2	3	2
CS1201.4	3	2	2	2	3	1	1	2	1	2	2	3	2
CS1201.5	3	3	3	2	3	2	2	3	2	3	3	3	3
Average	3	2.2	2	1.6	2.8	1.2	1.4	2	1.2	1.6	2.2	2.8	2.2

CS2404	OBJECT ORIENTED PROGRAMMING	L-T-P-C 3-0-3-4.5

Prerequisite: NIL

Syllabus:

Introduction to Object-Oriented Programming: History and evolution, Key concepts: classes, objects, inheritance, polymorphism; Classes and Object: Defining classes, Creating objects, Constructors and destructors; Inheritance: Types of inheritance, Implementing inheritance in C++ and Java, Overriding methods; Polymorphism: Static vs dynamic polymorphism, Operator overloading, Method overloading and overriding; Encapsulation and Abstraction: Data hiding, Access specifiers, Abstract classes and interfaces; Exception Handling: Types of exceptions, Try-catch blocks, Custom exceptions; File Handling: Reading and writing files, Serialization and deserialization; Templates and Generics: Template functions and classes in C++, Generics in Java and Python; Standard Template Library (STL): Containers, Iterators, Algorithms; Design Patterns: Introduction to design patterns, Common design patterns: Singleton, Factory, Observer; Advanced Topics: Multithreading and concurrency, Network programming, GUI development; Project and Case Studies: Building a small project using object-oriented concepts, Case studies of real-world applications.

Textbooks:

1. Object-Oriented Programming in C++ By Robert Lafore
2. Object Oriented Programming with C++ by Balaguruswamy, TMH
3. Dietel H.M, Dietel P.J, "Java: How to Program", Prentice-Hall, 7th Edition, 2006.
4. Flanagan D, "Java in a Nutshell", O'Reilly Media, Inc., 5th Edition. 2005.

References :

1. Object Oriented Programming By- Budd, Addison Wesley.
2. Mastering C++ By K.R Venugopal , Rajkumar, TMH.
3. An Introduction to Object Oriented Programming with C++ by Timthy Budd, Addition-Wesley
4. C++ and Object-Oriented Programming By - Kip R. Irvine, Prentice Hall.
5. P. Radha Krishna, “Object Oriented Programming through Java”, Universities Press, 2nd Edition, 2007
6. Bruce Eckel, “Thinking in Java”, Pearson Education, 4th Edition,2006

CS3501	SOFTWARE ENGINEERING	L-T-P-C 3-0-0-3

Course Outcomes

After completing this course, the student will be able to:

CS3501.1	Understand the principles of software engineering and software processes
CS3501.2	Apply requirements engineering and modeling techniques using UML and design concepts
CS3501.3	Analyze quality measures, metrics, and estimation techniques for software projects
CS3501.4	Evaluate software testing methods and risk management strategies
CS3501.5	Develop project schedules and apply maintenance strategies for software systems

Mapping of course outcomes with program outcomes:

High – 3 Medium -2 Low - 1

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CS3501.1	3	1		1		1					1		1
CS3501.2	2	2	3		1			1	1		1	2	1
CS3501.3	2	2		2	1				1	1	1	2	2
CS3501.4		2		3	2	1	1		1		1	1	2
CS3501.5		1	3	1	2				1	2	1	2	2
Average	1.4	1.6	1.2	1.4	1.2	0.4	0.2	0.2	0.8	0.6	1	1.4	1.6

Mapping of course outcomes with PSO:

High – 3 Medium -2 Low - 1

PSO **CO**	**PSO1**	**PSO2**
CS3501.1	3	2
CS3501.2	2	2

CS3501.3	2	2
CS3501.4	2	2
CS3501.5	2	2
Average	2	3

Software Engineering	CS3501
Credit scheme - L-T-P-C: 3-0-3-4.5	Nil

Prerequisite: NIL
Syllabus:
Software and Software Engineering; The Software Process: Process models; Modeling: Requirements engineering, requirements modeling, UML, design concepts, etc.; Quality Management; Product metrics; Process and project metrics; Software estimation techniques; Software testing strategies; Project scheduling; Risk management; Maintenance.

Texts :
1. Pressman, R.S., Software Engineering: A Practitioner's Approach, McGraw Hill, seventh edition, 2010.

References:
1. Sommerville, Ian, Software Engineering, Addison-Wesley, fifth edition, 2000.
2. Jalote, P., An Integrated Approach to Software Engineering, Narosa Publishing House, second edition, 2003.
3. Bennett S., McRobb S. & Farmer R., Object Oriented Systems Analysis and Design using UML, Tata McGraw-Hill, second edition, 2004.

CS3502	OPERATING SYSTEMS	L-T-P-C 3-0-3-4.5

Course Outcomes
After completing this course the student will be able to:

CS3502.1: effectively manage processes and threads by applying CPU scheduling algorithms.
CS3502.2: proficiently manage concurrency, resolve synchronization issues, and handle deadlocks in operating systems.
CS3502.3: apply fundamental memory management techniques, including allocation, protection, paging, and segmentation.
CS3502.4: implement virtual memory concepts such as demand paging, page replacement, and TLBs.
CS3502.5: effectively manage file systems and I/O operations, including device drivers and disk

Scheduling.

Mapping of course outcomes with program outcomes:

High – 3 Medium -2 Low - 1

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3			1	2	0	0	0	1	1	1	2	2	2
CO2	2	2	3	2	2	0	0	0	1	1	1	2	3	2
CO3	2	3	2	1	2	0	0	0	1	1	1	2	2	2
CO4	2	3		3	2	0	0	0	1	1	1	2	3	2
CO5		2		2	3	1	1	1	2	2	2	2	2	3
Average	1.8	2	1	1.8	2.2	0.2	0.2	0.2	1.2	1.2	1.2	2	2.4	2.2

Prerequisite: CS2402 and CS2403

Syllabus:

Process Management: process, thread, scheduling; Concurrency: mutual exclusion, synchronization, semaphores, deadlocks; Memory Management: allocation, protection, hardware support, paging, segmentation; Virtual Memory: demand paging, allocation, replacement, swapping, segmentation, TLBs; File Management: naming, file operations and their implementation; File Systems: allocation, free space management, directory management, mounting; I/O Management: device drivers, disk scheduling.

Texts :

1. Silberschatz, A. and Galvin, P. B. Operating System Concepts. 8/e. Wiley, 2008.

References :

1. Stalling, W. Operating Systems: Internals and Design Principles. 6/e. Pearson, 2008.
2. Tanenbaum, A. S. Modern Operating System. 3/e. Pearson, 2007.
3. Dhamdhere, D. M. Operating SystemsA Concept Based Approach, McGrawHill, 2008.

CS3503	COMPILER DESIGN	L-T-P-C 3-0-3-4.5

Course Outcomes

After completing this course, the student will be able to:

CS3503.1: Acquire knowledge of different phases of compiler and have the ability to apply the knowledge of lex tools to develop a scanner.

CS3503.2: Understand the parser and its types namely Top-Down and Bottom-Up Parsers and implementation and construction of LL and LR parsing table. Acquire skills in using yacc tool to develop a parser.

CS3503.3: Acquire knowledge on generating Intermediate Representations and understand the importance of designing simpler languages.

CS3503.4: Understand the importance of code optimization and analyse code optimization algorithms in order to improve the performance of a program in terms of space and time complexity.

CS3503.5: Understand the run time environment of target machine and analyse algorithm and its instruction set for code generation.

Mapping of Course Outcomes onto POs and PSOs

High – 3 Medium -2 Low - 1

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO 1	3	1							2	2		3	3
CO 2	3	2	2	1	3				1	3		2	3
CO 3	3	3	3	2	3				2	2		2	2
CO 4	3	2	2	2	1				2	1		1	3
CO 5	3	1	1		1				1	1		2	2

Prerequisite: CS2401

Syllabus:

Overview of different phases of a compiler: front-end; back-end; Lexical analysis: specification of tokens, recognition of tokens, input buffering, automatic tools; Syntax analysis: context free grammars, top down and bottom up parsing techniques, construction of efficient parsers, syntax-directed translation, automatic tools; Semantic analysis: declaration processing, type checking, symbol tables, error recovery; Intermediate code generation: run-time environments, translation of language constructs; Code generation: flow-graphs, register
allocation, code-generation algorithms; Introduction to code optimization techniques.

Texts :

1. Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, Compilers: Principles, Techniques, and Tools, 2nd Edition, Prentice Hall, 2009.

References :
1. V. Raghavan, Principles of Compiler Design, McGrawHill, 2010.
2. C.N. Fischer, R.J. Le Blanc, Crafting a Compiler with C, Pearson Education, 2009.
3. K. D. Cooper, L. Torczon, Engineering a Compiler, Morgan Kaufmann Publishers, 2004.

CS3504	DATA COMMUNICATION	L-T-P-C 3-0-0-3

Course Outcomes (COs):

CO3504.1: Understand the basic principles of digital communication, including signal behavior, noise, Nyquist rate, and Shannon capacity.

CO3504.2: Explain analog and digital transmission techniques such as modulation methods (AM, FM), PCM, ADPCM, line coding, and error handling.

CO3504.3: Compare different transmission media (twisted pair, coaxial, fiber optic) and describe guided and unguided communication channels.

CO3504.4: Analyze signaling methods (balanced and unbalanced) and apply interfacing techniques for effective data communication.

CO3504.5: Demonstrate knowledge of switching techniques and the architecture of local area networks including Ethernet, Fast Ethernet, Gigabit Ethernet, WLAN, and networking devices like hubs, bridges, and switches.

CO-PO and CO-PSO Mapping Table:

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO1 1**	**PSO 1**	**PSO 2**
CO3 504. 1	3	2	1	1	2	1	-	-	1	-	2	2	2
CO3 504. 2	3	3	2	1	3	-	-	-	-	-	2	3	2
CO3 504. 3	2	2	1	-	2	2	-	-	1	-	1	2	2

CO3 504. 4	2	2	2	-	3	-	-	-	1	-	1	3	2
CO3 504. 5	2	2	3	-	3	2	-	**1**	2	1	1	3	3

Prerequisite: NIL

Syllabus:

Basics of Digital communications: Signals, noise, Nyquist rate, Shannon capacity; Analog transmission: modulation techniques, fundamentals of modems, FDM;

Digital transmission: PCM, ADPCM, line coding, error handling techniques, TDM, xDSL, spread spectrum; Transmission media: Guided (twisted pair, coaxial, fiber optic)

and unguided media; Balanced and unbalanced signalling, interfacing; Principles of switching; Local area networks: Ethernet, Fast Ethernet, introduction to Gigabit Ethernet

and WLANs; Hubs, bridges and switches.

Texts :

1. W. Stallings, Data and Computer Communications, 8th Ed, Pearson India, 2007.
2. B. Forouzan, Data Communications and Networking, 4th Ed, Tata Mcgraw Hill, 2006.

References :

1. A. S. Tanenbaum, Computer Networks, 4th Ed, Pearson India, 2003.
2. J. Quinn, Digital Data Communications, 1st Ed, Prentice Hall Career and Technology, 1995.
3. P. C. Gupta, Data Communications and Computer Networks, 2nd Ed, Prentice Hall of India, 2009.
4. F. Halsall, Data Communications, Computer Networks and Open Systems, 4th Ed, Addison Wesley, 1996

CS3571	DIGITAL IMAGE PROCESSING	L-T-P-C 3-0-0-3

Course Outcomes

After completing this course, the student will be able to:

CS3571.CO1 – Apply fundamentals of image processing and transformation techniques.
CS3571.CO2 – Perform spatial and frequency domain image enhancement techniques.
CS3571.CO3 – Analyze and apply image restoration models to degraded images.
CS3571.CO4 – Apply segmentation algorithms to extract meaningful image regions.
CS3571.CO5 – Implement image compression and morphological processing techniques.

Mapping of course outcomes with program outcomes:

High – 3 Medium -2 Low - 1

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CS3571.1	3					2		3			
CS3571.2	2	2	3				3		1		
CS3571.3	2	3	2				2	2	2		3
CS3571.4	2	3			2				2	3	2
CS3571.5		2			2	2	2		1		2
Average	1.5	1.67	0.83	0.33	1	1.16	1.5	0.83	1	0.5	1.16

Mapping of course outcomes with PSO:

High – 3 Medium -2 Low - 1

PSO / CO	PSO1	PSO2
CS3571.1	3	2
CS3571.2	3	2
CS3571.3	3	2
CS3571.4	3	2
CS3571.5	3	2
CS3571.1	3	2

Syllabus:

Introduction - Elements of digital image processing systems, Elements of visual perception, brightness, contrast, hue, saturation, mach band effect, Color image fundamentals - RGB, HSI models, Image sampling, Quantization, dither, Two-dimensional mathematical preliminaries, 2D transforms - DFT, DCT, KLT, SVD. 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, 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. 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.
Texts : 1. Digital Image Processing, Rafael C.Gonzalez, Richard E.Woods, Second Edition, Pearson Education/PHI, 2000. 2. . W.K.Pratt, Digital Image Processing ,3/e Edn., John Wiley & sons, Inc. 2006. 3. K. R. Castleman, Digital Image Processing, Pearson, 2006. 4. Anil K. Jain, Fundamental of image processing, Pearson, 2002.
References : 1. Image Processing, Analysis, and Machine Vision, Milan Sonka, Vaclav Hlavac and Roger Boyle, Second Edition, Thomson Learning, 2008. 2. Introduction to Digital Image Processing with Matlab, Alasdair McAndrew, Thomson Course Technology,2001. 3. Computer Vision and Image Processing, Adrian Low, Second Edition, B.S. Publications, 2005. 4. Digital Image Processing using Matlab, Rafael C.Gonzalez, Richard E.Woods, Steven L. Eddins, Pearson Education, 2007.

CS3601	DATABASE MANAGEMENT SYSTEMS	L-T-P-C 3-0-3-4.5
Course Outcomes **CO1:** Model Entity-Relationship diagrams for enterprise level databases. **CO2:** Formulate Queries using SQL and Relational Formal Query Languages. **CO3:** Apply different normal forms to design the Database. **CO4:** Summarize concurrency control protocols and recovery algorithms. **CO5:** Identify suitable Indices and Hashing mechanisms for effective storage and retrieval of Data. **Mapping of Course Outcomes onto POs and PSOs** High – 3 Medium -2 Low - 1		

PO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PS O1	PS O2
CS360 1.1	2	2	2	1	1						1	2	1
CS360 1.2	2	2	1	1	2						1	2	1
CS360 1.3	2	2	2	1	2						1	2	1
CS360 1.4	1	2	1	2	2				1		1	2	1
CS360 1.5	1	2	1	1	2				1		1	2	2
Average	1.6	2	1.4	1.2	1.8	0	0	0	0.4	0	1	2	1.2

Prerequisite: NIL

Syllabus:

Data models with emphasis on the relational model; Database design with E-R model; Relational algebra and calculus; query Languages (specifically SQL); RDBMS design; File & system structure: indexed sequential, hashed, dynamic hashed, B-trees; Query processing; Concurrency control; error recovery; security; Case studies like ORACLE, Mysql, etc.; Introduction to Open Database Connectivity, Client-Server environment etc.

Texts :

1. A. Silberschatz, H. F. Korth and S. Sudarshan, Database System Concepts, 5/e, McGraw Hill, 2006
2. R. Ramakrishnan and J. Gehrke, Database Management Systems, 3/e, McGraw Hill, 2003

References :

1. Elmasri R, Navathe S B, Fundamentals of Database Systems, Benjamin Cummings Publishing Company, 1994.
2. ONeil P., Database : Principles, Programming, Performance, Morgan Kaufmann, 1994.
3. Theorey T J, Database Modeling & Design, 2/e, Morgan Kaufmann Publishers, 1994.
4. Melton J, Simon A R, SQL: A Complete Guide, Morgan Kaufmann Publishers, 1993.
5. H. GarciaMolina, J. D. Ullman and J. Widom, Database Systems The Complete Book,1/e, Pearson Education, 2CS4727

CS3602	COMPUTER NETWORKS	L-T-P-C 3-0-3-4.5

CO1: The student should be able to describe the basic concepts and terminology of computer networks, including network types, topologies, and models (OSI, TCP/IP).
CO2: The student should be able to explain various transmission media (guided and unguided), bandwidth, data rate limits (Shannon's and Nyquist's theorems), and signal propagation concepts.
CO3: The student should be able to identify the working of various data link layer protocols along with the numerical problems and applications.
CO4: Students will be able to describe logical addressing, routing; explain IP addressing schemes including IPv4, IPv6, subnetting, and CIDR; compare routing protocols like RIP, OSPF, and BGP.
CO5: The student should be able to demonstrate various concepts of TCP/UDP, applications of transport layers, various protocols in application layers and encryption.

Mapping of CO- PO and PSO

3- High 2- Medium 1- Low

CO/Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	1	1				1	1	2	2	1
CO2	3	3	2	2	1	1			1	2	2	1	2
CO3	2	3	3	2	2	1			2	2	2	2	2
CO4	2	2	2	2	2	1			2	1	2	2	2
CO5	2	2	3	3	2				2	1	2	2	1
	2.4	2.4	2.4	2	1.6	0.6	0	0	1.6	1.4	2	1.8	1.6

Prerequisite: CS2402
Syllabus:
Evolution of computer networks; Data link layer: Framing, HDLC, PPP, flow control, sliding window protocols, performance , medium access control, Token Ring, Virtual circuit switching: Frame relay, Network Layer: Internet addressing, class of address, IP, ARP, ICMP, CIDR, routing algorithms (RIP, OSPF, BGP); Transport Layer: UDP, TCP, flow control, congestion control; Application Layer: DNS, Web, email, authentication, encryption.

Texts :
1. L. L. Peterson and B. S. Davie, Computer Networks: A Systems Approach, 4th Ed, Elsevier India, 2007.
2. A. S. Tanenbaum, Computer Networks, 4th Ed, Pearson India, 2003.

References :
1. J. F. Kurose and K. W. Ross, Computer Networking: A Top down Approach, 3rd Ed, Pearson India, 2005.
2. D. E. Comer, Internetworking with TCP/IP Vol. 1, 5th Ed, Prentice Hall of India, 2006.
3. S. Keshav, An Engineering Approach to Computer Networking, 1st Ed, Pearson India, 1999.
4. B. Forouzan, Data Communications and Networking, 4th Ed, Tata McGraw Hill, 2006.

CS3603	ARTIFICIAL INTELLIGENCE	L-T-P-C 3-0-0-3

Prerequisite: CS2301

Course Outcomes

After completing this course the student will be able to:

CO1: Explain the foundations and history of AI, and agent design.

CO2: Illustrate problem-solving techniques, search methods, and CSP.

CO3: Demonstrate AI's use of knowledge representation through logic.

CO4: Design simple software to experiment with AI learning concepts.

CO5: Build self-learning and research skills in AI.

Mapping of Course Outcomes onto POs and PSOs

High – 3 Medium -2 Low - 1

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	1	2	-	-	-	1	2	1
CO2	-	3	3	-	2	-	-	-	-	-	-	3	2
CO3	2	-	-	3	3	-	-	-	-	-	-	2	2
CO4	-	2	2	-	3	-	-	1	-	2	-	3	2
CO5	-	-	-	-	-	2	1	-	2	-	3	2	3

Syllabus:

Introduction to intelligent agents. Problem Solving: Searching, Intelligent search methods, Game Playing. Knowledge and Reasoning: Building a Knowledge Base. Inference in First Order Logic, Logical reasoning systems. Planning. Uncertain Knowledge and Reasoning, Probabilistic Reasoning Systems.

Learning from Observations: Inductive Learning, Learning Decision Trees, Computational Learning Theory, Explanation Based Learning. Genetic algorithms, Artificial Neural Networks and Fuzzy Approaches. Introduction to Natural Language Processing. The course will include programming projects involving programming in Lisp, Prolog and C++.

Texts:

1. S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, 2nd Ed, Prentice Hall, 2003.

References:
1. E. Rich and K. Knight, Artificial Intelligence, McGraw Hill, 1991.
2. P. H. Winston and B. K. P. Horn, Lisp, 3rd Ed, Addison-Wesley, 1989.
3. P. Norvig, Paradigms of Artificial Intelligence Programming: Case studies in Common Lisp, Morgan Kauffman, 1991.

CS3674	PATTERN RECOGNITION	L-T-P-C	3-0-0-3

Course Outcomes
CO1: Understand the core theories and algorithms of pattern recognition.
CO2: Understand the state-of-the-art of pattern recognition algorithms.
CO3: Perform parametric classifier design, nonparametric classifier design, feature selection and dimension reduction, unsupervised data clustering.
CO4: Perform supervised learning with artificial neural networks.
CO5: Understand the applications such as face recognition, face detection, object detection, gesture recognition, speech recognition, etc.

Mapping of course outcomes with program outcomes:
High – 3 Medium -2 Low – 1

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	2	-	-	1	-	-	-	1	3	1
CO2	3	2	2	2	3	-	-	-	-	-	-	2	2
CO3	-	3	3	3	3	2	-	-	-	-	-	3	2
CO4	2	2	3	2	3	-	-	2	-	-	-	2	1
CO5	2	2	2	-	2	3	-	2	-	-	3	2	3

Syllabus: Introduction to Pattern Recognition: Learning paradigms, Supervised and unsupervised learning; Bayesian decision theory: Minimum error rate classifier; Parameter estimation: Maximum likelihood and Bayesian Estimation; Hidden Markov models; Nonparametric techniques: Nearest neighbor rules, Parzen windows; Decision trees: Axis-parallel, Oblique, Impurity measures; Feature selection: Forward, backward search; Component analysis and discriminant functions: Principal component analysis, Fisher linear discriminant, Perceptron, Support vector machines; Generalization ability of learning methods: Bias and variance, Regularization; Bootstrapping, Boosting, Bagging; Unsupervised learning and clustering: k-Means methods.

Texts:
1. R. O. Duda, P. E. Hart and D. G. Stork, Pattern classification, John Wiley & Sons, 2002.

References:

1. C. M. Bishop, Neural Networks for Pattern Recognition, Oxford University Press, 1995.
2. V. N. Vapnik, The Nature of Statistical Learning Theory, Springer, 2000.
3. N. Cristianini and J. Shawe-Taylor, An Introduction to Support Vector Machines, Cambridge University Press, 2000.
4. Selected Research Papers.

CS3685	STEGANOGRAPHY	L-T-P-C 3-0-0-3

Course Outcomes
CO1: Understand the importance of steganography in ancient time and difference between Steganography and Encryption
CO2: Gain complete knowledge of the carriers and formats of files required for steganography
CO3: Explain the different techniques for hiding information
CO4: Various methods of detecting hiding sensitive information .
CO5: Learn how to detect hidden messages in digital media using machine learning and artificial intelligence.

Mapping of course outcomes with program outcomes:
High – 3 Medium -2 Low – 1

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CS448.1	3	2	-	-	-	2	1	-	-	-	-	2	2
CS448.2	3	-	2	-	3	-	-	-	-	-	-	3	2
CS448.3	3	3	3	2	2	-	-	-	-	-	-	3	2
CS448.4	3	3	2	3	2	-	-	-	-	-	1	3	2
CS448.5	3	3	2	3	3	-	-	-	-	-	2	3	3

Syllabus:
Origins & Overview of Steganography - History of Use, Covert Messaging, Null Cipher Messages, Steganography vs. Encryption, Threats Posed by Steganography Use, Steganography in the Media, Availability & Production. Digital Carriers - Used to Exploit Human Weaknesses, Digital Images - Palette, True Color, Compressed Lossy, lossless, Formats: BMP, JPG, GIF, PNG, Digital Audio, Converters, Signal Processors, Wav files MP3, Dangers. Steganography Embedding Tools - Steganography Methods, Data Appending, Formatting Modification, Word Substitution, Color Palette Substitution, 24 Bit LSB Encoding, DCT Modification, PNS Modification, Covert Channels. Steganalysis - An Overview, The Statistical Properties of Images, The Visual Steganalytic System, IQM-Based

Steganalytic System, Learning Strategies, Introduction of the Support Vector Machine, Neural Networks, Principle Component Analysis, Frequency-Domain Steganalytic System.
Texts: 1. Information Hiding (Steganography and Watermarking - Attacks and Countermeasures), Johnson, Neil F./ Duric, Zoran/ Jajodia, Sushil , luwer Academic Pub, 2001 2. Information Hiding Techniques for Steganography and Digital Watermarking ,Katzenbeisser, Stefan (Edt)/ Petitcolas, Fabien, A.P. (Edt) , Artech House, 2000
References : 1. Intelligent Watermarking Techniques, J-S Pan, H-C Huang, L.C. Jain, World Scientific Pub. Co., 2004 2. Aliroo Home page, "www.aliroo.com 3. "ImageLock Home page", www.imagelock.com 4. "Digimarc Home page", www.digimarc.com

CS4701	COMPUTER GRAPHICS	L-T-P-C 3-0-3-4.5

Course Outcomes

CO1: Understand the basics of Computer Graphics, different graphics systems and applications of Computer Graphics

CO2: Understand various algorithms for scan conversion and drawing of basic objects for 3D rendering

CO3: Understand the core concepts of viewing pipeline, including viewing, projection, perspective, modelling and explore projections and visible surface detection methods for display of 3D scene on 2D screen

CO4: Acquire knowledge on use of geometric transformations on graphics objects and their application in composite form

CO5: Understand the concepts of color, lighting and shading models, textures, ray tracing, hidden surface elimination, anti-aliasing, and rendering

Mapping of Course Outcomes onto POs and PSOs

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO 1	3	1	1						2	1		3	3
CO 2	3	1	1						1	1		2	3
CO 3	3	3	3	2	3				2	2		2	2
CO 4	3	3	3	1	3				2	1		2	2
CO 5	3	1	2	2	2				1	1		1	1

Prerequisite: CS2402

Syllabus:

Introduction and organization of an interactive graphics system; Scan conversion: line, circle, and ellipse; Filling: rectangle, polygon, ellipse, and arc; Clipping: line, circle, ellipse, and polygon;Antialiasing: unweighted and weighted area sampling, and Gupta-Sproull methods; Transformations: 2D and 3D, homogeneous coordinates, composite and window-to-viewport transformations; 3D View: projections, specification and implementation of 3D view; Curves and Surfaces: polygon meshes, parametric cubic curves and bicubic surfaces, Hermite, Bezier, and B-splines curves and surfaces; Quadric surfaces; Solid Modeling: Boolean set operations, spatial partitioning methods (occupancy enumeration, octree, and binary space partitioning tree); Hidden line and surface removal: z-buffer, list-priority, and scan line algorithms, algorithms

for binary space partitioning trees and octrees, and ray tracing; Shading: illumination model, polygon shading (interpolated, Goursud, and Phong), texture mapping, shadow determination (scan line and z-buffer algorithms), transparency, global illumination model; Introduction to GPU and animation.

Texts :

1. D. Hearn and M. P. Baker, Computer Graphics with OpenGL, 3/e, Pearson, 2009.

References :

1. E. Angel. Interactive Computer Graphics: A Top-Down Approach using OpenGL, 5/e, Pearson, 2009.
2. J. D. Foley, A. Van Dam, S. K. Feiner and J. F. Hughes. Computer Graphics: Principles and Practice in C, 2/e, Addison-Wesley, 1995.
3. P. Shirley and S. Marschner. Computer Graphics. India Edition, Cengage Learning, 2009.

F. S. Hill. Computer Graphics using OpenGL, 3/e, Pearson, 2009.

CS4702	MACHINE LEARNING	L-T-P-C 3-0-3-4.5

Course Outcomes

CO1: Understand the basic concepts of machine learning, supervised, unsupervised, regression analysis, and machine learning algorithms.

CO2: Apply the learned concepts of machine learning to interpret various problems.

CO3: Analyze the different mathematical machine learning models for various systems.

CO4: Evaluate the performance of the machine learning model using various performance measures.

CO5: Develop an efficient machine learning system to solve various real-time problems.

Mapping of course outcomes with program outcomes:

High – 3 Medium -2 Low - 1

PO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PS O1	PS O2
CS4702.1	2	1	–	–	–	–	–	–	–	–	1	1	1
CS4702.2	2	2	1		1	–	–	–	–	–	–	2	1
CS4702.3	2	2	–	1	2	–	–	–	–	–	–	2	1
CS4702.4	1	2	–	2	2	–	–	–	–	–	–	2	1
CS4702.5	1	2	2	1	2	1	–	–	1	1	1	2	2
Average	1.6	1.8	0.6	0.8	1.4	0.2	0	0	0.2	0.2	0.4	1.8	1.2

Prerequisite:3603

Syllabus:

Introduction: Basic concepts; Supervised learning: Supervised learning setup, LMS, Logistic regression, Perceptron, Exponential family, Generative learning algorithms, Gaussian discriminant analysis, Naive Bayes, Support vector machines, Model selection and feature selection, Ensemble methods: Bagging, boosting, Evaluating and debugging learning algorithms; Learning theory: Bias/variance tradeoff, Union and Chernoff/Hoeffding bounds, VC dimension, Worst case (online) learning; Unsupervised learning: Clustering K-means, EM. Mixture of Gaussians, Factor analysis, PCA (Principal components analysis), ICA (Independent components analysis); Reinforcement learning and control: MDPs. Bellman equations, Value iteration and policy iteration, Linear quadratic regulation (LQR), LQG, Q-learning. Value function approximation, Policy search. Reinforce. POMDPs.

Texts :

1. Ethem Alpaydin, Introduction to Machine Learning, Second Edition, PHI, 2010
2. Machine Learning, Tom Mitchell, McGraw Hill, 1997.

References :

1. P. Langley, Elements of Machine Learning, Morgan Kaufmann, 1995.

CS4782	COMPUTER AND NETWORK SECURITY	L-T-P-C 3-0-0-3

Course Outcomes

CO1 Identify vulnerabilities, risks and liabilities in computer and network environment
CO2 Explain the Conventional Encryption Principles and the Public key cryptography principles.
CO3 Gain a complete knowledge on types of security attacks, services and mechanisms.
CO4 Identify the vulnerable points for attacks in simple networks and protect system from different types of threats, malicious software's vulnerabilities and attacks.
CO5 Distinguish and analyze available network and protocols such as SSL, IPSes, TLS, Kerberos, Firewalls, VPN.

CO-POS-PSO Mapping

CO Statement	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	3	–	–	1	–	–	–	–	–	–	2	–
CO2	2	2	–	–	–	–	–	–	–	–	–	–	–
CO3	2	2	1	–	–	–	–	–	–	–	–	1	–
CO4	2	3	2	–	1	–	–	–	–	–	–	2	1
CO5	2	3	2	–	1	–	–	–	–	–	–	2	1

Syllabus:
Overview, vulnerabilities, risk assessment, incidents. Cryptography: Classical Cryptography, Symmetric Cryptography, Public Key (Asymmetric cryptography), Modern Cryptography, Hash Functions, Key Exchange. Review: Installing Unix and common service daemons (Unix Security, Windows NT Security, Ping, traceroute, TCP Dump, sniffer etc.), Networking. Security issues: Terminology (Integrity, Availability, Confidentiality, Non-repudiation, Authentication, Authorization/Access Control, accounting, auditing, Passive and Active Attacker, Interruption, Interception, Modification, Fabrication, Social Engineering), Vulnerabilities and Counter Measures (Viruses, worms, Trojan horses, backdoors, unused services, buffer overflows, RPC), Exploits (Buffer overflow, Port Scanning etc). Applications Security (System Security, Audit Logs Intrusion Detection, Wrappers, Password and remote authorization tools e.g. PGP, S/MIME, SSH, Netscape/SSL, SET, IPsec, Kerberos, Firewalls, VPN etc, Secure (commerce) Transaction over a network, Network Anonymity. Practical Security Setup & Review: Installing Unix & Common Service Daemons, Unix Security & Windows NT Security, Networking & Security Tools: Ping, Traceroute, TCP Dump, Sniffers.

Texts :

1. W. Stallings, Cryptography and Network Security: Principles and Practice, 3rd Ed, Prentice Hall, 2003.

References :
1. B. Schneier, Applied Cryptography, 2nd Ed, John Wiley & Sons, Inc., 1996.
2. A. Menezes, P. van Oorshot and S. Vanstone, Handbook of Applied Cryptogrphy, CRC Press, 1997.
3. C. Kauffman, R. Perham and M. Speciner, Network Security: Private Communication in a Public World, Prentice-Hall, 1994.
4. H. C. A. van Tilborg, Fundamentals of Cryptology, Kluwer Academic Publishers, 2000.
5. P. Garrett, Making and Breaking Codes: An Introduction to Cryptology, Prentice-Hall, 2001.
6. P. Wayner, Disappearing Cryptography, 2nd Ed, Morgan Kaufmann, 2002.
7. W. Cheswick, S. Bellovin and A. Rubin, Firewalls and Internet Security. Repelling the Wiley Hacker, 2nd Ed, Addison-Wesley, 2003.
8. Related publications in Journals/Conferences.

CS4772	INFORMATION STORAGE AND RETRIEVAL	L-T-P-C 3-1-0-4

Course Outcomes

After completing this course the student will be able to :

CS4772.CO1 – Understand the foundational concepts and terminology of information retrieval systems.
CS4772.CO2 – Apply indexing and compression techniques for efficient information retrieval.
CS4772.CO3 – Compare and implement various information retrieval models.
CS4772.CO4 – Evaluate retrieval systems using performance metrics and classification
CS4772.CO5 – Implement clustering and advanced retrieval techniques to enhance search quality.

Mapping of course outcomes with program outcomes:

High – 3 Medium -2 Low - 1

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CS1201.1	3	2	1	1	2	1	1	1	1	1	2
CS1201.2	3	2	2	2	3	1	1	1	1	1	2
CS1201.3	3	3	2	2	3	1	1	2	1	1	2
CS1201.4	3	3	2	3	3	1	1	2	2	2	3
CS1201.5	3	3	3	2	3	2	1	2	2	2	3
Average	3	2.6	2	2	2.8	1.2	1	1.6	1.4	1.4	2.4

Syllabus:

Introduction: concepts and terminology of information retrieval systems, Significance of information retrieval and storage, Information Retrieval Vs Information Extraction; Indexing: inverted files, encoding, Zipf's Law, compression, boolean queries; Fundamental IR models: Boolean, Vector Space, probabilistic, TFIDF, Okapi, language modeling, latent semantic indexing, query processing and refinement techniques; Performance Evaluation: precision, recall, F-measure; Classification: Rocchio, Naive Bayes, k-nearest neighbors, support vector machine; Clustering: partitioning methods, k-means clustering, hierarchical; Introduction to advanced topics: search, relevance feedback, ranking, query expansion.

Texts :

1. Christopher D. Manning, Prabhakar Raghavan and Hinrich Schtze, Introduction to Information Retrieval, Cambridge University Press. 2008

2. Ricardo Baeza-Yates and Berthier Ribeiro-Neto, Modern Information Retrieval, Addison Wesley, 1st edition, 1999.

References :

1. Soumen Chakrabarti, Mining the Web, Morgan-Kaufmann Publishers, 2002.
2. Bing Liu, Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data, Springer, Corr. 2nd printing edition, 2009.
3. David A. Grossman, Ophir Frieder, Information Retrieval: Algorithms and Heuristics, Springer, 2nd edition, 2004.
4. William B. Frakes, Ricardo Baeza-Yates, Information Retrieval Data Structures and Algorithms, Prentice Hall, 1992.
5. G. Salton, M. J. McGill, Introduction to Modern Information Retrieval, McGraw-Hill, 1986.
6. C. J. Van Rijsbergen, Information Retrieval, Butterworth-Heinemann; 2nd edition, 1979.

CS4773	NATURAL LANGUAGE PROCESSING	L-T-P-C 3-0-0-3

Course Outcomes

After completing this course the student will be able to:

CO 1. Extract information from text automatically using concepts and methods from natural language processing (NLP) including stemming, n-grams, POS tagging, and parsing.
CO 2. Analyze the syntax, semantics, and pragmatics of a statement written in a natural language.
CO 3. Apply machine learning algorithms to natural language processing.
CO 4. Write scripts and applications in Python to carry out natural language processing using libraries such as NLTK, Gensim, and spaCY.
CO 5. Design NLP-based AI systems for question answering, text summarization, and machine translation.

Mapping of course outcomes with program outcomes:

High – 3 Medium -2 Low – 1

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	–	3	–	–	–	2	–	–	3	2
CO2	2	3	–	–	–	1	–	–	2	–	3	2	1
CO3	3	2	–	3	2	–	–	–	–	–	–	3	2
CO4	2	–	–	2	3	–	–	1	2	–	2	3	2
CO5	–	2	3	–	2	–	1	2	3	2	2	3	3

Syllabus:

Lexical Functional Grammar, Tree Adjoining Grammar, Government & Binding, Paninian Grammar. Comparison of Paninian Grammar with others. Logical Semantics, Script, Conceptual Dependency. Paragraph, Story, Dialogue understanding. Anaphora Resolution. Machine Translation with special reference to Indian Languages. Natural language interfaces to databases. Introduce more new research oriented topics, topics of current research which will focus on the state- of-the-art in various areas of Natural Language Processing.

Texts:

1. Grasz, Jones & Webber (Ed.): Readings in Natural Language Processing, Morgan Kaufmann, 1986.
2. Gazdar & Mellish: Natural Language Processing in PROLOG, Addision Wesley, 1989.
3. Leonard Bolc. (Ed.): Natural Language Parsing Systems, Springer Verlag, 1987.

References:

1. McDonald & Bolc. (Ed.): Natural Language Generation Systems, Springer Verlag, 1987.
2. W. J. Hutchins: Machine Translation - Past, Present & Future, Ellis Horwood, 1986.
3. Bharati, Chaitanya and Sangal: Natural Language Processing- a Paninian perspective, PHI, 1985.

CS4852	ARTIFICIAL INTELLIGENCE	L-T-P-C 3-0-0-3

Prerequisite: CS2301

Course Outcomes

After completing this course the student will be able to:

CO1: Explain the foundations and history of AI, and agent design.

CO2: Illustrate problem-solving techniques, search methods, and CSP.

CO3: Demonstrate AI's use of knowledge representation through logic.

CO4: Design simple software to experiment with AI learning concepts.

CO5: Build self-learning and research skills in AI.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	1	2	-	-	-	1	2	1
CO2	-	3	3	-	2	-	-	-	-	-	-	3	2
CO3	2	-	-	3	3	-	-	-	-	-	-	2	2
CO4	-	2	2	-	3	-	-	1	-	2	-	3	2
CO5	-	-	-	-	-	2	1	-	2	-	3	2	3

Syllabus:

Introduction to intelligent agents. Problem Solving: Searching, Intelligent search methods, Game Playing. Knowledge and Reasoning: Building a Knowledge Base. Inference in First Order Logic,

Logical reasoning systems. Planning. Uncertain Knowledge and Reasoning, Probabilistic Reasoning Systems. Learning from Observations: Inductive Learning, Learning Decision Trees, Computational Learning Theory, Explanation Based Learning. Genetic algorithms, Artificial Neural Networks and Fuzzy Approaches. Introduction to Natural Language Processing. The course will include programming projects involving programming in Lisp, Prolog and C++.
Texts: 1. S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, 2nd Ed, Prentice Hall, 2003.
References: 1. E. Rich and K. Knight, Artificial Intelligence, McGraw Hill, 1991. 2. P. H. Winston and B. K. P. Horn, Lisp, 3rd Ed, Addison-Wesley, 1989. 3. P. Norvig, Paradigms of Artificial Intelligence Programming: Case studies in Common Lisp, Morgan Kauffman, 1991.