NATIONAL INSTITUTE OF TECHNOLOGY MANIPUR

Minutes of the
40th Senate Meeting

Day: Monday | Date: 23/02/2026

Time: 3:00 pm

(Via Hybrid Mode)

MINUTES OF THE 40th SENATE MEETING HELD ON 23rd February, 2026

The 40th Senate Meeting of National Institute of Technology Manipur was held on 23rd of February, 2026 at 3:00 pm via Hybrid Mode.

The following members attended the meeting

- Prof. D V L N Somayajulu, Director, NIT Manipur : Ex-officio Chairman
- Prof.(Dr.) Tomba Singh, Registrar NIT Manipur : Secretary

1	Prof. G P Raja Sekhar (Online) IIT Kharagpur, External Member	11	Dr. Benjamin A. Shimray (HOD, EE)
2	Prof. P. Santhi Thilagam (Online) NITK, Surathkal, External Member	12	Dr. Prabhat Kumar (HOD, ME)
3	Prof. Priyankoo Sarmah (Online) IIT Guwahati, External Member	13	Dr. Sh. Lenin Singh (HOD, Physics)
4	Dr. Khelchandra Thongam Dean (AA), NIT Manipur	14	Dr. Th. David Singh (HOD, Chemistry)
5	Dr. Laousenbam Lolit Kumar Singh Dean(FW), NIT Manipur (Online)	15	Dr. Sunil Pandey (HOD, Mathematics)
6	Prof. Maibam Dinamani Singh Dean(R&C), NIT Manipur	16	Prof. Bakimchandra Oinam (CE)
7	Prof. Rajesh Kumar Bhushan Dean(P&D), NIT Manipur	17	Prof. Ashish Ranjan (HOD, ECE)
8	Dr. Mairangthem Nirmalkumar Singh (HOD, HSS)	18	Prof. P. Albino Kumar (CE)
9	Dr. A. Azhar (HOD, CE)	19	Prof. Ngangbam Romeji (CE)
10	Dr. Yambem Jina Chanu (HOD, CSE)	20	Dr. Chanam Birchand Singh (Mathematics)

The Chairman, Senate welcomed all the members of the Senate and requested Dean (AA) to present with the agenda items.

Item No.	Item Description	Resolutions
Item No. 40.1	To consider and confirm the minutes of 39th Senate meeting of National Institute of Technology Manipur, held in hybrid mode, on 06th December 2025 at NIT Manipur. **[Annexure- I]**	Confirmed.

Item No. 40.2	To consider the action taken report on the decisions of the 39th Senate meeting of National Institute of Technology Manipur held in hybrid mode on 10th December 2025 at NIT Manipur.	Noted
Item No. 40.3	To consider and approve Integrated Teacher Education Programme (ITEP). **[Annexure – II]**	Approved and advised to complete the registration as and when link is given by NCTE for registration.
Item No. 40.4	To consider and approve Minor Programmes with effect from Academic Year 2026-27 onwards.	Approved. Members advised the HoDs of concerned department to prepare the course structure and other required documents immediately for placing in the next senate.
Item No. 40.5	To consider and approve the syllabus of M.Tech program with Specialization in Intelligent Mechanical Systems offered by the Department of Mechanical Engineering with effect from Academic year 2026-27 onwards. **Annexure – III]**	Approved to start from academic session 2026-27.
Item No. 40.6	To consider and approve to offer Five Year Dual Degree Programme with effect from Academic year 2026-27 onwards.	Approved to start from the academic session 2026-27 and advised the HoDs to prepare the course structure immediately and detailed curriculum for placing in the next Senate meeting.
Item No. 40.7	To consider and approve the adoption of Relative grading system for all the programmes in the Institute. **[Annexure – IV]**	Approved and advised to start with the fresh admitting batch from the academic session 2026-27.

Item No. 40.8	To discuss and approve to consider four year BS degree for admission into M. Tech/ Ph.D programmes in NIT Manipur with effect from Academic year 2026-27 onwards. **[Annexure – V]**	Approved and the eligibility of candidates holding the BS degree from IIT Madras shall be considered on a case-to-case basis, subject to fulfillment of the Institute's prescribed admission requirements.
Item No. 40.9	To consider and approve the revised fee refund policy for cancellation of final admission for 1st Year B.Tech students **[Annexure – VI]**	Approved
Item No. 40.10	To consider and approve the Seat Matrix for Undergraduate Programmes for the Academic Session 2026-27 (JoSAA/CSAB 2026). **[Annexure – VII]**	Approved the seat matrix for both 4 year B.Tech and 5 year Dual Degree programmes for submission to JoSAA/CSAB 2026.
Item No. 40.11	**Information Items:** a) Prof. Prahalada Rao BB joined NIT Manipur on 12 February 2026 as Prime Minister Professor under the Anusandhan National Research Foundation (ANRF) scheme for a tenure of five years with the approved fellowship, research grant, and overhead support. b) The National Board of Accreditation (NBA) accreditation visit for three undergraduate programmes is scheduled during 13–15 March 2026, following submission of the e-SAR in November 2025. c) Applications for Adjunct Professor/Associate Adjunct Professor positions received up to	**Noted** **Noted** **Noted**

	January 2026 have been reviewed by the Institute-level committee, and appointment orders will be issued after Board approval.	
	ii. NIT Manipur and IIT Jodhpur entered into an MoU to facilitate Ph.D admission pathways, joint research collaboration and paid internship opportunities.	Noted

06/03/2026

(Prof. Kh. Tomba Singh)
Registrar,
Secretary, Senate
National Institute of Technology Manipur

6.3.2026

(Prof. D V L N Somayajulu)
Director,
Ex-Officio Chairman, Senate
National Institute of Technology Manipur

ANNEXURE – I

NATIONAL INSTITUTE OF TECHNOLOGY MANIPUR

Minutes of the

39^{th} Senate Meeting

Day: Tuesday

Date: [illegible]

Time: 3:00 pm

(Via Hybrid Mode)

MINUTES OF THE 39th SENATE MEETING HELD ON 16th December, 2025

The 39th Senate Meeting of National Institute of Technology Manipur was held on 16th of December, 2025 at 3:00 pm via Hybrid Mode.

The following members attended the meeting

- Prof. D V L N Somayajulu
  Director, NIT Manipur — Ex-officio Chairman
- Prof.(Kh. Tomba Singh
  Registrar, NIT Manipur — Secretary

1	Prof. U P Raja Sekhar (Online) IIT Kharagpur, External Member	10	Dr. Benjamin A. Shimray (HOD, EE)
2	Prof. P. Santhi Thilagam (Online) NITK, Surathkal, External Member	11	Dr. Prabhat Kumar (HOD, ME)
3	Prof. Priyankoo Sarmah, IIT Guwahati, External Member (Online)	12	Dr. Sh. Lenin Singh (HOD, Physics)
4	Dr. Khelchandra Thongam Dean (AA), NIT Manipur	13	Dr. Th. David Singh (HOD, Chemistry)
5	Dr. Lourembam Lolit Kumar Singh Dean(FW), NIT Manipur (Online)	14	Dr. Sunil Pandey (HOD, Mathematics)
6	Prof. Aheibam Dinamani Singh Dean(R&C), NIT Manipur	15	Prof. Bakimchandra Oinam (CE)
7	Dr. Moirangthem Nomalkumar Singh (HOD, ECE)	16	Prof. P. Albino Kumar (CE)
8	Dr. A. Ashim(HOD, CE)	17	Dr. Chanam Bamchand Singh (Mathematics)
9	Dr. Yambem Jina Chanu (HOD, CSE)		

The Chairman, Senate welcomed all the members of the Senate and requested Dean (AA) to present with the agenda items.

Item No.	Item Description	Resolution
Item No. 39.1	To consider and confirm the minutes of 38th Senate meeting of National Institute of Technology Manipur, held in hybrid mode, on 4th September 2025 at NIT Manipur **[Annexure - I]**	Confirmed
Item No. 39.2	To consider the action taken report on the decisions of the 38th Senate meeting of National Institute of Technology Manipur held in hybrid	Noted

	mode, on 4th September 2025 at NIT Manipur	
Item No. 39.3	To consider and approve the Odd semester results of UG, PG and PhD programme for the academic year 2025-26. **[Annexure - II]**	Approved
Item No. 39.4	To consider and approve the discontinuation of M.Tech Programme with Specialization "Thermal and Fluids Engineering" offered by Mechanical Engineering Department from the Academic year 2026-27. **[Annexure - III]**	Approved and recommended to start a new specialization **"Intelligent Mechanical Systems"**, suggested to draft curriculum and submit BOS minutes for approval.
Item No. 39.5	To consider and approve the inclusion of MA6xx Artificial Intelligence (3-0-0-6) to the list of Elective II in the 4th semester of the M.Sc (Mathematics and Computing) programme. **[Annexure - IV]**	Approved
Item No. 39.6	To consider and approve to reserve 25% of approved intake of all offered M.Tech programmes by various departments for Non-CCMT and remaining 75% of seats for all offered programmes through CCMT from academic year 2026-27. **[Annexure - V]**	• Approved to implement this from Academic year 2026 - 27 onwards with separate seat matrix for each category. Unfilled seats of each category of CCMT are to be filled from respective category of Non-CCMT merit list seat matrix. • Admission under Non-CCMT can be initiated without depending on CCMT admission process.
Item No. 39.7	To consider and approve the request of Lt. Col. Ng. Rajesh Singh to pursue M.Tech in Power and Control system from the academic session 2026-27. **[Annexure - VI]**	Approved and recommended to conduct interview for admission in the M.Tech programme and authorized Chairman to approve the minutes.
Item No. 39.8	To consider and approve the discontinuation of the following PhD Scholars **[Annexure - VII]** i. Mr. Devakoduru Phanidhapani (2340005) Department of EE	Approved

	ii. Mr. Priyaranjan Roy Lairikyengbam, Ph.D. Scholar (22407001), Department of ME (Self-Sponsored)	
Item No. 39.9	To consider and approve to revise quota for the allotment of Ph.D students to faculty	Approved
Item No. 39.10	To consider and approve to include the undertaking format at the time of Pre-synopsis Seminar by all the Ph.D scholars of the Institute. **[Annexure – VIII]**	Approved
Item No. 39.11	To consider and approve to revise 7.6 and 23.2 ordinances of Ph.D programme. [Annexure – IX]	Approved the following updated clauses: **Clause 7.6.** If any research paper authored by an Institute faculty member is retracted, one Ph.D. seat shall be reduced for a period of three years, effective from the academic year in which the retraction occurs. **Clause 23.2.** If any paper got retracted during the Course of PhD, the retracted paper shall not be counted as a part of the thesis and related work should not be reflected in the Thesis. In case the paper got retracted after awarding the degree: i. If the research scholar continues to meet the applicable ordinances for the award of the Ph.D. degree, the retracted papers shall not be considered for any job applications, academic purposes, or promotion-related benefits for both the scholar and the supervisor. ii. Otherwise, the DC and DPPC shall ensure that the retracted portions are removed from the thesis and certify

		that the remaining content is sufficient and academically valid for consideration toward the award of the Ph.D. degree as per ordinances.
Item No. 39.12	To consider and approve the Academic Calendar along with list of Holidays for the year 2026. **[Annexure - X]**	Approved
Item No. 39.13	**Ratification items:** To consider and ratify the award of 7 Ph.D degrees presented in 12th Convocation.	Approved
Item No 39.14	**Information item:** Incubation of YAIPHA AI Private Limited at NIT Manipur as per T&C of project titled "Development of mHealth Solution in Remote Tribal Areas of Manipur through a Customized Mobile Solution".	Noted
Item No 39.15	**Any other item with the permission of the Chair** i. Introduction of New Courses: Proposal to introduce three 1-credit Value Added courses(VAC) titled Rise Boost, and SOAR, along with a new UG elective course on Advanced Structural Systems Design. ii. Research Collaborations: Recommendation to collaborate for research (via MoUs or suitable arrangements) with reputed institutions: NITK Surathkal, Gati Shakti Vishwavidyalaya (Central University), Vadodara, and Yantai University, China.	Approved Approved

	iii. Considerations of Post-Doctoral candidates with external funding.	Approval to forward applications for external funding and recommended to start Post-doctoral programme with Institute Fellowship by obtaining necessary financial approval from FC/BOG.
	iv. Examination Malpractice Rule: Any student found indulging in examination malpractice will have their entire examination semester declared null and void, with zero marks awarded in all courses of that semester or any other penalty proposed to be imposed.	Approved the penalty proposed by Examination Section.

(Prof. Kh. Tomba Singh)
Registrar
Secretary, Senate
National Institute of Technology Manipur

5/2/2026
(Prof. D V L N Somayajulu)
Director,
Ex-Officio Chairman, Senate
National Institute of Technology Manipur

Annexure II

राष्ट्रीय प्रौद्योगिकी संस्थान मणिपुर
National Institute of Technology, Manipur
Langol Campus, Manipur – [illegible] [illegible]
[illegible] Govt. of India

NITM [illegible]

Date: [illegible]

MINUTES OF THE MEETING

Held on [illegible] January, [illegible] at [illegible]

The list of the members participated are :

1	Dr. [illegible]	Dean Academic
2	Dr. [illegible] Singh	Head, [illegible]
3	[illegible]	Supdt. (Acad.)
4	[illegible]	Supdt. (Accounts)
5	[illegible] Singh	AR, Accounts
6	Dr. [illegible] Singh	Head, Chemistry
7	Dr. [illegible]	Head, Mathematics
8	Dr. [illegible] Singh	Head, Physics
9	Prof. [illegible] Kumar	Coordinator, ITEP

Sl. No. — Minutes of the Meeting

1. • The meeting was convened to discuss the rollout of the Integrated Teacher Education Programme (ITEP) for the upcoming academic session at NIT Manipur, aligning with NEP 2020 mandates.
   • Meeting started with welcome note by the Chairman, Dr. [illegible] Singh. He briefed about the academic agenda necessary for opening the ITEP for the academic year 2025-2026.

2. All the members [illegible] the following agenda of the meeting.
   The committee resolved to offer the 4-Year B.Sc. B.Ed. (Secondary Stage) program. Following the successful models at NIT Calicut, NIT Warangal and NIT Agartala, the following disciplinary structure was recommended:

   - **Majors:** Physics, Chemistry, and Mathematics.
   - **Minors:** Computer Science and Engineering (CSE).
     Note: This combination is designed to combine STEM education with high digital proficiency, catering to the modern school curriculum.

3. **Seat Matrix**
   Referencing the NCTE norms and existing [illegible] (like NIT Warangal and NIT [illegible]), the following seat distribution was proposed with [illegible] % for Home state and [illegible] [illegible] [illegible] following the reservation policies of [illegible] and Central respectively.

   - **HOME STATE:** OBC-NCL ([illegible]), SC ([illegible]), ST ([illegible]), EWS ([illegible])
   - **OUTSIDE STATE:** OBC-NCL ([illegible]), SC ([illegible]), ST ([illegible]), EWS ([illegible])
   - **PwD:** [illegible] (within each category [illegible])

Subject	Quota	UR	UR (PwD)	OBC-NCL	OBC-NCL (PwD)	SC	SC (PwD)	ST	ST (PwD)	EWS	EWS (PwD)	Total Seats	Total Seats
Mathematics	[illegible]	1	0	1	[illegible]	1	[illegible]	1	1	0	[illegible]	[illegible]	18
	[illegible]	1	0	[illegible]	[illegible]	[illegible]	[illegible]	1	[illegible]	[illegible]	[illegible]	[illegible]	
Physics	[illegible]	1	[illegible]	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	18
	[illegible]	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
Chemistry	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
Total		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

4. **Tuition Fees**
The committee reviewed the fee structure of NIT Calicut and NIT Trichy. It was decided that the [illegible] tuition fees would remain unchanged [illegible]

Sl. No.	Fee Component	1st Sem	2nd Sem	3rd Sem	4th Sem	5th Sem	6th Sem	7th Sem	8th Sem
1	Admission Fee (one time)	1,000	—	—	—	—	—	—	—
2	Tuition Fee	45,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000
3	Institute Development Fee	7,500		7,500	—	7,500	—	7,500	—
4	Student Activity Fee	2,000	—	2,000	—	2,000	—	2,000	—
5	Technical & Cultural Activity Fee	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000
6	Sports Fee	1,000	—	1,000	—	1,000	—	1,000	—
7	Medical Insurance & OPD	1,750	—	1,750	—	1,750	—	1,750	—
8	Caution Money (Refundable)	5,000	—	—	—	—	—	—	—
9	Guide Card Fee	750	—	750	—	750	—	750	—
10	Smart ID Card	250	—	—	—	—	—	—	—
11	Library Fee	500	—	500	—	500	—	500	—
12	Internet Fee	500	500	500	500	500	500	500	500
13	Examination Fee	250	250	250	250	250	250	250	250
14	Laboratory Fee	400	400	400	400	400	400	400	400
15	Convocation Fee (final semester)	—	—	—	—	—	—	—	1,000
	Total	[illegible]	48,150	61,650	48,150	61,650	48,150	61,650	49,150

Fee Waiver: 100% Tuition Fee waiver for SC/ST/PwD students as per Government of India norms.

5. Admission Process:

- **Entrance Exam:** Admission will be strictly based on the **National Common Entrance Test (NCET)** conducted by the NTA.
- **Eligibility:** 10+2 with Physics, Chemistry, and Mathematics (minimum 60% aggregate).

6. Syllabus

Syllabus of the course will be decided by the BOS of the proposed programme.

The meeting ended with thanks to the Chairman of the committee.

Dr. Th. Khelchandra
Dean Academic
NIT Manipur

Copy to:

1. The Director for kind information
2. Registrar, NIT Manipur
3. Concerned File

ITEP Meeting 07 Jan 2026

(Attendance)

Sl.	Name	Dept/Section	Signature
1	Dr. Khwairakpam Nandakumar Singh	HO, HSS	[illegible]
2	N. Sherachand	Registrar (Academic)	N. Sherachand
3	[illegible]	Registrar (Adm)	[illegible]
4.	Mr HEMJIT SINGH	ACCOUNTS	[illegible]
5.	Dr. Th. David Singh	Chemistry	Th. David Singh
6	Dr. Sunil Pandey	Mathematics	Sunil Pandey
7.	Shagolsem Lenin Singh	HOD (Phy) & ITEP Coord.	[illegible]
8.	[illegible]	Civil	[illegible]

राष्ट्रीय प्रौद्योगिकी संस्थान मणिपुर
National Institute of Technology, Manipur
Takyelpat, Manipur – 795 001, Ph. (0385)2445812/ e-mail: [illegible]
An Autonomous Institute under MoE, Govt. of India

NITM.3/(156- Acad)/ITEP/2026-05

Date: 29/01/2026

MINUTES OF THE MEETING
Held on 29th January, 2026 at 3:00 P.M

The list of the members participated are:

1. Dr. Th. Khelchandra — Dean Academics
2. Dr. Maisnam Nirmalkumar Singh — Head, MS
3. Dr. Azharul Adan — Head, CE
4. Prof. Premlata Maibam — Head & Dean School of Education, Manipur University
5. Dr. Th. David Singh — Head, Chemistry
6. Dr. Sunil Panday — Head, Mathematics
7. Dr. Sagolsem Lenin Singh — Head, Physics
8. Prof. P. Albino Kumar — Coordinator, ITEP

Minutes of the Meeting

1. **Opening:** The Chairman/Dean (AA) welcomed members and outlined the objective to align NIT Manipur's curriculum with the National Council for Teacher Education (NCTE) Integrated Teacher Education Programme (ITEP) standards.
2. **Syllabus Review:** The Dean presented the detailed ITEP curriculum, highlighting the integration of liberal discipline (Science/Mathematics) with pedagogical studies, in line with NEP 2020 and ITEP guidelines.
3. **Key Confirmations:**
   a. **Structure:** Confirmed 4-Year structure comprising Foundational, Preparatory, Middle, and Secondary stage teacher preparation.
   b. **Content:** The syllabus covers foundational literacy, numeracy, Indian Knowledge Systems, digital literacy, and field-based training.
   c. The Syllabus prepared are for Major courses in (i) Physics (ii) Chemistry and Mathematics (with minor in Computer Science)
   d. **Assessment:** The evaluation mechanism aligns with NTA NCET patterns.
4. **Approval:** The committee unanimously approved the drafted syllabus for implementation (Annexure I).
5. **Action Items:**
   a. Final syllabus to be sent for regulatory approval to Senate.

The meeting concluded with a vote of thanks to the chair.

Dr. Th. Khelchandra
Dean Academics
NIT Manipur

Copy to
1. PS to Director for kind information
2. Registrar, NIT Manipur
3. Members, ITEP
4. Coordinator ITEP
5. Guard File

CURRICULUM FOR INTEGRATED TEACHER EDUCATION PROGRAMME LEADING TO B. Sc. B.Ed. DEGREE

Name of Degree	Name of Specialization	Total Intake (Tentative)	Year of Starting	Duration	Eligibility for Admission
B.Sc. B.Ed. (Secondary)	Science and Education	50	2024	4 years (8 semesters)	The ITEP shall be of four academic years comprising eight semesters including internship (field-based experiences and practice teaching). Candidates with minimum fifty percent marks in Senior Secondary or plus two examination or its equivalent (under 5+3+3+4 pattern) from a recognized board are eligible for admission through the National Common Entrance Test (NCET), conducted by the National Testing Agency (NTA).

COURSE CATEGORIES AND CREDIT REQUIREMENTS

The structure of B.Sc. B.Ed. Programmes shall have the following Course Categories:

Sl. No.	Course Category	No. of Courses	No. of credits
1.	Foundations of Education (FE)	13	23
2.	Disciplinary Major and Minor (MM)	15	64
3.	Stage Specific Content cum Pedagogy (CP)	8	16
4.	Ability Enhancement and Value-added Courses (AE)	12	24
5.	School Experience (SE)	4	20
6.	Community Engagement and Service (CE)	1	2

Total Credits required: 160

PROGRAMME STRUCTURE

Major Disciplinary Subject: PHYSICS

Minor: One discipline is to be chosen from amongst Chemistry, Mathematics, and Computer.

The effort to be put in by the student is indicated in the tables below as follows:

L: Lecture (One unit is of 60-minute duration)

T: Tutorial (One unit is of 60-minute duration)

P: Practical (One unit is of one-hour duration)

Subject code:
ED: Education | PH: Physics | CH: Chemistry
MA: Mathematics | CS: Computer

Semester 1							
Sl. No	Course Code	Title	Course Category	L	T	P	Credits
1	ED1101E	Evolution of Indian Education	FE	4	0	0	4
2	ED1191E	Language I – English	AE	4	0	0	4
3	ED1192E	Art Education-Collage Making	AE	1	0	2	2
4	ED1193E	Understanding India – I	AE	2	0	0	2
5	PH1101E	Mechanics and Properties of Matter	MM	3	1	0	4
6	CH1102E	Chemistry Minor – I: Basics of Theoretical Chemistry and Spectroscopy	MM	3	1	0	4
	MA1102E	Mathematics Minor – I: Calculus	MM	3	1	0	4
	CS1101E	Python Programming	MM	3	0	2	4
7	PH1141E	Physics Lab - I	MM	0	0	2	1
						Total	21

Semester 2							
Sl. No	Course Code	Title	Course Category	L	T	P	Credits
1	ED1291E	Language II – Manipuri	AE	4	0	0	4
	ED1292E	Language II – Hindi	AE	4	0	0	4
2	ED1293E	Understanding India – II	AE	2	0	0	2
3	ED1294E	Teacher and Society	AE	2	0	0	2
4	PH1201E	Heat and Thermodynamics	MM	3	1	0	4
5	PH1202E	Electricity and Magnetism	MM	3	1	0	4
6	CH1203E	Chemistry Minor – II: Physical Chemistry	MM	3	1	0	4
	MA1203E	Mathematics Minor – II: Algebra & Differential Equations	MM	3	1	0	4
	CS1201E	Computer Programming with C	MM	3	0	2	4
7	PH1241E	Physics Lab - II	MM	0	0	2	1
						Total	21

Semester 3							
Sl. No	Course Code	Title	Course Category	L	T	P	Credits
1	ED2301E	Child Development and Educational Psychology	PE	4	0	0	4
2	ED2302E	General Pedagogy	CP	3	1	0	4
3	PH2301E	Waves and Optics	MM	3	1	0	4
4	PH2302E	Electronics	MM	3	1	0	4
5	CH2305E	Chemistry Minor – III: Inorganic Chemistry	MM	3	1	0	4
	MA2305E	Mathematics Minor – III: Probability and Statistics	MM	3	1	0	4
	CS2301E	Data Structures with C	MM	3	0	2	4
6	PH2341E	Physics Lab – III	MM	0	0	2	1
						Total	21

Semester 4							
Sl. No	Course Code	Title	Course Category	L	T	P	Credits
1	ED2401E	Philosophical and Sociological Perspectives of Education – I	PE	4	0	0	4
2	ED2402E	Minor Pedagogy (Physical Science)	CP	3	1	0	4
3	PH2401E	Classical and Relativistic Mechanics	MM	3	1	0	4
4	PH2402E	Quantum and Statistical Mechanics	MM	3	1	0	4
5	CH2403E	Chemistry Minor – IV: Organic Chemistry	MM	3	1	0	4
	MA2403E	Mathematics Minor – IV: Mathematical Analysis	MM	3	1	0	4
	CS2401E	Digital Computer Fundamental	MM	3	0	2	4
6	PH2441E	Physics Lab IV	MM	0	0	2	1
						Total	21

Semester 5							
Sl. No	Course Code	Title	Course Category	L	T	P	Credits
1	ED2591E	ICT in Education	AE	1	0	2	2
2	ED2501E	Major Pedagogy – I (Physical Sciences)	CP	3	1	0	4
3	ED2502E	Pre-Internship Practice	SE	0	0	4	2
4	PH2501E	Atomic and Molecular Physics	MM	3	1	0	4
5	PH2502E	Nuclear and Solid State Physics	MM	3	1	0	4
6	PH2531E	Major Project	MM	0	0	8	4
						Total	20

Semester 6							
Sl. No.	Course Code	Title	Course Category	L	T	P	Credits
1	ED3601E	Assessment and Evaluation	FE	2	0	0	2
2	ED3602E	Major Pedagogy-II (Physical Sciences)	CP	3	1	0	4
3	ED3603E	Inclusive Education	FE	2	0	0	2
4	ED3691E	Mathematical and Quantitative Reasoning	AE	1	1	0	2
5	ED3604E	School Observation	SE	0	0	4	2
6 & 7	PH3601E	Elementary Particle Physics	MM	3	1	0	4
	PH3602E	Numerical Techniques and Computational Physics	MM	3	0	2	4
	PH3603E	Advanced Electronics	MM	3	1	0	4
	PH3604E	Laser Theory	MM	3	1	0	4
	PH3605E	Astronomy And Astrophysics	MM	3	1	0	4
						Total	20

Semester 7							
Sl. No.	Course Code	Title	Course Category	L	T	P	Credits
1	ED4701E	Perspectives on School Leadership and Management	FE	2	0	0	2
2	ED4702E	Curriculum Planning and Development	FE	2	0	0	2
3	ED4791E	Art Education- Performing and Visual	AE	1	0	2	2
4	ED4792E	Sports, Nutrition and Fitness	AE	1	0	2	2
5	ED4703E	School based Research Project	SE	0	0	4	2
6	ED4704E	Internship in Teaching	SE	0	0	20	10
						Total	20

Semester 8							
Sl. No.	Course Code	Title	Course Category	L	T	P	Credits
1	ED4801E	Philosophical and Sociological Perspectives of Education-II	FE	4	0	0	4
2	ED4802E	Education Policy Analysis	FE	2	0	0	2
3	ED4803E	Emerging Technologies in Education	FE	4	0	0	4
	ED4804E	Guidance and counselling	FE	4	0	0	4
4	ED4891E	Yoga and Understanding Self	AE	2	0	0	2
5	ED4892E	Citizenship Education, Sustainability and Environmental Education	AE	2	0	0	2
6	ED4805E	Post Internship (Review and Analysis)	SE	0	0	4	2
7	ED4806E	Teaching Learning Material Work Experience	SE	0	0	4	2
8	ED4807E	Community Engagement and Service	CE	0	0	4	2
						Total	20

Semester-wise distribution of credits:

Semester	1	2	3	4	5	6	7	8
Credit	21	21	21	21	20	20	20	20

CURRICULUM FOR INTEGRATED TEACHER EDUCATION PROGRAMME LEADING TO B. Sc. B.Ed. DEGREE

Name of Degree	Name of Specialization	Total Intake (Full-time)	Year of Starting	Duration	Eligibility for Admission
B.Sc. B.Ed. (Secondary)	Science and Education	50	2025	4 years (8 semesters)	The ITEP shall be of four academic years comprising eight semesters including internship (field-based experiences and practice teaching). Candidates with minimum fifty percent marks in Senior Secondary or plus two examination or its equivalent (under 5+3+3+4 pattern) from a recognized board are eligible for admission through the National Common Entrance Test (NCET), conducted by the National Testing Agency (NTA).

COURSE CATEGORIES AND CREDIT REQUIREMENTS:

The structure of B.Sc. B.Ed. Programmes shall have the following Course Categories.

Sl. No	Course Category	No. of Courses	No. of credits
1.	Foundations of Education (FE)	10	20
2.	Disciplinary Major and Minor (MM)	16	64
3.	Stage Specific Content cum Pedagogy (CP)	4	16
4.	Ability Enhancement and Value-added Courses (AE)	12	28
5.	School Experience (SE)	6	20
6.	Community Engagement and Service (CE)	1	2

Total Credits required: 160

PROGRAMME STRUCTURE

Major Disciplinary Subject: CHEMISTRY

Minor: One discipline to be chosen from amongst Physics, Mathematics, and Computer.
The effort to be put in by the student is indicated in the tables below as follows:

L: Lecture (One unit is of 60-minute duration)

T: Tutorial (One unit is of 60-minute duration)

P: Practical (One unit is of one-hour duration)

Semester 1							
Sl. No	Course Code	Title	Course Category	L	T	P	Credits
1	ED1101E	Evolution of Indian Education	FE	4	0	0	4
2	ED1191E	Language I – English	AE	4	0	0	4
3	ED1192E	Art Education-Collage Making	AE	1	0	2	2
4	ED1193E	Understanding India-I	AE	2	0	0	2
5	CH1101E	Structure, Bonding and Fundamentals of Spectroscopy	MM	3	1	0	4
6	PH1102E	Physics Minor-I Mechanics, Waves and Oscillations	MM	3	1	0	4
	MA1102E	Mathematics Minor-I Calculus	MM	3	1	0	4
	CS1103E	Python Programming	MM	3	0	2	4
7	CH1141E	Inorganic Chemistry Laboratory	MM	0	0	2	1
						Total	21

Semester 2							
Sl. No	Course Code	Title	Course Category	L	T	P	Credits
1	ED1291E	Language II- Manipuri	AE	4	0	0	4
	ED1292E	Language II- Hindi	AE	4	0	0	4
2	ED1293E	Understanding India – II	AE	2	0	0	2
3	ED1294E	Teacher and Society	AE	2	0	0	2
4	CH1201E	Basic Concepts in Organic Chemistry and Stereochemistry	MM	3	1	0	4
5	CH1202E	States of Matter and Chemical Thermodynamics	MM	3	1	0	4
6	PH1203E	Physics Minor-II Thermal Physics	MM	3	1	0	4
	MA1202E	Mathematics Minor-II Algebra & Differential Equations	MM	3	1	0	4
	CS1201E	Computer Programming with C	MM	3	0	2	4
7	CH1241E	Physical Chemistry Laboratory	MM	0	0	2	1
						Total	21

Semester 3							
Sl. No	Course Code	Title	Course Category	L	T	P	Credits
1	ED2301E	Child Development and Educational Psychology	FE	4	0	0	4
2	ED2302E	General Pedagogy	CP	3	1	0	4
3	CH2301E	Coordination Chemistry and its Applications	MM	3	1	0	4
4	CH2302E	Thermodynamics, Kinetics and Equilibria	MM	3	1	0	4
5	PH2303E	Physics Minor-III Electromagnetism and Relativity	MM	3	1	0	4
	MA2303E	Mathematics Minor-III Probability and Statistics	MM	3	1	0	4
	CS2301E	Data structures with C	MM	3	0	2	4
6	CH2304E	Organic Chemistry Laboratory	MM	0	0	2	1
						Total	21

Semester 4							
Sl. No	Course Code	Title	Course Category	L	T	P	Credits
1	ED2401E	Philosophical and Sociological Perspectives of Education-I	FE	4	0	0	4
2	ED2402E	Minor Pedagogy (Physical Science)	CP	3	1	0	4
3	CH2401E	Basic analytical chemistry and Introductory Electrochemistry	MM	3	1	0	4
4	CH2402E	Synthetic Methodologies in Organic Chemistry	MM	3	1	0	4
5	PH2402E	Physics Minor-IV Basic Electronics	MM	3	1	0	4
	MA2402E	Mathematics Minor-IV Mathematical Analysis	MM	3	1	0	4
	CS2401E	Digital Computer Fundamental	MM	3	0	2	4
6	CH2403E	Instrumental methods in Chemical analysis	MM	0	0	2	1
						Total	21

Semester 5							
Sl. No	Course Code	Title	Course Category	L	T	P	Credits
1	ED3501E	ICT in Education	AE	1	0	2	2
2	ED3502E	Major Pedagogy-I (Physical Science)	CP	3	1	0	4
3	ED3503E	Pre-internship Practice	SE	0	0	4	2
4	CH3501E	Chemistry of Main Group Elements and Organometallic Chemistry	MM	3	1	0	4
5	CH3502E	Natural Products, Heterocycles and Spectroscopic Methods of Characterization	MM	3	1	0	4
6	CH3531E	Major Project	MM	0	0	8	4
						Total	20

Semester 6							
Sl. No	Course Code	Title	Course Category	L	T	P	Credits
1	ED3601E	Assessment and Evaluation	FE	2	0	0	2
2	ED3602E	Major Pedagogy-II (Physical Sciences)	CP	3	1	0	4
3	ED3603E	Inclusive Education	FE	2	0	0	2
4	ED3691E	Mathematical and Quantitative Reasoning	AE	1	1	0	2
5	ED3604E	School Observation	SE	0	0	4	2
6 & 7	CH3601E	Solid State Chemistry	MM	3	1	0	4
	CH3602E	Fundamentals of Biochemistry	MM	3	0	2	4
	CH3603E	Surface Chemistry	MM	3	1	0	4
	CH3604E	Basic Analytical Chemistry and Instrumental methods	MM	3	1	0	4
	CH3605E	Chemistry of Multiple Bonds	MM	3	1	0	4
	CH3606E	Nuclear Chemistry	MM	3	1	0	4
	CH3607E	Physical Methods in Inorganic Chemistry	MM	3	1	0	4
	CH3608E	Bioinorganic Chemistry	MM	3	1	0	4
						Total	20

Semester 7							
Sl. No	Course Code	Title	Course Category	L	T	P	Credits
1	ED4701E	Perspectives on School Leadership and Management	FE	2	0	0	2
2	ED4702E	Curriculum Planning and Development	FE	2	0	0	2
3	ED4791E	Art Education - Performing and Visual	AE	1	0	2	2
4	ED4792E	Sports, Nutrition and Fitness	AE	1	0	2	2
5	ED4703E	School based Research Project	SE	0	0	4	2
6	ED4704E	Internship in Teaching	SE	0	0	20	10
						Total	20

Semester 8							
Sl. No	Course Code	Title	Course Category	L	T	P	Credits
1	ED4801E	Philosophical and Sociological Perspectives of Education-II	FE	4	0	0	4
2	ED4802E	Education Policy Analysis	FE	2	0	0	2
3	ED4803E	Emerging Technologies in Education	FE	4	0	0	4
	ED4804E	Guidance and counselling	FE	4	0	0	4
4	ED4891E	Yoga and Understanding Self	AE	2	0	0	2
5	ED4892E	Citizenship Education, Sustainability and Environment Education	AE	2	0	0	2
6	ED4805E	Post-Internship (Review and Analysis)	SE	0	0	4	2
7	ED4806E	Teaching Learning Material/Work Experience	SE	0	0	4	2
8	ED4807E	Community Engagement and Service	CE	0	0	4	2
						Total	20

Semester wise distribution of credits:

Semester	1	2	3	4	5	6	7	8
Credit	21	21	21	21	20	20	20	20

CURRICULUM FOR INTEGRATED TEACHER EDUCATION PROGRAMME LEADING TO B. Sc. B.Ed. DEGREE

Name of Degree	Name of Specialization	Total Intake (Full-time)	Year of Starting	Duration	Eligibility for Admission
B.Sc. B.Ed. (Secondary)	Science and Education	50	2024	4 years (8 semesters)	The ITEP shall be of four academic years comprising eight semesters including internship (field-based experiences and practice teaching). Candidates with minimum fifty percent marks in Senior Secondary or plus two examination or its equivalent (under 5+3+3+4 pattern) from a recognized board are eligible for admission through the National Common Entrance Test (NCET) conducted by the National Testing Agency (NTA)

COURSE CATEGORIES AND CREDIT REQUIREMENTS:

The structure of B.Sc. B.Ed. Programme shall have the following Course Categories:

Sl. No	Course Category	No. of Courses	No. of credits
1.	Foundations of Education (FE)	10	30
2.	Disciplinary Major and Minor (MM)	16	64
3.	Stage Specific Content cum Pedagogy (CP)	4	16
4.	Ability Enhancement and Value-added Courses (AE)	12	28
5.	School Experience (SE)	6	20
6.	Community Engagement and Service (CE)	1	2

Total Credits required: 160

PROGRAMME STRUCTURE

Major Disciplinary Subject: MATHEMATICS

Minor: One discipline is to be chosen from amongst Chemistry, Physics, and Computer.

The effort to be put in by the student is indicated in the tables below as follows:

L: Lecture (One unit is of 60-minute duration)

T: Tutorial (One unit is of 60-minute duration)

P: Practical (One unit is of one-hour duration)

Subject code: ED: Education PH: Physics	MA: Mathematics CS: Computer Science	CH: Chemistry

Semester 1							
Sl. No	Course Code	Title	Course Category	L	T	P	Credits
1	ED1101E	Evolution of Indian Education	FE	4	0	0	4
2	ED1191E	Language I – English	AE	4	0	0	4
3	ED1192E	Art Education-Collage Making	AE	1	0	2	2
4	ED1193E	Understanding India – I	AE	2	0	0	2
5	MA1101E	Set Theory and Logic	MM	3	1	0	4
6	CH1102E	Chemistry Minor – I: Basics of Theoretical Chemistry and Spectroscopy	MM	3	1	0	4
	PH1102E	Physics Minor-I Mechanics, Waves and Oscillations	MM	3	1	0	4
	CS1101E	Python Programming	MM	3	0	2	4
						Total	20

Semester 2							
Sl. No	Course Code	Title	Course Category	L	T	P	Credits
1	ED1291E	Language II – Manipuri	AE	4	0	0	4
	ED1292E	Language II – Hindi	AE	4	0	0	4
2	ED1293E	Understanding India – II	AE	2	0	0	2
3	ED1294E	Teacher and Society	AE	2	0	0	2
4	MA1201E	Single Variable Calculus and Matrix theory	MM	3	1	0	4
5	MA1202E	Analytical Geometry and Number theory	MM	3	1	0	4
6	CH1202E	Chemistry Minor – II: Physical Chemistry	MM	3	1	0	4
	PH1202E	Physics Minor-II Thermal Physics	MM	3	1	0	4
	CS1201E	Computer Programming with C	MM	3	0	2	4
						Total	20

Semester 3							
SL No	Course Code	Title	Course Category	L	T	P	Credits
1	ED2301E	Child Development and Educational Psychology	FE	4	0	0	4
2	ED2302E	General Pedagogy	CP	3	1	0	4
3	MA2301E	Real Analysis	MM	3	1	0	4
4	MA2302E	Multivariable Calculus and Vector Calculus	MM	3	1	0	4
5	CH2303E	Chemistry Minor - III: Inorganic Chemistry	MM	3	1	0	4
	PH2303E	Physics Minor-III Electromagnetism and Relativity	MM	3	1	0	4
	CS2301E	Data Structures with C	MM	3	0	2	4
						Total	20

Semester 4							
SL No	Course Code	Title	Course Category	L	T	P	Credits
1	ED2401E	Philosophical and Sociological Perspectives of Education - I	FE	4	0	0	4
2	ED2402E	Minor Pedagogy (Physical Science)	CP	3	1	0	4
3	MA2401E	Differential Equations	MM	3	1	0	4
4	MA2402E	Modern Algebra	MM	3	1	0	4
5	CH2403E	Chemistry Minor - IV: Organic Chemistry	MM	3	1	0	4
	PH2403E	Physics Minor-IV Basic Electronics	MM	3	1	0	4
	CS2401E	Digital Computer Fundamental	MM	3	0	2	4
						Total	20

Semester 5							
SL No	Course Code	Title	Course Category	L	T	P	Credits
1	ED3501E	ICT in Education	AE	1	0	2	3
2	ED3506E	Major Pedagogy - I (Mathematics)	CP	3	1	0	4
3	ED3502E	Pre-internship Practice	SI	0	0	4	2
4	MA3501E	Linear Algebra	MM	3	1	0	4
5	MA3502E	Complex analysis and Numerical analysis	MM	3	1	0	4
6	MA3511E	Major Project	MM	0	0	8	4
						Total	20

Semester 6							
Sl. No	Course Code	Title	Course Category	L	T	P	Credits
1	ED3601E	Assessment and Evaluation	FE	2	0	0	2
2	ED3602E	Major Pedagogy-II (Mathematics)	CP	3	1	0	4
3	ED3651E	Inclusive Education	FE	2	0	0	2
4	ED3641E	Mathematical and Quantitative Reasoning	AE	1	1	0	2
5	ED3604E	School Observation	SE	0	0	4	2
6 & 7	MA3601E	Probability and Statistics	MM	3	1	0	4
	MA3602E	Metric spaces and Topology	MM	3	0	2	4
	MA3603E	Introduction to Optimization	MM	3	1	0	4
	MA3604E	Functional Analysis	MM	3	1	0	4
	MA3605E	Fluid Dynamics	MM	3	1	0	4
						Total	20

Semester 7							
Sl. No	Course Code	Title	Course Category	L	T	P	Credits
1	ED4701E	Perspectives on School Leadership and Management	FE	2	0	0	2
2	ED4702E	Curriculum Planning and Development	FE	2	0	0	2
3	ED4791E	Art Education- Performing and Visual	AE	1	0	2	2
4	ED4792E	Sports, Nutrition and Fitness	AE	1	0	2	2
5	ED4703E	School based Research Project	SE	0	0	4	2
6	ED4704E	Internship in Teaching	SE	0	0	20	10
						Total	20

Semester 8							
Sl. No	Course Code	Title	Course Category	L	T	P	Credits
1	ED4801E	Philosophical and Sociological Perspectives of Education-II	FE	4	0	0	4
2	ED4802E	Education Policy Analysis	FE	2	0	0	2
3	ED4803E	Emerging Technologies in Education	FE	4	0	0	4
	ED4804E	Guidance and counselling	FE	4	0	0	4
4	ED4891E	Yoga and Understanding Self	AE	2	0	0	2
5	ED4892E	Citizenship Education, Sustainability and Environment Education	AE	2	0	0	2
6	ED4805E	Post-Internship (Review and Analysis)	SE	0	0	4	2
7	ED4806E	Teaching Learning Material/Work Experience	SE	0	0	4	2
8	ED4807E	Community Engagement and Service	CE	0	0	4	2
						Total	20

Semester-wise distribution of credits :

Semester	1	2	3	4	5	6	7	8
Credit	20	20	20	20	20	20	20	20

ITEP-NIT Manipur

1st BOS Meeting

Date: 02/02/2026, Time: 02:00 pm

Venue: Conference Room, Admin Block, NIT Manipur

SL	Name	Designation	Signature
1.	Dr KHELCHANDRA THONGAM	Dean (AA)	
2	Dr. SUNIL PANDAY	HOD (Maths)	
3.	Dr. Th. David Singh	HOD, Chem	
4.	Dr. Adani Azhoni	HOD, Civil	
5.	Dr. [illegible] Singh	HOD, HSS	
6.	Shagolsem Lenin Singh	HOD (Phys)	
7.	Prof. P. Albino KT	CO-ITEP	
8.	Prof. [illegible]	Head & Dean, School of [illegible] M.U.	

CURRICULUM FOR INTEGRATED TEACHER EDUCATION PROGRAMME LEADING TO B. Sc. B.Ed. DEGREE

Name of Degree	Name of Specialization	Total Intake (Full-time)	Year of Starting	Duration	Eligibility for Admission
B.Sc. B.Ed. (Secondary)	Science and Education	50	2026	4 years (8 semesters)	The ITEP shall be of four academic years comprising eight semesters including internship (field-based experiences and practice teaching). Candidates with minimum fifty percent marks in Senior Secondary or plus two examination or its equivalent (under 5+3+3+4 pattern) from a recognised board are eligible for admission through the National Common Entrance Test (NCET), conducted by the National Testing Agency (NTA).

COURSE CATEGORIES AND CREDIT REQUIREMENTS:

The structure of B.Sc. B.Ed. Programmes shall have the following Course Categories:

Sl. No	Course Category	No. of Courses	No. of credits
1.	Foundations of Education (FE)	10	30
2.	Disciplinary Major and Minor (MM)	18	84
3.	Stage Specific Content cum Pedagogy (CP)	4	16
4.	Ability Enhancement and Value-added Courses (AE)	12	28
5.	School Experience (SE)	6	20
6.	Community Engagement and Service (CE)	1	2

Total Credits required: 180

PROGRAMME STRUCTURE

Major Disciplinary Subject: MATHEMATICS

Minor: One discipline to be chosen from amongst Chemistry, Physics, and Computer.
The effort to be put in by the student is indicated in the tables below as follows:

L: Lecture (One unit is of 60-minute duration)

T: Tutorial (One unit is of 60-minute duration)

P: Practical (One unit is of one-hour duration)

Subject code:		
ED: Education	MA: Mathematics	CH: Chemistry
PH: Physics	CS: Computer Science	

Semester 1							
Sl. No	Course Code	Title	Course Category	L	T	P	Credits
1	ED1100E	Evolution of Indian Education	FE	4	0	0	4
2	ED1190E	Language I – English	AE	4	0	0	4
3	ED1192E	Art Education-Collage Making	AE	1	0	2	2
4	ED1193E	Understanding India – I	AE	2	0	0	2
5	MA1101E	Set Theory and Logic	MM	3	1	0	4
6	CH1102E	Chemistry Minor – I: Basics of Theoretical Chemistry and Spectroscopy	MM	3	1	0	4
	PH1102E	Physics Minor-I Mechanics, Waves and Oscillations	MM	3	1	0	4
	CS1101E	Python Programming	MM	3	0	2	4
						Total	20

Semester 2							
Sl. No	Course Code	Title	Course Category	L	T	P	Credits
1	ED1290E	Language II – Manipuri	AE	4	0	0	4
	ED1292E	Language II – Hindi	AE	4	0	0	4
2	ED1293E	Understanding India – II	AE	2	0	0	2
3	ED1294E	Teacher and Society	AE	2	0	0	2
4	MA1201E	Single Variable Calculus and Matrix theory	MM	3	1	0	4
5	MA1202E	Analytical Geometry and Number theory	MM	3	1	0	4
6	CH1203E	Chemistry Minor – II: Physical Chemistry	MM	3	1	0	4
	PH1203E	Physics Minor-II Thermal Physics	MM	3	1	0	4
	CS1201E	Computer Programming with C	MM	3	0	2	4
						Total	20

Semester 3							
Sl. No	Course Code	Title	Course Category	L	T	P	Credits
1	ED2301E	Child Development and Educational Psychology	PE	4	0	0	4
2	ED2302E	General Pedagogy	CP	3	1	0	4
3	MA2301E	Real Analysis	MM	3	1	0	4
4	MA2302E	Multivariable Calculus and Vector Calculus	MM	3	1	0	4
5	CH2305E	Chemistry Minor – III: Inorganic Chemistry	MM	3	1	0	4
	PH2305E	Physics Minor-III Electromagnetism and Relativity	MM	3	1	0	4
	CS2301E	Data Structures with C	MM	3	0	2	4
						Total	20

Semester 4							
Sl. No	Course Code	Title	Course Category	L	T	P	Credits
1	ED2401E	Philosophical and Sociological Perspectives of Education – I	PE	4	0	0	4
2	ED2402E	Minor Pedagogy (Physical Science)	CP	3	1	0	4
3	MA2401E	Differential Equations	MM	3	1	0	4
4	MA2402E	Modern Algebra	MM	3	1	0	4
5	CH2405E	Chemistry Minor – IV: Organic Chemistry	MM	3	1	0	4
	PH2405E	Physics Minor-IV Basic Electronics	MM	3	1	0	4
	CS2401E	Digital Computer Fundamental	MM	3	0	2	4
						Total	20

Semester 5							
Sl. No	Course Code	Title	Course Category	L	T	P	Credits
1	ED3301E	ICT in Education	AE	1	0	2	2
2	ED3302E	Major Pedagogy – I (Mathematics)	CP	3	1	0	4
3	ED3303E	Pre-internship Practice	SE	0	0	4	2
4	MA3301E	Linear Algebra	MM	3	1	0	4
5	MA3302E	Complex analysis and Numerical analysis	MM	3	1	0	4
6	MA3351E	Major Project	MM	0	0	8	4
						Total	20

Semester 6							
Sl. No	Course Code	Title	Course Category	L	T	P	Credits
1	ED3601E	Assessment and Evaluation	FE	2	0	0	2
2	ED3602E	Major Pedagogy-II (Mathematics)	CP	3	1	0	4
3	ED3603E	Inclusive Education	FE	2	0	0	2
4	ED3691E	Mathematical and Quantitative Reasoning	AE	1	1	0	2
5	ED3604E	School Observation	SE	0	0	4	2
6 & 7	MA3601E	Probability and Statistics	MM	3	1	0	4
	MA3602E	Metric spaces and Topology	MM	3	1	0	4
	MA3603E	Introduction to Optimisation	MM	3	1	0	4
	MA3604E	Functional Analysis	MM	3	1	0	4
	MA3605E	Fluid Dynamics	MM	3	1	0	4
						Total	20

Semester 7							
Sl. No	Course Code	Title	Course Category	L	T	P	Credits
1	ED4701E	Perspectives on School Leadership and Management	FE	2	0	0	2
2	ED4702E	Curriculum Planning and Development	FE	2	0	0	2
3	ED4791E	Art Education: Performing and Visual	AE	1	0	2	2
4	ED4792E	Sports, Nutrition and Fitness	AE	1	0	2	2
5	ED4703E	School based Research Project	SE	0	0	4	2
6	ED4704E	Internship in Teaching	SE	0	0	20	10
						Total	20

Semester 8							
Sl. No	Course Code	Title	Course Category	L	T	P	Credits
1	ED4801E	Philosophical and Sociological Perspectives of Education-II	FE	4	0	0	4
2	ED4802E	Education Policy Analysis	FE	2	0	0	2
3	ED4803E	Emerging Technologies in Education	FE	4	0	0	4
	ED4804E	Guidance and counselling	FE	4	0	0	4
4	ED4891E	Yoga and Understanding Self	AE	2	0	0	2
5	ED4892E	Citizenship Education, Sustainability and Environment Education	AE	2	0	0	2
6	ED4805E	Post-Internship (Review and Analysis)	SE	0	0	4	2
7	ED4806E	Teaching Learning Material/Work Experience	SE	0	0	4	2
8	ED4807E	Community Engagement and Service	CE	0	0	4	2
						Total	20

Semester-wise distribution of credits:

Semester	1	2	3	4	5	6	7	8
Credits	20	20	20	20	20	20	20	20

Semester wise Detailed Syllabus

Semester-I

ED1001E Evolution of Indian Education

Pre-requisites: Nil

Total Lecture Sessions: 52

L	T	P	C
4	0	0	4

Course Outcomes:

CO1: Understand the evolution of education in India, including its historical, social, and political influences, enabling them to act as effective teachers.

CO2: Analyse the historical development of education in ancient India, identifying key features and comparing it with modern educational practices.

CO3: Assess the genesis, vision, and evolution of education in India from ancient times to the contemporary era, understanding the impact of various educational philosophies and systems.

CO4: Recognise and appreciate the contributions of Indian thinkers to the evolution of the Indian education system and its practices.

Ancient Indian Education: Vedic Period – Vision, objectives and salient features of Vedic Education System- Teaching and Learning Process- Development of educational institutions: Finances and Management- Famous Educational institutions and Guru-Shishya Education at the time of Epics: Ramayana and Mahabharata.

Ancient Indian Education: Buddhist and Jain Period – Vision, objectives and salient features of Buddhist and Jain Education System- Teaching and Learning Process- Finance and Management of Educational Institutions- Educational Institutions: Nalanda, Taxila, Vikramshila, Vallabhi, Nadia- Famous Guru-Shishya.

Post-Gupta Period to Colonial Period: Vision, objectives, brief historical development perspective as well as salient features of Education in India- Teaching and Learning Process- Finance and Management of educational institutions.

Modern Indian Education: Colonial education in India; Woods Despatch, Macaulay Minutes and Westernisation of Indian Education- Shiksha in Bharatiyakaran (Indigenous Interventions in education); Swadeshi and Nationalist attempts of educational reforms with special reference to general contribution of Indian thinkers to the education systems of India; Savitribai and Jyotiba Phule, Rabindranath Tagore, Swami Vivekananda, Mahatma Gandhi, Sri Aurobindo, Gijubhai Badheka, Pt. Madanmohan Malaviya, Jiddu Krishnamurti and Dr. Bhima Rao Ambedkar. Education in Independent India; Overview of Constitutional values and educational provisions- Citizenship Education: Qualities of a good citizen, Education for fundamental rights and duties- UEE, RMSA, RTE Act 2009: Overview and impact- NEP 2020: vision and implementation for a vibrant India.

References:

1. Mookerji R.K. *Ancient Indian Education: Brahmanical & Buddhist*, Macmillan & Co, 1947.
2. F.E. Keay, *Indian Education: An Enquiry into its Origin, Development, and Ideals*. Oxford University Press, 1918.
3. K.V. Vaidyanatha Iyyar. *History of Education Policymaking in India (1947-2016)*, 4th Edition, University Press, 2017.

ED1191E Language I – English

Pre-requisites: Nil

Total Lecture Sessions: 52

L	T	P	C
4	0	0	4

Course Outcomes:

CO1: Demonstrates a knowledge of the relationship between Language and society.

CO2: Demonstrates the ability to use the conventions of grammar, vocabulary, and pronunciation to communicate effectively in a variety of contexts.

CO3: Develop and deliver effective presentations and speeches on a variety of topics using technology.

CO4: Demonstrates the ability to read and comprehend a variety of text types and write for different purposes.

Language, Society, and learning: Language acquisition and Language learning—Notion of first language, second language and others—Language variation and social variation— Languages, dialects and varieties— Bilingualism, Multilingualism and its advantages—Cultural transmission of language: language and gender, language and identity, language and power—Constitutional provisions and National Education Policy 2020

Grammar in Communication: Verb and Tenses—Conditionals—Multi word verbs: Phrasal verbs, Collocations—Phrase and clause in practice: Relative clauses, adverb clauses, dangling modifiers—Linking devices, Common errors

Speaking and Pronunciation: Pronunciation and intelligibility: Speech sounds, Tone- Stress, Pitch and Intonation —Tone and pitch in communication—Sense groups and connected speech—Speech and discourse markers—Speaking with confidence—Delivering speeches and presentations—Public speaking—Active listening

Critical reading and writing: Skimming and Scanning—Close Reading - Comprehension - Summarising and Paraphrasing - Analysis and Interpretation - Literary Knowledge Texts—Structure of an essay: argumentative, analytical, comparative—Writing as a process: outlining, drafting, revising and proof reading

References:

1. Mark Hancock, *English Pronunciation in Use*, Cambridge UP, 2003.
2. Martin Hewings, *Advanced Grammar in Use: A Reference and Practice Book for Advanced Learners of English*, 2nd edition, Cambridge University Press, 2005.
3. N. Sudarshana, C. Savitha, *English for Technical Communication*, Cambridge English, 2016.
4. J. Merrill, *Culture Bound*, Cambridge University Press, 1986.
5. S. Kumar, P. Lata, *Communication Skills*, Oxford University Press, 2012.
6. Grant Taylor, *English Conversation Practice*, McGraw Hill, 2001.

ED1192E Art Education- Collage Making

Pre-requisites: Nil

Total Lecture Sessions: 33

L	T	P	C
1	0	2	2

Course Outcomes:

CO1: Articulate the importance and the role of aesthetics and art in education.

CO2: Understand the medium of collage and its versatility.

CO3: Design, plan, and create an expressive self-portrait collage by applying a variety of collage techniques.

CO4: Design and set up an interactive visual art exhibition to display the artworks.

CO5: Understand and appreciate art-based learning experiences.

CO6: Develop the ability to reflect and challenge the assumptions and beliefs around art and develop new understandings.

Understand the importance of Art and Aesthetic in Education: Introduction to Art and Aesthetics, Different Artists works, Analysis and interpretation of artworks, Engagement through Art Experiences, Visual Thinking Strategy Exercise, Collective Analysis, Observing art and aesthetics in the surroundings.

Exploring paper collage and its techniques: Introduction to collage making, exploration of various mediums, Learning Visual Textures and Patterns, learning from nature- composition, colors, and textures, Utilizing and exploring various materials, collaborative analysis, and interpretation.

Ideating for an Expressive Self-Portrait: Observation, Sketching, and Self-Portrait Drawing, Exploration of Self-portrait collage using mixed mediums, Creation of paper sculpture compositions using 3D techniques, reflective dialogues.

Creation of an Expressive Self-Portrait Collage: Creation of a large expressive self-portrait using the medium of paper collage.

Designing and setting up an Exhibition: Planning and setting up an exhibition and showcasing the works.

References:

1. J. Berger, *Ways of Seeing*, Penguin Classics, 2008.
2. V. Finlay, *Color: A Natural History of the Palette*, Ballantine Books, 2002.
3. J. Dewey, *Art as Experience*, Perigee Books.
4. J. Ruskin, *The Elements of Drawing: In Three Letters to Beginners*, Dover.
5. Various works of artists such as Deborah Roberts, William Kentridge, Wangechi Mutu, etc.
6. Video: Mixer, Cut paper collage artist - [https://www.youtube.com/watch?v=[illegible]]
7. Video: G. Subramanian, Collage art - [https://www.youtube.com/watch?v=[illegible]]
8. Video: Amber Fleischbock, Collage artist - [https://www.youtube.com/watch?v=[illegible]]
9. Video: Arturo Hernandez, artist - [https://www.youtube.com/watch?v=Gage7_[illegible]]
10. JK's Face to face project (videos and readings)- [https://www.youtube.com/watch?v=4a_[illegible]]

ED1193E Understanding India I

Pre-requisites: Nil

Total Lecture Sessions: 28

L	T	P	C
2	0	0	2

Course Outcomes:

CO1: Develop an understanding of ancient Indian knowledge, tradition and culture and explain its potential benefits in modern times.

CO2: Appreciate ancient Indian art, literary, visual and cultural texts and identify its aesthetic and creative elements.

CO3: Familiarize with ancient Indian ideas of kingship, governance and law and appraise its benefits for individuals and society.

CO4: Gain an understanding of ancient Indian economy, its institutions, trade and revenue and identify its relative merits.

CO5: Demonstrate an understanding of traditional environmental practices and health traditions and justify its relevance in the 21st century.

Introduction to the Knowledge of India: Indian Knowledge Systems- scope and significance, need to revisit our ancient knowledge, traditions, and culture.

Culture - Art and Literature: Ancient Indian aesthetics, Rasa theory, Fine arts (Traditional art forms, Arts and spirituality, Arts and identity), Impact of globalization, Performing Arts (Indian dance systems, traditional Indian music, Dramaturgy, visual arts, folk arts, etc.). Literature with special reference to traditional institutions and value systems found in Sanskrit literature, Religious literature, Oral traditions, Folk literature, Sangam literature of South India and Vernacular literature- Bengali, Marathi etc.

Polity, Law and Economy: Kingship-types of government-Local village administration, Ancient Law: Dharma as basis, Criminal Justice, Courts, Police, Jails and punishments, Chanakyaniti-its relevance for modern day. Overview of Indian Economy from the Stone Age to the Guptas, Arthashastra and its relevance; Caste system and relation to professions, guilds, economic institutions; Harappan civilization- economy, agriculture growth of new occupations, Temple economy, Internal / external trade and commerce, trade routes, Indo-roman contacts, and maritime trade of South India. Land ownership - land grants and property rights, land revenue systems.

Environment and Health: Equilibrium between society and environment: Traditional Indian perception of natural resources like forests, land, water, and animals, Sustainable architecture and urban planning. Solving today's environmental challenges (best practices from indigenous knowledge, community-led efforts, etc.), India's Health Tradition: Ayurveda, Siddha, Ashtavaidya, Unani, and other schools of Medicine, Lessons from Sushruta Samhita and Charaka Samhita, Mental health in ancient India: its time-tested concepts of mental wellness (concept of mind, dhyana, mind-body relationship, Ayurveda, yoga darshan, asanas, etc.)

References:

(a) Books:

1. A.L. Basham, (ed.), *A Cultural History of India*, 7th edition, Oxford University Press, 2003.

2. A.L. Basham, *The Wonder That Was India*, Volume 1, Picador, 2019.
3. B.Mahadevan, Vinayak Rajat Bhat, R.N. Nagendra Pavana, *Introduction to Indian Knowledge Systems: Concepts and Applications*, PHI Learning, 2022.
4. B. N. Luniya, *Evolution of Indian Culture – From the earliest times to the present day*, 1992
5. Mohan Raghavan, M.S. Harsha Simha, C.R. Ramaswamy, *Elements of Indic Knowledge Systems and Heritage*, NTSK Institute2023

(b) Websites:

1. Indian Culture. *https://www.indianculture.gov.in/*
2. Indian Knowledge Systems, Govt. of India. *https://iksindia.org/*
3. Ministry of Culture, Govt. of India. *https://indiaculture.gov.in/*
4. Visual arts. CCRT. *https://ccrtindia.gov.in/resources/visual-arts/*

MA1101E Set Theory and Logic

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Use the language of set theory for interpreting issues in different areas of mathematics.

CO2: Understand the role and importance of proof in mathematics.

CO3: Use propositional and predicate calculus.

CO4: Correctly use quantifiers in everyday language.

Sets, relations and functions: Cantor's Concept of a Set. The Basis of Intuitive Set Theory. Inclusion. Operations for Sets. The Algebra of Sets. Relations. Equivalence Relations. Functions. Composition and Inversion for Functions. Operations for Collections of Sets. Ordering Relations.

Induction, Cardinality and Ordering: The Natural Number Sequence Proof and Definition by Induction. Cardinal Numbers. Countable Sets. Cardinal Arithmetic. Order types, Well-ordered Sets and Ordinal Numbers. The Axiom of Choice, Well-ordering Theorem and Zorn's lemma.

Propositional calculus: Statements. Conjunction. Disjunction. Negation. Conditional. Bi-conditional. Polynomials and Boolean polynomials. Propositions and truth tables. Tautologies and contradictions. Logical equivalence. Algebra of propositions. Logical implication. Logically true and logically equivalent statements. Propositional calculus and truth sets. Universal quantifier. Existential quantifier. Negation of propositions which contain quantifiers. Counter-examples. Notation. Propositional functions containing more than one variable.

References:

1. Robert R. Stoll, *Set Theory and Logic*, Dover, 1979.
2. Seymour Lipschutz, *Theory and Problems of Set theory and related Topics*, Schaum's Outline series, McGraw-Hill, 1998.
3. U. Daepp and P. Gorkin, *Reading, Writing, and Proving: A Closer Look at Mathematics*, Undergraduate Texts in Mathematics, Springer, 2011.
4. J. Słupecki, L. Borkowski, *Elements of Mathematical Logic and Set Theory*, Pergamon Press, PWN-Polish Scientific Publishers, Warszawa, 1967.

CH1102E Chemistry Minor – I
Basics of Theoretical Chemistry and Spectroscopy

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Apply the Chemical bonding principles in understanding the structure of molecules.

CO2: Describe the fundamental principles governing various spectroscopic techniques and their relevant applications.

Classical wave equation, Schrödinger equation, particle in a box, applications of particle in a box solutions for describing electronic levels and spectra in conjugated molecules.

Chemical bonding: Valence bond and molecular orbital descriptions of bonding, the linear combination of atomic orbitals (LCAO) approach, hybridization, bonding in H_2^+ and H_2.
Bonding in homonuclear diatomic molecules of the second period, bond orders, bond lengths, and bond strengths, bonding in heteronuclear diatomic molecules, concepts of g and u symmetries of molecular orbitals, polarity and electronegativity, and evidence from photoelectron spectroscopy.

Fundamental aspects of spectroscopy: Electromagnetic radiation, absorption, emission, scattering.

Atomic spectroscopy: Spectra of hydrogenic systems, coupling of orbital and spin angular momenta in many-electron systems, term symbols, fine and hyperfine structure, Zeeman and Stark effects.

Infrared spectroscopy: Harmonic oscillator model for diatomics, energy levels, selection rules, anharmonic effects, dissociation energies, and Morse oscillator.

Raman spectroscopy: Light scattering, Raman effect, classical model of scattering, polarizability, Stokes and anti-Stokes lines, selection rules, mutual exclusion principle, structure determination using IR and Raman spectroscopies.

Electronic Spectroscopy of Molecules: Jablonski diagram, absorption, emission, Franck-Condon principle, Stokes shift, 0-0 band, fluorescence, phosphorescence, and quantum yields.

Reference:

1. D. A. McQuarrie, *Quantum Chemistry*, Viva Student Edition, Viva, 2011.
2. P. Atkins, J. de Paula, J. Keeler, *Atkins' Physical Chemistry*, 11th Edition, O.U.P, 2018.
3. J. Barrett, *Structure and Bonding*, Wiley-Royal Society of Chemistry, 2002.
4. T. Engel and P. Reid, *Physical Chemistry*, 3rd Edition, Pearson, 2013.
5. R. J. Silbey, R. A. Alberty and M. G. Bawendi, *Physical Chemistry*, 4th Edition, Wiley Student Edition, 2006.
6. T. Engel, *Quantum Chemistry and Spectroscopy*, 3rd Edition, Pearson, 2006.
7. J. M. Hollas, *Modern Spectroscopy*, 4th Edition, Wiley, 2004.
8. C. N. Banwell and E. M. McCash, *Fundamentals of Molecular Spectroscopy*, 4th Edition, Tata McGraw- Hill, 2017.
9. N. Levine, *Physical Chemistry*, 6th Edition, Tata McGraw-Hill, 2011.

PH1102E Physics Minor-I Mechanics, Waves and Oscillations

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Solve problems in Mechanics using Newton's equations of motion.

CO2: Formulate and solve problems related to rotating systems and their dynamics.

CO3: Analyze oscillatory behavior under different conditions.

CO4: Apply principles of mechanics to describe interference, diffraction and polarization of waves.

Newton Equations: Review of Newtonian mechanics: Force, Newton's II law and equations of motion, motion in plane and space, examples - energy and work, conservative systems – rotational motion, angular momentum, moment of inertia, rotational dynamics – central force, gravitational force, Kepler's laws.

Oscillations: Oscillations, Simple Harmonic Oscillations, forced oscillations, damping, resonance, coupled oscillators, normal modes.

Wave motion: Waves – longitudinal and transverse waves – wave equation – solutions – superposition principle –wave groups, group velocity and dispersion – interference of waves – diffraction – polarization- light as a wave, interferenceYoung's double slit experiment – fringe pattern – visibility – coherence – diffraction – interferometry – Michelson interferometer – LASERS, working principle, characteristics and applications.

References:

1. 1. D. J. Morin, Introduction to Classical Mechanics: With Problems and Solutions, Cambridge University Press, 2008.
2. 2. D. Kleppner and R. J. Kolenkow, An Introduction to Mechanics, 1 st Edition, McGraw Hill, 2017.
3. 3. D. Halliday, R. Resnick and J. Walker, Fundamentals of Physics, 10th Edition, John Wiley & Sons, 2013.
4. 4. F. L. Pedrotti, L. M. Pedrotti and L. S. Pedrotti, Introduction to Optics, 3 rd Edition, Cambridge University Press, 2017.

CS1101E Python Programming

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	0	2	4

Course Outcomes:

CO1: Introduce the fundamental concepts of Python programming.

CO2: Provides a foundation for using the basic building blocks of Python.

CO3: Learn to write Python Scripts.

CO4: Explore various exception-handling mechanisms.

CO5: Develop Python packages.

Introduction to Python: Python variables, Python basic Operators, Python Data Types, variables, Declaring and using Numeric data types: int, float etc., Basic Input-Output Operations, Basic Operators.

Conditionals and loops: Boolean Values, if, else, and else if, Simple for loops in Python, for loop using ranges, string, lists, and dictionaries. Use while loops in Python, Loop manipulation using pass, continue, break and else.

Strings: Assigning values in strings, String manipulations, String special operators, String formatting operators, Triple Quotes, Raw String, Unicode String, Build-in-String methods.

Lists: Lists Introduction, accessing values in a list, List manipulations, List Operations, Indexing, slicing & matrices, use of tuple data type, programming using string, list, and dictionary in-built functions.

Functions: Built-in Functions and methods, Functions, writing functions in Python, returning a result from a function, Pass by value & pass by reference, function arguments & their types.

Laboratory: Programs using

1. Conditional control constructs
2. Loops
3. Strings
4. Lists
5. User defined functions and library functions
6. Built-in functions of packages matplotlib

Learning Resources:

Text Books:

1. William Mitchell, Pavel Solin, Martin Novak et al., *Introduction to Python Programming*, NCLab *Public Computing*, 2012.
2. Jacob Fredslund, *Introduction to Python Programming*, 2007.

Reference Books:

1. John C. Lusth, *An Introduction to Python*, The University of Alabama, 2011.
2. *Introduction to Python*, ©Dave Kuhlman, 2008.

SEMESTER - II

ED1201E Language II – Manipuri

Pre-requisites: Nil

Total Lecture Sessions: 52

L	T	P	C
4	0	0	4

Course Outcomes:

CO1: [illegible]

CO2: [illegible] (Linguistic Harmony) [illegible]

CO3: [illegible]

CO4: [illegible]

[illegible]

[illegible]:

[illegible]

[illegible]:

[illegible]

[illegible]:

[illegible]

[illegible]:

[illegible]

[illegible]:

5. A.R.A. Demers, R.M. Harnish, *Linguistics: An Introduction to Language and Communication*, MIT Press Cambridge, Mass 1979 (2nd ed.)
6. Bhatia, Vijay K. (2012). *Analysing Genre: Language Use in Professional Settings*. London: Routledge (1993). *Pragmatics*. Cambridge: Cambridge University Press

3. Carroll, John B. (ed.), (1956), *Language, Thought and Reality: Selected Writings of Benjamin Lee Whorf*, Cambridge, MA: MIT
4. Dr. K. Bimola, *Manipuri Lonmiti Shahan Khora*, JN Publication Imphal, 2022Dr. Ismail Singh, *Masheshi*, Imphal: Manipuri Sahitya Parishad, 2009
5. Dr. R.L. Varshney, *An Introductory Text Book of Linguistics and Phonetics* Students' Store, Bareily, 2013
6. From Kin Vand R. Rodman, *An Introduction of Language*, Holt Rinehart and Winston, Inc. New York, 1988
7. Fromkin, Victoria, Robert Rodman and Nina Hyams, 2014 *An Introduction to Language*, (10[th] Edition), Boston, MA: Wadsworth
8. Hockett, Chjmlas F. (1960), *Origin of Speech*, *Scientific American* 203:88-III
9. Konsam Priyokumar Singh, *Nongpi Tanabomidere*, Imphal: Writers' Forum, 1993
10. Lyons, John, *Introduction to Theoretical Linguistics*, Cambridge University Press, Cambridge, 1968
11. Levinson, Stephen C. (1983), *Pragmatics*, Cambridge: Cambridge University Press
12. Larson, Richard K., 2010. *Grammar as Science*, Cambridge, MA: MIT Press Stevensen Bo, *A Handbook of Lexicography*, Cambridge University, 1998
13. Simon, Peter, 2003, *Communication Skills*, (13[th] Edition), New Delhi: Raneah Publishing House
14. Oinam Bhogeswar Singh (ed.), *Chandrakirti Jila Chongba*, Imphal: Tamra Publications, 1995
15. Oinam Ibochaoba Singh, Ibohal Singh Kangjam (ed.), *Akhannaba Manipuri Shairong*, Imphal: Manipur Naharol Sahitya Sabha, 1975
16. Sri Nongmaithem Manaoyaima Singh (ed.), *Sanaphou*, Kakching: The Lila Singh Memorial Press, 1980

ED1292E Language II – Hindi

Pre-requisites: Nil

Total Lecture Sessions: 52

L	T	P	C
4	0	0	4

Course Outcomes:

CO1: Enable the students to acquire basic skills in functional language of Hindi

CO2: Develop independent reading skills and appreciate literary works in Hindi

CO3: Internalise grammar rules to facilitate fluency in speech and writing in Hindi

CO4: Develop functional and creative skills in Hindi language

History of Language and Literature: Hindi Bhasha ka Itihas - Aadi kaal, Madhya Kaal aur Aadhunik Kaal, Hindi Grammar Kaal and Kriya, Hindi Sahitya ka Itihas - Aadi kaal, Madhya Kaal, Ritikal Kaal aur Aadhunik Kaal.

Poetry: Kbeer ke Pramukh Dohe, Suryakant Tripathi Nirala: Juhi ki Kali, Dhoomil Sudhama Pandey: Proud Shiksh, Nagarjun: Akal Aur Uske Bad, Ramdarash Mishra: Chidiya, Kedarnath Singh: Akal Me Saras (For Extra Reading), Nandita Sreevastava: Main Ik Chidiya Hoon Pappa.

Gadya: Harishankar Parsai: Premchandh ka Phata Jutha (Nibandh), Bhagavathi Sharan Varma: Sbse Bada Aadmi (Ekanki), Mohan Rakesh Uski Roti (Short Story) (For Extra Reading), Bhisham Sahani: Chief ki Dawat (Short Story), Uday Prakash: Aparadh (Short Story), Chitra Mudgal: Domin Kaki (Lekha kosha)

References:

1. Ramchandra Shukla, Hindi Sahitya Ka Itihas, Rajkamal Prakashan.
2. Dr Nagendra, Hindi Sahitya Ka Itihas, Mayoor Paperbacks.
3. Manager Pandey, Bhakti Aandolan aur Surdas ka Kavya, Vani Prakashan.
4. Dr Ramdars Mishra, Hindi Kahani- Antarang Pahchan, Vani Prakashan.
5. Namvar Singh, Hindi Ka Gadyaparva, Rajkamal Prakashan.
6. Dr Ramvilas Sharma, Bhasha, Yugbodh aur Kavita, Vani Prakashan.
7. Dr P Ravi, Kavita ka Vartaman, Vani Prakashan.
8. Ramswaroop Chaturvedi, Hindi Kavya ka Itihas, Lokbharti Prakashan.
9. Kailash Nath Pandey, Prayojanmoolak Hindi ki Nayee Bhoomika, Rajkamal Prakashan Samooh.
10. Kamta Prasad Guru, Hindi Vyakaran, Sahitya Sarovar.

ED1293E Understanding India – II

Pre-requisite: ED1193E

Total Lecture Sessions: 26

L	T	P	C
2	0	0	2

Course Outcomes:

CO1: Demonstrate an understanding of ancient Indian knowledge, tradition and culture and evaluate its relevance in present times.

CO2: Analyse key Indian philosophical ideas, ethics and values and explain its position.

CO3: Demonstrate an understanding of ancient Indian linguistic traditions and explain its significance.

CO4: Show an awareness of traditional Indian dress, food and health practices and appraise its potential benefits.

CO5: Appreciate the contribution of Indian science and technology and identify the efficacy of ancient scientific concepts in day-to-day life.

Introduction of Knowledge of India: Recap of the previous semester's definitions and knowledge.

Philosophy, Ethics & Values: Schools of Philosophy: Vaisheshika, Nyaya, Samkhya, Yoga, Purva Mimamsa and Vedanta or Uttara Mimamsa (theory and the major thinkers) – Jain, Buddhist, and Charvak traditions; Vedanta philosophical systems (Advaita, Vishishtadvaita, Dvaita); Ethics, morality, and social dilemmas (including self-leadership) and their relevance in today's time, How do Indians value spirituality? Spirituality and Social Responsibility, Importance of Spirituality in current times; Using ethics in a technologically volatile world: leading an ethical and modern life; Practical Vedanta for well-being (mindfulness, inter-connectedness, society-self relationship, etc.).

Culture-Lifestyle: Language as culture and identity, Ancient Indian Linguistics and oral traditions, Evolution of different Indian languages-Ancient grammarians and their contributions, Food (regional cuisines, ayurvedic diet, food and festival, food and hospitality, impact of globalization), Clothes (traditional Indian clothing, Textile arts- handmade- texture-embroidery, clothing status- for occasions- significance of colour- varieties for gender, impact of globalization), The lifestyle of Yoga: adapting ancient lifestyle – A path towards longevity, Indian spirituality- Importance of spirituality in current times, Sports (traditional Indian sports, martial arts, sports and gender, impact of globalization).

Science & Technology: Arithmetic and Logic, Natural sciences: Mathematics, Physics, Chemistry, Metallurgy, Astronomy: India's contributions to the world, Indian notions of time and space, Technology in the economy: agriculture, transportation, etc.

References:

(a) **Books**

1. A.L. Basham, (ed.), *A Cultural History of India*, 7th edition, Oxford University Press, 2003.
2. A.L. Basham, *The Wonder That Was India*, Volume 1, Picador, 2019.
3. B.Mahadevan, Vinayak Rajat Bhat, R.N. Nagendra Pavana, *Introduction to Indian Knowledge Systems: Concepts and Applications*, PHI Learning, 2022.
4. B. N. Luniya, *Evolution of Indian Culture –From the earliest times to the present day*, 1992.
5. Mohan Raghavan, M.S. Hrishi Simha, C.R. Ramaswamy, *Elements of India Knowledge Systems and Heritage*, NTSS Institute2023
6. Samskrita Bharati, *Pride of India: A Glimpse in to India's Scientific Heritage*, 2006.

(b) Websites

7. Indian Culture. https://www.indianculture.gov.in/
8. Indian Knowledge Systems, Govt. of India. https://iksindia.org/
9. Ministry of Culture, Govt. of India. https://indianculture.gov.in/
10. Visual arts. CCRT. https://ccrtindia.gov.in/resources/visual-arts/

ED1294E Teacher and Society

Pre-requisites: Nil

Total Lecture Sessions: 28

L	T	P	C
2	0	0	2

Course Outcomes:

CO1: Critically examine the relationship between beliefs, values, character, life, social and cultural context of the teacher and teaching.

CO2: Explain the roles and characteristics of the teacher and its significant role in nurturing the posterity.

CO3: Identify the narrow and broad curricular aims of education and explain their role in shaping self, school, and society.

CO4: Develop positive classroom environment through engaging in the ethic of care.

CO5: Critically reflect on personal and collective practice in order to improve learning and teaching. CO6: explain individual, contextual, and structural dimensions of teacher agency and appreciate its impact in education.

Understanding the Teacher: Exploring the Personal and Professional Teacher: Exploring the wider Personal and General Social Context of Teacher: Life History, Teacher Beliefs, Values and Aspirations, Diverse Identities, Social Contexts and Commitment to Learning and Education; Exploring the Professional Teacher: Qualifications, Education in teaching, Attitude, Aptitude, Experience and Exposure. The Charismatic Teacher, the Communicator Teacher, The Missionary Teacher, The Competent Practitioner, The Reflective Practitioner, The Learning Teacher; Reflective Practice: Nurturing the Professional Capital through collaborative and/or collective engagement with self, others, the social context.

Nurturing the Teacher: A Dialogue beyond the curricular goals, for Life and Posterity: Teaching: One profession, many roles; Teaching Character: Nurturing Teachers for Human Flourishing; Holistic Teacher Development: Nurturing the Panchakoshas; Teacher Values, Beliefs, and current Philosophy of Teaching: A Reflective Dialogue; Developing an Ethic of Care in Teacher Education: Nurturing Teachers towards a pedagogy of care.

Understanding and Fostering Teacher Agency: Role in shaping Education Systems of Tomorrow: eacher Agency: meaning and importance, Individual, Cultural and Structural Dimensions of Teacher Agency; Teacher discourses, Philosophy, Relationships, Networks and Professional Development: Shaping teacher agency and Creative insubordination; Challenges and Issues in fostering Teacher Agency: Performativity, Non-academic engagements, Systemic apathy, Policy and Practice gaps and others; Role of Teacher in shaping the educational policy, practice, and reforms.

Teacher as an Architect of the New India: Shaping the Society of Tomorrow:
Engaging in Critical Education: Dialogues on power relations associated with Gender, Ethnicity, Culture, Disability, Class, Poverty, the reproduction of disadvantage and realising the true human potential, Being a Critical Teacher: Raising debates around rapid technological advancement and impact on individual, family and social life, the growing isolation and impact on mental and social health and well-being, changing relationships between the 'state' and the 'market' and their impact on formal education; the conceptualisation of teacher, teaching and teacher roles, 'globalisation' and the reconstructed nationalism shaping the socio-political milieu and impact on social psyche, growing materialistic urge, sensory drives and the gradual deterioration of the individual and societal character.

References:

1. Julie Ellison Justice, F. Blake Tenore (Ed.) *Becoming Critical Teacher Educators: Narratives of Disruption, Possibility, and Praxis*, Routledge, 2018.
2. Donna Walker Tileston, *10 Best Teaching Practices: How Brain Research and Learning Styles Define Teaching Competencies*, 3rd edition, Corwin Press 2011.
3. Danielle Herro, Cassie Quigley, *An Educator's Guide to STEAM*, Teachers' College Press, 2019.
4. Ellen Nuijten, Fred Korthagen, *The Power of Reflection in Teacher Education and Professional Development: Strategies for In-Depth Teacher Learning*, Routledge, 2022.
5. Becky Zayas, Ian Jukes, et al. *Learner Choice, Learner Voice: A Teacher's Guide to Promoting Agency in the Classroom (Eye on Education)*, Routledge, 2022.
6. Todd Whitaker, *What Great Teachers do differently-Nineteen things that matter most*, 3rd edition, Routledge, 2020.
7. Denise Mifsud, Stephen P. Day (Ed.), *Teacher Education as an ongoing Professional Trajectory*, Springer, 2023.
8. N. Entwistle (ed.), *Handbook of educational ideas and practices*, Routledge, 1990.

MA1201E Single Variable Calculus and Matrix Theory

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Find the limits, check for continuity and differentiability of real valued functions of one variable.

CO2: Find the maxima and minima of real valued functions of one variable.

CO3: Test the consistency of the system of linear equations and then solve it.

CO4: Diagonalize symmetric matrices and use it to find the nature of quadratic forms.

Functions of one variable: Limit, continuity, differentiability, Higher derivatives, Leibnitz's theorem. Monotone functions, maxima and minima, Rolle's theorem, Mean value theorem, Taylor's theorem, indeterminate form, L'Hopital's rule, Integration, fundamental theorem of calculus, applications: finding volume and area, improper integrals, Gamma and Beta functions.

Matrices: Algebra of matrices, Symmetric and Skew Symmetric, Hermitian and Skew Hermitian matrices and their standard properties, Determinants, Adjoint of a square matrix, Singular and non-singular matrices, System of linear equations: Gauss elimination method, row echelon form, row space, row rank, existence and uniqueness, homogeneous system, Linear independence and span of row vectors, linearly independent solutions, rank-nullity relation for homogeneous linear system.

Matrix Eigen Value Problem: Eigenvalues and eigenvectors of a matrix, Cayley-Hamilton theorem, eigenvectors associated with distinct eigenvalues, diagonalization of matrices, Eigen values of symmetric, skew-symmetric and orthogonal matrices, orthogonal diagonalization of symmetric matrices, bilinear and quadratic forms, definiteness of quadratic forms, transformation into principal axes.

References:

1. H. Anton, I. Bivens and S. Davis, *Calculus*, 10th edition, John Wiley & Sons, 2013.
2. G. B. Thomas, M.D. Weir, J. Hass, *Thomas' Calculus*, 12th edition, Pearson, 2013.
3. E. Kreyszig, *Advanced Engineering Mathematics*, 10th edition, John Wiley & Sons, 2013.
4. G. Strang, *Introduction to Linear Algebra*, Cambridge Press, 2016.

MA1202E Analytical Geometry and Number Theory

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Use various formulas of distance, angle and locus and apply in various problems of geometry.

CO2: Understand various conic sections in Cartesian and polar system.

CO3: Understand the fundamental concepts in number system like GCD, LCM.

CO4: Use the technique of congruences in various applications.

Plane Analytical Geometry: The Cartesian Plane, Distance and Point-of-Division Formulas, Slope, Parallel and Perpendicular Lines, Angle from One Line to another, Graphs and Points of Intersection, Equation of a Locus, Vectors in plane, Dot product and applications, Various forms of lines in two dimensions, families of lines, circles, conic sections, parabola, hyperbola and ellipse, transformation of coordinates, polar coordinates, parametric equations.

Solid Analytical Geometry: Distance and Point-of-Division Formulas, Vectors in Space, Direction Angles, Cosines, and Numbers, lines, planes, cylinders, Cross Product, Quadric Surfaces, Cylindrical and Spherical Coordinates.

Theory of Numbers: Division Algorithm, Prime and Composite Numbers proving the existence and uniqueness of greatest common divisor and the Euclidean Algorithm, fundamental theorem of Arithmetic, the least common multiple, congruences, linear congruences, Wilson's theorem, Simultaneous congruences, Theorems of Euler, Fermat and Lagrange.

References:

1. Douglas F Riddle, *Analytic Geometry*, PWS Publishing Company, 1996.
2. S K Stein, *Calculus with Analytic Geometry*, McGraw-Hill Pub. 1987.
3. Thomas and Finney, *Calculus and Analytic Geometry*, Pearson Education India, 2010.
4. David M. Burton, *Elementary Number Theory*, McGraw Hill, 2002.
5. Thomas Koshy, Elementary Number Theory with applications, Academic press, 2007.

CH1203E Chemistry Minor – II
Physical Chemistry

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Apply the building models of equations of state and molecular behaviours on experimental observations.

CO2: Comprehend and disseminate the basic concepts of thermodynamics.

CO3: Use analytical methods in chemistry for practical problems.

CO4: Describe the law of chemical equilibrium and electrochemistry.

States of matter: Variables of states, equations of state, Boyle's law, Charles's law, Avogadro's principle, mixtures of gases, ideal and nonideal gases, gas laws, Dalton's law of partial pressures, molecular speeds and translational energies, equations of state for nonideal gases, liquefaction of gases and the critical phenomena, virial coefficients, critical constants, van der Waals equation, physical properties of liquids, vapour pressure, excess pressure, viscosity and Reynold's number, Raoult's law and Henry's law, ideal and nonideal solutions, azeotropic mixtures, distillation, nature of the solid state, anisotropy, amorphous and crystalline solids, space groups, crystal lattices, lattices and unit cells, crystal systems, Bravais lattices, Miller indices, identification of lattice planes, inter planar distances, Bragg's law, X-ray diffraction, X-ray diffraction for cubic system.

Thermodynamics: Definition of thermodynamic terms, first law of thermodynamics, heat capacities at constant volume and at constant pressure & their relationship, standard enthalpy changes, enthalpy of formation, Hess's law, variation of enthalpy of reaction with temperature, Kirchhoff equation, expansion of ideal gas, work done in isothermal expansion and reversible isothermal expansion, second law of thermodynamics, concept of entropy, criteria of spontaneity and equilibrium, third law of thermodynamics, residual entropy.

Chemical Kinetics: rate of reactions, rate law and rate constant, order and molecularity of reaction, methods to determine the order, integration of rate expressions, half-life of reaction, Arrhenius equation, significance of Arrhenius parameters, steady state approximation, parallel reactions, opposing reactions, consecutive reactions and chain reactions with examples (elementary idea only), theories of reaction rates, collision theory, transition state theory.

Equilibria and Adsorption: Chemical equilibrium, law of mass action, thermodynamic derivation, Van't Hoff reaction isotherm, phase equilibrium, phase, component, degree of freedom, Gibbs phase rule, Clausius-Clapeyron equation, phase diagram for one component systems, with applications, two component systems, simple eutectic system (lead - silver system), Pattinson's process, adsorption by solids, chemisorption and physisorption, types of adsorption isotherms, adsorption isotherms: Freundlich and Langmuir isotherms.

Analytical Principles: Analytical methods for the separation and analysis of compounds, theory of gravimetric analysis, solubility product, common ion effect, principles of volumetric analysis, primary standard, standard solution, calculation of normality, molality and molarity of solutions, theory of acid

- base titrations, redox titrations, chromatography, paper and thin layer chromatography, column chromatography.

Electrochemistry: Arrhenius concept, Bronsted-Lowry concept, Lewis concept, weak and strong electrolytes, dissociation of water, pH scale, Ostwald's dilution law, its uses and limitations – Debye Huckel - Onsager's equation for strong electrolytes.

References:

1. P. Atkins, J. de Paula, *Atkin's Physical Chemistry*, 11th Edition, Oxford university press, 2018.
2. G. K. Vemulapalli, *Physical Chemistry*, PHI Learning Pvt. Ltd., 1996.
3. B. R. Puri, L. R. Sharma, M. S. Pathania, *Principles of Physical Chemistry*, 48th Edition, Vishal Publishing Co., 2021.
4. R. A. Day Junior, A. L. Underwood, *Quantitative Analysis*, 5th Edition, Prentice Hall of India Pvt. Ltd. 1988.
5. J. Mendham, R. C. Denney, J. D. Barnes, M. Thomas, *Vogel's Text Book of Quantitative Chemical Analysis*, 6th Edition, Pearson Education, 2003.
6. D. A. Skoog, D. M. West, F. J. Holler, S. R. Crouch, *Fundamentals of Analytical Chemistry*, Brooks/Cole.

PH1303E Physics Minor – II Thermal Physics

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Identify the relevant variables of a thermodynamic system and set up equations of state.

CO2: Evaluate entropy changes involved in a process and distinguish processes as reversible and irreversible.

CO3: Apply the first and second laws of thermodynamics to thermodynamic systems.

CO4: Analyse the thermodynamic properties of a given system using appropriate thermodynamic potentials.

Basic Concepts: Assumptions of the kinetic theory of gases- the pressure of an ideal gas- r.m.s. speed- kinetic interpretation of temperature- intensive and extensive parameters - equation of state- ideal gas and real gas - Maxwell's speed distribution law- thermodynamic state- phase diagrams- triple point.

Heat & Calorimetry: Heat as a form of energy- units of heat- principle of calorimetry- specific heat capacity and molar heat capacity- measurement- specific latent heat of fusion and vaporization- measurement- mechanical equivalent of heat- heat capacity - enthalpy and specific heats of ideal gases.

Zeroth Law and First Law: Thermodynamic systems – types- thermal equilibrium– Zeroth law of thermodynamics – temperature- mechanical, chemical, and thermodynamic equilibrium - work done in a process - - first law of thermodynamics – work done in isothermal and adiabatic processes - heat engines - Carnot cycle.

Second Law and Third Law: Limitations of first law- definition of entropy – irreversible processes- entropy changes in reversible and irreversible processes- Clausius and Kelvin-Planck statement ofsecond law– equivalence of the two statements – combined first and second laws - thermodynamic potentials– Helmholtz and Gibb's functions- chemical potential first-order phase transitions - phase-coexistence - Clausius-Clapeyron equation- third law of thermodynamics- statements- equivalence of the statements- consequences.

References:

1. M. W. Zemansky, R. H. Dittman, Heat and Thermodynamics, 8th Edition, McGraw-Hill, 2007.
2. S. J. Blundell, K. M. Blundell, Concepts in Thermal Physics, 2 nd Edition, Oxford University Press, 2010.
3. H. C. Verma, Concepts of Physics, Vol- 2, 3 rd Reprint, Bharati Bhawan, 2009.
4. A. H. Carter, Classical and Statistical Thermodynamics, 1st Edition, Pearson, 1999.

CS1201E Computer Programming with C

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	0	2	4

Course Outcomes:

CO1: Implement programs using classes and objects.

CO2: Able to understand the overloading concept.

CO3: Specify the forms of inheritance and use them in programs.

CO4: Analyze polymorphic behavior of objects and polymorphism.

CO5: Understand virtual functions.

C Fundamentals: The C character set identifiers and keywords, data type & sizes, variable names, declaration, statements.

Operators & Expressions: Arithmetic operators, relational and logical operators, type, conversion, increment and decrement operators, bit wise operators, assignment operators and expressions, precedence and order of evaluation. Input and Output: Standard input and output, formatted output – printf, formatted input scanf. C pre-processor, command line arguments.

Flow of Control: Statement and blocks, if – else, switch, loops - while, for, do while, break and continue, go to and labels.

Functions: Basic of functions, function types, functions returning values, functions not returning values, auto, external, static and register Variables, scope rules, recursion

Arrays and Pointers: One-dimensional, two-dimensional arrays, pointers and functions, multidimensional arrays.

Structures Union and File: Structure, union, structures and functions, arrays of structures, file read, file write.

Laboratory:

1. Programs on expression evaluation.
2. Programs on conditional branching, iterations, pattern matching.
3. Programs on function, recursion.
4. Programs on arrays, pointers, parameter passing.
5. Programs on string using array and pointers. 6. Programs on structures, union.

Learning Resources:

Text Books:

1. B. S. Gottfried, "Programming with C", McGraw Hill Education, Fourth edition, 2018.
2. B. W. Kernighan, D. Ritchie, "The C Programming Language", Pearson Education India, Second edition, 2015.

Reference Books:

1. E. Balagurusamy, "Computing Fundamentals and C Programming", McGraw Hill Education, Second edition, 2017.
2. Y. Kanetkar, "Let Us C", BPB Publications, Sixteenth edition, 2017.
3. E. Balagurusamy, "Programming in ANSI C", McGraw Hill Education India Private Limited, Seventh edition, 2017.

SEMESTER – III

ED2301E Child Development and Educational Psychology

Pre-requisites: Nil

Total Lecture Sessions: 52

L	T	P	C
4	0	0	4

Course Outcomes:

CO1: Understand and articulate the meaning, concept, characteristics, factors affecting growth and Development and use the knowledge of Indian concept of self.

CO2: Analyse the process and factors that affect development and use proper tools and technique to identify learner with different abilities.

CO3: Conceptualize the advance theories of learning to design classroom practice, apply various problem solving and learning strategies in real classroom settings.

CO4: Analyse the need and importance of motivation and implement suitable classroom management strategies that promote effective teaching and learning.

Child Development: Child Development-Meaning and process: Biological, cognitive, socio-emotional, and moral, Significance of understanding the process of Child Development, Developmental characteristics of a child during: Infancy stage, Early Childhood stage, Middle to Late Childhood stage, Adolescence stage. The Indian concept of self: Mind, Intellect, Memory, Pancha-koshiya Vikas. Educational Implications.

Developmental Process: Development across domains: Physical Development, Cognitive Development, Language Development, Socio-Emotional Development, Aesthetic Development, Moral Development Factors affecting development (During each of the above-mentioned developmental stages of a child) Individual differences, Children with special needs including developmental disorders, Tools and Techniques for Identifying Learner with different abilities. Teachers' role and strategies to address the needs of learners with different learning abilities.

Process of Learning: Conceptual Clarity and significance, Approaches- Behaviorist, Cognitivist, Constructivist, and Developmental. Information processing Model of learning. Shri Aurobindo's Integral approach, Problem Solving and Learning Strategies: Inquiry and problem-based learning, Steps and Strategies in problem solving, Factors hindering problem solving, How to Learn: Significance and Strategies.

Motivation and Classroom Management: Motivation: Conceptual clarity, nature, and significance, Intrinsic and Extrinsic Motivation, Strategies for Motivation, Classroom management: Creating a positive learning environment, Planning space for learning, Managing behavioral problems, Group dynamics: Classroom as a social group, Characteristics of group, Understanding group interaction-Sociometry, Strategies to facilitate group learning.

References:

1. E. B. Hurlock, *Child Growth and Development*, Tata Mc Graw - Hill Education, 2013.
2. S. K. Mangal, *Advance educational psychology*, 2nd edition, PHI Learning Pvt. Limited, 2019.
3. C. S. Hall, L. Gardner, B. C. John, *Theories of personality*, Agarwal Printing Press, 2010.
4. W. Buskist, S. F. Davis (Eds.), *Handbook of the teaching of psychology*, Blackwell Publication, 2006.

5. E. E. Smith, S. M. Kosslyn, *Cognitive psychology mind and brain*, Prentice Hall of India Pvt. Ltd, 2008.
6. E. B. Hurlock, *Developmental psychology: A life-span approach*, McGraw-Hill, 1980.
7. A. Woolfolk, *Educational psychology*, Pearson Publication, 2008.

ED2302E General Pedagogy

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Develop an understanding and appreciation of factors that influence learning ability.

CO2: Gain a knowledge of pedagogical strategies for multidisciplinary learning.

CO3: Demonstrate an ability to identify teaching methods and strategies that are appropriate for different contexts.

CO4: Explore ways of updating current trends in education and identify strategies for developing professionally.

The physical, mental, social, and emotional growth of learners, Thought processes and cognitive skills of learners, Characteristics of secondary stage learners: Unique capabilities, Conflicts and challenges. Relationship between Aims and Values of Education, Curriculum and Pedagogy, Concept, characteristics and functions of teaching, Teaching- learning process as a behavioural change, knowledge domains and cognitive processes, action words. Anderson and Krathwohl's revised Bloom's taxonomy. Dale's cone of experiences and its implications in the classroom teaching learning process.

Pedagogical approaches: Role of prior knowledge in constructing new knowledge (Ausubel), Piaget's theories of learning (schema- disequilibrium), Vygotsky's theories of role of language and context in learning, Von Glasersfeld's theory. Concept Attainment Model (Bruner), collaborative approach; reflective approach; integrative approach, inquiry- based approach; other contemporary approaches, art-integrated learning, sports- integrated learning. Building values through art integrated activities, community engagement etc.

Types of pedagogy: social pedagogy, critical pedagogy, culturally responsive pedagogy, Socratic pedagogy in inclusive setup, Role of pedagogy in effective learning: how does pedagogy impact the learner.

Teaching and Microteaching, Meaning and Definition of Teaching, Teacher-Training Programme Before Microteaching, Meaning and Concept of Microteaching, Definitions of Microteaching, Objectives of Microteaching, Microteaching at Work, Propositions of Microteaching - Phases, Activities and Components of Microteaching, Knowledge Acquisition Phase - Skill Acquisition Phase - Transfer Phase of Microteaching, Evaluation of Microteaching Teaching Skills, Core Teaching Skills, Organisation of Microteaching Cycle, Development of Microteaching, Assumptions of Microteaching, Principles of Microteaching Technique, Skill of Probing Questions, Skill of Explaining, Skill of Illustrating with Examples, Skill of Reinforcement, Skill of Stimulus Variation, Skill of Classroom Management, Skill of Using Blackboard.

Importance of planning, unit plan and lesson plan. Elements of unit plan and lesson plan, developing lesson plans on different topics and through various approaches taking examples form secondary stage. Development of constructivist practices in science teaching, 5E learning model, 7E model, making abstract concepts enjoyable by relating them to real life situations, promoting learner participation and engagement in learning, promoting multidisciplinary learning through integration of different disciplines.

Differences between occupation and profession, Teaching as a profession, professional and ethical competencies and need for updating content and pedagogical competencies to develop their professional competencies.

References:

1. R. W. Canestrari, B. A. Marlowe, *Educational Foundations: An Anthology of Critical Readings*, 4th Edition, Sage, 2020.
2. N. Denby (ed.), *Training to Teach: A Guide for Students*, Sage Publications Ltd., 2015.
3. C. Kyriacou, *Essential Teaching Skills*, Oxford University Press.
4. R. P. Pathak, *Teaching Skills*, Pearson Education India, 2012.
5. J. Loughran, M. L. Hamilton, *International Handbook of Teacher Education*, Vol 2, Springer, 2016.
6. W. W. Murawski, K. L. Scott, *What Really Works in Secondary Education*, Corwin, 2015.
7. *National Curriculum Framework for School Education*, 2023.
8. *Mandate documents: Guidelines for the development of National Curriculum Frameworks*, National Council of Educational Research and Training, 2022.
9. *National Education Policy* 2020, Ministry of Education, Government of India, 2020.
10. *National Policies on Education* 1968, 1986 and 2020.
11. G. Petty, *Teaching Today*, 3rd edition, Oxford University Press, 2004.
12. J. Scrivener, *Learning Teaching*, Macmillan, 1994.

MA2301E Real Analysis

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:
CO1: Understand the concepts of real number system and real sequences.
CO2: Test for convergence of sequences and series.
CO3: Find the Fourier series representations of periodic functions.
CO4: Carry out various techniques of integration.

The Real Field: Sets, Field structure and order structure, Intervals, open and closed intervals, bounded and unbounded sets, infimum and supremum, completeness of R, Archimedean property, Dedekind's form, Absolute value, Countable and Uncountable sets, Neighborhoods, Open Sets, Closed Sets, Limit points of a set, Closure of a set, Interior of a set, Compactness, Connectedness.

Sequences and Series: Real sequences, Convergent, divergent and Oscillatory sequences, Bounded sequences, Cauchy's general principle of convergence, Cauchy sequences, Monotonic sequences, Limit superior and limit inferior of a sequence, Infinite Series, Convergence of series, Cauchy's general principle of Convergence for Series, Series of positive terms, Geometric series, Comparison test, Cauchy's root test, D'Alembert's Ratio test, Raabe's test, Maclaurin's integral test, power series, radius of convergence, Taylor series, periodic functions and Fourier series expansions, half-range expansions.

Riemann Integration: Upper and lower sums, Criterion for integrability, Integrability of continuous functions and monotone functions, Fundamental theorem of Calculus, Change of variables, Integration by parts, First and Second Mean Value Theorems of Integral Calculus.

References:

1. J. M. Howie, *Real Analysis*, Springer, 2007.
2. S. C. Malik, *Principles of real analysis*, Wiley Eastern, 1982.
3. Shanthinarayan, *Mathematical Analysis*, S. Chand and Co. Ltd., 2003.
4. H. L. Royden, *Real Analysis*, Prentice Hall of India Pvt. Ltd. 2015.
5. T. M. Apostol, *Mathematical Analysis*, 2nd Edition, Pearson, 1974.
6. R. G. Bartle, D.R. Sherbert, *Introduction to Real Analysis*, 4th Edition, Wiley, 2011.
7. W. Rudin, *Principles of Mathematical Analysis*, 2nd Edition, McGraw Hill, 1964.

MA2302E Multivariable Calculus and Vector Calculus

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Find the limits, check for continuity and differentiability of real valued functions of two or more variables.

CO2: Evaluate double and triple integrals.

CO3: Find divergence and curl of vector fields.

CO4: Carry out parametrization of surfaces and evaluate the area.

Function of several variables: Review of single variable calculus, Functions of several variables, limit, continuity, partial derivatives, partial differentiation of composite functions, directional derivatives, gradient, local maxima and local minima of functions of two variables, critical point, saddle point, Taylor's formula for two variables, hessian, second derivative test, method of Lagrange multipliers.

Multiple integrals and change of coordinates: Double integral, Triple integral, Change of variables, Jacobian, Polar coordinates, Cylindrical and spherical coordinates, mass of a lamina, Centre of gravity, Moments of inertia.

Vector calculus: Vector field, Divergence, Curl, Identities involving divergence and curl, Scalar potential, Parametrized curves in space, arc length, tangent and normal vectors, curvature and torsion. Line integral, independence of path, Conservative field, Green's theorem for plane, finding areas using Green's theorem, Parametrized surfaces, Surface area and surface integral, Flux, Gauss' divergence theorem, Stokes' theorem.

References:

1. H. Anton, I. Bivens, S. Davis, *Calculus*, 10th edition, John Wiley & Sons, 2015.
2. G. B. Thomas, M. D. Weir, J. Hass, *Thomas' Calculus*, 12th edition, Pearson, 2015.
3. E. Kreyszig, *Advanced Engineering Mathematics*, 10th edition, John Wiley & Sons, 2015.
4. R. Larson, B. H. Edwards, *Calculus*, 10th edition, Cengage Learning, 2015.

CH2303E Chemistry Minor – III
Inorganic Chemistry

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Apply the concepts of inorganic chemistry to real-life problems.

CO2: Correlate the chemical bonding and structure.

CO3: Apply the organometallic chemistry concepts for the catalysis applications.

Elements and periodicity, classification of elements, concepts of atomic, ionic, and covalent radii, oxidation state, ionization energy, electronegativity, electron affinity, polarizability, inert pair effect, lanthanoid contraction.

Structure and bonding, crystal lattices and unit cell, crystal packing and defects, structures of NaCl, CsCl, and wurtzite, lattice enthalpy, Born-Haber cycle, structures of elemental B, C, Si, P, and S, bonding in boron halides, PF_5, SF_4, interhalogens, and xenon fluorides, Bent's rule, Berry pseudo rotation, Molecular orbital diagrams of selected molecules: N_2, O_2, HF, BeH_2 and CO_2.

Oxidation and reduction, reduction potential, electrochemical series, redox reactions, balancing of redox equations, factors affecting redox stability, Frost diagrams for redox reactions, Ellingham diagrams and extraction of elements.

Acids and bases: Arrhenius concept, solvent systems (in H_2O, NH_3, SO_2, and HF), Bronsted concept, Lux- Flood concept, and Lewis's concept, HSAB principle, superacids, relative strengths of acids; acid-base neutralization curves and indicators.

Main group chemistry, structure and bonding of compounds of boron, carbon, and noble gas elements.

Coordination compounds, geometries and isomerism of coordination compounds, crystal field theory, spectrochemical series, weak field and strong field ligands, spinel, and inverse spinel structures, Jahn-Teller effect, thermodynamic stability and kinetic lability of coordination complexes, optical activity of coordination complexes.

Organometallic chemistry and catalysis, introduction to organometallic compounds, structure and bonding, 18-electron rule, concepts and applications of catalysis in homogeneous and heterogeneous processes such as Wilkinson hydrogenation, Wacker oxidation, and Ziegler-Natta polymerization.

References:

1. P. Atkins, T. Overton, J. Rourke, F. Armstrong, M. Hagerman, *Shriver and Atkins' Inorganic Chemistry*, 5th edition, W. H. Freeman and Company, 2009.
2. G. L. Miessler, D. A. Tarr, *Inorganic Chemistry*, 3rd Edition, Pearson, 2008.
3. J. E. House, *Inorganic Chemistry*, 3rd edition, Academic Press, 2019.
4. J. E. Huheey, E. A. Keiter, R. L. Keiter, *Inorganic Chemistry – Principles of Structure and Reactivity*, 4th edition, Pearson Education, 2006.
5. C. E. Housecroft, A. G. Sharpe, *Inorganic Chemistry*, 4th edition, Pearson, 2012.

PH2303E Physics Minor – III Electromagnetism and Relativity

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Apply concepts in vector calculus to calculate electric and magnetic fields.

CO2: Identify simplifying principles like symmetry to compute Electric and Magnetic fields.

CO3: Analyse the generation and propagation of electromagnetic waves in vacuum and material medium.

CO4: Analyse the consequences of special relativity to measurement of space, time and idea of simultaneity.

Electrostatics: Electric charge, conservation, electrostatics, Coulomb's law, Electric field, charge density, flux of the electric field, Gauss law, applications to calculating electric field, electric potential, potential and field of a dipole, electrostatic work and potential energy, dielectric material, dielectric constant, capacitance, capacitors in series and parallel, energy of charge configurations and fields.

Magnetostatics: Current, resistance, Ohm's law, resistors in series and parallel, resistivity, force on a conductor in magnetic field, Lorentz force law, Magnetic fields, Biot-Savart law, Ampere's law, Magnetic fields due to straight wire, solenoid, toroid etc, Faraday's law of induction, Lenz's law, induced electric fields, inductors, mutual and selfinductance. Energy stored in magnetic field, magnetic material, magnetic fields in materials.

Electromagnetism: Electromagnetism, Maxwell's equations, Induced electric and magnetic fields, electromagnetic wave equation, electromagnetic waves, plane and spherical waves, energy transport and Poynting vector, polarization, reflection and refraction, total internal reflection, polarization due to reflection.

Relativity: Special relativity, relative velocity, Newtonian relativity, Galilean transformation, invariance of velocity of light, Michelson-Morley experiment, Einstein's theory of relativity, length contraction, time dilation, simultaneity, velocity addition, relativity of mass and energy.

References:

1. D. Halliday, R. Resnick and J. Walker, Fundamentals of Physics, 10th Edition, John Wiley & Sons, 2013.
2. E. Purcell, D. Morin, Electricity and Magnetism, 3 rd Edition, Cambridge University Press, 2013.
3. D. J. Griffiths, Introduction to Electrodynamics, 4 th Edition, PHI Learning, 2012.
4. R. P. Feynman, R. Leighton, M. Sands, Feynman Lectures on Physics, Vol-II, Millennium Edition, Pearson, 2012.

CS2301E Data Structures with C

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Understand the concept of data structure and create new data structure and also analyzing the efficiency of the same.

CO2: Identify and differentiate different types of data structures and implement the appropriate data structure and analyse the same.

CO3: Understand and implement stack, queue and dequeue by selecting appropriate methods.

CO4: Understand and implement different non-linear data structures by selecting appropriate methods.

CO5: Understand different factors of sorting and searching algorithm and select the appropriate algorithm and also implement and analyse the algorithm.

Array: Introduction to sequential representation, Linearization of multidimensional array. Application of array- representation of polynomial using array, Representation of Sparse matrix using array.

Sorting and searching: Definition and need of sorting, different types of sorting algorithm (Bubble sort, Insertion sort, Selection sort, Quick sort, Merge sort, Radix sort, Sequential search, Binary search

Linked List: Introduction to linked representation, Implementation of different types of linked listSingly linked list, Doubly linked list, Circular linked list, Circular Doubly Linked List. Application of Linked list- Representation of polynomial.

Stack: Definition of Stack, implementations of stack using array and linked list Applications of stack-infix to postfix conversion, Postfix Evaluation Recursion: Principles of recursion - use of stack, tail recursion. Tower of Hanoi using recursion.

Queue: Definition of Queue, Implementation of queue using array- physical, linear and circular model. Implementation of queue using linked list.

Dequeue- Definition and different types of dequeue

Laboratory:

- Implementation of Bubble sort, selection sort, Insertion sort, Quick sort, Merge Sort and Radix sort using appropriate data structure.
- Implementation of list as data structure using linked list of different types.
- Implementation of polynomial as data structure using array and linked list.
- Implementation of sparse matrix as data structure using array.
- Implementation of stack as data structure using array and linked list.
- Implementation of queue as data structure using array (physical, linear and circular model) and linked list.
- Converting infix to post-fix and evaluating post-fix expression using stack.

- Implementing Tower-of-Hanoi problem

Learning Resources:

Text Books:

1. Fundamentals of Data Structures of C by Ellis Horowitz, Sartaj Sahni, Susan Anderson-freed 2nd Edition, Universities Press
2. Data Structures and Program Design In C by Robert L. Kruse, Bruce P. Leung 2nd Edition, Pearson

Reference Books:

1. Samiran Chattopadhyay, Debabrata Ghosh Dastidar, Matangini Chattopadhyay, *Data Structures Through 'C' Language*, BPB Publications, 2001
2. S. Lipschutz, *Data Structures*, Special Indian Edition, Tata McGraw Hill Education (India) Private Limited
3. Aaron M. Tenenbaum, *Data Structures in C*, 1st Edition, Pearson

SEMESTER – IV

ED2401E Philosophical and Sociological Perspectives of Education – I

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
4	0	0	4

Course Outcomes:

CO1: Understand the philosophical schools of thought from both Bharatiya and Western traditions, and their implications for education.

CO2: Understand how various philosophies influence educational practices and theories.

CO3: Critically reflect on the visions of prominent Indian and global educators.

CO4: Develop a comprehensive understanding of concepts of the Indian value system in contemporary society, with a special focus on effectively addressing pedagogical challenges.

Philosophical Schools and Education: Conceptual Clarity of the following schools of thoughts with their implications for educational practices: Bharatiya: Samakhya, Yoga, Nyaya, Vaisheshika, Mimamsa, Vedanta. Western: Idealism, Naturalism, Pragmatism, Progressivism.

Educational Thinkers: Deliberations on aims, process and educational institutions developed on thoughts of following thinkers and practitioners: Bharatiya: Swami Vivekananda, Sri Aurobindo Ghosh, Gurudev Rabindra Nath Tagore, J. Krishnamurti, Mahamana Madan Mohan Malaviya, Mahatma Gandhi, Gijubhai Badheka. Western: J. Rousso, Maria Montessori, Friedrich Froebel, John Dewey.

Value Education: Conceptual Clarity, Significance and Types of Values, Indian Traditional Values, Guru Shishya-Parampara and Educational Values, Convocation message in Taittriya Upanishad, Values enshrined in Indian Constitution, NEP- 2020 and Values with special reference to 21st Century, Pedagogical Issues.

References:

1. P. Smeyers, *International Handbook of Philosophy of Education*, Springer, 2018.
2. R. Bailey, R. Barrow, D. Carr, C. McCarthy(Eds.), *The SAGE Handbook of Philosophy of Education*, SAGE Publications, 2010.
3. H. Siegel, (Ed.) *The Oxford Handbook of Philosophy of Education*, Oxford University Press, 2009.
4. A.S. Thakur, S. Berwal, *Education in emerging Indian society*, Vikash Publication, 2007.
5. H.K. Rawat, *Sociology: Basic Concepts*, Rawat Publication, 2012.
6. C.N.S. Rao(eds.), *Sociology: Principles of Sociology with an Introduction to Social Thought*, S.Chand & Company Pvt. Ltd. 2007.

ED2402E Minor Pedagogy (Physical Sciences)

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Explain the nature of science and specify the goals and objectives of science teaching.

CO2: Apply various theories of science learning and analyse the implications for teaching science.

CO3: Create unit plans, lesson plans in an artistic and scientific way and explore the inter-relation between science and other subjects.

CO4: Explore various assessment strategies for evaluating learning in Physical sciences.

CO5: Explain the necessity of the professional development of a teacher and identify various means for it.

Nature and scope of science, Scientific method, steps, historical development of physical science with illustrations from suitable topics, various branches of physical science, science and technology, science and society, aims of teaching physical science in the school curriculum, development of process skills, basic and advanced process skills, scientific attitude, values through science teaching. The school science curriculum with regard to NCF 2005, recommendation of NEP 2020. Brief study of famous curricular reform projects such as Nuffield, STEM, PSSC, and CHEMSTUDY. Major pedagogical shifts. Various approaches in teaching Science. Teacher's role as a facilitator, scaffolding.

Knowledge domains and cognitive processes Types of knowledge- factual, conceptual, procedural and metacognitive knowledge. Various stages of learning, Bloom's Taxonomy of Educational Objectives, action words, Revised Bloom's Taxonomy by Anderson and Krathwohl, Importance of planning, unit plan and lesson plan. Elements of physical science unit plan and lesson plan, content analysis, learning objective writing, and developing lesson plans on different topics of secondary stage such as Atoms and Molecules, Chemical Reactions and Equations, Acids, Bases and Salts, Metals and Non-Metals, Motion, Work and Energy, Sound, Light – Reflection and Refraction, Electricity, Magnetic Effects of Electric Current etc., Development of constructivist practices in science teaching, 5E model, 7E model, Characteristics of an ideal lesson plan.

Developing core teaching skills- Writing instructional objectives, Organising the content, Creating set for introducing the lesson, Structuring classroom questions. Question delivery and its distribution, Response management, Explaining, Illustrating with examples, Using teaching aids (selection of suitable learning resources, and developing low cost/ no cost teaching aids), Stimulus variation, Pacing of the lesson, Promoting pupil participation, Use of blackboard, Achieving closure of the lesson, Giving assignment, Evaluating the pupil's progress, Diagnosing pupil learning difficulties and taking remedial measures, Management of the class. Science laboratories: designing, management, and safe practices. ICT integration in physical science teaching: different forms of ICT and its application in science education.

Importance of feedback in facilitating learning, difference between test, examination, measurement, assessment and evaluation, Continuous and Comprehensive Evaluation (CCE) and its features, making a question paper, blue print, measurement of students' achievement, marks and grading. Various tools and techniques of assessment- assessment of written and oral work, project work, laboratory work, Use of observation, questioning, rubrics, and portfolio assessment in Physical Sciences, diagnosing learning difficulties and misconception in Physical Sciences, Use of ICT in assessment. Teaching as a profession and the professional competencies of a physical science teacher. Need for updating content and pedagogical competencies, preservice and in-service courses and initiatives.

References:

1. Pedagogy of Science: Physical Science, Part I, NCERT, 2013.
2. Pedagogy of Science Physical Science, Part II, NCERT, 2013.
3. National Curriculum Framework -2005, NCERT,2005.
4. S. Alsop, K. Hicks, *Teaching Science : A Handbook for Primary and Secondary School Teachers*, Kogan Page, 2007.
5. J. Bennett, *Teaching and Learning Science : A guide to recent research and its applications*, Continuum, 2003.
6. N. S. Whitton, *Teaching Science Creatively*, Saunders Company, 1967.
7. A. Carin, R. B. Sund, *Teaching Science through Discovery*, Charles E. Merrill Books Inc., 1964.
8. R. Martin, C. Sexton, J. Gerlovich, *Science for All Children: Methods for Constructing Understanding*, Allyn and Bacon, 2002.

MA2401E Differential Equations

L	T	P	C
3	1	0	4

Pre-requisites: 201

Total Lecture Sessions: 39

Course Outcomes:

CO1: Check for the existence and uniqueness of solutions of differential equations.

CO2: Solve various types of ordinary differential equations.

CO3: Formulate some real world problems as ODEs and hence solve such problems.

CO4: Solve various types of partial differential equations.

CO5: Formulate some real world problems as PDEs and hence solve such problems.

Ordinary Differential Equations: Existence and uniqueness of solution of first order ODE, methods of solutions of first order ODE, linear ODE, orthogonal trajectories, linear homogeneous second order ODEs with constant coefficients, fundamental system of solutions, existence and uniqueness of solutions, Wronskian, method of undetermined coefficients, solution by variation of parameters, Euler-Cauchy equations, applications of first and second order ODEs, system of linear ODEs with constant coefficients.

Series solutions and Transform techniques: Power series solutions of differential equations, Frobenius Method, Legendre Equation, Bessel's Equation, Sturm-Liouville's problems, Orthogonal eigen function expansions, Laplace transform, inverse Laplace transform, transforms of derivatives and integrals, shifting theorems, differentiation and integration of transform, solution of differential equations using Laplace transform.

Partial differential Equations: Basic Concepts, Cauchy's problem for first order equations, Linear Equations of the first order, Nonlinear Partial Differential Equations of the first order, Lagrange and Charpit's Method, Classification of second order partial differential equations, Method of Separation of variables, Modelling through PDE: Heat, Wave, and Laplace equations.

References:

1. H. Anton, I. Bivens, S. Davis, *Calculus*, 10th edition, John Wiley & Sons, 2015.
2. G. B. Thomas, M. D. Weir, J. Hass, *Thomas' Calculus*, 13th edition, Pearson Education, 2015.
3. E. Kreyszig, *Advanced Engineering Mathematics*, 10th edition, John Wiley &Sons, 2015.
4. V. I. Arnold, *Ordinary Differential Equations*, Springer, 2006.
5. I. N. Sneddon, *Elements of Partial Differential Equations*, Dover Publications, 2006.
6. M. D. Raisinghania, *Ordinary and Partial Differential Equations*, 20th edition, S. Chand, 2020.
7. S. L. Ross, *Differential Equations*, 3rd edition, John Wiley & Sons, 2007.
8. D. Greenspan, *Introduction to Partial Differential Equations*, 1st edition, Dover Publications, 2000.
9. P. Dyke, *An Introduction to Laplace Transforms and Fourier Series*, Springer, 2014.

MA2402E Modern Algebra

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Define algebraic structures such as groups, rings and fields and construct substructures.

CO2: Analyse given algebraic structures and develop new structures based on given structures.

CO3: Understand the homomorphism and isomorphism by using the relationship between groups and rings.

CO4: Understand field extensions and solve mathematical problems that involve polynomial equations.

Groups: Definition, Examples, Properties and types, Sub-groups, Cyclic groups and properties, Cosets, Lagrange's theorem, Dihedral groups, Normal subgroups, Quotient groups, Homomorphism and Isomorphism of groups, Kernel of a Homomorphism, Fundamental theorem of Homomorphism, Cauchy's theorem for abelian groups, Permutation group, Alternating Group, Cayley's Theorem.

Rings: Rings, Integral Domains, Division Rings, Fields, Properties, Field of quotients, Ideals, Quotient rings, Maximal, Prime and Principal ideals, Principal ideal ring, Divisibility in an Integral domain, Units and Associates, Ring homomorphism, Isomorphism, Fundamental theorem of Homomorphism.

Fields: Polynomial rings, Divisibility, Irreducible polynomials, Division Algorithm, Greatest Common Divisor, Euclidean Algorithm, Unique Factorization Theorem, Eisenstein's Criterion of irreducibility, Field extensions, Algebraic and transcendental elements, Algebraic extensions, Splitting field of a polynomial, Algebraic closure of a field.

References:

1. J.B. Fraleigh, *A First Course in Abstract Algebra*, 7th edition, Pearson Education, 1994.
2. I. N. Herstein, *Topics in Algebra*, 2nd edition, Wiley-Eastern, 1975.
3. N. Jacobson, *Basic Algebra*, Vol. I & II, Hindustan Publishing company, 1984.
4. J. A. Gallian, *Contemporary Abstract Algebra*, D. C. Heath and Company, 1990.
5. P. B. Bhattacharya, S. K. Jain, S. R. Nagpaul, *Basic Abstract Algebra*, 2nd Edition, Cambridge University Press, 1994.
6. J. R. Durbin, *Modern Algebra – An Introduction*, 5th Edition, Wiley, 2004.
7. M. Artin, *Algebra*, Pearson Education India, 2013.

CH2403E Chemistry Minor – IV
Organic Chemistry

Pre-requisites: 201

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Apply the principles of organic stereochemistry to real time problems.

CO2: Demonstrate and apply the fundamental concepts of reaction mechanisms.

CO3: Develop competency to work with biomolecules and apply the understanding of the reactivity and bonding features to address problems in industries.

Optical isomerism - concept of chirality and elements of symmetry, enantiomers, stereogenic centres, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres, diastereomers, meso compounds, resolution of enantiomers, inversion, retention, racemization, racemic modifications, R and S nomenclature, E and Z nomenclature, conformational analysis of ethane, n-butane cyclohexane and monosubstituted cyclohexane derivatives.

Definition of reaction mechanism, thermodynamic and kinetics data, substituent effects, linear free energy relationships, Hammett equation and related modifications, basic mechanistic concepts like kinetic vs thermodynamic control, electrophilic and nucleophilic substitutions, formation of carbocations, stability and rearrangements.

Chemistry of alkanes, alkenes and alkynes, mechanism of hydroboration oxidation, ozonolysis, *syn* and *anti*- hydroxylation (oxidation), Diels-Alder reaction, hydration of alkynes, catalytic hydrogenation and alkylation of terminal alkynes. Hückel's rule of aromaticity, aromatic electrophilic and nucleophilic substitutions, Introduction to heterocyclic compounds, their synthesis and reactivity.

Introduction to biomolecules, Carbohydrates- depicting stereochemistry using Fischer projections, Osazone formation, classification and properties of amino acids, Zwitter ion, Isoelectric point, Strecker and Gabriel phthalimide synthesis of amino acids, formation of peptide bonds, nucleotides and nucleic acids, base pairing in DNA, replication, transcription and translation.

References:

1. R. T. Morrison, R. N. Boyd, S. K. Bhattacharjee, *Organic Chemistry*, 7th Edition, Pearson Education, 2010.
2. J. McMurry, *Introduction to Organic Chemistry*, Cengage Learning, 2007.
3. M. A. Fox, J. K. Whitesell, *Organic Chemistry*, 7th Edition, Jones and Bartlett Publishers, 2019.
4. B. S. Bahl, A. Bahl, *Advanced Organic Chemistry*, 5th Edition, S. Chand Publisher, 2012.
5. T. W. G. Solomons, C. B. Fryhle, S. A. Snyder, *Organic Chemistry*, 12th Edition, Wiley Student Edition, 2016.
6. J. Clayden, N. Greeves, S. Warren, *Organic Chemistry*, 2nd Edition, Oxford Publisher, 2014.

MA2403E Physics Minor – IV Basic Electronics

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Apply the circuit theorem knowledge and solve electronic circuits.

CO2: Develop the basic knowledge on construction, operation and characteristics of semiconductor devices.

CO3: Design simple circuits like amplifiers (inverting and non-inverting), integrator and differentiator using Op-amps.

CO4: Develop competency to construct basic digital circuits using of basic gates.

Basic Circuit Concepts: Passive components: Resistance, Inductance, Capacitance; series, parallel combinations; Kirchhoff's law: Voltage, Current; Source Transformations; Circuit Theorem: Superposition Theorem, Thevenin's Theorem, Norton's Theorem; Signal Sources: Ideal and Practical Voltage and Current sources; Controlled Sources: VCVS, CCVS, VCCS, CCCS; Concept of Gain, Transconductance, Transimpedance.

Semiconductors and Diodes: Concept of Conductors, Semiconductors, and Insulators; Intrinsic Semiconductors and Extrinsic Semiconductors, p-type and n-type semiconductors; Diode Theory: Basic Idea, The Ideal Diode, Forward and Reverse Bias, Diode Equation, Current-voltage Characteristic; Zener Diode: Symbol, Operation, I-V Characteristics; Photo diode: Symbol, Working Principle; Light Emitting Diode (LED): Symbol, Principle; Diode as Rectifiers: Half-Wave Rectifier, Full-Wave Rectifier, Bridge Rectifier, derivation of Ripple factor, Efficiency of Half-Wave, Full-Wave, and Bridge Rectifiers, Comparison of Half-Wave, Full-Wave, and Bridge Rectifiers.

Bipolar Junction Transistor (BJT): Types of BJT and Their Symbols; Construction and Working Principles of n-p-n transistor; Transistor as an Amplifier: Active Mode; Common Base (CB), Common Emitter (CE), and Common Collector (CC) Configurations; Transistor as an amplifier in CE Configuration; Biasing of Transistor, Concept of DC Load Line and Q Point; Transistor as a Switch: Cut-Off and Saturation Modes.

Characteristics of Operational Amplifier (Op-amp): Introduction to Operational Amplifier (Op-amp); Op-amp Block Diagram; Ideal and Practical Op-amp Specifications; 741 Op-amp & Its Features; Op-amp Parameters: Input & Output off-set Voltages, Input offset and Bias Currents, Slew Rates, CMRR; Op-amp Applications: Inverting and Non-Inverting Amplifier, Integrator, Differentiator, and Comparator.

Boolean Algebra and Logic Circuits: Binary numbers, Octal & Hexa Decimal Numbers, Number Base Conversion; Binary Addition in 1's and 2's Complements; Logic gates and Their truth Tables: NOT Gate, AND Gate, OR Gate, XOR Gate, NAND Gate, NOR Gate, X-NOR Gate; Universal Gates: NAND and NOR Implementations; Boolean Algebra, Basic Theorems and Properties of Boolean Algebra; Boolean Functions, Sum-of-Product and Product-of-Sum Forms.

References:

1. R.Boylstead, Introductory circuit analysis, 5th edition, PHI,2010.
2. R.Boylestad, L.Nashelsky, Electronic Devices and Circuit Theory,10th Edition, Pearson., 2012.
3. A. S. Sedra, K. C. Smith, Microelectronic Circuits, 6th Edition, Oxford University Press, 2008.
4. R. A. Gayakwad, Op-amps and Linear Integrated Circuits, 4 th Edition, Pearson Education, 2008.
5. S.Salivahanan, K. Vallavaraj, Electronic Devices and Circuits, 2 nd Edition, Tata McGraw Hill, 2008.

CS2401E Digital Computer Fundamental

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Identify the logic gates and their functionality.

CO2: Perform number conversions from one system to another system.

CO3: Understand the functions of combinational circuits.

CO4: Perform number conversions.

CO5: Perform Counter design and learn its operations.

Number System and Codes: Number System-Base Conversion – Binary Codes – Code Conversion. Digital Logic: Logic Gates – Truth Tables – Universal Gates.

Boolean Algebra: Laws and Theorems – SOP, POS Methods – Simplification of Boolean Functions-Using Theorems, K-Map, Prime – Implicant Method–Binary Arithmetic: Binary Addition – Subtraction – Various Representations of Binary Numbers– Arithmetic Building Blocks – Adder – Subtractor

Combinational Logic: Multiplexers – Demultiplexers – Decoders – Encoders –Code Converters-Parity Generator and Checkers.

Sequential Logic: RS, JK, D, and T Flip-Flops – Master-Slave Flip-Flops.

Registers: Shift Registers–Types of Shift Registers.

Counters: Asynchronous and Synchronous Counters - Ripple, Mod, Up-Down Counters- Ring Counters. Memory: Basic Terms and Ideas –Types of ROMs –Types of RAMs.

Learning Resources:

Text Books:

1. V. Rajaraman and T.Radhakrishnan, *Digital Computer Design*, Prentice Hall of India, 2001
2. D.P. Leach and A. P. Malvino, *Digital Principals and Applications*, TMH, Fifth Edition, 2002.
3. M. Moris Mano, *Digital Logic and Computer Design*, PHI, 2001.

Reference Books:

1. T.C. Bartee, *Digital Computer Fundamentals*, 6th Edition, Tata McGraw Hill, 1991.

Web Resources:

1. *https://onlinecourses.swayam2.ac.in/cec19_cs06/preview*
2. *https://onlinecourses.swayam2.ac.in/cec21_cs17/preview*

SEMESTER – V

ED3501E ICT in Education

Pre-requisites: Nil

Total Lecture Sessions: 13

L	T	P	C
1	0	2	2

Course Outcomes:

CO1: Explain various aspects of communication and identify strategies for effective classroom communication.

CO2: Appraise the relative advantages of different technological tools and strategies for teaching and learning.

CO3: Choose appropriate web-based technologies for providing multi-sensory learning experience in the online and offline mode.

CO4: Explain ethical and safety issues in the use of web-based technology for education.

CO5: Identify the ways of using ICT tools for teaching, learning and assessment of different subjects.

Aspects of Communication: Communication-definition, Communication cycle, Verbal and non-verbal communication, Factors affecting communication, Components of effective classroom communication- Classroom interaction analysis- Flanders's Interaction Analysis Category System (FIACS).

Technology in education: Use of technology for education –Edgar Dale's Cone of Experience- Visual aids, audio aids, Multimedia aids. Advancements in World Wide Web and the changing role of teacher in the Digital era, Use of Tools: Smart Phone, Apps, Social Media, and Generative AI (ChatGPT, Gemini) for teaching and learning, Strategies: Blended learning, Collaborative learning, Flipped classroom, Synchronous and Asynchronous learning.

Web technologies for education: Learning Management Systems (LMS), Computer Assisted Instruction (CAI), Massive Open Online Courses (MOOCs), "anytime anywhere learning", Challenges in use of technology for education- Ethical issues, Safety issues- Cyber bullying, Hacking, Data protection- theft, Misuse, Deepfake technology, Wise use of web resources, Netiquette.

ICT in Teaching- Learning and Assessment: Techno-Pedagogy- Techno Pedagogical Content Knowledge Analysis (TPACK), Discipline specific ICT tools- Geogebra, PhET, Stellarium, Open Street Map, Marble, Turtle Art, Technological tools for Mind mapping, Varied learning experiences: Augmented reality, Gamification, Simulations, Virtual labs, Technological tools for assessment- e-portfolio, Online and offline assessment tools-Rubrics, Test generators.

References:

1. A. M. Bissonette, *Cyber Law- Maximizing Safety and Minimizing risk in classrooms*, Sage Publications India Pvt. Ltd, 2009.
2. C. R. Tucker, T. Wycoff, J. T. Green, *Blended Learning in Action: A Practical Guide Toward Sustainable Change*, 1st edition, Corwin, 2016.
3. E. Dale, *Audiovisual Methods in Teaching*, Dryden Press, 1969.
4. C. Davies, R. Eynon (ed.), *Education and Technology*, 1st Edition, Routledge and Kegan Paul, 2012.
5. K. Cennamo, J. Ross, P. Ertmer, *Technology Integration for Meaningful Classroom Use: A Standards- Based Approach*, Cengage Publishers, 2013.

6. W. Kist, *The Socially Networked Classroom: Teaching in the New Media Age*, Sage Publications Pvt Ltd, 2012.
7. R. S. Johnson, J. S. Mims-Cox, A. Doyle-Nichols, *Developing Portfolios in Education: A Guide to Reflection, Inquiry & Assessment*, 2nd edition, Sage Publications Pvt. Ltd, 2012.
8. J. K. Parker, *Teaching Tech-Savvy Kids- Bringing Digital Media into the Classroom, Grade 5-12*, Sage Publications. Pvt. Ltd, 2012.
9. M. D. Roblyer, A. H. Doering, *Integrating Educational Technology into Teaching*, 6th edition, Pearson, 2013.

ED3902E Major Pedagogy – I (Mathematics)

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Explain the nature of Mathematics as an important subject for human development and identify the aims and objectives of teaching mathematics.

CO2: Critically analyse the current place of Mathematics in the school curriculum and recommend ways to improve the current situation.

CO3: Select suitable approaches and methods that are suitable for teaching Mathematics topics in a way ensuring participation from the learners.

CO4: Develop various skills that are essential for teaching Mathematics and demonstrate these skills.

Nature of Mathematics, abstractness, preciseness, brevity, language and symbolism; structure (building blocks) of mathematics–undefined terms, defined terms, definitions, axioms, propositions, theorems, proofs, open sentences, quantifiers, postulates, conjectures. Nature of mathematical propositions, Calculus of Propositions, Calculus of Open Sentences and Venn Diagrams, Logical Validity of Conclusions, necessary and sufficient conditions (one and two way), A Mathematical Theorem and its Invariants- converse, inverse and contra positive, proofs in Mathematics: inductive deductive reasoning. Development of Mathematics from a historical perspective. Contributions of Indian Mathematicians. Scope of Mathematics, Importance of Mathematics knowledge in everyday life. Linkages of Mathematics with other school subjects. Aims and objectives of teaching Mathematics at secondary stage. Learning outcomes and competencies of teaching Mathematics at secondary stage. Meaning and Difference between Goals, Aims and Objectives, Need for Establishing General Aims and Objectives of Teaching Mathematics, General Aims of School Mathematics Education, General Aims of Teaching of Mathematics – Classifications, General Objectives of Teaching Mathematics, Taxonomies of Educational Objectives, Instructional Objectives at Different Levels, Principles of place of mathematics in school curriculum, Content Areas in Mathematics, School Mathematics Curriculum, Syllabus, Curriculum and Curriculum Framework, Mathematics, Designing Mathematics Curriculum, Mathematics Curriculum for Different Stages of Schooling, Some Highlights of the Mathematics Curriculum, Organisation of Mathematical content- horizontal and vertical linkage (within and between classes IX and X); linkage between upper primary, secondary and senior secondary mathematics, Recommendations of various committees, commissions and policies related to Mathematics education at Secondary stage with special emphasis on NEP 2020 and NCF 2005, Inculcation of values through teaching of Mathematics, Aesthetic Sense in Mathematics.

Exploring Learners, Assessing Students' Readiness, Relating Learning of Mathematics to Learners Real-life Situations, Allowing Students to Attempt Problems Independently, Encouraging Cooperative Learning Strategies, Promoting Classroom Dialogue, Nature of concepts, types of concept, process of concept formation, Moves in teaching concepts) Exemplar moves- giving examples and non-examples (with or without reasoning); comparing and contrasting; giving counter example b) Characterisation move- definition, stating necessary and/or sufficient condition, concept Attainment Model (Bruner), Advance Organiser Model (Ausubel), Meaning and nature of Proof, kinds of proof- direct, proof by mathematical induction, proof by contradiction, proof by contraposition, proof by cases, proof by counter examples, planning and teaching of various theorems in mathematics (secondary level), Definition of problem, problem solving, Meaning and nature of Problem solving, strategies of problem solving, Planning and implementation of strategies for teaching various mathematical concepts (secondary level Mathematics).

Implication of various approaches of teaching Mathematics – inductive, deductive, analytical synthetical, constructivist, blended learning, experiential learning, transdisciplinary, interdisciplinary, and multidisciplinary, Mastery Learning Strategy, Learner centric and participative methods of teaching of Mathematics: lecture cum demonstration, problem solving, inductive- deductive, analytico-synthetic, Play-Way, Laboratory (learning by doing), project based, Analytical pedagogical concerns in teaching of Mathematics for higher order thinking skills such as critical, creative, decision making, reflective, collaborative, and cooperative, Techniques of teaching learning Mathematics: oral, written, drill work, homework, self- study, group study, supervised study, concept-mapping, art and sports integrated learning. Important skills required to teach in Constructivist mode.

References:

1. C. H. Butler, F. L. Wren, *The Teaching of Secondary Mathematics*, 4th Edition, McGraw Hill Book company,1965.
2. T. J. Cooney, E. J. Davis, K. B. Henderson, *Dynamics of Teaching Secondary School Mathematics*, Houghton, Mifflin, 1975.
3. Focus Group Report, *Teaching of Mathematics*, NCERT, 2005.
4. J. Stillwell, *Mathematics and its History- undergraduate Texts in Mathematics*, Springer, 1989.
5. *A textbook of Content-Cum-Methodology of Teaching Mathematics*, NCERT.
6. *Pedagogy of Mathematics- textbook for Two-year B.Ed. course*, NCERT, 2012.
7. R. B. Davis, *Learning Mathematics: The cognitive approach to Mathematics Education*, Croom Helm Australia Pty Ltd, 1984.
8. W. Servas, T Varga, *Teaching school Mathematics:* UNESCO source book.
9. T. V. Somashekar, G. Viswanathappa, A. James, *Methods of Teaching Mathematics*, Neelkamal publications Pvt Ltd, 2014.

ED3502E Pre-internship Practice

Pre-requisites: Nil

Total Lecture Sessions: 8

L	T	P	C
0	0	4	2

Course Outcomes:

CO1: acquainted with various pedagogic practices, classroom management skills, assessment tools and learning standards.

CO2: get experience of conducting classes by observing lessons transacted by teacher educators (demonstration lessons).

CO3: develop lesson plans to transact them using appropriate pedagogies and learning resources.

CO4: develop and practice teaching skills in a guided environment to be an effective teacher.

Activities to be conducted:

- Observation of a minimum of 3 lessons transacted by teacher educators to identify pedagogic skills, followed by a critical analysis of the classes observed.

- Content analysis and development of a unit plan.

- Preparation of a minimum of 2 types of lesson plans under two different topics. Develop concept map of the each of the lessons.

- Practice on the skills of introduction, questioning and black board writing.

- Development of at least one Teaching Learning Materials (TLMs).

- Observation of the lesson demonstrated by teacher educators/experts in the institute.

MA3501E Linear Algebra

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Understand an axiomatic description of an abstract vector space and determine a basis and the dimension of a finite-dimensional space.
CO2: Find a matrix representation for linear transformations and analyse changes due to basis transformations.
CO3: Determine the key properties of inner product spaces.
CO4: Use the Gram-Schmidt process to construct orthonormal vectors.

Vector Spaces
Vector spaces, Subspaces, Linear Combinations, Linear span, Linear dependence and Linear independence of vectors, Basis and Dimension, Finite dimensional vector space – some properties. Quotient spaces, Homomorphisms and Isomorphisms of vector spaces, Direct sums.

Linear Transformation
Linear transformation, the algebra of linear transformations, Linear operators, Isomorphism, Representation of linear transformations by matrices, Change of basis and associated matrices, Kernel and Image of a linear transformation, Rank- Nullity theorem.

Inner Product Spaces
Inner product spaces, Euclidean vector spaces, Distance, Length, Properties, Cauchy- Schwarz inequality, Orthogonal and orthonormal vectors, Gram Schmidt Orthogonalization Process, Orthogonal complement.

References:

1. K. Hoffman, R. Kunze, *Linear Algebra*, 2nd Edition, Pearson Education, 2015.
2. G. Strang, *Introduction to Linear Algebra*, 5th Edition, Wellesley- Cambridge Press, 2003.
3. S. H. Friedberg, A. J. Insel, L. E. Spence, *Linear Algebra*, 4th Edition, Pearson Education, 2003.
4. S. Axler, *Linear Algebra Done Right*, 3rd Edition, Springer, 2015.
5. S. Lang, *Linear Algebra*, 3rd Edition, Springer, 2004.
6. S. Lipschutz, *Theory and Problems of Linear Algebra*, *Schaum Outline Series*, McGraw- Hill, 1978.
7. F. M. Stewart, *Introduction to Linear Algebra*, Dover, 2019.
8. Shanthinarayan, P. K. Mittal, *Vector Algebra*, S Chand and Co. Ltd., 1996.
9. L. Smith, *Linear Algebra*, Springer, 1998.

MA3602E Complex analysis and Numerical analysis

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Check for analyticity of complex functions and find conjugates of given harmonic functions.

CO2: Find images of regions under standard complex functions.

CO3: Make use of residue theorem to evaluate contour integrals.

CO4: Solve linear and nonlinear equations using numerical methods.

CO5: Evaluate definite integrals and solve ODEs using numerical methods.

Complex Numbers and Functions: Complex functions, Derivative, Analytic functions, Cauchy-Riemann equations, Harmonic functions, Geometry of Analytic functions: Conformal mapping, Linear fractional Transformations, Transformation by other elementary functions.

Complex Integration: Line integral in the Complex plane, Cauchy's integral theorem, Cauchy's integral formula, Power series, Taylor series and Maclaurin series, Laurent series, Singularities and Zeros, Residue theorem, Evaluation of real Integrals.

Numerical Methods: Solution of algebraic and transcendental equations: Fixed point iteration method, Regula-Falsi method, Newton Raphson method. Iterative methods to solve linear system of equations: Gauss Jacobi, Gauss Seidel, Successive over relaxation method. Numerical integration: Composite Trapezoidal and Simpson's methods. Numerical solution of ordinary differential equations: Euler's method, modified Euler's method, Taylor's method, Runge-Kutta methods, Multistep methods- Milne's and Adams' methods.

References:

1. S. Ponnusamy, H Silverman, *Complex variables with applications*, Birkhauser, 2006.
2. E. Kreyszig, *Advanced Engineering Mathematics*, 9th Edition, John Wiley and Sons, 2012.
3. M. K. Jain, S. R. K. Iyengar, R. K. Jain, *Numerical methods for Scientific and Engineering Computation*, 8th edition, New Age International Ltd, 2022.
4. L. V. Ahlfors, *Complex Analysis*, 3rd Edition, McGraw Hill International Edition, 2021.
5. B. P. Palka, *Introduction to the Theory of Functions of a Complex Variable*, Springer, 1991.
6. S. Lang, *Complex Analysis*, 2nd Edition, Springer, 2013.
7. S. S. Sastry, *Introductory Methods of Numerical Analysis*, 5th Edition, PHI Learning Pvt. Ltd, 2012.
8. F. B. Hildebrand, *Introduction to Numerical Analysis*, Tata McGraw Hill Publishing Ltd, 1956.
9. F. Scheid, *Numerical Analysis*, Schaum's Outline Series, 1988.

MA3631E Major Project

L	T	P	C
0	0	8	4

Pre-requisites: Nil

Total Lecture Sessions: Nil

Course Outcomes:

CO1: Identify a domain-specific, contemporary, or application-oriented problem in Mathematics.

CO2: Review relevant mathematical literature to identify research gaps and clearly define the objectives and scope of the work.

CO3: develop appropriate mathematical models, algorithms, simulations, computational codes, or analytical frameworks to address the stated objectives.

CO4: Analyse the results obtained through theoretical analysis or computational experiments and draw valid mathematical conclusions.

Description:

Students are expected to select a real-world, educational, or contemporary problem and apply mathematical concepts, theories, and tools learned during the programme to analyse and solve the problem. The project may involve:

- Mathematical modelling of real-life phenomena
- Analytical or numerical solution of mathematical problems
- Algorithm development and implementation
- Simulation and visualization using mathematical software
- Applications of Mathematics in science, engineering, economics, data analysis, or education

The suitability and academic worthiness of the project topic shall be decided by a Departmental Project Evaluation Panel constituted by the Department.

The department constituted panel will decide the suitability and worthiness of the project.

The students are required to submit a report showing that plagiarism is within 20%. The B.Sc. B.Ed. Mathematics Major Project work will be evaluated for 100 marks, with the following weightages:

Component	Weightage
Periodic evaluation by Guide	40 marks
Mid-term review	20 marks
End Semester viva-voce examination	40 marks
Total	100 marks

The midterm review and the end semester viva-voce examination will be conducted by a committee constituted by the Head of the Department. If the performance of a student is not satisfactory, he/ she can be awarded 'F' grade. Such a student will be given a maximum time of three months to improve his/her performance. If the performance of such a student is not satisfactory even after the extended time period, he/ she will have to repeat the project work in the next academic year.

Evaluation Criteria:

The student will be evaluated by the panel based on the below criteria. Weightage for each criterion will be determined by the panel and will be informed to the students.

Criteria	Description	Weightages
I	Selection of Topic	10
II	Literature Survey	10
III	Objectives and Solution Methodology	20
IV	Execution of the Work and Conceptual Clarity	40
V	Report Preparation	10
VI	Presentation and Response to questions	10

SEMESTER – VI

ED3601E Assessment and Evaluation

Pre-requisites: Nil

Total Lecture Sessions: 28

L	T	P	C
2	0	0	2

Course Outcomes:

CO1: Explain the importance of assessment in education and understand different forms of assessment.

CO2: Select and implement students with diverse assessment approaches to comprehensively evaluate students' performance.

CO3: Select and implement various tools and techniques to evaluate attitudes, interests, social, and personal behavior, with a focus on fostering self-assessment and peer assessment.

CO4: Perform suitable technique of analysis of the students' performance scores and provide constructive feedback.

Assessment in Education: Meaning and significance of assessment and evaluation in educational field, Conceptual Clarity and purpose of Measurement, Assessment, Examination, Appraisal and Evaluation in Education, Learning outcomes across the stages and assessment, revised taxonomy of Objectives and Implications, Forms of Assessment: Formative, Summative, diagnostic, prognostic, Internal and External assessment, Assessment for learning, Assessment of learning and Assessment as learning

Process of Assessment and Evaluation: Formative and Summative Assessment: Concept and Characteristics, Approaches to assess and evaluate student performance such as time-constrained examinations, closed/open-book tests, problem-based assignments, practical assignment reports, observation of practical skills, individual and group project reports, oral presentations, viva-voce interviews, computerised adaptive testing, online assessment.

Assessing Higher Order Thinking Abilities: Problem solving, critical thinking, creative thinking, communication skills, judgement and decision making, ethical and moral reasoning, Tools and Techniques: Observation, rating scale, check list, anecdotes, interviews, Assessment of attitudes and interests, Socio-metric techniques, Criteria for assessment of social and personal behaviour.

Analysis and Interpretation: Analysis of students' performance and scores, credit and grading, Graphical representation- Histogram,

Frequency Curve, Interpretation of student's performance based on the analysis, constructive feedback, Reporting student's performance, 360-degree progress reports, cumulative records and their uses, portfolios, PTA meetings, qualitative reporting based on the observations, descriptive indicators in report-cards.

References:

1. R. N. Patel, *Educational Evaluation: Theory and Practice*, Himalaya Publishing House, 2011
2. J. C. Aggarwal, *Essentials of Examination System: Evaluation, Tests and Measurement*, Vikas Publishing House Pvt. Ltd, 2006.
3. Tom Diamond, Mark Sanders. Reference Assessment and Evaluation. Routledge, 2006.
4. M. David Miller, Robert L. Linn, and Norman Gronlund, *Measurement and Assessment in Teaching*, 11th edition. Pearson, 2012.
5. N. E. Gronlund, *How to Make Achievement Tests and Assessments*, 5th edition, Allyn & Bacon, 1992.
6. N. E. Gronlund, *How to Write and Use Instructional Objectives*, 6th edition, Pearson, 1999.

7. R. L. Ebel, D. A. Frisbie, *Essentials of Educational Measurement*. 5th Edition, Prentice-Hall, 1991.

ED2605E Major Pedagogy – II (Mathematics)

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Formulate objectives based on learning outcomes for Mathematics teaching.

CO2: Develop unit plans and lessons plans that are suitable for a constructivist teaching learning of various topics in Mathematics.

CO3: Explain various technological tools for teaching and learning of Mathematics and integrate technology judiciously to facilitate teaching learning.

CO4: Determine role of teacher in facilitating learning by selecting suitable learning materials, and judiciously using it for teaching various topics in Mathematics.

CO5: Design and develop innovative strategies and techniques for successful in teaching and learning Mathematics.

Planning for Teaching - Learning Mathematics, Introduction, Unit Planning, Lesson Plan, Bloom's Taxonomy of Educational Objectives, action words, Revised Bloom's Taxonomy by Anderson and Krathwohl, Characteristics of a good instructional objectives, Analysis for identification of axioms, concepts, rules, formulae, theorems, corollaries, pedagogical content knowledge of arithmetic, algebra, geometry, mensuration, and trigonometry of secondary stage, Writing specific learning objectives of different content categories in mathematics; Pedagogical Analysis of Some Topics in Mathematics, Developing annual plan, unit plan, lesson plan- its importance and writing unit plan and lesson plan for mathematics lessons using the format, Planning and evaluating learning experiences in an inclusive setup based on learning outcomes and competencies, building a community of mathematicians in classrooms.

Teaching learning materials for secondary school Mathematics, Types of teaching learning resources for offline/ online classroom teaching and learning, print media- textbook, teachers' manual/ handbook, laboratory manual, non-print and digital media- charts, models, web resources, interactive boards, animations, simulations, Audio-Visual Multimedia, Identification and use of learning resources in Mathematics from the local environment, community resources, Pooling of Learning Resources, Handling Hurdles in Utilizing Resources, ICT- Meaning, Scope and importance, Importance of the use of ICT in teaching learning mathematics, Technological Pedagogical Content Knowledge (TPCK) for Mathematics Teaching. Use of tools, software, and platforms such as, digital repository, Augmented Reality (AR), Virtual Reality (VR) and Artificial Intelligence (AI) based digital resources and open education resources, GeoGebra, national teacher's portal, DIKSHA, SWAYAM. Developing ICT integrated lesson plans using TPCK. Mathematics resource room/ laboratory – equipment and management, concept of virtual laboratories; Organization of Mathematics club, fairs, exhibitions, learner community.

Assessment and Evaluation, Informal Creative Evaluation, Formal Ways of Evaluation, Assessment Framework, Mathematics for All, Identifying Learners Strengths and Weaknesses, Activities Enriching Mathematics Learning. Selection of appropriate tools for formative and summative assessment, creation of rubric, portfolios, Criterion reference test, Norm referenced test based on set criteria, construction, administration, scoring, interpretation of a unit test and providing feedback to learners, Meaning need and organization of oral, written, and practical assessment in Mathematics, Construction of types of questions in Mathematics: objective, short answer, long answer, considerations for the marking different types of questions in Mathematics, Planning and developing teachers made tests in Mathematics - Table of Specification (TOS), question paper setting and preparing answer key, Tools to identify learning difficulties and provide corrective measures in Mathematics, concept of 3600 measurement, holistic progress card and assessment of mathematical aspects of students.

Professional Development of Mathematics Teachers, qualities of a Mathematics teacher as professional, Inservice Programmes, Mathematics Teachers' Association, Journals, other Resource Material in Mathematics Education, Professional Growth, Divergent thinking for innovation in psychological, sociological, and philosophical perspectives of Mathematics, Innovative practices in Mathematics, access to higher Mathematics, construction of learners' identity in a Mathematics classroom, Recent trends and research related to teaching learning of Mathematics – digital gaming, digital storytelling, using Artificial Intelligence for Mathematics teaching and learning. Action research for solving problems of teaching and learning of Mathematics: meaning, significance, steps, and planning, Need for and importance of how to learn 21st century skills such as practicing imagination, spatial visualization, mathematical reasoning, problem solving for learners and teachers of Mathematics.

References:

1. Butler and Wren, *The Teaching of Secondary Mathematics*, 4th Edition, McGraw Hill Book company,1965.
2. T. J. Cooney others, *Dynamics of Teaching Secondary School Mathematics*, Houghton Mifflin, 1975.
3. Focus Group Report, *Teaching of Mathematics*, NCERT, 2005.
4. Iglewicz, Boris, Stoyle Judith, *An Introduction to Mathematical Reasoning*, The McMillan company, 1973.
5. John Stillwell, *Mathematics and its History- undergraduate Texts in Mathematics*, Springer-Verlag New York Inc, 1989.
6. NCERT, *A textbook of Content-Cum-Methodology of Teaching Mathematics*, NCERT.
7. NCERT, *Pedagogy of Mathematics- textbook for Two-year B.Ed. course*, 2012.
8. Polya George, *How to solve it*, Garden city, Doubleday, 1957.
9. Robert B Davis, *Learning Mathematics-The cognitive approach to Mathematics Education*, Sydney, Croom Helm Australia Pty Ltd, 1984.
10. W. Servais, T Varga, *Teaching school Mathematics*, UNESCO source book
11. T V Somashekar, G Viswanathappa, Anice James, *Methods of Teaching Mathematics*, Neelkamal publications Pvt Ltd, 2004.

ED3603E Inclusive Education

Pre-requisites: Nil

Total Lecture Sessions: 28

L	T	P	C
2	0	0	2

Course Outcomes:

CO1: Understand various terms and phrases associated with Inclusive Education and create an inclusive learning environment.

CO2: Understand the paradigm shift in Inclusive education and analyse related policies and acts in India and abroad.

CO3: Identify the diverse learning needs of students with disabilities and children belonging to marginalized groups and adopt suitable teaching learning processes.

CO4: Identify the pedagogical, issues in connection with children with special needs and design and implement suitable ways to address them.

Inclusion and Education: Various terms and phrases associated with Inclusive Education: Integrated Education, Special Education, Impairment and Disability, Assessment and Evaluation, Curriculum adaptation, modification and differentiation, universal design of learning, shifting from Disability to the Inclusive view, Shifting Paradigms from Bio centric to Human Rights, Introductory reference of Policies/Acts with reference to educational implications for Children with Disabilities: Right to Education Act- 2009/ 2012, RPWD Act- 2016, UNCRPD2006, National Trust Act- 1999, National Educational Policy -2020.

Children with Disabilities and Marginalized Groups: Nature and needs of children with sensory impairments: cognitive impairments and intellectual disability, physical disabilities, cerebral palsy, multiple disabilities, Specific needs of children with behavioral, emotional learning disabilities, Health Problems, Educational needs of children belonging to Marginalized Groups.

Pedagogical Issues: The specific needs of Children with various disabilities, meeting the challenge of providing equal opportunities in classroom teaching learning process, arts, sports, and vocation-related activities, making the school buildings and compounds barrier free and accessible, Provision for supporting learning activities and resources for individualized learning environment, Need for and ways to implement assistive devices and technology-based tools, language-appropriate teaching-learning materials, suitable assessment strategies.

Reference:

1. M. Ainscow, T. Booth, *Index for Inclusion: Developing Learning and Participation in Schools*, Bristol: CSIE, 2002.
2. M. Ainscow, A. Dyson, T. Booth, *Improving Schools, Developing Inclusion*, Routledge, 2006.
3. M. Alur, M. Bach, *The Journey for Inclusive Education in the Indian Sub- Continent*, Vol. 23, Routledge, 2009.
4. A. C. Armstrong, D. Armstrong, I. Spandagou, *Inclusive Education, International Policy & Practice*, Sage, 2009.
5. D. Mitchell, D. Sutherland, *What Really Works in Special and Inclusive Education: Using Evidence-Based Teaching Strategies*, Routledge, 2020.
6. S. J. Pijl, C. J. Meijer, S. Hegarty (Eds.) *Inclusive Education: A Global Agenda*, Psychology Press, 1997.

7. M. Puri, G. Abraham, (Eds.). *Handbook of Inclusive Education for Educators, Administrators and Planners: Within Walls, Without Boundaries*, Sage, 2004.
8. Geetha Gopinath, Hemalatha, *Diversifying teaching, New Era of Inclusive Education*. Authors press.

ED3691E Mathematical and Quantitative Reasoning

Pre-requisites: Nil

Total Lecture Sessions: 13

L	T	P	C
1	1	0	2

Course Outcomes:

CO1: Adapt mathematical reasoning to solve problems in the real world and explain the fundamental ideas and tenets in this field.

CO2: Interpret & deduce the right conclusions from numerical representations like formulas, graphs, or tables.

CO3: Demonstrate critical thinking and problem-solving skills using mathematical and quantitative reasoning methods.

CO4: Analyse mathematical, quantitative and reasoning problems and evaluate the solutions.

Introduction to mathematical and quantitative reasoning: Meaning, nature and scope of mathematical and quantitative reasoning, Importance of mathematical and quantitative reasoning in various fields, Types of quantitative reasoning, Usage of mathematical and quantitative reasoning, Concept of mathematisation.

Introduction to data in Education: Data requirement, different sources of data, School enrolment: gross enrolment ratio, net enrolment ratio, educational progression: dropout rate, literacy: measures of literacy, Indian censuses, details of different items on which Indian censuses collect data, Nationwide sample surveys, National family health survey, District level household survey, UDISE.

Data Analysis & Interpretation: Concept of data interpretation (equation, diagram, graph, tables), Statistical analysis of data in educational context and its applications (measures of central tendency, measures of variability, percentile), Visual and numerical representation of data and its application (bar diagram, histogram, pie charts), Learning analytics: concept, significance, types, levels, and its applications in educational context.

References:

1. H. S Bhatia, *Ageing and Society*, The Arya's Book Centre Publishers, 1983.
2. A. Bhende, T. Kanitkar, *Principles of Population Studies*, Himalaya Publishing House, 2019.
3. D. Bogue, *Principles of Demography*, John Wiley and Sons, 1969.
4. Heer, David, *Society and Population*, Prentice-Hall, 1975.
5. P. Krishnan, K. Mahadevan, *Elderly Population Today: Policies Problems and Prospects*, B. R. Publishing House, 2008.

ED3604E School Observation

Pre-requisites: Nil

Total Lecture Sessions: Nil

L	T	P	C
0	0	4	2

Course Outcomes:

CO1: describe various schooling systems,

CO2: describe the processes, practices, and overall environment of the school,

CO3: establish rapport with the stakeholders of the school system state the process of conducting different activities in the school,

CO4: describe the available school infrastructure (classrooms, libraries, laboratories, playground, sanitation, drinking water facility, mid-day meal facility, inclusive facilities, safety and security, rainwater harvesting),

CO5: describe the availability and usage of ICT and TLMs,

CO6: summarise the available documents in both physical and digital modes, including UDISE data,

CO7: reflect upon relationships among the stakeholders,

CO8: analyse various assessment processes adopted in different types of schools,

CO9: prepare and present a comprehensive profile of the schools observed (including classroom processes).

Syllabus:

As school is the heart of the teacher education programme, the student teachers need to gain hands-on experiences from various activities organised by the school. School observation offers an opportunity to learn the processes and practices in a school setup. To expose the student teachers to various schooling systems (urban, rural, tribal, residential, non-residential, government, private, affiliated to different school boards like Central Board, State Board, International Board) prevailing in the country. School observation will also prepare the student teachers to build relationships with various stakeholders. The school observation by the student teachers is aimed at helping them build perspective in the schooling system, student needs, pedagogies, and assessment.

The school observation as a field-based activity will cover observation of school and classroom processes. The student teachers under the mentorship of teacher educators will visit schools, interact with teachers and students and other stakeholders, and relate the observation with the courses studied during the previous semesters, i.e. Foundations of Education, Disciplinary Courses, Pedagogy courses and Ability Enhancement & Value-Added Courses.

- Meaning and Nature of school observation process
- Difference between monitoring and observation
- Theory and practices of school observation components such as:
    1. Schooling system
    2. Rapport with all the stakeholders
    3. Office management procedures of different types of schools
    4. School environment in all perspectives
    5. Process of conducting curricular activities in the schooling process
    6. Existing infrastructure available in the school
    7. Utility of ICT and TLM facilities
    8. Interpersonal relationships among the stakeholders
    9. Various assessment processes adopted in different types of schools
    10. Engagement of parents and other community members in school activities

Activities to be conducted.

- Visit three types of secondary schools with observation formats developed in the institute and get acquainted with various schooling systems. Establish rapport with all stakeholders.
- Collect information about the demography of students in classes IX to XII and understand the linkage of the secondary stage with the middle stage and higher education through interaction with teachers, students and staff.
- Observe school processes and transactions of the curriculum through experiential learning and prepare a report.
- Interact with teachers and students and report on implementing ten bag-less days and internship opportunities to learn vocational subjects.
- Study the available opportunities for learning interdisciplinary subjects.
- Observe the availability and usage of library resources, laboratories (Atal Tinkering Lab, Physics, Chemistry, Biology, Mathematics, Languages, Social Science, Computer), sports facilities, and art and music learning facilities.
- Study the provision of other student support services- guidance and counselling, NCC, NSS, health and wellness programme.
- Observe the organisation of various activities like classroom teaching-learning processes, laboratory activities, library activities, sports and games, debate/elocution/essay writing and other competitions.
- Interact with School heads and subject teachers to understand how students are evaluated by following different tools and techniques of evaluation, how examinations are conducted, how answers are assessed, and how the result is communicated to parents in at least two different types of schools.

Assessment

Competence Artifact	Method of assessment	Assessed By	Credits
Involvement and active participation during the school visit	Observations	Teacher Educator	0.5
Comprehensive school profile	Presentation & reflection	Teacher-Educator	1.5

Components for school observation report

- School information (Context, Vision and Mission, Association with the Board)
- School Infrastructure
- Provision for CWSN/Divyang Children
- Inclusiveness at all levels
- Teacher-Student Ratio
- Teaching-Learning process
  - Academic plan
  - Classroom activities
  - Assessment
- School Development Plan (SDP
- Academic Calendar
- Administrative processes
  - Maintenance of students' records
  - Maintenance of teachers' records
- Cultural activities
- Sports activities

- Annual Day
- National and Social functions
- School Management
- School Discipline
- Interpersonal Relationships
- Understanding different types (socio-economic status, ability) of students and their needs
- Development of ICT and TLMs
- Engagement of parents and community members in the school activity
- Office Management
- The assessment process includes provision and practices for 360-degree holistic assessment
- The overall progress of the school (planning, organizing, staffing, directing, motivating and controlling)
- Challenges faced and overcoming them.

MA3601E Probability and Statistics

L	T	P	C
3	1	0	4

Pre-requisites: Nil

Total Lecture Sessions: 39

Course Outcomes:

CO1: Handle application problems involving random variables and functions of random variables.

CO2: Identify statistical problems and make use of statistical inferences while handling stochastic systems.

CO3: Apply regression and correlation analysis for studying relationship between variables.

CO4: Identify situations where analysis of variance is appropriate and apply it.

CO5: Use probabilistic and statistical analysis in various applications of education.

Probability Distributions: Probability distributions, Random variables, Expectation of a function of a random variable, Mean, Variance and Moment generating function of a probability distribution, Chebyshev's theorem, Binomial distribution, Poisson distribution, Geometric distribution, Hyper-geometric distribution, Normal Distribution, Uniform distribution, Gamma distribution, Beta distribution and Weibull distribution. Transformation of a random variable, Probability distribution of a function of a random variable, Jointly distributed random variables, Marginal and conditional distributions, Bi-variate Normal distribution, Joint probability distribution of functions of random variables.

Statistical Inference: Population and samples, The sampling distribution of the mean (σ known and σ unknown), Sampling distribution of the variance, Point estimation, Maximum likelihood estimation, Method of moments, Interval estimation, Point estimation and interval estimation of mean and variance. Tests of hypothesis, Hypothesis tests concerning one mean and two means. Hypothesis tests concerning one variance and two variances, Estimation of proportions, Hypothesis tests concerning one proportion and several proportions, Analysis of $r \times c$ contingency tables, Chi-square test for goodness of fit.

Regression and ANOVA: Curve fitting, Method of least squares, Estimation of simple regression models and hypotheses concerning regression coefficients, Correlation coefficient, Estimation of correlation coefficient, Hypothesis concerning correlation coefficient, Analysis of single factor experiments: Introduction to Analysis of Variance (ANOVA).

References:

1. R. A. Johnson, *Miller and Freund's Probability and Statistics for Engineers*, 8th edition., PHI, New Delhi, 2011.

2. W. W. Hines, D. C. Montgomery, D. M. Goldsman, C. M. Borror, *Probability and Statistics in Engineering*, 4th edition, John Wiley & Sons, Inc., 2003.

3. S.M. Ross, *Introduction to Probability and statistics for Engineers and Scientists*, 5th edition, Academic Press (Elsevier), New Delhi, 2014.

MA3602E Metric Spaces and Topology

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Extend the concepts of convergence of sequences, completeness and continuous functions to Metric Spaces.

CO2: Expand the concept of continuous functions to Topological spaces, and characterize the continuous functions in terms of open sets, closed sets etc.

CO3: Explain the concept of product of finite and arbitrary Topological Spaces.

CO4: Develop the concept of Compactness, Separation and connectedness in Metric and Topological Spaces.

Metric spaces: The definition and some examples - Open sets - Closed sets - Convergence, Completeness and Baire's theorem. Continuous mappings, Spaces of continuous functions - Euclidean and Unitary spaces.

Topological spaces and Compactness: Topological spaces: The definition and some examples - Elementary concepts, Open bases and open sub bases, Weak Topologies, Compactness: Compact spaces - Heine - Borel theorem, Product of Spaces - Tychonoff's theorem and locally Compact spaces - Compactness for metric spaces - Ascoli's theorem.

Separation and Connectedness: T1-Spaces and Hausdorff spaces, Completely Regular Space and Normal Space, Urysohn's Lemma, Tietze Extension Theorem, Connected Spaces- Definitions and Examples, Components of a Space, Totally Disconnected Spaces, Locally Connected Spaces.

References:

1. G. F. Simmons, *Introduction to Topology and Modern Analysis*, McGraw - Hill Ltd, 2017.
2. James R. Munkres: *Topology – A First Course*, Pearson Education, 2000.
3. K. D. Joshi, *Introduction to General Topology*, New Age Publications, 2022.

MA2603E Introduction to Optimization

Pre-requisites: Nil

L	T	P	C
3	1	0	4

Total Lecture Sessions: 39

Course Outcomes:

CO1: Apply the concepts of Linear Programming Techniques in optimization problems.

CO2: Explain duality in Linear Programming and theorems of duality.

CO3: Solve various types of Assignments and transportation problems.

CO4: Identify strategic situations and represent them as games.

Linear programming: Linear Programing Problem (LPP), Introduction and Problem formulation, Concept from Geometry, Geometrical aspects of LPP, Graphical solutions, Linear programming in standard form, Simplex, Big M and Two-Phase Methods, Revised simplex method, Special cases of LPP.

Duality theory: Dual simplex method, Sensitivity analysis of LP problem, Transportation, Assignment and travelling salesman problem. Integer programming problems: Branch and bound method, Gomory cutting plane method for all integer and for mixed integer LPP.

Theory of games: Saddle point, linear programming formulation of matrix games, two-person zero-sum games with and without saddle points, pure and mixed strategies, graphical method of solution of a game, solution of a game by simplex method.

References:

1. Hamdy A. Taha, *Operations Research: An Introduction*, 8th edition, PHI, 2007.
2. S. Chandra, Jayadeva, Aparna Mehra, *Numerical Optimization with Applications*, Narosa Publishing House, 2009.
3. Ravindran, D.T. Phillips, J.J. Solberg, *Operations Research*, John Wiley and Sons, 2005.
4. M. S. Bazaraa, J. J. Jarvis and H. D. Sherali, Linear Programming and Network Flows, 3rd Edition, Wiley, 2004.
5. D. G. Luenberger, Linear and Nonlinear Programming, 2nd Edition, Kluwer, 2003.
6. S. A. Zenios (editor), Financial Optimization, Cambridge University Press, 2002.
7. F. S. Hillier, G. J. Lieberman, Introduction to Operations Research, 8th edition, McGraw Hill, 2006.

MA3604E Functional Analysis

Pre-requisites: MA3501E

L	T	P	C
3	1	0	4

Total Lecture Sessions: 39

Course Outcomes:

CO1: Identify the classical normed spaces and Analyse their properties.

CO2: Analyse operators for their continuity properties and apply results on operators to problems of practical interest.

CO3: Analyse the spectrum and spectral properties of bounded linear operators.

Normed linear spaces and bounded linear operators: Review of vector spaces and metric spaces, normed linear spaces, Banach spaces, examples including L^p spaces and sequence spaces, Schauder basis, separable spaces, Riesz Lemma, finite dimensional spaces, bounded linear maps, bounded linear functionals, dual spaces and transpose operators, reflexive spaces.

Inner product spaces and operators between Hilbert spaces: Inner product spaces, Hilbert spaces, orthonormal sets and orthonormal basis, Bessel's inequality, Fourier expansion and Parseval's identity, Projection theorem, Riesz-Fischer Theorem, Riesz representation theorem, Adjoint of bounded operators.

Fundamental theorems on operators: Hahn-Banach extension Theorem and applications, Hahn-Banach separation theorem, Uniform boundedness principle, Banach-Steinhaus theorem, Arzela-Ascoli theorem, Open mapping theorem, Closed graph theorem.

References:

1. B. V. Limaye, *Functional Analysis*, New Age International Publishers, Revised 3 rd Edition, 2014.
2. M. T. Nair, *Functional Analysis: A First Course*, PHI, 2nd Edition, 2021.
3. G. F. Simmons, *Introduction to Topology and Modern Analysis*, McGraw Hill, 2017
4. E. Kreyszig, *Introductory Functional Analysis with Applications*, Wiley, 2007
5. S. Kumaresan and D. Sukumar, *Functional Analysis: A First Course*, Narosa, 2020

MA3606E Fluid Dynamics

Pre-requisites: MA2302E, MA2401E

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Derive the governing equations of the fluid mechanics.

CO2: Identify the non-dimensional parameters for given systems and use such numbers for the characterization.

CO3: Solve fluid and thermal problems using the concept of different approximation methods.

CO4: Apply the concept of different types of fluid flows to solve real life problems.

Motivation, Reviews of integral theorems of vector calculus, Fundamental concepts about fluids, Kinematics of fluids, Visualization of a moving fluid, Eulerian and Lagrangian description, The Transport Theorem, Continuity equation, Equation of motion, Stress tensor, Euler's equation, Navier-Stokes equations.

The energy equation, Boundary and initial conditions, Dimensional analysis, Buckingham's Pi theorem, Transformation of Cartesian Coordinates, Curvilinear Coordinates, Boussinesq approximation, Basic properties of irrotational flow, Incompressible and irrotational flow, Stream lines, Path lines, Streak lines, Plane potential flow.

Laplace equation, Bernoulli equation, Application of Bernoulli's equation, Vorticity dynamics, Kelvin's circulation theorem, Laminar flow, Steady flow in a pipe, Steady flow between concentric cylinders, Flow due to an oscillating plate, High and low Reynold's number flows, Boundary layer theory, Similarity solutions, Blasius solution, gravity waves, Shallow water waves.

References:

1. M. Feistauer, *Mathematical Methods in Fluid Dynamics*, Longman Scientific and Technicals, 1993.
2. A. J. Chorin, J. E. Marsden, *A mathematical introduction to fluid mechanics*, Springer, 3 rd Edition, 2000.
3. L. D. Landau, E. M. Lifshitz, *Fluid Mechanics*, Butterworth-Heinemann Ltd, 2 nd edition, 1987.
4. J. H. Spurk, N. Aksel, *Fluid Mechanics*, Springer-Verlag, 2 nd Edition, 2007.
5. G. K. Batchelor, *An Introduction to Fluid Dynamics*, Cambridge Univ. Press, 2000.
6. P.K. Kundu, I.M. Cohen, *Fluid Mechanics*, Academic Press, 2008.

SEMESTER – VII

ED4701E Perspectives on School Leadership and Management

Pre-requisites: Nil

Total Lecture Sessions: 28

L	T	P	C
2	0	0	2

Course Outcomes:

CO1: Analyse the diversity of schools and develop a comprehensive understanding of the educational landscape of India.

CO2: Explain the concept of school leadership and its various aspects.

CO3: Apply The principles of educational leadership in different contexts.

CO4: Develop the culture of evidence-based decision-making that helps to promote collaboration, teamwork, and cooperation among stakeholders.

Understanding School Leadership: School Leadership: Definition and practice, Being a School Leader: exploring the multiple roles and responsibilities, issues and challenges of school leadership in the Indian context, best practices on School leadership at National and International levels.

Schools as Learning Organizations: Role of School Leadership: Schools as motivating learning spaces: Developing inspiring school ethos, Schools as learning organization: promoting personal mastery, examining mental models, and developing a shared vision, team learning and a system's thinking perspective, Development of a shared vision and shaping of the school culture, Use of data for school improvement focused on students' learning, addressing equity challenges, and building an equitable school culture that promotes excellence for all, Nurturing school belongingness: engaging students, teachers, staff, parents, School management committee (SMC), and community in the formulation of a whole school development plan, Designing professional and collaborative learning opportunities for self and others (teachers, parents, and SMC members) and improving teaching and learning.

Reference:

1. T. A. Kasik, A. D. Swanson, *Fundamental Concepts of Educational Leadership and Management* 3rd edition, 2010.
2. D. Lewis, N. Kanji, *Non-governmental organizations and development*, London and New York, Routledge, 2009.
3. P. Drucker, J. Maciariello, (n.d.). *366 Days of Insight and Motivation for Getting the Right Things Done*, Routledge.
4. Palgrave Macmillan, *The Palgrave Handbook of Educational Leadership and Management Discourse*, 2020.
5. E. Camburn, J. P. Spillane, J. Sebastian, *Assessing the utility of a daily log for measuring principal leadership practice. Educational Administration Quarterly*, 46(5), 707–737, 2010.
6. P. Gronn, *Distributed properties: A new architecture for leadership. Educational Management and Administration*, 28(3), 317–338, 2000.
7. J. Lumby, *Distributed leadership: The uses and abuses of power. Educational Management Administration &; Leadership*, 41(5), 581–597, 2013.

ED4702E Curriculum Planning and Development

Pre-requisites: Nil

Total Lecture Sessions: 28

L	T	P	C
2	0	0	2

Course Outcomes:

CO1: Identify the relative merits of different types of curriculums by developing an understanding of curriculum and its different types.

CO2: Explain the principles and stages of curriculum development and its relevance.

CO3: Familiarize with approaches to curriculum construction and identify ways of addressing societal concerns and learner needs.

CO4: Explain the ways of operationalizing a curriculum and appraise the specific role of teachers in it.

Education and Curriculum: Meaning, need and significance, Types of Curriculum: subject-centered, activity-centered, environmental centered, community-centered, National Education Policy, National Curriculum Framework, State Curriculum framework-Syllabuses: NCERT/ State.

Principles and stages of Curriculum development: Basic principles: Personalization, Breadth, Relevance, Challenge and Enjoyment, Stages: Needs assessment, Planning session, Content development, Pilot delivery, Evaluation and Reporting, Finalizing the refined package.

Approaches to curriculum construction: Curriculum planning as a cyclic process, Incorporating principles of Integration, Utility, Character formation, Flexibility, Creativity and Conservation. Addressing various aspects- socio-cultural aspects, environmental concerns, values, gender concerns, inclusiveness, technological advancement and impact of globalization.

Curriculum implementation and evaluation: Process oriented, Learner-centred curriculum for different levels (Secondary and Higher Secondary), Role of State School Boards in implementation of curriculum, Role of teachers in operationalizing and evaluating the curriculum with special reference to: Course books, Teachers' Handbooks, Source books, Workbooks and Manuals, Learning resources, Audio Visuals and digital multimedia materials, Library, Laboratory, Playground, Neighborhood etc.

References:

1. Julie Dirksen, *Design for How People Learn*, 2nd Edition, Pearson, 2015.
2. Julie Harris Stern, Krista Ferraro, Kayla Duncan, Trevor Aleo, *Learning That Transfers: Designing Curriculum for a Changing World*, Corwin, 2021.
3. C. R. Kilbane, N. B. Milman, *Teaching Models: Designing Instruction for 21st Century Learners*, 1st Edition, Pearson, 2013.
4. Klein, Julie Thompson, *Beyond Interdisciplinarity: Boundary Work, Communication, and Collaboration*, Oxford University Press, 2021.
5. R. A. Reiser, J. V. Dempsey, *Trends and Issues in Instructional Design and Technology, Pearson*, 4th Edition, 2021.
6. J. B. Short, Hirsh Stephanie, *Transforming Teaching Through Curriculum-Based Professional Learning*, Corwin, 2022.

ED4791E Art Education-Performing and Visual

Pre-requisites: Nil

Total Lecture Sessions: 13

L	T	P	C
1	0	2	2

Course Outcomes:

CO1: Practice different forms of arts such as visual arts and performing Arts (Drama, Music, & dance).

CO2: Integrate different art forms in the teaching process.

CO3: Construct/design any type of drawing and painting Drama script craft on their own.

Visual Arts: Different materials of visual arts– Rangoli, pastels, posters, clay, paintings. Using different methods of visual arts- Paintings, block printing, clay modelling. Listening/viewing performing art forms of music, dance and theatre.

Performing arts in Drama: Drama as a medium of education- Identification of local performing art forms and their integration in teaching – learning. - Listening/viewing performing art skit, mime, one act play or theatre. Evaluation strategies, assessing the different forms of Art.

Fundamentals of Drawing and Painting: Concept and Types of drawing- Colours and Sketching-understanding of various media and perspectives, Different forms of painting. Use of Drawing and Painting in Education -Chart making, Poster making, matchstick drawing and other forms. Model making – Clay modelling, Origami, Decorative – Rangoli, and any other local art.

References:

1. J. Dewey, Art as experience, Minton, 1934.
2. H. Read, *Education through art*, Faber and Faber, 1958.
3. E. W. Eisner, *Educating artistic vision*, Macmillan, 1972.
4. B. John, C. Yogin, R. Chawla, *Playing for real: Using drama in the classroom*, Macmillan, 2007.
5. B. Jefferson, *Teaching art to children – Continental view point*, Allyn Bacon, 1969.
6. R. Tagore, *Lectures and addresses*, Macmillan, 1962.
7. A. K. Coomaraswamy, *Christian and oriental philosophy of art*, Munshiram Manoharlal,1974.
8. Rupali Tripathi, *Teaching of music*, Mohit Publications, 2004.
9. B. N. Dash, Teacher and Education in the Emerging India Society (Vol. I & II), 2002.
10. Kalaimani Saraswathi, *Bharata Natyakalai*, Thirumagal Nilayam, 1994.

ED4702E Sports, Nutrition and Fitness

Pre-requisites: Nil

Total Lecture Sessions: 13

L	T	P	C
1	0	2	2

Course Outcomes:

CO1: Explain the concept of holistic health, its various dimensions, and determinants.

CO2: Sensitise the need and acquire the skills for physical fitness, learn correct postural habits and activities for its development.

CO3: Create interest for the practice of yogasana and meditations.

CO4: Carry out various ways of effective assessment of health and physical fitness.

Evolution of Health and Physical Education: Health and Physical Education: Conceptual Clarity (locally as well as globally), importance and aims, Place in School Curriculum: Historical Development as a subject, Objectives with special reference to Indian Education and its relationship with other subjects, Status of Health and Physical Education: From primary to secondary education in a global perspective, ayurvedic and yogic concept of Health Education, legal perspective of Health and Health Education in India.

Health Education: Concept, dimensions, and determinants of health with special focus on India, Psycho-social concerns of children and adolescents including differently abled children, Understanding the body system and its functions, Common health problems and diseases: causes, prevention and cure, immunization and first aid, Impact of Physical activities, games, sports and yoga on different body systems, Food and nutrition, nutrients and their functions.

Games and Fitness: Physical fitness and its components: athletics (general physical fitness exercises), games (lead-up games, relays, and major games), Rhythmic activities, gymnastics, and their impact on health, Development of physical fitness: Postures and Importance of relaxation, Fitness tests, Resources and services for games and sports and Health, Fundamentals skills of sports: Sports for recreation and competition, Sports awards and scholarships, sportsmanship, Indigenous and self-defense activities, School and family, health services, policies and major health and physical education- related programmes, blood banks, role of media, Safety and security, First Aid: Need and Principles.

Policies, Programmes and Assessment: Policies, programmes, and services for addressing health needs, School Health Programmes: school health services, health promoting schools, global school health initiatives, Yoga: Meaning, initiation, historicity, classification, streams, and schools of yoga, Need and importance and role of yoga for healthy life and living.

Yoga as a Psychotherapy, POCSO (Protection of Children from Sexual Offences Act, 2012), PWD 2016, the Integrated Child Protection Scheme, Assessment of health performance testing in games and sports, reporting of health condition and performance of child in the sport fields.

References:

1. NCERT, *Health And Physical Education, A Teachers' Guide for Class VIII*, 2016.
2. Harold W. Kohl III and Heather D. Cook, (Ed.), *Educating the Student Body: Taking Physical Activity and Physical Education to School*, Committee on Physical Activity and Physical Education in the School Environment, Food and Nutrition Board, Institute of Medicine, 2013.

5. Dean Dudley, Amanda Telford, Louisa Peralta, Claire Stonehouse, Matthew Winslade, *Teaching Quality Health & Physical Education*, 2nd edition, Cengage Learning, 2020

ED4703E School based Research Project

Pre-requisites: Nil

Total Lecture Sessions: Nil

L	T	P	C
0	0	4	2

Course Outcomes:

CO1: Present contextual problems, an appropriate research design and the plan of action for undertaking school-based research;

CO2: demonstrate the tools and techniques used for the collection of relevant data;

CO3: summarize the analysed data used to identify the causes;

CO4: demonstrate the interventions used for addressing the problems;

CO5: present the effectiveness of the intervention(s);

CO6: share the school-based research experiences through reports and presentation.

The student teachers during previous semesters have studied different courses in Foundations of Education, Disciplinary Courses, Stage-specific pedagogy courses, Ability Enhancement and Value Added Courses. The required knowledge of action research and case study includes- the concept and importance of action research/case study, the steps of conducting action research/case study (objectives, methods, research design, design tools, data collection, and data analysis) and report writing.

The research problem will be taken from the day-to-day teaching-learning process of the school. Some of the significant areas may cover:

- Learning progress and outcomes in different subjects
- School-based assessment
- Learners' diversity and inclusion
- Participation in arts, games, sports

Suggestive Mode of Transaction

The following strategies will be used during the school-based research project:

- Discussions with teacher educator, school head, mentors, and peers for identification of problem and development of intervention(s).
- Finalize the school-based research project proposal outline through discussion with mentor teachers/teacher educators.
- Document analysis, interaction with all stakeholders, and field visits.
- Sharing and presentation of the outcomes of school-based research.

ED4704E Internship in Teaching

Pre-requisites: Nil

Total Lecture Sessions: Nil

L	T	P	C
0	0	20	10

Course Outcomes:

CO1: explain the overall functioning of the school.
CO2: describe and appreciate the different roles played by a teacher in the school.
CO3: experience the importance of teacher-student relationships for effective teaching.
CO4: develop age-appropriate pedagogic skills.
CO5: use different pedagogies learnt in real-life classrooms.
CO6: create appropriate teaching-learning materials.
CO7: develop necessary planning and execution skills to conduct school activities (assembly, celebrations, cultural programmes).
CO8: express the school, teacher, parents, and community relationships.
CO9: create rapport with the stakeholders and understand their roles in the school system.
CO10: create student portfolios and comprehensive 360-degree (holistic) progress reports.
CO11: discuss the importance of maintaining different types of records in the school system.
CO12: develop research aptitude and ability to conduct action research for the situations/problems faced during their school internship experience.

Syllabus:

1. Pedagogies' different methods and strategies
2. Scheme of lessons
3. Peer lesson observation
4. Management of substitute classes
5. Various TLMs (including ICT tools) and their uses in teaching-learning
6. Achievement test
7. Diagnostic tests
8. Analysis of the result of the achievement test
9. Assembly activities
10. Action research and case studies.

Activities:

Student teachers are required to undertake the following stage specific activities:

1. Meet the subject-based mentors, collect timetables of classes IX to XII and develop a scheme of lessons from the syllabus to be covered during the internship.
2. Get acquainted with the school within 2-3 days. Observe classroom teaching of school teachers.
3. Plan and transact minimum 80 lessons (40*40), including 4 stray lessons (2*2). Stray lessons are class appropriate lessons on any topic(s) to be transacted by student teachers as per their convenience to build up confidence gradually. The last 5 lessons in each pedagogy course may be transacted using lesson notes.
    - Lesson plans should include the components to develop critical and reflective thinking, problem-solving, differential learning, synthesis, and application of knowledge in real-life situations.
    - Lesson plans must promote education for sustainability, including equity, environment, global citizenship, pride and rootedness in Indian knowledge systems and character building.

4. Participate in post-lesson discussions with peers, mentor(s) and teacher educators.
5. Observe peer lessons and discuss with the group.
6. Conduct laboratory activities (Atal Tinkering Lab, Physics, Chemistry, Biology, Mathematics, Languages, Social Science, Computer), sports, and arts and crafts activities.
7. Participate in student support services: guidance and counselling, NCC, NSS, health and wellness programmes.
8. Create teaching-learning materials, including ICT tools for opted pedagogic courses.
9. Plan assessment, prepare material and formative and summative assessment tools, and analyse the results.
10. Prepare and conduct diagnostic tests to identify learning difficulties, analyse data and prepare learning enhancement plan.
11. Experience classes as a substitute teacher.
12. Participate in library functioning and literary activities.
13. Participate in teacher development and training activities.
14. Organise school assemblies and other events (cultural, sports, yoga, and other development activities).
15. Attend Parents-Teachers Association (PTA) meetings if held during the internship.
16. Attend School Management Committee (SMC) meeting if held during the internship.
17. Study the process of parent and community engagement for the school development programmes.
18. Conduct action research /case study.
19. Prepare a sample student portfolio.
20. Write a reflective diary daily and prepare a report of each activity.

SEMESTER – VIII

ED4801E Philosophical and Sociological Perspectives of Education – II

Pre-requisites: Nil

Total Lecture Sessions: 52

L	T	P	C
4	0	0	4

Course Outcomes:

CO1: Identify the relationship between education and society, significance, and aims.

CO2: Explore the meaning, dimensions, and dynamics of social change, and examine the role of education in both facilitating and responding to these changes.

CO3: Examine the relationship between education and culture, emphasizing education as a socialization process.

CO4: Analyze the impact of various factors on promoting social equality and equity within the educational framework.

CO5: Develop a comprehensive understanding of various types of values, including constitutional values, and their significance within the educational context.

Education and Society: Conceptual clarity, relationship, significance and aims of studying the relationship between Education and society. Educational sociology and social perspective of education: meaning and functions. Education as a Social System. Conceptual clarity of society, social behaviour, status, institution, ideology, system, sub-system, socialization, social system, social values and norms, conflict, and modernization. Understanding the relation between individual and group behaviour with special reference to the context of education.

Education and Social Change: Meaning, relation, and dimensions of Social Change, Factors affecting Education and Social Change: technology, social and educational movements, curricular innovations, value conflicts, legal provisions, Constitution of India and Education, Education and Modernity, Role of education with reference to social change.

Education, Culture and Socialization: Relationship between Education and Culture, Education as a process of Socialization, Preservation of Culture through Educational Process, Social Welfare, Social Reform Movements, Legal interventions on Child Marriage, Child labor Act, Educational Policies and Acts, Adult Literacy, New Technology of communication, Equality, Constitutional Provisions and Education with special reference to Social Equality and Equity.

Education and Values: Conceptual Clarity, Relationship and Significance. Types of Values, Constitutional Values and its impact on Education, Human Rights and Values, Environment and Education, Pedagogical issues.

References:

1. P. Smeyers, *International Handbook of Philosophy of Education*, Springer, 2018.
2. R. Bailey, R. Barrow, D. Carr, C. McCarthy, (Eds.), *The SAGE Handbook of Philosophy of Education*, SAGE Publications, 2010.
3. H. Siegel (Ed.), *The Oxford Handbook of Philosophy of Education*, Oxford University Press, 2009.
4. J. C. Aggarwal, Philosophical foundation of education, Shri Vinod Pustak Mandir, 2020.
5. A. S. Thakur, S. Berwal, *Education in emerging Indian society*, Vikash Publication, 2007.
6. H.K. Rawat, *Sociology: Basic Concepts*, Rawat Publication, 2012.

7. C.N.S. Rao, (eds.). *Sociology Principles of Sociology with an Introduction to Social Thoughts*, S. Chand & Company Pvt. Ltd.

ED4802E Education Policy Analysis

Pre-requisites: Nil

Total Lecture Sessions: 28

L	T	P	C
2	0	0	2

Course Outcomes:

CO1: Explain the significance of various policies on education, and their uses.

CO2: Analyse educational policies since Indian independence and identify the modifications made from time to time.

CO3: Familiarise with the ways of implementing an educational policy and explain the challenges in implementation.

Planning an Educational Policy: Meaning and significance of 'Policy on Education', Purpose and Dimensions of an Educational Policy at local and Global level, Philosophical and Sociological Perspective of planning an Educational Policy, Historical development of Educational Policies in India, Basic steps involved in planning, Constitutional provision for Policy on Education, Fundamental principles for analysing an Educational Policy.

Educational Policies in India: Critical analysis of Policies on Education since Independence: 1968, 1986 (Modified in 1992), 2020 in the context of: need and significance, goals and frameworks of educational policies, content of policies, issues raised in policies, constitutional provisions, Issues of modifications.

Implementation of an Educational Policy: Meaning, need and significance, Mechanism of Policy Implementation, Strategies to Implement an Educational Policy, Programme of action and implementation: conceptual clarification and significance, Role of different Organization / Groups: Legislature/ Judiciary/ Political Will and Parties/ Voluntary Organizations/ Non-governmental organizations (NGOs)/ Pressure Groups/ Public, Challenges for Implementation.

References:

1. Burhan Akgun, Alpaydin (ed.), *Education Policies in the 21st Century: Comparative Perspectives*. Palgrave Macmillan.
2. R.V. Vaidyanatha Ayyar, *History of Education Policymaking in India, 1947-2016*, Oxford University Press, 2017.
3. Marilyn Cochran-Smith, *Policy, Practice and Politics in Teacher Education*, Corwin, 2006.

EDUCATION: ELECTIVES

ED4801E Emerging Technologies in Education

Pre-requisites: Nil

Total Lecture Sessions: 52

L	T	P	C
4	0	0	4

Course Outcomes:

CO1: Explain the need and significance of digitalization in social, economic and ethical issues.

CO2: Demonstrate an understanding of ways of employing ICT tools and resources for teaching learners with different needs and abilities.

CO3: Demonstrate the ability to utilize online and offline softwares for teaching different types of contents.

CO4: Compare different e-contents based upon their relative merit.

CO5: Develop the ability to produce learning aids matching instructional design principles.

Information and Communication Technology: Historical Development of the use of Technology in Education, Web 2.0, Web 3.0 and Web 4.0 for teaching and learning, Shift from print to digital content and its impact on teaching, learning and cognition, Social, Economic, and Ethical issues associated with the use of ICT.

Technology in Education and Pedagogy: Universal Design for Learning (UDL), Principles of using Online and Offline tools for teaching and learning, Use of various platforms for Online teaching and learning, Subject specific online resources and their uses in lesson Planning, Use of Technology for children with special needs: Tools and processes.

Online and Offline Software Applications: Educational applications of Documentation, Presentation, Spreadsheet softwares Drawing tools – diagrams, concept maps, timelines, flow charts. Use of Smart Phone with different AI-based apps for teaching and learning, social media for teaching and learning. Use of OER, free online resources for teaching and learning. Online forums/discussion groups and collaborative learning.

Instructional Design and e-content

Characteristics of good e-content, Tools for e-content authoring: Open source and proprietary alternatives, Multimedia tools for audio editing, video editing, screen casting, graphic editing, and animation, Reusable learning objects (RLO) – meaning, types and characteristics, RLO repositories, metadata and standards, Design and development of e-content: Need analysis, Identifying learning objectives, Developing a design, Creating a storyboard, Developing a prototype, Testing and evaluating impact.

References:

1. Catlin R. Tucker, Tiffany Wycoff, Jason T. Green, *Blended Learning in Action: A Practical Guide Toward Sustainable Change*, 1st edition, Corwin, 2016.
2. Centre for Educational Research and Innovation, *Open Educational Resources – Conceptual Issues. In Giving Knowledge for Free: The Emergence of Educational Resources*. OECD, 2007.
3. I. Chang, L.V. Refoot, A. Basu, Multimedia *in Education: Adaptive Learning and Testing*, World Scientific Pub Co Inc, 2009.

4. J. Collins, M. Hammond, J. J. Wellington, Teaching *and Learning with Multimedia, Routledge*, 1997.
5. R. D'Antoni, C. Savage, (eds) Open *Educational Resources: Conversations in Cyberspace*, United Nations Educational, Scientific and Cultural Organization, 2009.
6. Chris Davies, Rebecca Eynon, (ed.) Education *and Technology*, 2nd edition, Routledge and Kegan Paul.
7. D.H. Jonassen, (ed.) *Learning to Solve Problems with Technology: A Constructivist Perspective*, Merrill, 2003.
8. B.R. Joyce, M. Weil, E. Calhoun, *Models of Teaching, Alternative e-Text Formats Series*, 8th edition, Pearson/Allyn and Bacon Publishers, 2009.
9. J. L. Krauss, K. Prottsman. *Computational Thinking and Coding for Every Student: The Teacher's Getting-Started Guide*, Corwin, 2016.
10. R. E. Mayer, *Multimedia Learning*, Cambridge University Press, 2009.
11. S. Mishra, R. C. Sharma, (eds). *Interactive Multimedia in Education and Training*, Idea Group Inc (IGI), 2005.
12. M. D. Roblyer, A. H. Doering, *Integrating Educational Technology into Teaching*, 6th edition, Pearson New International Edition, 2013.
13. G. Solomon, L. Schrum, Web 2.0: *New Tools, New Schools*, International Society for Technology in Education, 2007.
14. K. Spencer, *The Psychology of Educational Technology and Instructional Media*, United Writers Press, 1991.
15. J. N. Timothy, A. S. Donald, D. L. James, D. R. James, *Educational Technology for Teaching and Learning*, 4th edition, Pearson Education, 2010.

ED4804E Guidance and Counselling

Pre-requisites: Nil

Total Lecture Sessions: 28

L	T	P	C
2	0	0	2

Course Outcomes:

CO1: Explain the fundamental concepts of guidance in the context of education involving meaning, nature, scope and types.

CO2: Explain the need and significance of counselling, different tools and techniques used and its roles within educational settings.

CO3: Identify various types of psychological testing.

CO4: Critically evaluate ethical issues and challenges in the field of counseling and to design, implement, and evaluate effective guidance counseling programs at school level.

Guidance: Meaning, need, nature and scope of Guidance, Brief historical background of Guidance movement in India, Individual and Group Guidance, Basic assumptions and principles of Guidance, Need to understand the needs of the individual and group in the context of Guidance, Essential information for Effective Guidance, Vocational Guidance and Role of teachers.

Counselling: Meaning, importance, areas, and types of Counselling, Approaches to Counselling-directive, non-directive, eclectic, behaviorally oriented, and cognitively oriented. Process of Counselling: initiating counselling, preparation, and intake procedures, establishing rapport, termination of and response to initial interview, Establishing Structure: attending behaviour, observation, non-verbal behaviour, listening, verbal patterning and communication responses, silence, use of questions, transference and countertransference, regarding and respect in counselling relationships, involuntary clients, client expectations, Role of family and community.

Tools and Techniques to Collect Data: Psychological Testing and Diagnosis: Need and Nature, Test use and interpretation, appraisal techniques, Counselling Interview: Essential aspects, basic procedures, problems, and their handling, Personality Assessment: Historical perspective, Material administration, scoring, interpretation, and evaluation of frequently used personality inventories/ questionnaires and projective tests. Personal Orientation Tests and Rating Scales: Type A behaviour, Locus of Control, Attitude scale, STAI, other clinical rating scales, Case Study: Need and Importance.

Issues Related to Guidance and Counselling: Factors affecting Guidance and Counselling, Ethical issues in Guidance and Counseling, Limitation of diagnosis with special reference to Counselling, Challenges to organize Guidance and Counselling programmes in schools, Counselling and Guidance of persons with learning disabilities, visual and hearing impairment, Challenges related to counselling services in schools.

Reference:

1. J. Zimmak-Deigle, *Counseling Children and Adolescents*, Taylor & Francis, 2017.
2. Diwakar Singh Sikarwar, *Handbook on School Counseling*, Notion Press, 2020.
3. S. Rao, *Counselling and Guidance*, 3rd edition McGraw Hill Education, 2017.
4. Namita Ranganathan, Toolika Wadhwa, *Guidance and Counseling for Children and Adolescents in Schools (India)*, SAGE Publications, 2017.

5. J. Ziomek-Daigle, *School Counseling Classroom Guidance: Prevention, Accountability, and Outcomes (Counseling and Professional Identity)*, SAGE Publications, 2015
6. M. Gibson, *Introduction to Counselling and Guidance*, Pearson Education, 2015.
7. R. Nelson-Jones, *Theory and Practice of Counselling and Therapy*, SAGE, 2012.
8. R. L. Gibson, *Introduction to Counselling and Guidance*, 6th edition, Prentice Hall of India, 2005.
9. R.A. Thompson, *Professional school counselling: Best Practices for working in the schools*, 3rd edition, New York, Routledge, 2012.
10. D. S. Sikarwar, *Handbook on School Counseling*, Notion Press.

ED4891E Yoga and Understanding Self

Pre-requisites: Nil

Total Lecture Sessions: 28

L	T	P	C
2	0	0	2

Course Outcomes:

CO1: Explain the importance of Yoga for an individual in understanding Self.

CO2: Describe the importance of practicing Yoga Asana. CO3: Practice basic Yoga Asanas/ Kriyas.

Philosophical and Historical Perspective of Yoga: Concept and Meaning of Yoga, Philosophy of Yoga, Brief history and development of Yoga (Classical Yoga, Post Classical Yoga and Modern Period), Importance of Yoga for healthy living, Yoga and its relevance in modern times, Traditions in Yoga.

Schools of Yoga: Different streams/schools of Yoga (Gyana, Bhakti, Karma), Construction of Yoga Practice for all round development, Principles of Yoga: - Ahimsa, Satya, Asteya, Brahmacharya, Aparigraha, Shoucha, Santhosha, Tapas, swadyaya and Iswara Panidhana.

Modern Principles of Yoga and Meditation: Modern Principles: Human Body is a holistic entity, Individuals and their need are Dharana & Dhyana, etc, meditation and reflective practices, the importance of these aspects in becoming an effective teacher, unique Self-empowering, the quality and state of an individual mind, healing Meditation - Importance, Types, and Process, Pranayama: importance, types and process, Yoga as a Way of life for Peace, Harmony, Health, love and happiness. Yoga in Indian philosophy for understanding Self.

References:

1. Swami Vivekananda, *The Complete Book of Yoga*, Sanage Publishing House LLP, 2022.
2. Peter Connolly, *A Student's Guide to the History and Philosophy of Yoga*, Equinox Publishing Limited, 2014.
3. L. D. Allman, *Yogic Wisdom*, Page Publishing, 2020.
4. M. A. Kassapp, *Meditation, An Ancient Practice for Modern Time*, Robertson Publishing, 2018.
5. N. K. Ford, *Principles of Teaching Yoga to Kids*, Balboa Press, 2020.

ED4892E Citizenship Education, Sustainability, and Environment Education

Pre-requisites: Nil

Total Lecture Sessions: 28

L	T	P	C
2	0	0	2

Course Outcomes:

CO1: Explain the concept of citizenship, citizenship education, global citizenship and global Citizenship Education, aims and various approaches to foster active citizenship.

CO2: Investigate the significance of Vasudhaiva Kutumbakam in fostering a holistic perspective.

CO3: Develop a comprehensive understanding of sustainability and emphasize the role of education in promoting a sustainable development.

CO4: Identify the environmental issues, realize the need for environmental education and actively participate in school and community-based environmental activities.

Citizenship Education: Concept of citizenship, citizenship education, Aims of citizenship education and its various approaches, Global Citizenship, Global Citizenship Education, Aims of Global Citizenship Education, and its various approaches, Concept of Vasudhaiva Kutumbakam, its importance in development of a holistic perspective towards local and global communities.

Sustainability: Concept of "Sustainability" in all fields of human activities, Approaches to achieving sustainable development in economic, social, and environmental dimensions, Sustainable development goals, Sustainable management of natural resources, School- and community-based activities, Education for sustainable development.

Environmental Education: Environmental issues, Actions required for mitigating the effects of climate change, reducing environmental degradation, pollution, Initiatives required for effective waste management, conservation of biological diversity, management of biological natural resources, forest and wildlife conservation, sustainable development and living. Approaches to delivering Environmental Education, Role of Mass Media and Technology in delivering environmental education. Roles of Governmental and Non-Governmental Organizations in promoting Environmental Education. School and community-based environmental education activities.

References:

1. A. Acharya, *Citizenship in Globalizing World*, Pearson.
2. T. P. Kumar, *Environmental Education*, A.P.H. Publications.
3. R. K. Khitoliya, *Environment Pollution-Management, Control for Sustainable Development*, S. Chand and Company.
4. V. Krishnamacharyulu, G. S. Reddy, *Environmental Education*, Neelkamal Publications.
5. M. A. Choudhary, S. M. Tripathy, *Environmental Education and training – Trends, Traditions and Transformation*, Global Vision Publishing House.
6. R. A. Sharma, *Environmental Studies*, Chand Publication.

ED4805E Post – Internship (Review and Analysis)

Pre-requisites: Nil

Total Lecture Sessions: Nil

L	T	P	C
0	0	4	2

Course Outcomes:

CO1: Develop a comprehensive understanding of the school ecosystem.

CO2: Describe the all-round develop attained during internship.

CO3: Develop effective reflective practices in teaching and learning.

Experience Sharing and Reflective Learning

- Presentation of reflective journal summary
- My Learning Journey: by each student-teacher
- Gallery walks (Exhibition): TLMs, display of participation in school activities (photos stories) and other artefacts created during the internship by student teachers.
- Sharing of best practices (PPTs, Videos.)
- Survey and collect the local stories and rhymes from the parents and community (in the context of the secondary stage)
- Holding a training workshop for the parents and community and encouraging them to act as volunteers.
- Awareness and advocacy programme in Foundational Literacy and Numeracy FLN for parents and community: Role play with parents and community on conducting specific FLN activities.
- Organizing a parents /community mela fair on homemade TLM for secondary stage children

Submission of Internship Report

- Reflective Journal
- Lesson Plans and TLMs
- Observation records (Teacher Educator, Mentor, school heads, Teachers, Parents)
- Assessment records and Student Portfolio
- Action research report/case study
- Comprehensive internship report.

ED4806E Teaching Learning Material/Work Experience

Pre-requisites: Nil

Total Lecture Sessions: Nil

L	T	P	C
0	0	4	2

Course Outcomes:

CO1: Assess the need for Teaching Learning Materials and prepare innovative TLMs.

CO2: Develop an understanding of the importance of work experience and competencies of a local crafts person, artisans and entrepreneurs.

Content:

- Understanding how students learn at different stages.
- Knowledge of toys and other TLMs from different parts of the country
- Addressing the individual differences and knowing of relevant TLMs for specific groups of children- CWSN, kinesthetic learners, visual learners, auditory learners.

Activities to be conducted:

- Orientation workshop on work experience and development of learning resources.
- Field visit for interaction with local artisans, craftspeople, and entrepreneurs.
- Observe Traditional work practices and their integration into Local Technologies and Ideas.
- Analysis of available local specific, indigenous learning resources, including toys and their use in the learning-teaching process.
- Development of at least two low-cost learning resources as per the local contexts (secondary) and presentation exhibition.
- Prepare the manual of TLM highlighting the objectives that will be achieved by its use, the material used, the process of its development and its use during classroom transaction.

ED4807E Community Engagement and Service

Pre-requisites: Nil

Total Lecture Sessions: Nil

L	T	P	C
0	0	4	2

Course Outcomes:

CO1: Recognize the socio-economic issues in the community and identify initiatives that could help solve problems faced by the community.

CO2: Demonstrate an awareness of the functions of the community, and explain the measures required for enlisting community participation in school-related activities.

CO3: undertake initiatives that are required to make the community aware of the importance of education to meet various challenges.

CO4: suggest actions in collaboration with community members to address the social, cultural and educational problems in the community.

Approach to curriculum transaction

The student teachers will be provided opportunities to have exposure to community life for ten days. (two days in Preparation for Community Engagement & Service in the institution, seven days working with the community, and the last day in the institution for sharing their experiences and reflections). The activities may be conducted in groups or individually, as appropriate.

Days 1-2: Preparation for community services (In the institution)

- Orientation of student teachers on Community Engagement & Services through discussion and group activities.
- Workshop for developing tools for different activities during the programme.

Days 3-9: Engagement with the community (Mandatory onsite stay with the community). Students will be divided into smaller groups; They would participate in the planned activities with defined roles for seven days on a rotation basis. These activities include:

- Participation of student teachers in activities undertaken under the National Service Scheme (NSS), New India Literacy Programme, Student mentoring initiatives, etc.
- Survey of community resources for supporting school activities.
- Study of the situation regarding school dropout and the reason thereof (stage wise).
- Survey of specific settlement to assess the situation about non-literates in the settlement, including identification of 4-5 non-literate youth and adults who will be supported by student teachers to become literate.
- Training of local youth in First Aid and other relevant interventions.
- Assessment of the situation about Health and wellness of children in a locality.
- Creating awareness of the importance of sustainable development, and making the community members aware of the need to support initiatives to ensure environmental protection, creating awareness of rainwater harvesting, mentoring school students with learning deficits, guidance and counselling to school students etc.
- Visit and interact with local artisans and craftsperson.

The above activities typically will include working with the community, collecting data, playing local games, community awareness programmes like nukkad natak, rallies, organising and participating in the cultural programmes with the community members etc.

The student teachers shall conduct different pre-scheduled activities throughout the day. Morning sessions will be used for activities with the community and data collection. The afternoon session will be devoted to data analysis and preparation of the report, and participation in games & sports activities. Evening session will involve cultural activities with community members.

Day 10: Feedback session and Reflection (In the Institution)

- Sharing experiences and discussion on activities carried out.
- Presentation and submission of report on the activities carried out.
- Evaluation of the activities by collecting feedback on the effectiveness of the campaign from the mentor and the students.
- Reflection of experience (individual/group) of organizing community service

CURRICULUM FOR INTEGRATED TEACHER EDUCATION PROGRAMME LEADING TO B. Sc. B.Ed. DEGREE

Name of Degree	Name of Specialization	Total Intake (Full-time)	Year of Starting	Duration	Eligibility for Admission
B.Sc. B.Ed. (Secondary)	Science and Education	50	2024	4 years (8 semesters)	The ITEP shall be of four academic years comprising eight semesters including internship (field-based experiences and practice teaching). Candidates with minimum fifty percent marks in Senior Secondary or plus two examination or its equivalent (under 5+3+3+4 pattern) from a recognised board are eligible for admission through the National Common Entrance Test (NCET), conducted by the National Testing Agency (NTA).

COURSE CATEGORIES AND CREDIT REQUIREMENTS:

The structure of B.Sc. B.Ed. Programmes shall have the following Course Categories:

Sl. No	Course Category	No. of Courses	No. of credits
1.	Foundations of Education (FE)	10	30
2.	Disciplinary Major and Minor (MM)	16	64
3.	Stage Specific Content cum Pedagogy (CP)	4	16
4.	Ability Enhancement and Value-added Courses (AE)	12	28
5.	School Experience (SE)	6	20
6.	Community Engagement and Service (CE)	1	2

Total Credits required: 160

PROGRAMME STRUCTURE

Major Disciplinary Subject: CHEMISTRY

Minor: One discipline to be chosen from amongst Physics, Mathematics, and Computer
The effort to be put in by the student is indicated in the tables below as follows:

L: Lecture (One unit is of 60-minute duration)

T: Tutorial (One unit is of 60-minute duration)

P: Practical (One unit is of one-hour duration)

Semester 1							
Sl. No	**Course Code**	**Title**	**Course Category**	**L**	**T**	**P**	**Credits**
1	ED1100E	Evolution of Indian Education	FE	4	0	0	4
2	ED1190E	Language I – English	AE	4	0	0	4
3	ED1192E	Art Education-Collage Making	AE	1	0	2	2
4	ED1195E	Understanding India -I	AE	2	0	0	2
5	CH1101E	Structure, Bonding and Fundamentals of Spectroscopy	MM	3	1	0	4
6	PH1102E	Physics Minor-I Mechanics, Waves and Oscillations	MM	3	1	0	4
	MA1102E	Mathematics Minor-I Calculus	MM	3	1	0	4
	CS1101E	Python Programming	MM	3	0	2	4
7	CH1141E	Inorganic Chemistry Laboratory	MM	0	0	2	1
						Total	21

Semester 2							
Sl. No	**Course Code**	**Title**	**Course Category**	**L**	**T**	**P**	**Credits**
1	ED1291E	Language II- Manipuri	AE	4	0	0	4
	ED1292E	Language II- Hindi	AE	4	0	0	4
2	ED1293E	Understanding India – II	AE	2	0	0	2
3	ED1294E	Teacher and Society	AE	2	0	0	2
4	CH1201E	Basic Concepts in Organic Chemistry and Stereochemistry	MM	3	1	0	4
5	CH1202E	States of Matter and Chemical Thermodynamics	MM	3	1	0	4
6	PH1202E	Physics Minor-II Thermal Physics	MM	3	1	0	4
	MA1202E	Mathematics Minor-II Algebra & Differential Equations	MM	3	1	0	4
	CS1201E	Computer Programming with C	MM	3	0	2	4
7	CH1241E	Physical Chemistry Laboratory	MM	0	0	2	1
						Total	21

Semester 3							
Sl. No	Course Code	Title	Course Category	L	T	P	Credits
1	ED2301E	Child Development and Educational Psychology	FE	4	0	0	4
2	ED2302E	General Pedagogy	CP	3	1	0	4
3	CH2301E	Coordination Chemistry and its Applications	MM	3	1	0	4
4	CH2302E	Thermodynamics, Kinetics and Equilibria	MM	3	1	0	4
5	PH2303E	Physics Minor-III Electromagnetism and Relativity	MM	3	1	0	4
	MA2303E	Mathematics Minor-III Probability and Statistics	MM	3	1	0	4
	CS2301E	Data structures with C	MM	3	0	2	4
6	CH2341E	Organic Chemistry Laboratory	MM	0	0	2	1
						Total	21

Semester 4							
Sl. No	Course Code	Title	Course Category	L	T	P	Credits
1	ED2401E	Philosophical and Sociological Perspectives of Education-I	FE	4	0	0	4
2	ED2402E	Minor Pedagogy (Physical Science)	CP	3	1	0	4
3	CH2401E	Basic analytical chemistry and Introductory Electrochemistry	MM	3	1	0	4
4	CH2402E	Synthetic Methodologies in Organic Chemistry	MM	3	1	0	4
5	PH2403E	Physics Minor-IV Basic Electronics	MM	3	1	0	4
	MA2403E	Mathematics Minor-IV Mathematical Analysis	MM	3	1	0	4
	CS2401E	Digital Computer Fundamental	MM	3	0	2	4
6	CH2441E	Instrumental methods in Chemical analysis	MM	0	0	2	1
						Total	21

Semester 5							
Sl. No	Course Code	Title	Course Category	L	T	P	Credits
1	ED3398E	ICT in Education	AE	1	0	2	2
2	ED3301E	Major Pedagogy-I (Physical Sciences)	CP	3	1	0	4
3	ED3302E	Pre-internship Practice	SE	0	0	4	2
4	CH3301E	Chemistry of Main Group Elements and Organometallic Chemistry	MM	3	1	0	4
5	CH3302E	Natural Products, Heterocycles and Spectroscopic Methods of Characterization	MM	3	1	0	4
6	CH3331E	Major Project	MM	0	0	8	4
						Total	20

Semester 6

Sl No	Course Code	Title	Course Category	L	T	P	Credit
1	ED3601E	Assessment and Evaluation	PE	2	0	0	2
2	ED3602E	Major Pedagogy-II (Physical Sciences)	CP	3	1	0	4
3	ED3603E	Inclusive Education	PE	2	0	0	2
4	ED3691E	Mathematical and Quantitative Reasoning	AE	1	1	0	2
5	ED3694E	School Observation	SE	0	0	4	2
6 & 7	CH3601E	Solid State Chemistry	MM	3	1	0	4
	CH3602E	Fundamentals of Biochemistry	MM	3	0	2	4
	CH3603E	Surface Chemistry	MM	3	1	0	4
	CH3604E	Basic Analytical Chemistry and Instrumental methods	MM	3	1	0	4
	CH3605E	Chemistry of Multiple Bonds	MM	3	1	0	4
	CH3606E	Nuclear Chemistry	MM	3	1	0	4
	CH3607E	Physical Methods in Inorganic Chemistry	MM	3	1	0	4
	CH3608E	Bioinorganic Chemistry	MM	3	1	0	4
						Total	20

Semester 7

Sl No	Course Code	Title	Course Category	L	T	P	Credit
1	ED4701E	Perspectives on School Leadership and Management	PE	2	0	0	2
2	ED4702E	Curriculum Planning and Development	PE	2	0	0	2
3	ED4791E	Art Education - Performing and Visual	AE	1	0	2	2
4	ED4792E	Sports, Nutrition and Fitness	AE	1	0	2	2
5	ED4703E	School based Research Project	SE	0	0	4	2
6	ED4704E	Internship in Teaching	SE	0	0	20	10
						Total	20

Semester 8

Sl No	Course Code	Title	Course Category	L	T	P	Credit
1	ED4801E	Philosophical and Sociological Perspectives of Education-II	PE	4	0	0	4
2	ED4802E	Education Policy Analysis	PE	2	0	0	2
3	ED4803E	Emerging Technologies in Education	PE	4	0	0	4
	ED4804E	Guidance and counselling	PE	4	0	0	4
4	ED4891E	Yoga and Understanding Self	AE	2	0	0	2
5	ED4892E	Citizenship Education, Sustainability and Environment Education	AE	2	0	0	2
6	ED4805E	Post-Internship (Review and Analysis)	SE	0	0	4	2
7	ED4806E	Teaching Learning Material/Work Experience	SE	0	0	4	2
8	ED4807E	Community Engagement and Service	CE	0	0	4	2
						Total	20

Semester-wise distribution of credits:

Semester	1	2	3	4	5	6	7	8
Credits	21	21	21	21	20	20	20	20

Semester wise Detailed Syllabus

Semester-I

ED101E Evolution of Indian Education

L	T	P	C
4	0	0	4

Pre-requisites: Nil
Total Lecture Sessions: 62

Course Outcomes:

CO1: Understand the evolution of education in India, including its historical, social, and political influences, enabling them to act as effective teachers.

CO2: Analyze the historical development of education in ancient India, identifying key features and comparing it with modern educational practices.

CO3: Assess the genesis, vision, and evolution of education in India from ancient times to the contemporary era, understanding the impact of various educational philosophies and systems.

CO4: Recognize and appreciate the contributions of Indian thinkers to the evolution of the Indian education system and its practices.

Ancient Indian Education: Vedic Period Vision, objectives and salient features of Vedic Education System-Teaching and Learning Process- Development of educational institutions: Finances and Management- Famous Educational Institutions and Guru-Shishya Education at the time of Epics: Ramayana and Mahabharata.

Ancient Indian Education: Buddhist and Jain Period Vision, objectives and salient features of Buddhist and Jain Education System- Teaching and Learning Process- Finance and Management of Educational Institutions- Educational Institutions: Nalanda, Taxila, Vikramshila, Vallabhi, Nadia- Famous Guru-Shishya.

Post-Gupta Period to Colonial Period Vision, objectives, brief historical development perspective as well as salient features of Education in India- Teaching and Learning Process- Finance and Management of educational institutions.

Modern Indian Education Colonial education in India, Woods Despatch, Macaulay Minutes and Westernization of Indian Education- Shiksha ka Bhartiyakaran (Indigenous Interventions in education); Swadeshi and Nationalist attempts of educational reforms with special reference to general contribution of Indian thinkers to the education systems of India; Savitribai and Jyotiba Phule, Rabindranath Tagore, Swami Vivekananda, Mahatma Gandhi, Sri Aurobindo, Gijubhai Badheka, Pt. Madanmohan Malaviya, Jiddu Krishnamurti and Dr. Bhima Rao Ambedkar. Education in Independent India; Overview of Constitutional values and educational provisions- Citizenship Education: Qualities of a good citizen.
Education for fundamental rights and duties- UEE, RMSA, RTE Act 2009: Overview and impact- NEP 2020: vision and implementation for a vibrant India.

References:

1. Mookerji R.K. *Ancient Indian Education: Brahmanical & Buddhist*, Macmillan & Co, 1947.
2. F.E Keay, *Indian Education: An Enquiry into its Origin, Development, and Ideals*. Oxford University Press, 1918.
3. R.V. Vaidyanatha Iyyer. *History of Education Policymaking in India (1947-2016)*. 4th Edition, University Press, 2017.

ED1191E Language I - English

Pre-requisites: Nil

Total Lecture Sessions: 52

L	T	P	C
4	0	0	4

Course Outcomes:

CO1: Demonstrates a knowledge of the relationship between Language and society.

CO2: Demonstrates the ability to use the conventions of grammar, vocabulary, and pronunciation to communicate effectively in a variety of contexts.

CO3: Develop and deliver effective presentations and speeches on a variety of topics using technology.

CO4: Demonstrates the ability to read and comprehend a variety of text types and write for different purposes.

Language, Society, and learning: Language acquisition and Language learning—Notion of first language, second language and others—Language variation and social variation—Languages, dialects and varieties— Bilingualism, Multilingualism and its advantages—Cultural transmission of language: language and gender, language and identity, language and power—Constitutional provisions and National Education Policy 2020

Grammar in Communication: Verb and Tenses—Conditionals—Multi word verbs: Phrasal verbs, Collocations—Phrase and clause in practice: Relative clauses, adverb clauses, dangling modifiers—Linking devices, Common errors

Speaking and Pronunciation: Pronunciation and intelligibility: Speech sounds, Tone- Stress, Pitch and Intonation —Tone and pitch in communication—Sense groups and connected speech—Speech and discourse markers—Speaking with confidence—Delivering speeches and presentations—Public speaking—Active listening

Critical reading and writing: Skimming and Scanning—Close Reading - Comprehension - Summarising and Paraphrasing - Analysis and Interpretation - Literary Knowledge Texts—Structure of an essay: argumentative, analytical, comparative—Writing as a process: outlining, drafting, revising and proof reading

References:

1. Mark Hancock, *English Pronunciation in Use*. Cambridge UP. 2003.
2. Martin Hewings, *Advanced Grammar in Use: A Reference and Practice Book for Advanced Learners of English*. 3rd edition, Cambridge University Press, 2005.
3. N. Sudarshana, C. Savitha, English for Technical Communication, Cambridge English, 2016. 4. J. Merrill, *Culture Bound*, Cambridge University Press. 1986.
5. S. Kumar, P. Lata, Communication Skills, Oxford University Press, 2015.
6. Grant Taylor, *English Conversation Practice*, McGraw Hill, 2001.

ED1192E Art Education- Collage Making

Pre-requisites: Nil

L	T	P	C
1	0	2	2

Total Lecture Sessions: 13

Course Outcomes:

CO1: Articulate the importance and the role of aesthetics and art in education.
CO2: Understand the medium of collage and its versatility.
CO3: Design, plan, and create an expressive self-portrait collage by applying a variety of collage techniques. CO4: Design and set up an interactive visual art exhibition to display the artworks.
CO5: Understand and appreciate art-based learning experiences.
CO6: Develop the ability to reflect and challenge the assumptions and beliefs around art and develop new understandings.

Understand the importance of Art and Aesthetics in Education: Introduction to Art and Aesthetics, Different Artists works, Analysis and interpretation of artworks, Engagement through Art Experiences, Visual Thinking Strategy Exercise, Collective Analysis, Observing art and aesthetics in the surroundings.
Exploring paper collage and its techniques: Introduction to collage making, exploration of various mediums, Learning Visual Textures and Patterns, learning from nature- composition, colors, and textures; Utilizing and exploring various materials, collaborative analysis, and interpretation.
Ideating for an Expressive Self-Portrait: Observation, Sketching, and Self-Portrait Drawing, Exploration of Self-portrait collage using mixed mediums. Creation of paper sculpture compositions using 3D techniques, reflective dialogues.
Creation of an Expressive Self-Portrait Collage: Creation of a large expressive self-portrait using the medium of paper collage.
Designing and setting up an Exhibition: Planning and setting up an exhibition and showcasing the works.

References:

1. J. Berger, *Ways of Seeing*, Penguin Classics, 2008.
2. V. Finlay, *Color: A Natural History of the Palette*, Ballantine Books, 2002.
3. J. Dewey, *Art as Experience*, Perigee Books.
4. J. Ruskin, *The Elements of Drawing: In Three Letters to Beginners*, Dover.
5. Various works of artists such as Deborah Roberts, William Kentridge, Wangechi Mutu, etc.
6. Video: Marc, Cut paper collage artist - [https://www.youtube.com/watch?v=0jgRZM3-Oh0]

7. Video: G. Subramanian, Collage art - [https://www.youtube.com/watch?v=oRBJ8R46a0]
8. Video: Amber Fletschock, Collage artist - [https://www.youtube.com/watch?v=zz7p1vYqUc4]
9. Video: Arturo Herrera, artist - [https://www.youtube.com/watch?v=Oagx3_NZ5HU]
10. JR's Face to face project (videos and readings) - [https://www.youtube.com/watch?v=4u_G0G6Jag4]

ED0192E Understanding India

Pre-requisites: Nil

L	T	P	C
2	0	0	2

Total Lecture Sessions:26

Course Outcomes:

CO1: Develop an understanding of ancient Indian knowledge, tradition and culture and explain its potential benefits in modern times.
CO2: Appreciate ancient Indian art, literary, visual and cultural texts and identify its aesthetic and creative elements.
CO3: Familiarize with ancient Indian ideas of kingship, governance and law and appraise its benefits for individuals and society.
CO4: Gain an understanding of ancient Indian economy, its institutions, trade and revenue and identify its relative merits.
CO 5: Demonstrate an understanding of traditional environmental practices and health traditions and justify its relevance in the 21st century.

Introduction to the Knowledge of India:
Indian Knowledge Systems- scope and significance, need to revisit our ancient knowledge, traditions, and culture.

Culture - Art and Literature:
Ancient Indian aesthetics, Rasa theory, Fine arts (Traditional art forms, Arts and spirituality, Arts and identity), Impact of globalization, Performing Arts (Indian dance systems, traditional Indian music, Dramaturgy, visual arts, folk arts, etc.). Literature with special reference to traditional institutions and value systems found in Sanskrit literature, Religious literature, Oral traditions, Folk literature, Sangam literature of South India and Vernacular literature- Bengali, Marathi etc.

Polity, Law and Economy:
Kingship-types of government-Local village administration, Ancient Law: Dharma as basis, Criminal Justice, Courts, Police, Jails and punishments; Chanakyaniti-its relevance for modern day, Overview of Indian Economy from the Stone Age to the Guptas; Arthashastra and its relevance; Caste system and relation to professions, guilds, economic institutions; Harappan civilization- economy, agriculture growth of new occupations, Temple economy, Internal / external trade and commerce, trade routes, Indo-roman contacts, and maritime trade of South India. Land ownership - land grants and property rights, land revenue systems.

Environment and Health:
Equilibrium between society and environment: Traditional Indian perception of natural resources like forests, land, water, and animals, Sustainable architecture and urban planning, Solving today's environmental challenges (best practices from indigenous knowledge, community-led efforts, etc.), India's Health Tradition: Ayurveda, Siddha, Ashtavaidya, Unani, and other schools of Medicine; Lessons from Sushruta Samhita and Charaka Samhita, Mental

health in ancient India. Its time-tested concepts of mental wellness (concept of mind, dhyana, mind-body relationship, Ayurveda, yoga darshan, atman, etc.)

References:

1. Books

1. A.L. Basham,(ed.), *A Cultural History of India*, 7th edition, Oxford University Press, 2003.

2. A.L. Basham, *The Wonder That Was India*, Volume 1, Picador, 2019.

3. B.Mahadevan, Vinayak Rajat Bhat, R.N. Nagendra Pavana, *Introduction to Indian Knowledge Systems: Concepts and Applications*, PHI Learning, 2022.

4. B. N. Luniа, *Evolution of Indian Culture –From the earliest times to the present day*, 1992

5. Mohan Raghavan, M.S. Haruha Sinha, C.R. Ramaswamy, *Elements of Indic Knowledge Systems and Heritage*, HTSR Institute2023

2. Websites

1. Indian Culture. https://www.indianculture.gov.in/

2. Indian Knowledge Systems, Govt. of India. https://iksindia.org/ 3. Ministry of Culture, Govt. of India. https://indiaculture.gov.in/ 4. Visual arts. CCRT. https://ccrtindia.gov.in/resources/visual-arts/

CH1101E Structure, Bonding and Fundamentals of Spectroscopy

L	T	P	C
3	1	0	4

Pre-requisites: NIL

Total Lecture Sessions: 39

Course Outcomes:
CO1: Develop basic concept of quantum theory of the structure of atoms.
CO2: Apply the concepts of molecular symmetry and theories of bonding.
CO3: Describe the fundamental principles governing various spectroscopic techniques and identify the relevant applications.

Classical wave equation, Schrödinger equation, operators, postulates of quantum mechanics, solutions of Schrödinger equation for a free particle, particle-in-a-box, applications of particle-in-a box solutions for describing electronic levels and spectra in conjugated molecules. Schrödinger equation for the hydrogen atom, qualitative description of solutions, concepts of orbitals and quantum numbers, qualitative description of many-electron systems.

Chemical Bonding: Molecular symmetry, symmetry elements, symmetry operations, point groups, and character tables. Valence bond and molecular orbital descriptions of bonding, the linear combination of atomic orbitals (LCAO) approach, hybridization, bonding in H_2^+ and H2. Bonding in homonuclear diatomic molecules of the second period, bond orders, bond lengths, and bond strengths, bonding in heteronuclear diatomic molecules, concepts of g and u symmetries of molecular orbitals, polarity and electronegativity, photoelectron spectroscopy. Fundamental Aspects of Spectroscopy: Electromagnetic radiation, absorption, emission, scattering, Einstein's A and B coefficients, signal-to-noise ratio, resolving power.

Atomic Spectroscopy: Spectra of hydrogenic systems, coupling of orbital and spin angular moments in many-electron systems, term symbols, fine and hyperfine structure, Zeeman and Stark effects. Rotational Spectroscopy: Rigid rotor model for diatomics, rotational angular momentum, rotational energy levels, rotational constant, selection rules, microwave spectra of representative diatomics, and isotope effects.
Infrared Spectroscopy: Harmonic oscillator model for diatomics, energy levels, selection rules, anharmonic effects, dissociation energies, and Morse oscillator.
Raman Spectroscopy: Light scattering, Raman effect, classical model of scattering, polarizability, Stokes and anti-Stokes lines, selection rules, mutual exclusion principle, structure determination using IR and Raman spectroscopies.
Electronic Spectroscopy of Molecules: Jablonski diagram, absorption, emission, Frank-Condon principle, Stokes shift, 0-0 band, fluorescence, phosphorescence, and quantum yields.

References:
1. D. A. McQuarrie, *Quantum Chemistry*, Viva Student Edition, Viva, 2011. 2. P. Atkins, J. de Paula and J. Keeler, *Atkins' Physical Chemistry*, 11[th] Edition, O.U.P. 2018. 3. J. Barrett, *Structure and Bonding*, Wiley-Royal Society of Chemistry, 2002. 4. T. Engel and P. Reid, *Physical Chemistry*, 3[rd] Edition, Pearson, 2013
5. R. J. Silbey, R. A. Alberty and M. G. Bawendi, *Physical Chemistry*, 4[th] Edition, Wiley Student Edition, 2006.
6. T. Engel, *Quantum Chemistry and Spectroscopy*, 3[rd] Edition, Pearson, 2006.

PH1102E Physics Minor-I Mechanics, Waves and Oscillations

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	O	C
3	1	0	8	4

Course Outcomes:

CO1: Solve problems in Mechanics using Newton's equations of motion.

CO2: Formulate and solve problems related to rotating systems and their dynamics.

CO3: Analyze oscillatory behavior under different conditions.

CO4: Apply principles of mechanics to describe interference, diffraction and polarization effects.

Newton Equations:

Review of Newtonian mechanics: Force, Newton's II law and equations of motion, motion in plane and space, examples - energy and work, conservative systems – rotational motion, angular momentum, moment of inertia, rotational dynamics – central force, gravitational force, Kepler's laws.

Oscillations:

Oscillations, Simple Harmonic Oscillations, forced oscillations, damping, resonance, coupled oscillators, normal modes.

Wave motion

Waves – longitudinal and transverse waves – wave equation – solutions – superposition principle –wave groups, group velocity and dispersion – interference of waves – diffraction – polarization- light as a wave, interference Young's double slit experiment – fringe pattern – visibility – coherence – diffraction – interferometry – Michelson interferometer – LASERS, working principle, characteristics and applications.

Reference:

1. D. J. Morin, *Introduction to Classical Mechanics: With Problems and Solutions*, Cambridge University Press, 2008.

2. D. Kleppner and R. J. Kolenkow, *An Introduction to Mechanics*, 1st Edition, McGraw Hill, 2017. 3. D. Halliday, R. Resnick and J. Walker, *Fundamentals of Physics*, 10th Edition, John Wiley & Sons, 2013. 4. F. L. Pedrotti, L. M. Pedrotti and L. S. Pedrotti, *Introduction to Optics*, 3rd Edition, Cambridge University Press, 2017.

MA1102E Mathematics Minor-I Calculus

Pre-requisites: Nil

L	T	P	C
3	1	0	4

Total Lecture Sessions: 39

Course Outcomes:

CO1: Find the limits, check for continuity and differentiability of real valued functions of one variable

CO2: Find the limits, check for continuity and differentiability of real valued functions of two or more variables.

CO3: Find the maxima and minima of real valued functions of one variable or two variables.

CO4: Find the parametric representation of curves and surfaces in space and evaluate integrals over curves and surfaces.

Functions of one variable

Limit, continuity, differentiability, higher derivatives, Leibnitz's theorem. Monotone functions, maxima and minima, Rolle's theorem, Mean value theorem, Taylor's theorem, Indeterminate forms, L'hôpital's rule, Integration, Fundamental theorem of calculus, applications: finding volume and area, improper integrals, Gamma and Beta functions.

Function of several variables:

Limit, continuity, partial derivatives, partial differentiation of composite functions, directional derivatives, gradient, local maxima and local minima of functions of two variables, critical point, saddle point, Taylor's formula for two variables, Hessian, second derivative test, method of Lagrange multipliers.

Vector calculus:

Vector field: divergence, curl, identities involving divergence and curl, scalar potential, Parameterized curves in space, arc length, tangent and normal vectors, curvature and torsion, Line integral, independence of path, irrotational and solenoidal vector fields, Green's theorem for plane, parameterized surface, surface area and surface integral, flux, Gauss' divergence theorem, Stoke's theorem.

Reference:

1. H. Anton, I. Bivens, S. Davis, *Calculus*, 10th edition, John Wiley & Sons,2015.
2. G. B. Thomas, M.D. Weir, J. Hass, *Thomas' Calculus*, 12th edition, Pearson Education, 2015. 3. E. Kreyszig, *Advanced Engineering Mathematics*, 10th edition, John Wiley & Sons, 2015. 4. Apostol, *Calculus Vol I*, 1st edition, Wiley, 2014.

CS1101E Python Programming

Pre-requisites: Nil

L	T	P	C
3	0	2	4

Total Lecture Sessions: 39

Course Outcomes:

CO-1: Introduce the fundamental concepts of Python.
CO-2: provides a foundation for using the basic building blocks of Python.
CO-3: Learn to write Python Scripts.
CO-4: Explore various exception-handling mechanisms.
CO-5: Develop Python packages.

Syllabus:

Introduction to Python: Python variables, Python basic Operators, Python Data Types, variables, Declaring and using Numeric data types: int, float etc., Basic Input-Output Operations, Basic Operators.

Conditionals and loops: Boolean Values, if, else, and else if, Simple for loops in Python, for loop using ranges, string, lists, and dictionaries. Use while loops in Python, Loop manipulation using pass, continue, break and else.

Strings: Assigning values in strings, String manipulations, String special operators, String formatting operators, Triple Quotes, Raw String, Unicode String, Build-in-String methods.

Lists: Lists Introduction, accessing values in a list, List manipulations, List Operations, Indexing, slicing & matrices, use of tuple data type, programming using string, list, and dictionary in-built functions.

Functions: Built–in Functions and methods, Functions, writing functions in Python, returning a result from a function, Pass by value & pass by reference, function arguments & their types.

Lab: Programs using

1. Conditional control constructs
2. loops
3. Strings
4. Lists
5. user defined functions and library functions
6. built-in functions of packages matplotlib Learning Resources:

Text Books:

1. William Mitchell, Pavel Solin, Martin Novak et al., Introduction to Python Programming, NCLab Public Computing, 2012.
2. Introduction to Python Programming, ©Jacob Fredslund, 2007.

Reference Books:

1. John C. Lusth, An Introduction to Python, The University of Alabama, 2011.
2. Introduction to Python, ©Dave Kuhlman, 2008.

CH1141E Inorganic Chemistry Laboratory

Pre-requisites: NIL

L	T	P	C
0	0	2	1

Course Outcomes:

CO 1. Acquire analytical skills in inorganic qualitative/quantitative analysis.

CO 2. Analyse various colored chemical reactions of metal ions.

List of Experiments:

Introduction to lab safety protocols. Qualitative and quantitative estimations of inorganic salts containing mixtures of metal ions. Synthesis, separation, purification, characterization (spectroscopic techniques), and property measurements of inorganic compounds with an emphasis on different techniques of reaction set-up (air-sensitive, moisture-sensitive, etc.)

Reference:

1. G. H. Jeffery, J. Bassett, R. C. Denny, Vogel's Quantitative Chemical Analysis, 3ed, ELBS and Longmans Green & Co Ltd, 1971.

2. A. J. Elias, General Chemistry Experiments, 3ed, Universities Press (India) Pvt Ltd, 2002. 3. J. Derek Woollins, Inorganic Experiments, 3ed, Wiley, 2010.

SEMESTER – II

ED1291E Language II – Manipuri

Pre-requisites: Nil

L	T	P	C
4	0	0	4

Total Lecture Sessions: 52

Course Outcomes:

CO1: [illegible]

CO2: [illegible] (Linguistic Harmony) [illegible]

CO3: [illegible]

CO4: [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

১. A.K.A. Demers, R.M. Harnish, *Linguistics: An Introduction to Language and Communication*, MIT Press Cambridge, Mass 1979 (2nd ed.)

২. Bhatia, Vijay K. (2013), *Analysing Genre: Language Use in Professional Settings*, London: Routledge (1983), *Pragmatics*, Cambridge: Cambridge University Press

৩. Carroll, John B. (ed.), (1956), *Language, Thought and Reality: Selected Writings of Benjamin Lee Whorf*, Cambridge, MA: MIT

৪. Dr. N. Bimola, *Manipuri Lonmit Shaklon Khara*, JN Publication: Imphal, 2012Dr. Iomal Singh, *Madhabi*, Imphal: Manipuri Sahitya Parishad, 2009

৫. Dr. R.L. Varshney, *An Introductory Text Book of Linguistics and Phonetics* Students' Store, Bareily, 2003

৬. Fromkin V and R. Rodman, *An Introduction of Language*, Holt Rinehart and Winston, Inc, New York, 1988

৭. Fromkin, Victoria, Robert Rodman and Nina Hyams, 2014 *An Introduction to Language*, (10th Edition), Boston, MA: Wordsworth

৮. Hockett, Charles F. (1960), *Origin of Speech*, *Scientific American* 203:88-111

৯. Kasham Priyokumar Singh, *Nongpok Tarakhidara*, Imphal: Writers' Forum, 1993

১০. Lyons, John, *Introduction to Theoretical Linguistics*, Cambridge University Press, Cambridge, 1968

১১. Levinson, Stephen C. (1983), *Pragmatics*, Cambridge: Cambridge University Press

১২. Larson, Richard K., 2010, *Grammar as Science*, Cambridge, MA: MIT Press Svensen Bo, *A Handbook of Lexicography*, Cambridge University, 1998

১৩. Simon, Peter, 2003, *Communication Skills*, (10th Edition), New Delhi: Ramesh Publishing House

১৪. Oinam Bhagat Singh (ed.), *Chandrakirti Jila Chongba*, Imphal: Tamna Publications, 1993

১৫. Oinam Ibochaoba Singh, Ibohal Singh Kangjam (ed.), *Ahlonnaba Manipuri Sheireng*, Imphal: Manipur Naharol Sahitya Sabha, 1973

১৬. Sri Nongmaithem Manaoyaima Singh (ed.), *Faorephom*, Kakching: The Lila Singh Memorial Press, 1980

ED1392E Language-II Hindi

Pre-requisites: NIL

L	T	P	C
4	0	0	4

Total Lecture Sessions: 52

Course Outcomes:

CO1: Enable the students to acquire basic skills in functional language of Hindi

CO2: Develop independent reading skills and appreciate literary works in Hindi

CO3: Internalize grammar rules to facilitate fluency in speech and writing in Hindi

CO4: Develop functional and creative skills in Hindi language

History of Language and Literature

Hindi Bhasha ka Itihas - Aadi kaal, Madhya Kaal aur Aadhunik Kaal, Hindi Grammar Kaal and Kriya, Hindi Sahitya ka Itihas - Aadi kaal, Madhya Kaal, Riti Kaal aur Aadhunik Kaal

Poetry

kbeer ke Paanch Doha, Suryakant Tripathi Nirala: Joohi ki Kali, Dhoomil Sudhama Panday: Proud Sikosh, Nagarjun: Aakal Aur Uske Bad, Ramdarash Mishra: Chidiya, Kedarnath Singh: Aakal Me Saras (For Extra Reading), Jitendra Sreevastava: Main Ik Chidiya Hoon Pappa

Gadya

Harishankar Parsai: Premchandh ke Phate Jutte (Nibandh), Bhagavathi Sharan Varma: Sbse Bada Aadmi (Ekanki), Mohan Rakesh: Uski Roti (Short Story) (For Extra Reading), Bhisham Sahani: Chief ki Dawat (Short Story), Uday Prakash: Aparadh (Short Story), Chitra Mudgal: Domin Kaaki (Laghu katha)

Reference:

1. Ramchandra Shukla, Hindi Sahitya Ka Itihas, Rajkamal Prakashan.
2. Dr Nagendra, Hindi Sahitya Ka Itihas, Mayoor Paperbacks.
3. Manager Pandey, Bhakti Aandolan aur Surdasi ka Kavya, Vani Prakashan. 4. Dr Ramdarash Mishra, Hindi Kahani- Antarang Pahchan, Vani Prakashan. 5. Namvar Singh, Hindi Ka Gadyaparva, Rajkamal Prakashan.
6. Dr Ramvilas Sharma, Bhasha, Yugbodh aur Kavita, Vani Prakashan.
7. Dr P Ravi, Kavita ka Vartmaan, Vani Prakashan.
8. Ramswaroop Chaturvedi, Hindi Kavya ka Itihas, Lokbharti Prakashan.
9. Kailash Nath Pandey, Prayojanmoolak Hindi ki Nayee Bhoomika, Rajkamal Prakashan Samooh. 10. Kamta Prasad Guru, Hindi Vyakaran, Sahitya Sarowar.

ED1293E **Understanding India-II**

L	T	P	C
2	0	0	2

Pre-requisites: ED1004E Understanding India-I

Total Lecture Sessions: 26

Course Outcomes:

CO1: Demonstrate an understanding of ancient Indian knowledge, tradition and culture and evaluate its relevance in present times.
CO2: Analyse key Indian philosophical ideas, ethics and values and explain its position.
CO3: Demonstrate an understanding of ancient Indian linguistic traditions and explain its significance.
CO4: Show an awareness of traditional Indian dress, food and health practices and appraise its potential benefits.
CO5: Appreciate the contribution of Indian science and technology and identify the efficacy of ancient scientific concepts in day-to-day life.

Introduction of Knowledge of India: Recap of the previous semester's definitions and knowledge.

Philosophy, Ethics & Values: Schools of Philosophy: Vaisheshika, Nyaya, Samkhya, Yoga, Purva Mimamsa and Vedanta or Uttara Mimamsa (theory and the major thinkers) – Jain, Buddhist, and Charvak traditions; Vedanta philosophical systems (Advaita, Vishishtadvaita, Dvaita); Ethics, morality, and social dilemma (including self-leadership) and their relevance in today's time. How do Indians value spirituality? Spirituality and Social Responsibility; Importance of Spirituality in current times; Using ethics in a technologically volatile world: leading an ethical and modern life; Practical Vedanta for well-being (mindfulness, inter-connectedness, society-self relationship, etc.)

Culture-Lifestyle:

Language as culture and identity, Ancient Indian Linguistics and oral traditions, Evolution of different Indian languages-Ancient grammarians and their contributions, Food (regional cuisines, ayurvedic diet, food and festival, food and hospitality; impact of globalization), Clothes (traditional Indian clothing, Textile arts handmade- texture–embroidery, clothing status- for occasions-significance of colour- varieties for gender, impact of globalization). The lifestyle of Yoga; adapting ancient lifestyle – A path towards longevity, Indian spirituality-Importance of spirituality in current times, Sports (traditional Indian sports, martial arts, sports and gender, impact of globalization).

Science & Technology:

Arithmetic and Logic, Natural sciences: Mathematics, Physics, Chemistry, Metallurgy, Astronomy: India's contributions to the world, Indian notions of time and space, Technology in the economy: agriculture, transportation, etc.

References:

1. Books

1. A.L. Basham,(ed.), *A Cultural History of India*, 7th edition, Oxford University Press, 2003.
2. A.L. Basham, *The Wonder That Was India*, Volume 1, Picador, 2019.
3. B.Mahadevan, Vinayak Rajat Bhat, R.N. Nagendra Pavana, *Introduction to Indian Knowledge Systems: Concepts and Applications*, PHI Learning, 2022.
4. B. N. Luniya, *Evolution of Indian Culture –From the earliest times to the present day*, 1992.
5. Mohan Raghavan, M.S. Harsha Simha, C.R. Ramaswamy, *Elements of Indic Knowledge System and Heritage*, HTSR Institute2023
6. Samskrita Bharati, *Pride of India: A Glimpse in to India's Scientific Heritage*, 2006.

2. Websites

1. Indian Culture. https://www.indianculture.gov.in/
2. Indian Knowledge Systems, Govt. of India. https://iksindia.org/ 3. Ministry of Culture, Govt. of India. https://indiaculture.gov.in/ 4. Visual arts. CCRT. https://ccrtindia.gov.in/resources/visual-arts/

ED1294E Teacher and Society

Pre-requisites: NIL

L	T	P	C
2	0	0	2

Total Lecture Sessions: 26

Course Outcomes:

CO1: Critically examine the relationship between beliefs, values, character, life, social and cultural context of the teacher and teaching.

CO2: Explain the roles and characteristics of the teacher and its significant role in nurturing the posterity.

CO3: Identify the narrow and broad curricular aims of education and explain their role in shaping self, school, and society.

CO4. Develop positive classroom environment through engaging in the ethic of care.

CO5: Critically reflect on personal and collective practice in order to improve learning and teaching.

CO6: explain individual, contextual, and structural dimensions of teacher agency and appreciate its impact in education.

Understanding the Teacher: Exploring the Personal and Professional Teacher : Exploring the wider Personal and General Social Context of Teacher: Life History, Teacher Beliefs, Values and Aspirations, Diverse Identities, Social Contexts and Commitment to Learning and Education; Exploring the Professional Teacher: Qualifications, Education in teaching, Attitude, Aptitude, Experience and Exposure; The Charismatic Teacher, the Communicator Teacher, The Missionary Teacher, The Competent Practitioner, The Reflective Practitioner, The Learning Teacher; Reflexive Practice; Nurturing the Professional Capital through collaborative and/or collective engagement with self, others, the social context.

Nurturing the Teacher: A Dialogue beyond the curricular goals, for Life and Posterity: Teaching: One profession, many roles; Teaching Character: Nurturing Teachers for Human Flourishing; Holistic Teacher Development: Nurturing the Panchakoshas; Teacher Values, Beliefs, and current Philosophy of Teaching: A Reflective Dialogue; Developing an Ethic of Care in Teacher Education: Nurturing Teachers towards a pedagogy of care.

Understanding and Fostering Teacher Agency: Role in shaping Education Systems of Tomorrow: Teacher Agency: meaning and importance; Individual, Cultural and Structural Dimensions of Teacher Agency; Teacher discourses, Philosophy, Relationships, Networks and Professional Development; Shaping teacher agency and Creative insubordination; Challenges and Issues in fostering Teacher Agency: Performativity, Non-academic; engagements, Systemic apathy, Policy and Practice gaps and others; Role of Teacher in shaping the educational policy, practice, and reforms.

Teacher as an Architect of the New India: Shaping the Society of Tomorrow: Engaging in Critical Education: Dialogues on power relations associated with Gender, Ethnicity, Culture, Disability, Class, Poverty, the reproduction of disadvantage and realizing the true human potential; Being a Critical Teacher: Raising debates around rapid technological advancement and impact on individual, family and social life; the growing isolation and impact on mental and social health and well-being; changing relationships between the 'state' and the 'market' and their impact on formal education; the conceptualization of teacher, teaching and teacher roles, 'globalization' and the reconstructed nationalism shaping the socio-political milieu and impact on social psyche, growing materialistic urge, sensory drives and the gradual deterioration of the individual and societal character.

References:

1. Julie Ellison Justice, F. Blake Tenore (Ed) *Becoming Critical Teacher Educators: Narratives of Disruption, Possibility, and Praxis*, Routledge, 2018.
2. Donna Walker Tileston, *10 Best Teaching Practices: How Brain Research and Learning Styles Define Teaching Competencies*, 3rd edition, Corwin Press 2011.
3. Danielle Herro, Cassie Quigley, *An Educator's Guide to STEAM*, Teachers' College Press, 2019. 4. Ellen Nuijten, Fred Korthagen, *The Power of Reflection in Teacher Education and Professional Development: Strategies for In-Depth Teacher Learning*, Routledge, 2022.
5. Becky Zayas, Ian Jukes, et al. *Learner Choice, Learner Voice: A Teacher's Guide to Promoting Agency in the Classroom (Eye on Education)*, Routledge, 2022.
6. Todd Whitaker, *What Great Teachers do differently-Nineteen things that matter most*, 3rd

edition, Routledge, 2020
7. Dennis Mifsud, Stephen P. Day (Ed.), *Teacher Education as an ongoing Professional Trajectory*, Springer, 2023
8. N. Entwistle (ed.), *Handbook of educational ideas and practices*, Routledge, 1990

CH111E Basic Concepts in Organic Chemistry and Stereochemistry

Pre-requisites: NIL

L	T	P	C
3	1	0	4

Total Lecture Sessions: 39

Course Outcomes:

CO1. Comprehend and disseminate the concepts, terminologies, and reactions in organic chemistry.

CO2. Propose methods for the synthesis and predict the reactivity of aromatic hydrocarbons.

CO3. Apply stereochemistry principles to organic reactions.

Fundamentals of organic chemistry: Organic compounds-classification, nomenclature, molecular shapes and hybridisation, conventions of drawing structures; electronic displacements- inductive effect, electromeric effect, resonance and hyperconjugation; cleavage of bonds- homolysis, heterolysis, nucleophiles, electrophiles; reaction intermediates - carbocations, carbanions, free radicals; strength of organic acids and bases- comparative study with emphasis on factors affecting pK values.

Types of organic reactions- substitution, addition, elimination, free radical, oxidation-reduction, rearrangement reactions.

Aliphatic hydrocarbons: Alkanes-methods of preparation- catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagents; reactions- free radical substitution. Alkenes: methods of preparation- elimination reactions- dehydration of alcohols and dehydrohalogenation of alkyl halides (Saytzeff's rule); Addition reactions- *cis*- and *trans*-addition, addition of halogens, HX (Markownikoff's and anti-Markownikoff's addition), hydration, ozonolysis, oxymercuration-demercuration, hydroboration-oxidation.

Alkynes: methods of preparation- acetylene from CaC2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides; reactions- formation of metal acetylides, addition of bromine and alkaline KMnO4, ozonolysis, oxidation, reduction. Aromatic hydrocarbons: Concepts of aromaticity and antiaromaticity, Huckel's rule, benzene and its congeners, annulenes; electrophilic aromatic substitution reactions- nitration, sulphonation, and halogenation, Friedel Craft's alkylation (polyalkylation) and acylation; substituent effects on reactivity and regioselectivity: ortho-, para-, and meta-directing groups; nucleophilic aromatic substitution reactions.

Stereochemistry of carbon compounds: Molecular symmetry and chirality, geometrical and optical isomerism, stereoisomerism, centre of chirality, configurational nomenclature: D/L, threo/erythro, and R/S nomenclature, CIP rules, projection formulae, interconversion of Wedge, Newmann, Sawhorse and Fischer representations. E/Z nomenclature; racemic mixture, racemization and resolution techniques; conformations of acyclic and monocyclic molecules.

References:

1. Marc Loudon and Jim Parise, *Organic Chemistry*, 6th Edition, WH Freeman, 2015. 2. J. Clayden, N. Greeves and S. Warren, *Organic Chemistry*, 2nd Edition, O.U.P. India, 2023. 3. T. W. Graham Solomons, C. B. Fryhle and S. A. Snyder, *Solomons' Organic Chemistry*, 12th Edition, Wiley, 2016.

4. Paula Y. Bruice, *Organic Chemistry*, 8th Edition, Pearson Education, 2020. 5. R. T. Morrison, R. N. Boyd, and S. K. Bhattacharjee, *Organic Chemistry*, 7th Edition, Pearson Education, 2010.

6. D. Nasipuri, *Stereochemistry of Organic Compounds: Principles and Applications*, 4th Edition, New Age International Publishers, India, 2021.

7. D. G. Morris, *Stereochemistry (Basic Concepts in Chemistry)*, Royal Society of Chemistry, Cambridge, UK, 2002.

CH1112E States of Matter and Chemical Thermodynamics

Pre-requisites: NIL

L	T	P	C
3	1	0	4

Total Lecture Sessions: 39

Course Outcomes:

CO1: Apply the building models of equations of state and molecular behaviours on experimental observations.

CO2: Explain the basics of various crystalline solids and their characteristics.

CO3: Comprehend and disseminate the basic concepts of thermodynamics.

The properties of gases: Variables of states, equations of state, Boyle's law, Charles's law, Avogadro's principle, mixtures of gases, ideal and nonideal gases, states of gases, gas laws, gas constant, Dalton's law of partial pressures, molecular speeds and translational energies, compression factor, equations of state for nonideal gases, liquefaction of gases and the critical phenomena, virial coefficients, critical constants, van der Waals equation. Collision properties: collision cross section, collision number, collision frequency, collision diameter and mean free path of molecules. Relation between mean free path, degrees of freedom, molecular energies, Maxwell's distribution of speeds, molecular speeds, intermolecular collisions, collisions on the wall and effusion.

Liquid state and molecular interactions: Physical properties of liquids, vapour pressure, excess pressure, viscosity and Reynold's number, solutions Raolt's law and Henry's law, ideal and nonideal solutions, azeotropic mixtures, distillation, optical activities. Electric properties of molecules, electric dipole moments, polarizability, relative permittivity, interactions between dipoles, hydrogen bonding, repulsive and total interactions, molecular interactions in liquids, liquid– vapour interface, surface tension, capillary actions, condensation. Colloids and suspensions, surface- active agents, micelles, critical micelle concentration (CMC), Kraft temperature. Purification of colloids, ultrafiltration and electrodialysis, optical and electrical properties of colloids.

Solid state: The nature of the solid state, anisotropy, amorphous and crystalline solids. Symmetry elements and symmetry operations, representation of molecular point groups, space groups, crystal lattices, lattices and unit cells, crystal systems, Bravais lattices, Miller indices, identification of lattice planes, inter planar distances, Bragg's law. X-ray diffraction, X-ray diffraction for cubic system, close packing, hexagonal close packing, cubic close packing, unit cells. Metallic solids, ionic solids, band theory of solids, metallic conductors, insulators, semiconductors, superconductors. Structure of NaCl and KCl Rutile, Zinc blend, Wurtzite, imperfections in crystals, point defects, Schottky and Frenkel defects, non-stoichiometric defects, line defects, edge dislocation, screw dislocation.

Thermodynamics: Definition of thermodynamic terms, first law of thermodynamics, heat capacities at constant volume and at constant pressure & their relationship, standard enthalpy changes, enthalpy of formation, Hess's law, variation of enthalpy of reaction with temperature, Kirchhoff equation, expansion of ideal gas, work done in isothermal expansion and reversible isothermal expansion, Joule - Thomson effect and liquefaction of gases, second law of thermodynamics, concept of entropy as a function of V & T and P & T, entropy of mixing, criteria of spontaneity and equilibrium. Carnot's cycle and its efficiency, work and free energy functions, Gibbs-Helmholtz equation, partial molar free energy, concept of chemical potential, Gibbs-Duhem equation, Clapeyron-Clausius equation and its application. Third law of thermodynamics, Nernst heat theorem, residual entropy.

References:

1. P. Atkins, J. de Paula, *Atkin's Physical Chemistry*, 11 Ed, Oxford university press, Oxford, 2018. 2. G. K. Vemulapalli, *Physical Chemistry*, PHI Learning Pvt. Ltd., 1996.
3. S. Glasstone, *Thermodynamics For Chemists*, East-West Press, 2008.
4. J. B. Ott, J. Boerio Goates, *Chemical Thermodynamics-Principles and Applications*, Academic Press, Elsevier Science & Technology Books, 2000.
5. B. R. Puri, L. R. Sharma, M. S. Pathania, *Principles of Physical Chemistry*, 48 Ed, Vishal

PHI203E Physics Minor-II Thermal Physics

Pre-requisites: Nil

L	T	P	C
3	1	0	4

Total Lecture Sessions: 39

Course Outcomes:

CO1: Identify the relevant variables of a thermodynamic system and set up equations of state.

CO2: Evaluate entropy changes involved in a process and distinguish processes as reversible and irreversible.

CO3: Apply the first and second laws of thermodynamics to thermodynamic systems.

CO4: Analyze the thermodynamic properties of a given system using appropriate thermodynamic potentials.

Basic Concepts

Assumptions of the kinetic theory of gases- the pressure of an ideal gas- r.m.s. speed- kinetic interpretation of temperature- intensive and extensive parameters - equation of state- ideal gas and real gas - Maxwell's speed distribution law- thermodynamic state- phase diagrams- triple point.

Heat & Calorimetry

Heat as a form of energy- units of heat- principle of calorimetry- specific heat capacity and molar heat capacity- measurement- specific latent heat of fusion and vapourization- measurement- mechanical equivalent of heat- heat capacity - enthalpy and specific heats of ideal gases.

Zeroth Law and First Law

Thermodynamic systems – types- thermal equilibrium– Zeroth law of thermodynamics – temperature- units mechanical, chemical, and thermodynamic equilibrium - work done in a process- - first law of thermodynamics – work done in isothermal and adiabatic processes - heat engines - Carnot cycle.

Second Law and Third Law

Limitations of first law- definition of entropy – irreversible processes- entropy changes in reversible and irreversible processes- Clausius and Kelvin-Planck statement ofsecond law- equivalance of the two statements – combined first and second laws - thermodynamic potentials– Helmholtz and Gibb's functions- chemical potential first-order phase transitions - phase-coexistence - Clausius-Clapeyron equation- third law of thermodynamics- statements- equivalence of the statements- consequences.

References:

1. M. W. Zemansky, R. H. Dittman, *Heat and Thermodynamics*, 8th Edition, McGraw-Hill, 2017. 2. S. J. Blundell, K. M. Blundell, *Concepts in Thermal Physics*, 2nd Edition, Oxford University Press, 2010. 3. H. C. Verma, *Concepts of Physics, Vol- 2*, 3rd Reprint, Bharati Bhawan, 2009.
4. A. H. Carter, *Classical and Statistical Thermodynamics*, 1st Edition, Pearson, 1999.

MA1202E Mathematics Minor-II Algebra & Differential Equations

Pre-requisites: Nil

L	T	P	C
3	1	0	4

Total Lecture Sessions: 39

Course Outcomes:

CO1: Check the consistency and solve the system of linear equations. CO2: Diagonalise symmetric matrices and use it to find the nature of quadratic forms.
CO3: Acquire sufficient knowledge about vector spaces, linear transformation and theory of matrices.
CO4: Formulate some real world problems as ODEs and hence solve such problems. CO5:

Formulate some real world problems as PDEs and hence solve such problems.

System of Linear equations:
Gauss elimination, Rank of a matrix, Consistency of linear system. Vector spaces, Subspaces, Basis and dimension, Linear transformation, Rank-nullity theorem, Inner-product, Gram-Schmidt orthogonalization, Matrix representation of linear transformation. Eigenvalues and Eigenvectors of matrices, Cayley-Hamilton theorem, Similarity of matrices, Diagonalization.

Ordinary Differential Equation:
Existence and uniqueness of solution of first order ODE, methods of solutions of first order ODE, linear ODE, orthogonal trajectories, linear homogeneous second order ODEs with constant coefficients, fundamental system of solutions, existence and uniqueness of solutions, Wronskian, method of undetermined coefficients, solution by variation of parameters, Euler-Cauchy equations, applications of first and second order ODEs, system of linear ODEs with constant coefficients.

Partial differential Equations:
Basic Concepts, Cauchy's problem for first order equations, Linear Equations of the first order, Nonlinear Partial Differential Equations of the first order, Charpit's Method, Special Types of first order equations, Classification of second order partial differential equations, Method of Separation of variables.

References:

1. H. Anton, I. Bivens, S. Davis, *Calculus*, 10th edition, John Wiley & Sons, 2015.
2. G. B. Thomas, M.D. Weir, J. Hass, *Thomas' Calculus*, 12th edition, Pearson Education, 2015. 3. E. Kreyszig, *Advanced Engineering Mathematics*, 10th edition, John Wiley &Sons, 2015. 4. V. I. Arnold, *Ordinary Differential Equations*, Springer, 2006.
5. G. Strang, *Introduction to Linear Algebra*, Cambridge Press, 2016.
6. I. N Sneddon, *Elements of Partial Differential Equations*, Dover Publications, 2006. 7. T. Amarnath, *An Elementary Course in Partial Differential Equations*, Narosa Publishing House,2003.

CS1201E Computer Programming with C

Pre-Requisite: None

L	T	P	C
3	0	2	4

Course Outcomes:
CO-1: Implement programs using classes and objects.
CO-2: Able to understand the overloading concept.
CO-3: Specify the forms of inheritance and use them in programs.
CO-4: Analyze polymorphic behavior of objects and polymorphism.
CO-5: Understand virtual functions.
Syllabus:
C Fundamentals: The C character set identifiers and keywords, data type & sizes, variable

names, declaration, statements.
Operators & Expressions: Arithmetic operators, relational and logical operators, type, conversion, increment and decrement operators, bit wise operators, assignment operators and expressions, precedence and order of evaluation. Input and Output: Standard input and output, formatted output – printf, formatted input scanf. C pre-processor, command line arguments.
Flow of Control: Statement and blocks, if - else, switch, loops - while, for, do while, break and continue, go to and labels.
Functions: Basic of functions, function types, functions returning values, functions not returning values, auto, external, static and register Variables, scope rules, recursion.
Arrays and Pointers: One dimensional, two dimensional arrays, pointers and functions, multidimensional arrays.
Structures Union and File: Structure, union, structures and functions, arrays of structures, file read, file write.

Lab
1. Programs on expression evaluation.
2. Programs on conditional branching, iterations, pattern matching.
3. Programs on function, recursion.
4. Programs on arrays, pointers, parameter passing.
5. Programs on string using array and pointers. 6. Programs on structures, union.

Learning Resources:
Text Books:
1. B. S. Gottfried, "Programming with C", McGraw Hill Education, Fourth edition, 2018.
2. B. W. Kernighan, D. Ritchie, "The C Programming Language", Pearson Education India, Second edition, 2015.
Reference Books:
1. E.Balaguruswamy, "Computing Fundamentals and C Programming", McGraw Hill Education, Second edition, 2017.
2. Y. Kanetkar, "Let Us C", BPB Publications, Sixteenth edition, 2017.
3. E. Balaguruswamy, "Programming in ANSI C", McGraw Hill Education India Private Limited, Seventh edition, 2017.

CH113E: Physical Chemistry Laboratory

L	T	P	C
0	0	2	1

Pre-requisites: NIL

Total Lecture Sessions: 28

Course Outcomes:
CO1: Students will be able to verify the laws of thermodynamics.
CO2: Students will be able to verify the laws of chemical kinetics.
CO3: Students will be able to determine molecular mass of unknown compounds.

Syllabus/List of Experiments:

Phase equilibria-phase diagram-two component system, verification of laws of thermodynamics, Equilibrium Constant, Distillation of an Azeotropic Mixture, electroanalytical experiments, Chemical kinetics, colligative properties and determination of molar mass of unknown compounds, Verification of the Lambert-Beer Law, etc.

Reference:

1. C. Garland, J. Nibler, D. Shoemaker, *Experiments in Physical Chemistry*, McGraw-Hill, (2008) 2. P. Atkins, J. de Paula, *Atkin's Physical Chemistry* , *11 Edn*, Oxford university press, Oxford, 2018. 3. A. J. Elias, *General Chemistry Experiments, 3 Edn*, Universities Press (India) Pvt Ltd, 2002. 4. B. R. Puri, L. R. Sharma, M. S. Pathania, *Principles of Physical Chemistry, 48 Ed*, Vishal Publishing Co., Jalandhar, 2021

SEMESTER - III

ED2301E Child Development and Educational Psychology

Pre-requisites: Nil
Total Lecture Sessions: 52

L	T	P	C
4	0	0	4

Course Outcomes:

CO1: Understand and articulate the meaning, concept, characteristics, factors affecting growth and Development and use the knowledge of Indian concept of self.

CO2: Analyse the process and factors that affect development and use proper tools and technique to identify learner with different abilities.

CO3: Conceptualize the advance theories of learning to design classroom practice, apply various problem solving and learning strategies in real classroom settings.

CO4: Analyse the need and importance of motivation and implement suitable classroom management strategies that promote effective teaching and learning.

Child Development:

Child Development-Meaning and process: Biological, cognitive, socio-emotional, and moral, Significance of understanding the process of Child Development, Developmental characteristics of a child during Infancy stage, Early Childhood stage, Middle to Late Childhood stage, Adolescence stage. The Indian concept of self: Mind, Intellect, Memory, Panch-koshiya Vikas. Educational Implications.

Developmental Process:

Development across domains: Physical Development, Cognitive Development, Language Development, Socio-Emotional Development, Aesthetic Development, Moral Development Factors affecting development (During each of the above-mentioned developmental stages of a child) Individual differences, Children with special needs including developmental disorders, Tools and Techniques for Identifying Learner with different abilities. Teachers' role and strategies to address the needs of learners with different learning abilities.

Process of Learning:

Conceptual Clarity and significance, Approaches- Behaviorist, Cognitivist, Constructivist, and Developmental. Information processing Model of learning. Shri Aurobindo's Integral approach, Problem Solving and Learning Strategies. Inquiry and problem-based learning. Steps and Strategies in problem solving, Factors hindering problem solving, How to Learn: Significance and Strategies.

Motivation and Classroom Management:

Motivation: Conceptual clarity, nature, and significance, Intrinsic and Extrinsic Motivation, Strategies for Motivation, Classroom management: Creating a positive learning environment, Planning space for learning, Managing behavioral problems, Group dynamics: Classroom as a social group, Characteristics of group, Understanding group interaction-Sociometry, Strategies to facilitate group learning.

References:

1. E. B. Hurlock, *Child Growth and Development*, Tata Mc Graw - Hill Education, 2013. 2. S. K. Mangal, *Advance educational psychology*, 2nd edition, PHI Learning Pvt. Limited, 2019. 3. C. S. Hall, L. Gardner, B. C. John, *Theories of personality*, Agarwal Printing Press, 2010.
4. W. Buskist, S. F. Davis (Eds.), *Handbook of the teaching of psychology*, Blackwell Publication, 2006. 5. E. E. Smith, S. M. Kosslyn, *Cognitive psychology: mind and brain*, Prentice Hall of India Pvt. Ltd, 2008.
6. E. B. Hurlock, *Developmental psychology: A life-span approach*, McGraw-Hill, 1980. 7. A. Woolfolk, *Educational psychology*, Pearson Publication, 2006.

ED2302E General Pedagogy

Pre-requisites: Nil

L	T	P	C
3	1	0	4

Total Lecture Sessions: 39

Course Outcomes:
CO1: Develop an understanding and appreciation of factors that influence learning ability.
CO2: Gain a knowledge of pedagogical strategies for multidisciplinary learning.
CO3: Demonstrate an ability to identify teaching methods and strategies that are appropriate for different contexts.

CO4: Explore ways of updating current trends in education and identify strategies for developing professionally.

The physical, mental, social, and emotional growth of learners, Thought processes and cognitive skills of learners, Characteristics of secondary stage learners- Unique capabilities, Conflicts and challenges.

Relationship between Aims and Values of Education, Curriculum and Pedagogy. Concept, characteristics and functions of teaching, Teaching- learning process as a behavioral change, knowledge domains and cognitive processes, action words. Anderson and Krathwohl's revised Bloom's taxonomy. Dale's cone of experiences and its implications in the classroom teaching learning process.

Pedagogical approaches: Role of prior knowledge in constructing new knowledge (Ausubel), Piaget's theories of learning (schema- disequilibrium), Vygotsky's theories of role of language and context in learning, Von Glasersfeld's theory. Concept Attainment Model (Bruner); collaborative approach, reflective approach, integrative approach, inquiry- based approach, other contemporary approaches, art-integrated learning, sports- integrated learning. Building values through art integrated activities, community engagement etc.

Types of pedagogy: social pedagogy, critical pedagogy, culturally responsive pedagogy, Socratic pedagogy in inclusive setup, Role of pedagogy in effective learning: how does pedagogy impact the learner.

Teaching and Microteaching, Meaning and Definition of Teaching, Teacher-Training Programme. Before Microteaching, Meaning and Concept of Microteaching, Definitions of Microteaching - Objectives of Microteaching - Microteaching at Work, Propositions of Microteaching - Phases, Activities and Components of Microteaching, Knowledge Acquisition Phase - Skill Acquisition Phase - Transfer Phase of Microteaching, Evaluation of Microteaching

Teaching Skills, Core Teaching Skills, Organization of Microteaching Cycle, Development of Microteaching, Assumptions of Microteaching, Principles of Microteaching Technique, Skill of Probing Questions, Skill of Explaining, Skill of Illustrating with Examples, Skill of Reinforcement, Skill of Stimulus Variation, Skill of Classroom Management, Skill of Using Blackboard

Importance of planning, unit plan and lesson plan. Elements of unit plan and lesson plan, developing lesson plans on different topics and through various approaches taking examples form

secondary stage. Development of constructivist practices in science teaching, 5E learning model, 7E model, making abstract concepts enjoyable by relating them to real-life situations, promoting learner participation and engagement in learning, promoting multidisciplinary learning through integration of different disciplines,

Differences between occupation and profession. Teaching as a profession, professional and ethical competencies and need for updating content and pedagogical competencies to develop their professional competencies.

References:

1. R. W. Canestrari, B. A. Marlowe, *Educational Foundations: An Anthology of Critical Readings*, 4th Edition. Sage, 2020

2. N. Denby (ed.), *Training to Teach: A Guide for Students*, Sage Publications Ltd., 2015. 3. C. Kyriacou, *Essential Teaching Skills*, Oxford University Press.

4. R. P. Pathak, *Teaching Skills*, Pearson Education India, 2012.

5. J. Loughran, M. L. Hamilton, *International Handbook of Teacher Education*, Vol 2, Springer, 2016. 6. W. W. Murawski, K. L. Gandhi, *What Really Works in Secondary Education*, Corwin, 2015. 7. *National Curriculum Framework for School Education*, 2023.

8. *Mandate documents: Guidelines for the development of National Curriculum Frameworks*, National Council of Educational Research and Training, 2022.

9. *National Education Policy 2020*, Ministry of Education, Government of India, 2020.

10. *National Policies on Education* 1968, 1986 and 2020.

11. G. Petty, *Teaching Today*. 5th edition, Oxford University Press, 2004.

12. J. Scrivener, *Learning Teaching*, Macmillan, 1994.

CH2301E Coordination Chemistry and Its Application

Pre-requisites: NIL

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Predict different types of isomerism exhibited by coordination compounds CO2: Use the theories of bonding in coordination complexes to explain their geometry, stability and magnetic properties.

CO3: Acquire enough knowledge on the kinetics and thermodynamic stability of coordination complexes.

CO4: Design new metal complexes using the acquired knowledge on inorganic reaction mechanisms.

Introduction and coordination chemistry- Transition elements and their oxidation states. Types of ligands: unidentate, bidentate and polydentate ligands, chelating ligands and chelates- IUPAC nomenclature of coordination compounds.

Isomerism in coordination compounds: Structural isomerism, hydrate isomerism, coordination isomerism, ionization isomerism, linkage isomerism, coordination position isomerism. Stereoisomerism: Geometrical isomerism of four and six-coordinate complexes, optical isomerism of four and six-coordinate complexes, Werner and Sidgwick theories, methods of detecting complex formation.

Theories of coordination compounds: Valence bond theory, limitations of valence bond theory, crystal field theory- splitting of d orbitals in octahedral, tetrahedral and square planar fields, CFSE, factors affecting CFSE, colour, geometry and magnetic properties of coordination compounds, Jahn– Teller distortion (an elementary idea).
Molecular orbital theory: Molecular orbital diagram for $[Co(NH_3)_6]^{3+}$. Ligand field theory (An elementary treatment only).

Labile and inert complexes, stability of coordination compounds– thermodynamic and kinetic stability, the relationship between stepwise formation constant and overall formation constant, factors affecting the stability of complexes. Unimolecular and bimolecular nucleophilic substitution reactions in octahedral and square planar complexes, trans effect – theories of trans effect and applications.

Essentials and trace elements of life; basic reactions in the biological systems and the role of metal ions, especially Fe^{2+}, and Zn^{2+}, structure and function of myoglobin, hemoglobin and carbonic anhydrase.

Metal carbonyls: Mono and binuclear carbonyls of Cr, Co and Mn – preparation, structure, reactions, bonding and uses.

References:

1. F. A. Cotton, G. Wilkinson and P. L. Gaus, *Basic Inorganic Chemistry*, Wiley India Ltd., New Delhi, 2009.
2. J. E. Huheey, E. A. Keiter, R. L. Keiter, and O. K. Medhi, *Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson India Ltd., 2009.
3. F. A. Cotton, G. Wilkinson, C. A. Murillo and M. Bochmann, *Advanced Inorganic Chemistry*,
John Wiley & Sons, Inc., New York, 2009.
4. P. Atkins, T. Overton, J. Rourke, M. Weller and F. Armstrong, *Shriver & Atkins: Inorganic Chemistry*, 5th Edition, Oxford University Press, Oxford, 2010.
5. J. D. Lee, Concise *Inorganic Chemistry*, Blackwell Science, Oxford, 2008. 6. F. A. Carey, G. Wilkinson, C. A. Murillo and M. Bochmann, *Advanced Inorganic Chemistry*, Wiley Interscience, 2003.
7. C. E. Housecroft and A. G. Sharpe, *Inorganic Chemistry*, Pearson, 2012.

CH2302E Thermodynamics, Kinetics And Equilibria

L	T	P	C
3	1	0	4

Pre-requisites: NIL

Total Lecture Sessions: 39

Course Outcomes:

CO1: Apply the laws of thermodynamics to industry-based applications and practical systems.

CO2: Identify and apply different factors that determine the rate of chemical changes.

CO3: Construct the phase diagrams of one, two and three-component systems.
CO4: Apply the concept of ionization of electrolytes with emphasis on weak acid and base and hydrolysis of salt.

Thermodynamics: Applications of second law of thermodynamics, Heat engine, expression for efficiency of Carnot's engine, reversibility of Carnot's cycle. Principle of refrigeration, Carnot's theorem, Fugacity, activity and standard states, Concept of ensembles and Statistical postulates, Examples of probability distributions; Maxwell's distribution; Introduction to partition function.
Chemical equilibria: Conditions for equilibrium – derivation of law of chemical equilibrium from thermodynamics – Van't Hoff reaction isotherm, relation between Kp, Kc and Kx, thermodynamics of solutions –colligative properties- Van't Hoff Factor.
Phase equilibria: Gibbs Phase Rule– Conditions for equilibrium between phases, Clapeyron Clausius equation, One component system – water- metastable equilibrium, triple point, two component system- simple eutectic systems, cooling curves, (eg. Pb-Ag), three component solid liquid systems.
Kinetics: Rate of reaction, order and molecularity, rate laws and rate constants- integration of rate expression of first, second and n^{th} order reactions, half life time of a reaction, the temperature dependence of reaction rates. theories of reaction rates – collision theory and activated complex theory of bimolecular gaseous reactions. Lindemann – Hinshelwood mechanism of unimolecular reactions. kinetics of opposing, consecutive, parallel reactions (first order examples) – steady state approximation, chain reactions H2–Cl2, H2–Br2 and H2–O2 reaction, polymerization kinetics – stepwise polymerization, chain polymerization.
Ionic equilibria: Strong, moderate and weak electrolytes, degree of ionization, ionic product of water, effects of solvents on ionic strength, levelling effect, pka and pkb values, solubility product and common ion effect and their applications, pH and its determination by indicator methods, buffer solution, buffer action, Henderson's equation, buffer capacity - hydrolysis of salts of all types, degree of hydrolysis and hydrolytic constant, determination of degree of hydrolysis, relation between hydrolytic constant and ionic product of water.

Reference:

1. P. Atkins, J. de Paula, Atkin's *Physical Chemistry*, 11 Ed, Oxford university press, Oxford, 2018.
2. I. N. Levine, Physical Chemistry (Sixth Edition), New Delhi: Tata McGraw-Hill, 2009 3. B.R. Puri, L.R Sharma, M.S. Pathania, *Principles Physical Chemistry* (46th edition), New Delhi: Vishal Publishing Co., 2015.
4. J. B. Ott, J. Boerio Goates, *Chemical Thermodynamics-Principles and Applications*, Academic Press, Elsevier Science & Technology Books, 2000.
5. Arun Bahl, B S Bahl, G D Tuli, *Essentials of Physical Chemistry*, S Chand Publishing, New Delhi, 2022.
6. Frank R. Foulkes, *Physical Chemistry for Engineering and Applied Sciences*, CRC Press, 2013.
7. Raymond Chang, John W. Thoman Jr., *Physical Chemistry for the Chemical Sciences*, University Science Books, AIP Publishing, 2014.
8. G. K. Vemulapalli, *Physical Chemistry*, PHI Learning Pvt. Ltd., 1998.

PH2303E Physics Minor-III Electromagnetism and Relativity

Pre-requisites: Nil
Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Apply concepts in vector calculus to calculate electric and magnetic fields. CO2: Identify simplifying principles like symmetry to compute Electric and Magnetic fields. CO3: Analyze the generation and propagation of electromagnetic waves in vacuum and material medium. CO4: Analyze the consequences of special relativity to measurement of space, time and idea of simultaneity.

Electrostatics:

Electric charge, conservation, electrostatics, Coulomb's law, Electric field, charge density, flux of the electric field, Gauss law, applications to calculating electric field, electric potential, potential and field of a dipole, electrostatic work and potential energy, dielectric material, dielectric constant, capacitance, capacitors in series and parallel, energy of charge configurations and fields.

Magnetostatics:

Current, resistance, Ohm's law, resistors in series and parallel, resistivity, force on a conductor in magnetic field, Lorentz force law, Magnetic fields, Biot-Savart law, Ampere's law, Magnetic fields due to straight wire, solenoid, toroid etc, Faraday's law of induction, Lenz's law, induced electric fields, inductors, mutual and self inductance. Energy stored in magnetic field, magnetic material, magnetic fields in materials. **Electromagnetism:**

Electromagnetism, Maxwell's equations, Induced electric and magnetic fields, electromagnetic wave equation, electromagnetic waves, plane and spherical waves, energy transport and Poynting vector, polarization, reflection and refraction, total internal reflection, polarization due to reflection.

Relativity:

Special relativity, relative velocity, Newtonian relativity, Galilean transformation, invariance of velocity of light, Michelson-Morley experiment, Einstein's theory of relativity, length contraction, time dilation, simultaneity, velocity addition, relativity of mass and energy.

References:

1. D. Halliday, R. Resnick and J. Walker, *Fundamentals of Physics*, 10th Edition, John Wiley & Sons, 2013.
2. E. Purcell, D. Morin, *Electricity and Magnetism*, 3rd Edition, Cambridge University Press, 2013. 3. D. J. Griffiths, *Introduction to Electrodynamics*, 4th Edition, PHI Learning, 2012.
4. R. P. Feynman, R. Leighton, M. Sands, *Feynman Lectures on Physics*, Vol.-II, Millennium Edition, Pearson, 2012.

MA2303E Mathematics Minor-III Probability and Statistics

Pre-requisites: Nil

L	T	P	C
3	1	0	4

Total Lecture sessions: 39

Course Outcomes:

CO1: Develop the basic concepts of one and two dimensional random variables and apply in Real life applications.
CO2: Use techniques of statistical inferences and their applications.
CO3: Apply regression and correlation for analyzing real life problems.
CO4: Apply sampling distributions and statistical techniques to various fields.

Probability Distributions

Random Variables: Introduction to discrete and continuous random variables, quantify spread and central tendencies of discrete and continuous random variables, Chebyshev's inequality, Some important discrete distributions; Properties and applications of Normal, Student's t, Chi-Square and F distributions, Transformation of a random variable, Probability distribution of a function of a random variable. Jointly
distributed random variables, Marginal and conditional distributions, Bi-variate Normal distribution, Joint probability distribution of functions of random variables.

Statistical Inference

Point and interval estimates of population parameters: Point Estimation of the population mean, distribution of the sample means, confidence Intervals on the population mean, optimal sample size to obtain precision and confidence in interval estimates of mean, maximum likelihood parameter estimation; Hypothesis Testing: Formulation of null and alternate hypotheses, errors in hypothesis tests, power of hypothesis tests, hypothesis tests on population means, variances and ratios of variances. Estimation of proportions. Hypothesis tests concerning one proportion and several proportions, Analysis of �� × �� contingency tables, Chi-square test for goodness of fit.

Regression and ANOVA

Curve fitting, Method of least squares, Estimation of simple regression models and hypotheses concerning regression coefficients, Correlation coefficient, Estimation of correlation coefficient, Hypothesis concerning correlation coefficient, Analyse single factor experiments: Introduction to Analysis of Variance (ANOVA).

References:

1. S. Ross, *A First Course in Probability*, 9th Edition, Pearson, 2014.

2. R. A. Johnson, *Miller and Freund's: Probability and Statistics for Engineers*, 8th edition, Prentice Hall of Indian, 2011.

3. W. W. Hines, D. C. Montgomery, D. M. Goldsman, C. M. Borror, *Probability and Statistics in Engineering*, 4th Edition, John Wiley & Sons, Inc., 2003.

4. D.C. Montgomery, G. C. Runger, *Applied statistics and probability for engineers*, 7th Edition, Wiley, 2019.

5. Walpole, *Probability and statistics for engineers and scientists*, Pearson Education India; 9th edition, 2013.

L	T	P	C
3	1	0	4

CS2301E Data structures with C

Pre-Requisite: None

Course Outcomes:
CO-1: Understand the concept of data structure and create new data structure and also analyzing the efficiency of the same.
CO-2: Identify and differentiate different types of data structures and implement the appropriate data structure and analyze the same.
CO-3: Understand and implement stack, queue and dequeue by selecting appropriate methods.
CO-4: Understand and implement different non-linear data structures by selecting appropriate methods.
CO-5: Understand different factors of sorting and searching algorithm and select the

appropriate algorithm and also implement and analyze the algorithm.

Syllabus:

Array: Introduction to sequential representation, Linearization of multidimensional array. Application of array- representation of polynomial using array, Representation of Sparse matrix using array.
Sorting and searching: Definition and need of sorting, different types of sorting algorithm (Bubble sort, Insertion sort, Selection sort, Quick sort, Merge sort, Radix sort, Sequential search, Binary search
Linked List: Introduction to linked representation, Implementation of different types of linked listSingly linked list, Doubly linked list, Circular linked list, Circular Doubly Linked List. Application of Linked list- Representation of polynomial.
Stack: Definition of Stack, implementations of stack using array and linked list Applications of stack- infix to postfix conversion, Postfix Evaluation Recursion: Principles of recursion - use of stack, tail recursion. Tower of Hanoi using recursion.
Queue: Definition of Queue; Implementation of queue using array- physical, linear and circular model; Implementation of queue using linked list
Dequeue- Definition and different types of dequeue

Learning Resources:
Text Books:
1. Fundamentals of Data Structures of C by Ellis Horowitz, Sartaj Sahni, Susan Anderson-freed 2nd Edition, Universities Press
2. Data Structures and Program Design In C by Robert L. Kruse, Bruce P. Leung 2nd Edition, Pearson
Reference Books:
1. Seymour Chattopadhyay, Debabrata Ghosh Dastidar, Matangini Chattopadhyay, Data Structures Through 'C' Language by, Edition: 2001, BPB Publications
2. Data Structures by S. Lipschutz, Special Indian Edition, Tata McGraw Hill Education (India) Private Limited
3. Data Structures in C by Aaron M. Tenenbaum, 1st Edition, Pearson.
Lab
• Implementation of Bubble sort, selection sort, Insertion sort, Quick sort, Merge Sort and Radix sort using appropriate data structure.
• Implementation of list as data structure using linked list of different types.
• Implementation of polynomial as data structure using array and linked list.
• Implementation of sparse matrix as data structure using array. Implementation of stack as data structure using array and linked list.
• Implementation of queue as data structure using array (physical, linear and circular model) and linked list.
• Converting infix to post-fix and evaluating post-fix expression using stack.
• Implementing Tower-of-Hanoi problem.

CH2341E Organic Chemistry Laboratory

L	T	P	C
0	0	2	1

Pre-requisites: NIL

Course Outcomes:

CO1: extract and characterize natural product using spectroscopy

CO2: identify functional groups

List of Experiments

Introduction to laboratory safety, various safety protocols related to hazardous

chemicals. Basic laboratory techniques, functional group identifications, isolation and purification processes: filtration, recrystallization, solvent extraction, distillation, vacuum distillation. Methods of separation of mixtures by chromatography (TLC/column chromatography). Natural product extraction and characterization by spectroscopy.
Derivatization, isolation and characterization of organic compounds.

References:

1. B. S. Furniss, A. J. Hannaford, P. W. G. Smith and A. R. Tatchell, *Vogel's Text Book of Practical Organic Chemistry*, 5th Edition, Pearson India, 2003.
2. F. G. Mann and B. C. Saunders, *Practical Organic Chemistry*, 4th Edition, Pearson Education India, 2009.

SEMESTER – IV

ED1401E Philosophical and Sociological Perspectives of Education-I

Pre-requisites: Nil

Total Lecture Sessions: 52

L	T	P	C
4	0	0	4

Course Outcomes:

CO1: Understand the philosophical schools of thought from both Bharatiya and Western traditions, and their implications for education.

CO2: Understand how various philosophies influence educational practices and theories.

CO3: Critically reflect on the visions of prominent Indian and global educators.

CO4: Develop a comprehensive understanding of concepts of the Indian value system in contemporary society, with a special focus on effectively addressing pedagogical challenges.

Philosophical Schools and Education: Conceptual Clarity of the following schools of thoughts with their implications for educational practices: Bharatiya: Samakhya, Yoga, Nyaya, Vaishashika, Mimamsa, Vedanta. Western: Idealism, Naturalism, Pragmatism, Progressivism.

Educational Thinkers: Deliberations on aims, process and educational institutions developed on thoughts of following thinkers and practitioners: Bharatiya: Swami Vivekananda, Sri Aurobindo Ghosh, Gurudev Rabindra Nath Tagore, J. Krishnamurti, Mahamana Madan Mohan Malaviya, Mahatma Gandhi, Gijubhai Badheka. Western: J. Rousse, Maria Montessori, Friedrich Froebel, John Dewey.

Value Education: Conceptual Clarity, Significance and Types of Values, Indian Traditional Values, Guru Shishya-Parampara and Educational Values, Convocation message in Taittiriya Upanishad, Values enshrined in Indian Constitution, NEP- 2020 and Values with special reference to 21st Century, Pedagogical Issues.

References:

1. P. Smeyers, *International Handbook of Philosophy of Education*, Springer, 2018. 2. R. Bailey, R. Barrow, D. Carr,C. McCarthy(Eds.), *The SAGE Handbook of Philosophy of Education*, SAGE Publications, 2010.
3. H. Siegel, (Ed.) *The Oxford Handbook of Philosophy of Education*, Oxford University Press, 2009. 4. A.S. Thakur, S. Berwal, *Education in emerging Indian society*, Vikash Publication, 2007. 5. H.K. Rawat, *Sociology Basic Concepts*, Rawat Publication, 2012.
6. C.N.S.Rao(eds.), *Sociology: Principles of Sociology with an Introduction to Social Thought*, S.Chand & Company Pvt. Ltd. 2007.

ED2402E Minor Pedagogy (Physical Science)

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	O	C
3	1	0	8	4

Course Outcomes:

CO1: Explain the nature of science and specify the goals and objectives of science teaching.
CO2: Apply various theories of science learning and analyse the implications for teaching science.
CO3: Create unit plans, lesson plans in an artistic and scientific way and explore the inter-relation between science and other subjects.

CO4: Explore various assessment strategies for evaluating learning in Physical sciences

CO5: Explain the necessity of the professional development of a teacher and identify various means for it.

Nature and scope of science, Scientific method, steps, historical development of physical science with illustrations from suitable topics, various branches of physical science, science and technology, science and society, aims of teaching physical science in the school curriculum, development of process skills, basic and advanced process skills, scientific attitude, values through science teaching. The school science curriculum with regard to NCF 2005, recommendation of NEP 2020, Brief study of famous curricular reform projects such as Nuffield, STEM, PSSC, and CHEMSTUDY, Major pedagogical shifts. Various approaches in teaching Science, Teacher's role as a facilitator, scaffolding.

Knowledge domains and cognitive processes Types of knowledge- factual, conceptual, procedural and metacognitive knowledge. Various stages of learning. Bloom's Taxonomy of Educational Objectives, action words, Revised Bloom's Taxonomy by Anderson and Krathwohl, Importance of planning, unit plan and lesson plan. Elements of physical science unit plan and lesson plan, content analysis, learning objective writing, and developing lesson plans on different topics of secondary stage such as Atoms and Molecules, Chemical Reactions and Equations, Acids, Bases and Salts, Metals and Non-Metals, Motion, Work and Energy, Sound, Light – Reflection and Refraction, Electricity, Magnetic Effects of Electric Current etc., Development of constructivist practices in science teaching, 5E model, 7E model, Characteristics of an ideal lesson plan.

Developing core teaching skills- Writing instructional objectives, Organizing the content, Creating set for introducing the lesson, Structuring classroom questions, Question delivery and its distribution, Response management, Explaining, Illustrating with examples, Using teaching aids (selection of suitable learning resources, and developing low cost/ no cost teaching aids), Stimulus variation, Pacing of the lesson, Promoting pupil participation, Use of blackboard, Achieving closure of the lesson, Giving assignment, Evaluating the pupil's progress, Diagnosing pupil learning difficulties and taking remedial measures, Management of the class. Science laboratories: designing, management, and safe practices. ICT integration in physical science teaching: different forms of ICT and its application in science education.

Importance of feedback in facilitating learning, difference between test, examination, measurement, assessment and evaluation, Continuous and Comprehensive Evaluation (CCE) and its features, making a question paper, blue print, measurement of students' achievement, marks and grading. Various tools and technique of assessment- assessment of written and oral work, project work, laboratory work, Use of observation, questioning, rubrics, and portfolio assessment in Physical Sciences, diagnosing learning difficulties and misconception in Physical Sciences, Use of ICT in assessment. Teaching as a profession and the professional competencies of a physical science teacher. Need for updating content and pedagogical competencies, pre
service and in-service courses and initiatives.

References:

1. Pedagogy of Science: Physical Science, Part I, NCERT, 2013.
2. Pedagogy of Science Physical Science, Part II, NCERT, 2013.
3. National Curriculum Framework -2005, NCERT 2005.
4. S. Alsop, K. Hicks, *Teaching Science : A Handbook for Primary and Secondary School Teachers*, Kogan Page, 2007.
5. J. Bennett, *Teaching and Learning Science : A guide to recent research and its applications*, Continuum, 2003.
6. N. S. Washton, *Teaching Science Creatively*, Saunders Company, 1967.
7. A. Carin, B. R. Sund, *Teaching Science through Discovery*, Charles E. Merrill Books Inc., 1964. 8. R. Martin, C. Sexton, J. Gerlovich, *Science for All Children: Methods for Constructing Understanding*, Allyn and Bacon, 2002.

CH2401E Basic Analytical Chemistry and Introductory Electrochemistry

Pre-requisites: NIL

L	T	P	C
3	1	0	4

Total Lecture Sessions: 39

Course Outcomes:

CO1: Develop a basic background of chemical principles that are important to analytical chemistry.
CO2: Apply the concepts of analytic chemistry to obtain relevant analytical data.
CO3: Describe the fundamental principles and concepts of electrochemistry.

Fundamentals of Analytical Chemistry

SI Units, mean and the median, significant figures, accuracy, precision, error, types of errors determinate and indeterminate errors, distribution of random errors, mathematical expression for error, absolute and relative error, methods to reduce error, statistical tools for expressing precision- standard deviation, relative standard deviation, variance, comparison of results, student's t test, F- test, criteria for rejecting a value, Q- test, confidence interval, correlation and regression, linear regression analysis, distribution of experimental results, histogram, samples and populations, statistical treatment of random errors, safety in laboratories.

Analytical Techniques

Titrimetric analysis and calculations, different types of titrations - neutralization, redox (permanganometry, dichrometry, iodometry, iodimetry), complexometric (EDTA titrations) and precipitation titrations – Principle of all types of titrations, titration curves, indicators. Chromatography- Selection of mobile and stationary phase, TLC, column chromatography gas chromatography, HPLC, supercritical fluid chromatography, ion exchange chromatography, size exclusion chromatography, potentiometry – principle, indicator electrode, different types of indicator electrodes, reference electrodes, potentiometric titrations.

Fundamentals of Electrochemistry

Electrochemical cells and reactions, redox reactions, standard reduction potentials, reference electrodes, Nernst equation for electrode potential and EMF of a cell, relationship between free energy and electrical energy. Gibbs Helmholtz equation to galvanic cells. Concentration cells: concentration cells with and without transference, liquid junction potential (LJP). Application of EMF measurements. The variation potential with pH, determination of pH. Faradaic and non-Faradaic processes, specific conductance, equivalent conductance and molar conductance, variation of conductance with dilution.

Electrochemical equilibria

Kohlrausch's law, degree of ionization of weak electrolytes, application of conductance measurements, conductometric titrations. Electrolysis, theory of electrolytic dissociation (ionic theory), weak and strong electrolytes, Ostwald's dilution law, its uses and limitations, Debye Huckel- Onsager's equation for strong electrolytes (elementary treatment only, derivation is not required), Debye- Falkenhagen and Wein effects, migration of ions and transport number and its determination. Degree of dissociation, ionic product, solubility product, activity coefficient.

References

1. A. I. Vogel, *Vogel's Quantitative Chemical Analysis*, 6th Edition, Pearson Education, 2009.
2. D. A. Skoog, D. M. West, F. J. Holler and S. R. Crouch, *Fundamentals of Analytical Chemistry*, 10th Edition, Cengage Learning India Pvt. Ltd, India, 2022.
3. P. Atkins and J. de Paula, *Atkin's Physical Chemistry*, 8th Edition, Oxford University Press, Oxford, 2006.
4. S. Glasstone, *An Introduction to Electrochemistry*, East-West Press Pvt. Ltd., New Delhi, 2007. 5. A. J. Bard and L. R. Faulkner, *Electrochemical Methods: Fundamentals and Applications*, 2nd Edition, John Wiley & Sons, 2001.

CH2402E Synthetic Methodologies in Organic Chemistry

L	T	P	C
3	1	0	4

Pre-requisites: NIL

Total Lecture Sessions: 39

Course Outcomes:

CO1: Propose appropriate oxidation and reduction reactions for the synthesis of novel organic molecules.

CO2: Explain the principles and application of pericyclic reactions.

CO3: Comprehend and disseminate C-C and C-Het bond formation strategies.

Principles of oxidation reactions, functional group conversions through oxidation:

alcohols to carbonyls – chromium, manganese and aluminium reagents, DMSO-mediated oxidations, CAN oxidations, DDQ oxidation, SeO2 oxidation, oxidations of alkenes – hydroxylation reactions.

Principles of reduction reactions, catalytic hydrogenation – heterogeneous and homogeneous catalysts – reduction with metal hydrides: lithium aluminium hydride, sodium borohydride, boranes- selectivity in the reduction of carbonyl compounds.

Aldol, Claisen, Michael reactions, Hofmann- Curtius- Lossen rearrangement, Wolff rearrangement, Simmons- Smith reaction, Reimer- Tiemann reaction, Darzen's reaction, Wittig reaction and McMurry reaction; Pinacol-pinacolone, Favorskii, benzilic acid rearrangements, Baeyer-Villiger reaction; oxidation and reduction reactions in organic chemistry.

Diels- Alder, electrocyclic and sigmatropic reactions; functional group inter-conversions and structural problems using chemical reactions.

C-C bond formation reactions with carbanions: acidity of alpha hydrogen, alpha alkylation of ketones and related compounds, $S_N2$type reactions with carbanions, nucleophilic addition of carbanion to carbon-heteroatom multiple bonds, nucleophilic conjugated addition of carbanions.

Organometallic reagents in organic synthesis. Grignard, organo- lithium, organo-copper and organo zinc.
Palladium- catalysed coupling reactions: Suzuki, Heck, Sonogashira and Negishi coupling reactions.

References:

1. F. A. Carey and R. J. Sundberg, *Advanced Organic Chemistry, Part A: Structure and Mechanisms*, 5th Edition, Springer, 2007.
2. J. J. Li, *Name Reactions: A Collection of Detailed Mechanism and Synthetic Applications*, 5th Edition, Springer Nature, 2014.
3. R. T. Morrison, R. N. Boyd, and S. K. Bhattacharjee, *Organic Chemistry*, 7th Edition, Pearson Education India, 2010.
4. T. W. H. Solomons, C. B. Fryhle and S. A. Snyder, *Organic Chemistry*, 12th Edition, Wiley, 2016.

ED2314E Basic Electronics

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:
CO1: Apply the circuit theorem knowledge and solve electronic circuits.
CO2: Develop the basic knowledge on construction, operation and characteristics of semiconductor devices.
CO3: Design simple circuits like amplifiers (inverting and non-inverting), integrator and differentiator using Op-amps.

CO4: Develop competency to construct basic digital circuits using of basic gates.

Basic Circuit Concepts:
Passive components: Resistance, Inductance, Capacitance; series, parallel combinations; Kirchhoff's law: Voltage, Current; Source Transformations; Circuit Theorems: Superposition Theorem, Thevenin's Theorem, Norton's Theorem; Signal Sources: Ideal and Practical Voltage and Current sources; Controlled Sources: VCVS, CCVS, VCCS, CCCS; Concept of Gain, Transconductance, Transimpedance.

Semiconductors and Diodes:
Concept of Conductors, Semiconductors, and Insulators; Intrinsic Semiconductors and Extrinsic Semiconductors; p-type and n-type semiconductors; Diode Theory: Basic Ideas, The Ideal Diode, Forward and Reverse Bias, Diode Equation, Current-voltage Characteristic; Zener Diode: Symbol, Operation, I-V Characteristics; Photo diode: Symbol, Working Principle; Light Emitting Diode (LED): Symbol, Principle; Diode as Rectifiers: Half-Wave Rectifier, Full-Wave Rectifier, Bridge Rectifier, derivation of Ripple factor, Efficiency of Half-Wave, Full-Wave, and Bridge Rectifiers, Comparison of Half-Wave, Full-Wave, and Bridge Rectifiers.

Bipolar Junction Transistor (BJT)
Types of BJT and Their Symbols; Construction and Working Principles of n-p-n transistor; Transistor as an Amplifier: Active Mode; Common Base (CB), Common Emitter (CE), and Common Collector (CC) Configurations; Transistor as an amplifier in CE Configuration; Biasing of Transistor, Concept of DC Load Line and Q Point; Transistor as a Switch: Cut-Off and Saturation Modes. Characteristics of Operational Amplifier (Op-amp) Introduction to Operational Amplifier (Op-amp); Op-amp Block Diagram; Ideal and Practical Op-amp Specifications; 741 Op-amp & Its Features; Op-amp Parameters: Input & Output off-set Voltages, Input offset and Bias Currents, Slew Rates, CMRR, Op-amp Applications: Inverting and Non-Inverting Amplifier, Integrator, Differentiator, and Comparator.

Boolean Algebra and Logic Circuits:
Binary numbers; Octal & Hexa Decimal Numbers; Number Base Conversion; Binary Addition in 1's and 2's Complements; Logic gates and Their truth Tables: NOT Gate, AND Gate, OR Gate, XOR Gate, NAND Gate, NOR Gate, X-NOR Gate; Universal Gates: NAND and NOR Implementations; Boolean Algebra; Basic Theorems and Properties of Boolean Algebra; Boolean Functions; Sum-of Product and Product-of-Sum Forms.

References:

1.R Boylstead, Introductory circuit analysis, 5th edition, PHI,2010.

2. R. Boylestad, L. Nashelsky, Electronic Devices and Circuit Theory,11th Edition, Pearson, 2012.

3. A. S. Sedra, K. C. Smith, Microelectronic Circuits, 6th Edition, Oxford University Press, 2006.

4. R. A. Gayakwad, Op-amps and Linear Integrated Circuits, 4th Edition, Pearson Education, 2003.

5. S Salivahanan, K. Vallavaraj, Electronic Devices and Circuits, 2nd Edition, Tata McGraw Hill, 2003.

MA2403E Mathematics Minor-IV Mathematical Analysis

Pre-requisites: Nil

L	T	P	C
3	1	0	4

Total Lecture Sessions: 39

Course Outcomes:
CO1: Test for convergence of sequences and series.
CO2: Find the Fourier series representations of periodic functions.
CO3: Check for analyticity of complex functions and find conjugates of given harmonic functions.

CO4: Find images of regions under standard complex functions.

CO5: Make use of residue theorem to evaluate contour integrals.

Sequences and Series

Real sequences, Convergent, divergent and Oscillatory sequences, Bounded sequences, Cauchy's general principle of convergence, Cauchy sequences, Monotonic sequences, Limit superior and limit inferior of a sequence, Infinite Series, Convergence of series, Cauchy's general principle of Convergence for Series, Series of positive terms, Geometric series, Comparison test, Cauchy's root test, D'Alembert's Ratio test, Raabe's test, Maclaurin's integral test, power series, radius of convergence, Taylor series, periodic functions and Fourier series expansions, half-range expansions.

Complex Numbers and Functions

Complex functions, Derivatives, Analytic functions, Cauchy- Riemann equations, Harmonic functions, Geometry of Analytic functions: Conformal mapping, Linear fractional Transformations, Transformation by other elementary functions.

Complex Integration

Line integral in the Complex plane, Cauchy's integral theorem, Cauchy's integral formula, Power series, Taylor series and Maclaurin series, Laurent series, Singularities and Zeros, Residue theorem, Evaluation of real Integrals.

References:

1. S. Ponnusamy, H Silverman, *Complex variables with applications*, Birkhauser, Boston, 2006. 2. E. Kreyszig, *Advanced Engineering Mathematics*, John Wiley and Sons, 9th Edn, 2012. 3. L.V Ahlfors, Complex Analysis, McGraw Hill International Edition.
4. B.P Palka, *Introduction to the Complex Function theory*, Springer Verlag, 1991. 5. Serge Lang, *Complex Analysis*, Springer Verlag
6. J.M. Howie, *Real Analysis*, Springer 2007.
7. S.C Malik, *Real Analysis*, Wiley Eastern
8. Shanthinarayan, *Mathematical Analysis*, S. Chand and Co. Ltd
9. Royden, *Real Analysis*, Prentice Hall of India Pvt. Ltd
10. T.M Apostol, *Mathematical Analysis*, 2nd Edition, Addison Wesley

ED2408E Economics Minor IV- Money and Personal Finance

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Gain a comprehensive understanding of the fundamentals of money and the money market within the Indian context.

CO2: Acquire knowledge about banking operations and the institutional frameworks that shape the Indian financial sector.

CO3: Develop insights into personal finance management and taxation principles, particularly within the context of India's financial landscape.

L	T	P	C
3	1	0	4

Money: Basics and Policies

Understanding Money: definition and functions of money- Types of Currency- Fiat, Crypto currency, Commodity Money, Measures of money supply, Simple and compound interest, time value of money, savings and investment, Meeting financial goals- Rate of return, Managing risk- Time and diversification, Power of compounding, Financial Planning, Financial goal setting.

Banking in India

Banking- Savings account, recurring deposits, fixed deposit and deposit insurance, Types of banks- public sector, private sector, cooperative banks, regional rural banks, New banking models- payment banks, small finance banks, Development finance institutions, NBFIs, Microfinance institutions, credit and debt management, Digital payments- Internet banking, wallets, NEFT, RTGS, IMPS, role of Reserve Bank of India- Banking sector reforms in India.

Investment: Practices and strategies

Investment- Risk, returns, liquidity, evaluating investment options, Investment options: short-term investment options- savings bank deposits, money market liquid funds, fixed deposits, long-term financial options- post office savings, public provident funds, company fixed deposits, bonds, mutual funds. Stock exchanges-equity, debt instruments, derivatives, mutual funds, Index, dematerialisation, depository, market capitalization,
Securities market- Primary market and secondary market, Inflation and returns on investment, Introduction to the Stock Market: meaning and definitions, BSE & NSE-SEBI, Insurance, Mutual funds and Pension schemes.

References:

1. L. M. Bhole, J. Mahakud, *Financial Institutions and Markets*, 5th edition, Tata McGraw Hill, 2009. 2. M. Y. Khan, *Indian Financial System*, 11th edition, Tata McGraw Hill, 2010.
3. R. K. Tayal, *The Art of Handling money and finances: A Practical Guide to Personal Finances*, Atlantic Publishers, 2022.
4. J. R. Kapoor, *Personal Finance*, McGraw Hill, 2020.
5. *Various reports and publications*, National Council for Financial Education.

CS2401E Digital Computer Fundamental

Pre-requisites: Nil

Total Lecture Sessions: 39

Course Outcomes:

CO1: Identify the logic gates and their functionality.
CO2: Perform number conversions from one system to another system.
CO3: Understand the functions of combinational circuits.

CO4: Perform number conversions.
CO5: Perform Counter design and learn its operations.

Syllabus:
Number Systems and Codes: Number System–Base Conversion – Binary Codes – Code Conversion. Digital Logic: Logic Gates – Truth Tables – Universal Gates.
Boolean Algebra: Laws and Theorems – SOP, POS Methods – Simplification of Boolean Functions– Using Theorems, K-Map, Prime – Implicant Method–Binary Arithmetic: Binary Addition
– Subtraction – Various Representations of Binary Numbers– Arithmetic Building Blocks – Adder – Subtractor
Combinational Logic: Multiplexers – Demultiplexers – Decoders – Encoders –Code Converters–Parity Generators and Checkers.
Sequential Logic: RS, JK, D, and T Flip-Flops – Master-Slave Flip-Flops.
Registers: Shift Registers–Types of Shift Registers
Counters: Asynchronous and Synchronous Counters - Ripple, Mod, Up- Down Counters– Ring Counters. Memory: Basic Terms and Ideas –Types of ROMs –Types of RAMs.

Learning Resources:
Text Books:
1. V. Rajaraman and T.Radhakrishnan, Digital Computer Design, Prentice HallofIndia,2001
2. D. P. Leach and A. P. Malvino, Digital Principle sand Applications–TMH–Fifth Edition–2002
3. M. Moris Mano, Digital Logic and Computer Design,PHI,2001.
Reference Books:
1. T.C. Bartee, Digital Computer Fundamentals, 6th Edition, Tata McGraw Hill,1991.
Web Resources:
1. https://onlinecourses.swayam2.ac.in/cec19_cs06/preview
2. https://onlinecourses.swayam2.ac.in/cec21_cs17/preview

CH2441E Instrumental Methods in Chemical Analysis

L	T	P	C
0	0	2	1

Pre-requisites: NIL

Total Lecture sections: NIL

Course Outcomes:

CO1: Interpret spectra obtained from FTIR, UV-visible

CO2: Interpret TGA and DSC data to assess material purity

List of Experiments
Molecular and material characterisation using FTIR, UV visible spectroscopy, NMR spectroscopy, TGA, DSC, Optical microscope and HRMS

References:

1. A. I. Vogel and B. S. Furniss, *Vogel's Text Book of Practical Organic Chemistry*, Longman and Scientific Technical, New York, 1989
2. D. A. Skoog, D. M. West, F. J. Holler and S. R. Crouch, *Fundamentals of Analytical Chemistry*, 10th Edition, Cengage Learning India Pvt Ltd., India, 2022.

SEMESTER – V

ED3591E ICT in Education

Pre-requisites: Nil

L	T	P	C
1	0	2	2

Total Lecture Sessions: 13

Course Outcomes:
CO1: Explain various aspects of communication and identify strategies for effective classroom communication
CO2: Appraise the relative advantages of different technological tools and strategies for

teaching and learning.

CO3: Choose appropriate web-based technologies for providing multi-sensory learning experience in the online and offline mode.

CO4: Explain ethical and safety issues in the use of web-based technology for education. **CO5**: Identify the ways of using ICT tools for teaching, learning and assessment of different subjects.

Aspects of Communication:

Communication-definition, Communication cycle, Verbal and non-verbal communication, Factors affecting communication, Components of effective classroom communication-Classroom interaction analysis- Flanders's Interaction Analysis Category System (FIACS).

Technology in education:

Use of technology for education –Edgar Dale's Cone of Experience- Visual aids, audio aids, Multimedia aids.

Advancements in World Wide Web and the changing role of teacher in the Digital era, Use of Tools: Smart Phone, Apps, Social Media, and Generative AI (ChatGPT, Gemini) for teaching and learning, Strategies: Blended learning, Collaborative learning, Flipped Classroom, Synchronous and Asynchronous learning.

Web technologies for education:

Learning Management Systems (LMS), Computer Assisted Instruction (CAI), Massive Open Online Courses (MOOCs), 'anytime anywhere learning', Challenges in use of technology for education- Ethical issues, Safety issues- Cyber bullying, Hacking, Data protection- theft, Misuse, Deepfake technology, Wise use of web resources, Netiquette.

ICT in Teaching- Learning and Assessment:

Techno-Pedagogy- Techno Pedagogical Content Knowledge Analysis (TPACK), Discipline specific ICT tools- Geogebra, PhET, Stellarium, Open Street Map, Marble, Turtle Art, Technological tools for Mind mapping,Varied learning experiences: Augmented reality, Gamification, Simulations, Virtual labs, Technological tools for assessment- e-portfolio, Online and offline assessment tools-Rubrics, Test generators.

References:

1. A. M. Bissonette, *Cyber Law- Maximizing Safety and Minimizing risk in classrooms*, Sage Publications India Pvt. Ltd, 2009.
2. C. R. Tucker, T. Wycoff, J. T. Green, *Blended Learning in Action: A Practical Guide Toward Sustainable Change*, 1st edition, Corwin, 2016.
3. E. Dale, *Audiovisual Methods in Teaching*, Dryden Press, 1969.
4. C. Davies, R. Eynon (ed.), *Education and Technology*, 1st Edition, Routledge and Kegan Paul, 2015. 5. K. Cennamo, J. Ross, P. Ertmer, *Technology Integration for Meaningful Classroom Use: A Standards- Based Approach*, Cengage Publishers, 2011.
6. W. Kist, *The Socially Networked Classroom- Teaching in the New Media Age*, Sage Publications Pvt Ltd, 2012.
7. R. S. Johnson, J. S. Mims-Cox, A. Doyle-Nichols, *Developing Portfolios in Education- A Guide to Reflection, Inquiry & Assessment*, 2nd edition, Sage Publications Pvt. Ltd, 2012. 8. J. K. Parker, *Teaching Tech-Savvy Kids- Bringing Digital Media into the Classroom, Grade 5-12*, Sage Publications Pvt Ltd, 2012.
9. M. D. Roblyer, A. H. Doering, *Integrating Educational Technology into Teaching*, 6th edition, Pearson, 2013.

ED3501E Major Pedagogy-I (Physical Science)

Pre-requisites: Nil

Total Lecture Sessions: 39

Course Outcomes:

CO1: Explain the nature of science as an important subject for human development and identify the aims and objectives of teaching science.

CO2: Critically analyze the current place of science in the school curriculum and recommend ways to improve the current situation.

CO3: Select suitable approaches and methods that are suitable for teaching science topics in a way ensuring participation from the learners.
CO4: Develop various skills that are essential for teaching science and demonstrate these skills.

Nature of Physical Sciences, Science as an empirical body of knowledge: structure of knowledge, facts, concepts, principles, generalizations, theories, Science both as a process and a product. Science as a way of thinking: inquiry, Science as an intellectual quest, Science as a way of investigation: scientific method, process skills of science, Aims and objectives of teaching Physical Sciences at secondary stage, Aims of Learning Physical Science, developing scientific attitude, Development of scientific attitude and scientific temper, Nurturing the natural curiosity, creativity and aesthetic sense, open mindedness, objectivity, truthfulness, critical thinking, logical thinking, development of problem solving skill, observation, problem-solving, rational thinking, reasoning, scientific attitude, critical thinking, Imbibing the values through science teaching, nurturing curiosity, creativity and aesthetic sense, Development of problem solving skills.

Science and Society, Physical science and society, Linkages of Physical Sciences with other school subjects and place of the Physical Sciences in school curriculum, relating Science to daily life, Relating physical science education to natural and social environment, technology and society, Contributions of some eminent scientists, School Curriculum in Physical Science, Curriculum framework, curriculum and syllabus, Recommendations of NCFs on science curriculum, Role of the teacher, Teacher as curriculum developer Recommendations/suggestions of various committees, commissions, and policies inreference to Physical Sciences. NCF 2005, NEP 2020.

Exploring Learners, uniqueness, Approaches and Strategies for Learning Physical Science, From subject-centered to behaviorist to constructivist approach to curriculum development, Pedagogical Shift in Physical Science, shift from science as fixed body of knowledge to the process of constructing knowledge, Scenario from 1950-1980 Post 1980 scenario, Democratizing science learning: Critical pedagogy, Inclusion, social learning, Involving learners in teaching-learning process, Role of learners in negotiating and mediating learning in physical science, linking the previous knowledge, Encouraging learners to raise and ask questions, Encouraging learners to collect materials from local, resources, Process of concept formation. Development of conceptions in science: conceptions, alternate conceptions and misconceptions in science, Various approaches - inductive deductive, constructivist, experiential learning, art integrated learning, Methods of teaching learning Physical Sciences: lecture and lecture cum demonstration, activity, discussion, problem-solving, laboratory, project, scientific inquiry

Approaches and strategies for learning physical Science, Constructivist approach, 5E learning model, Collaborative Learning Approach (CLA), Problem Solving Approach (PSA), Concept mapping, Experiential learning, Cognitive conflict, Inquiry approach, Analogy strategy, Facilitating learners for self-study, Communication in science, consolidating students' ideas, questioning-techniques and strategies, higher order and metacognitive questioning, Cooperative and Collaborative learning approach, problem solving approach, concept mapping, experiential learning, cognitive conflict, inquiry approach.

analogy strategy: grouping students, multiple learning experiences, discussing and negotiating ideas. Concept mapping: role and procedure, studying linkages between concepts, within the same subject, and across subjects. Teaching concepts and generalizations: inductive, deductive, approaches, using advance organizers, problem solving approach, investigatory approach, project method, cooperative learning method, Laboratory approaches, Field trips.

References:

1. *Pedagogy of Physical Science*, Text book for B.Ed, Part I, NCERT
2. *Pedagogy of Physical Science*, Text book for B.Ed, Part II, NCERT
3. **National Curriculum Framework 2005**, NCERT, New Delhi.
4. Steve Alsop, Keith Hicks, *Teaching Science: A Handbook for Primary and Secondary School Teachers*, Kogan Page, 2007.
5. Judith Bennett, *Teaching and Learning Science: A guide to recent research and its applications*, Continuum, 2003. 6. Robin Millar, *Doing Science: Images of Science in Science Education*, The Falmer Press, 1984. 7. *State Textbook in Physics and Chemistry for classes VIII, IX and X*
8. Nathan S Washton, *Teaching Science Creatively*, Saunders Company, 1967.
9. *History of Physics in the 20th Century*, Internet Browsing.
10. D J Novak, D Bob Gowin, *Learning how to learn*, Press Syndicate of the University of Cambridge, Ohio 1111984
11. Carin A, B R Sund, *Teaching Science through Discovery*, Charles E. Merrill Books Inc., 1964 12. Columbus Ohio II, Ralph Martin, Colleen Sexton, Kay Wagner, Jack Gerlovich, *Science for All Children: Methods for Constructing Understanding*, Allyn and Bacon, 2000.
13. *School Science Review*, The Association for School Education, College Lane, Hatfield, Hertfordshire, AL 109 AA, UK.
14. *Physics Education*, Institute of Physics Publishing, Dirac House, Temple Block, Bristol BS1 6BE, UK. 15. *Physics Teacher*, American Association of Physics Teachers, Department of Physics and Astronomy, University of Maryland.
16. Kamala Mukunda,. *What did you ask at school today? A Handbook on Child Learning*, 2009

ED3602E Pre-internship Practice

Pre-requisites: Nil

L	T	P	C
0	0	3	2

Total Lecture Sessions: 0

Course Outcomes:

CO1: acquainted with various pedagogic practices, classroom management skills, assessment tools and learning standards.

CO2: get experience of conducting classes by observing lessons transacted by teacher educators (demonstration lessons)

CO3: develop lesson plans to transact them using appropriate pedagogies and learning resources.

CO4: develop and practice teaching skills in a guided environment to be an effective teacher.

Activities to be conducted:

• Observation of a minimum of 3 lessons transacted by teacher educators to identify pedagogic skills, followed by a critical analysis of the classes observed. • Content analysis and development of a unit plan.

• Preparation of a minimum of 2 types of lesson plans under two different topics. Develop concept map of the each of the lessons.

• Practice on the skills of introduction, questioning and black board writing. • Development of at least one Teaching Learning Materials (TLMs).

• Observation of the lesson demonstrated by teacher educators/experts in the institute.

CH3501E Chemistry of Main Group Elements and Organometallic Chemistry

Pre-requisites: NIL

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Classify elements based upon their periodicity.

CO2: Describe the structure and properties of main group compounds.

CO3: Employ the basics of organometallic chemistry to understand catalytic reactions.

Periodic classification of elements. Variation in electronic properties. Reactions of alkali and alkaline earth metals with oxygen, hydrogen and water; Alkali and alkaline earth metals in liquid ammonia; Gradation in properties of main group elements in a group; Inert pair effect.

Synthesis, structure and properties of diborane, ammonia, silane, phosphine and hydrogen sulphide; Allotropes of carbon; Oxides of nitrogen, phosphorus and sulphur; Oxoacids of phosphorus, sulphur and chlorine; Halides of silicon and phosphorus; Synthesis and properties of borazine, silicone and phosphazene; Synthesis and reactions of xenon fluorides.

Definition and classification of organometallic compounds based on bond type. Concept of hapticity of organic ligands. Electron counting, oxidation states and stability. Organometallic Chemistry of Main Group and Transition metals for applications in organic transformations. Carbanionic Organometallics: Organolithium, magnesium, zinc, copper, and titanium reagents. Chemistry of Organoboron, aluminum, silicon and tin compounds. Organomercurials and organothallium compounds. Chemistry of Metal carbonyls: chromium, iron and cobalt carbonyl reagents. Metal carbon multiple bonds: carbenes, carbynes, and N-heterocyclic carbenes. Chemistry of Metallocenes: Ferrocene and related compounds. Organometallic Chemistry of the Noble Metal: Pd, Rh, Ru and Au catalyzed reactions, involving metal-catalyzed coupling, C-H activation and metathesis reactions.

Types of organometallic reactions. Ligand substitution Oxidative addition and Reductive elimination. σ (Sigma) bond metathesis 1, 2- insertion and β- hydride elimination and cyclometallation. General principle and the term used in catalysis, Homogeneous and Heterogeneous catalysis, application in Alkene hydrogenation, Hydroformylation, Wacker Process, Synthetic gasoline.

References:

1. J. D. Lee, Concise Inorganic Chemistry, 5th Edition, Oxford University Press, Indian Edition.
2. F. A. Cotton and G. Wilkinson, Basic Inorganic Chemistry, Wiley publication.
3. P. Atkins, T. Overton, J. Rourke, F. Armstrong and M. T. Weller, Shriver and Atkin's Inorganic Chemistry, 4th Edition, Oxford University Press, 2009.
4. B. R. Puri, L. R. Sharma and K. C. Kalia, Principles of Inorganic Chemistry, 3rd Edition, Milestone
Publishers and Distributors, New Delhi, 2006.
5. J. E. Huhey, Inorganic chemistry, 4th Edition, Wesley Publishing Company.
6. F. Basalo and R. G. Pearson, Mechanism of Inorganic reaction, 2nd Edition, Wiley Eastern Pvt Ltd.,
1967.
7. P. J. Durrant and B. Durrant, Introduction to Advanced Inorganic Chemistry, 2nd Edition, John Wiley,
1970.
8. Satya Prakash, G. D. Tuli, S. K. Basu and R. D. Madan, Advanced Inorganic Chemistry, Volume 1,
18th Edition, S. Chand Publication, 2000
9. G. Raj, Advanced Inorganic Chemistry, 23rd Edition, Goel Publishing House, 1998.

CH3602E Natural Products, Heterocycles and Spectroscopic Methods of Characterization

Pre-requisites: NIL

L	T	P	C
3	1	0	4

Total Lecture Sessions: 39

Course Outcomes:

CO1: Comprehend the structural diversity of natural products and their importance.

CO2: Classify heterocyclic compounds and explain classical methods for their synthesis.

CO3: Demonstrate an understanding of fundamental theory, instrumentation, and their applications in structure elucidation.

L	T	P	C
3	0	3	4

Carbohydrates – Occurrence, classification, and their biological importance. monosaccharides – constitution and absolute configuration of glucose and fructose, epimers and anomers, mutarotation, determination of ring size of glucose and fructose, Haworth projections and conformational structures; Interconversions of aldoses and ketoses; Kiliani- Fischer synthesis, Polysaccharides – elementary treatments of starch and cellulose.

Basic concepts of amino acids and nucleic acids, classifications, structures, applications.

Chemistry of alkaloids, steroids and terpenes; Natural occurrence, General structural features, isolation, and their physiological action.

Heterocyclic compounds – classification, nomenclature, structure, stability, aromaticity; 5-membered and 6-membered rings containing one heteroatom – pyrrole, furan, thiophene, and pyridine – synthesis, reactions with electrophiles, nucleophiles, and free radicals.

Spectroscopic techniques - Basic concepts, general principles in electronic and infrared spectroscopy, group frequencies, electronic spectroscopy of conjugated molecules, Woodward-Fieser Rule. Introduction to NMR spectroscopy - Fundamentals of 1H and 13C NMR, chemical shifts and factors influencing them; Spin-spin coupling and coupling constant, Anisotropic effects. Structure elucidation of organic molecules using spectroscopic techniques.

Basic principles of mass spectrometry - ionization methods, introduction to soft ionization techniques, ESI- MS, isotope abundance, high- resolution MS, molecular ions, fragmentation processes of organic molecules and their applications in structural elucidations.

References:

1. K. Williams, Organic Spectroscopy, 3rd Edition, Indian Edition, MacMillan, 2019.
2. B. G. Davis and A. J Fairbanks, Carbohydrate Chemistry, Oxford Chemistry Primer, Oxford University Press, 2002.
3. P. S. Kalsi, Spectroscopy of Organic Compounds, 7th Edition, New Age International Pvt. Ltd., 2016.
4. T. W. H. Solomons, C. B. Fryhle and S. A. Snyder, Organic Chemistry, 12th Edition, Wiley, 2016.
5. J. Clayden, N. Greeves and S. Warren, Organic Chemistry, 2nd Edition, Oxford Publisher, 2014.

CH3601E – Major Project

Pre-requisites: Nil

Total Lecture Sessions: Nil

Course Outcomes:

CO1: Identify a domain specific and contemporary topic.
CO2: Review literature to identify gaps and define objectives & scope of the work.
CO3: Develop a prototype/model, experimental set-up or software systems to meet the

objectives
CO4: Analyze the results to draw valid conclusions

Description:
Students are expected to choose real-world contemporary problem and apply the engineering principles learned, to solve the problem through building prototypes or simulations or writing codes or establishing processes/synthesis/correlations etc. The department constituted panel will decide the suitability and worthiness of the project.

The students are required to submit a report showing that plagiarism is within 20%. The B.Tech. Project work will be evaluated for 100 marks, with the following weightages:

Component	Weightage
Periodic evaluation by Guide	40 marks
Mid-term review	20 marks
End Semester viva-voce examination	40 marks
Total	100 marks

The midterm review and the end semester viva-voce examination will be conducted by a committee constituted by the Head of the Department. If the performance of a student is not satisfactory, he/ she can be awarded 'F' grade. Such a student will be given a maximum time of three months to improve his/her performance. If the performance of such a student is not satisfactory even after the extended time period, he/ she will have to repeat the project work in the next academic year.

Evaluation Criteria:
The student will be evaluated by the panel based on the below criteria. Weightage for each criterion will be determined by the panel and will be informed to the students.

Criteria	Description	Weightage
I	Selection of Topic	10
II	Literature Survey	10
III	Objectives and Solution Methodology	20
IV	Performance of the Task and clarity on the work	40
V	Report Preparation	10
VI	Presentation and Response to questions	10

SEMESTER – VI

ED3603E Assessment and Evaluation

Pre-requisites: Nil

Total Lecture Sessions: 26

L	T	P	C
2	0	0	2

Course Outcomes:

CO1: Explain the importance of assessment in education and understand different forms of assessment. CO2: Select and implement students with diverse assessment approaches to comprehensively evaluate students' performance.

CO3: Select and implement various tools and techniques to evaluate attitudes, interests, social, and personal behavior, with a focus on fostering self-assessment and peer assessment.

CO4: Perform suitable technique of analysis of the students' performance scores and provide a constructive feedback.

Assessment in Education: Meaning and significance of assessment and evaluation in educational field, Conceptual Clarity and purpose of Measurement, Assessment, Examination, Appraisal and Evaluation in Education, Learning outcomes across the stages and assessment, revised taxonomy of Objectives and Implications, Forms of Assessment: Formative, Summative, diagnostic, prognostic, Internal and External assessment, Assessment for learning, Assessment of learning and Assessment as learning

Process of Assessment and Evaluation: Formative and Summative Assessment: Concept and Characteristics, Approaches to assess and evaluate student performance such as time-constrained examinations; closed/open-book tests; problem-based assignments; practical assignment reports; observation of practical skills; individual and group project reports; oral presentations; viva-voce interviews; computerized adaptive testing; online assessment. Assessing Higher Order Thinking Abilities: Problem solving, critical thinking, creative thinking, communication skills, judgement and decision making, ethical and moral reasoning, Tools and Techniques: Observation, rating scale, check list, anecdotes, interviews, Assessment of attitudes and interests, Socio-metric techniques, Criteria for assessment of social and personal behavior,

Analysis and Interpretation: Analysis of students' performance and scores, credit and grading, Graphical representation- Histogram, Frequency Curve, Interpretation of student's performance based on the analysis, constructive feedback, reporting student's performance, 360-degree progress reports, cumulative records and their uses, portfolios, PTA meetings, qualitative reporting based on the observations, descriptive indicators in report-cards.

References:

1. R. N. Patel, Educational Evaluation: Theory and Practice, Himalaya Publishing House, 2013

2. J. C. Aggarwal, Essentials of Examination System: Evaluation, Tests and Measurement, Vikas Publishing House Pvt. Ltd, 2006.

3. Tom Diamond, Mark Sanders, Reference Assessment and Evaluation, Routledge, 2008

4. M. David Miller, Robert L. Linn, and Norman Gronlund, Measurement and Assessment in Teaching, 11th edition, Pearson, 2012.

5. E. G. Norman, How to Make Achievement Tests and Assessments., 5th edition, Allyn& Bacon, 1992. 6. E. G. Norman, How to Write and Use Instructional Objectives, 6th edition, Pearson, 1999

7. R. L. Ebel, D. A. Frisbie, Essentials of Educational Measurement. 5th Edition, Prentice-Hall, 1991.

ED3602E Major Pedagogy-II (Physical Sciences)

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
2	0	0	2

Course Outcomes:

CO1: Formulate objectives based on learning outcomes for science teaching

CO2: Develop unit plans and lessons plans that are suitable for a constructivist teaching learning of various topics in science

CO3: Explain various technological tools for teaching and learning of science and integrate technology judiciously to facilitate teaching learning

CO4: Determine role of teacher in facilitating learning by selecting suitable learning materials, and judiciously using it for teaching various topics in science

CO4: Design and develop innovative strategies and techniques for successful in teaching andlearning science

An analysis of content taking examples from topics of physical sciences textbooks at secondary stage (facts, concepts, laws, theories), identification of concepts, content analysis, listing learning outcomes and competencies, learning objectives and action verbs, learning as a behavioral change. Revised Bloom's Taxonomy, learning objective of physical science, Meaning of learning objectives, Developing learning objectives, contents, Anderson and Krathwohl's taxonomy, Writing learning objectives, Illustrations on learning objectives for secondary and higher secondary stages. Learning objectives in the constructivist perspective, Planning for Teaching-learning of physical science, planning in teaching, concept, and importance of planning, unit plan, developing unit plans of the selected topics from textbooks of physical sciences at secondary stage, lesson planning, concept, types and importance of lesson planning, various types, 5E and 7E models of lesson planning, Elements of a physical science lesson, Making groups, Planning and organizing activities in physical science, Planning laboratory work, developing lesson plans of the selected topics from textbooks of physical sciences at secondary stage

Teaching learning aids/materials: concept, definition, role and importance in classroom teaching learning the physical sciences, Dale's cone of experiences, Types of teaching learning aids/ materials, Identification and use of learning resources in physical sciences from the local environment, Print and ICT Resources in Learning Physical Science, Print resources, Different forms of ICT and its application in science education Using and selecting appropriate media, Skills to be developed in students in interconnected world, Social networking sites and their use in education Integrating ICT in teaching learning process: An example, Scope and importance of ICT in physical sciences, Community Resources, Using community resources Pooling of learning resources Improvisation of apparatus, Handling hurdles in utilization of resources, Some inexpensive sources of chemicals, Science kits, Laboratory as a learning resource, Importing process skills through laboratory activities, Basic and advanced process skills, Importance of experiments in science teaching learning, Designing and developing a laboratory, Safety aspects in a physical science laboratory, Assessment of laboratory work

Tools and Techniques of Assessment for Learning Physical Science, Test, examination, measurement, assessment and evaluation, Need for the assessment and importance of the assessment in the teaching learning process, formative and summative assessment, formal, informal assessments, Assessment based on learning outcomes, Continuous and Comprehensive Evaluation (CCE), strategies for continuous assessment, qualitative assessment, 3600 assessment, Performance assessment: assessment of group activities, creating platform and portfolio management, assessment of assignments, projects, and

presentations, Tools and techniques of assessment and evaluation - unit test based on Table of Specification (TOS) and its importance, basic steps of question paper setting, blue print, types of test items, preparing answer key, criteria for assessment, Assessment framework, Assessment of learning of students with special needs.
Qualities of a Physical Science teacher as professional for enhancing teaching learningskills, Lifelong learning in physical science, Developing lifelong learning attributes through teaching- learning of science, Professional Development of Physical Science Teachers Teaching as a profession, Difference between occupation and profession, pre-service professional development programmes, in-service professional development programmes, Reflective practices in professional development, Teacher as a Researcher, Recent trends in research related to teaching learning of Physical Sciences, Action research vs. research, Need and importance of 21st century skills for learners and teachers of physical sciences.

References:

1. Pedagogy of Physical Science, Text book for B.Ed, Part I, NCERT
2. Pedagogy of Physical Science, Text book for B.Ed, Part II, NCERT
3. National Curriculum Framework 2005, NCERT, New Delhi
4. Steve Alsop, Keith Hicks, Teaching Science: A Handbook for Primary and Secondary School
Teachers, Kogan Page, 2007.
5. Judith Bennett, Teaching and Learning Science: A guide to recent research and its applications,
Continuum, 2003.
6. Robin Millar, Doing Science: Images of Science in Science Education, The Falmer Press, 1984. 7. State Textbook in Physics and Chemistry for classes VIII, IX and X.
8. Nathan S Washton, Teaching Science Creatively, Saunders Company, 1967. 9. History of Physics in the 20th Century, Internet Browsing
10. D J Novak, D Bob Gowin, Learning how to learn, Press Syndicate of the University of Cambridge, Ohio 1111984
11. Carin A, B R Sund, Teaching Science through Discovery, Charles E. Merrill Books Inc., 1964
12. Columbus Ohio II, Ralph Martin, Colleen Sexton, Kay Wagner, Jack Gerlovich, Science for All Children: Methods for Constructing Understanding, Allyn and Bacon, 2000
13. School Science Review, The Association for School Education, College Lane, Hatfield, Hertfordshire, AL 109 AA, UK.
14. Physics Education, Institute of Physics Publishing, Dirac House, Temple Block, Bristol BS1 6BE,
UK
15. Physics Teacher, American Association of Physics Teachers, Department of Physics and Astronomy, University of Maryland
16. Kamala Mukunda., What did you ask at school today? A Handbook on Child Learning, 2009

ED3603E Inclusive Education

L	T	P	C
2	0	0	2

Pre-requisites: Nil

Total Lecture Sessions: 28

Course Outcomes:

CO1: Understand various terms and phrases associated with Inclusive Education and create an inclusive learning environment.
CO2: Understand the paradigm shift in Inclusive education and analyse related policies and acts in India and abroad.
CO3: Identify the diverse learning needs of students with disabilities and children belonging to marginalized groups and adapt suitable teaching learning processes.
CO4: Identify the pedagogical issues in connection with children with special needs and design and implement suitable ways to address them.

Inclusion and Education: Various terms and phrases associated with Inclusive Education: Integrated Education, Special Education, Impairment and Disability, Assessment and Evaluation, Curriculum adaptation, modification and differentiation, universal design of learning, shifting from Disability to the Inclusive view, Shifting Paradigms from Bio centric to Human Rights, Introductory reference of Policies/Acts with reference to educational implications for Children with Disabilities: Right to Education Act- 2009/ 2012, RPWD Act- 2016, UNCRPD- 2006, National Trust Act- 1999, National Educational Policy -2020.
Children with Disabilities and Marginalized Groups: Nature and needs of children with sensory impairments: cognitive impairments and intellectual disability, physical disabilities, cerebral palsy, multiple disabilities, Specific needs of children with behavioral, emotional learning disabilities, Health Problems, Educational needs of children belonging to Marginalized Groups.
Pedagogical Issues: The specific needs of Children with various disabilities, meeting the challenge of providing equal opportunities in classroom teaching learning process, arts, sports, and vocation-related activities, making the school buildings and compounds barrier free and accessible, Provision for supporting learning activities and resources for individualized learning environment, Need for and ways to implement assistive devices and technology-based tools, language-appropriate teaching-learning materials, suitable assessment strategies.

Reference:

1. M. Ainscow, T. Booth, Index for Inclusion: Developing Learning and Participation in Schools, Bristol: CSIE, 2002.
2. M. Ainscow, A. Dyson,T. Booth, Improving Schools, Developing Inclusion, Routledge, 2006.
3. M. Alur, M. Bach, The Journey for Inclusive Education in the Indian Sub- Continent, Vol. 23, Routledge, 2009.
4. A. C. Armstrong, D. Armstrong, I. Spandagou, Inclusive Education, International Policy & Practice, Sage, 2009.
5. D. Mitchell,D. Sutherland, What Really Works in Special and Inclusive Education: Using Evidence Based Teaching Strategies, Routledge, 2020.
6. S. J. Pijl, C. J. Meijer, S. Hegarty,(Eds.), Inclusive Education: A Global Agenda, Psychology Press, 1997.
7. M. Puri, G. Abraham, (Eds.) Handbook of Inclusive Education for Educators, Administrators and Planners: Within Walls, Without Boundaries, Sage, 2004.

S. Geetha Gopinath, Hemalatha, Diversifying teaching: New Era of Inclusive Education. Authors press, 2020

ED3691E Mathematical and Quantitative Reasoning

Pre-requisites: Nil

L	T	P	C
1	1	0	2

Total Lecture Sessions: 13

Course Outcomes:

CO1: Adapt mathematical reasoning to solve problems in the real world and explain the fundamental ideas and tenets in this field.

CO2: Interpret & deduce the right conclusions from numerical representations like formulas, graphs, or tables.

CO3: Demonstrate critical thinking and problem-solving skills using mathematical and quantitative reasoning methods.

CO4: Analyze mathematical, quantitative and reasoning problems and evaluate the solutions.

Introduction to mathematical and quantitative reasoning: Meaning, nature and scope of mathematical and quantitative reasoning. Importance of mathematical and quantitative reasoning in various fields. Types of quantitative reasoning. Usage of mathematical and quantitative reasoning. Concept of mathematization.

Introduction to data in Education: Data requirement, different sources of data. School enrolment: gross enrolment ratios, net enrolment ratios, educational progression: dropout rate, literacy: measures of literacy, Indian censuses, details of different items on which Indian censuses collect data, Nationwide sample surveys, National family health survey, District level household survey, UDISE.

Data Analysis & Interpretation: Concept of data interpretation (equation, diagram, graph, tables). Statistical analysis of data in educational context and its applications (measures of central tendency, measures of variability, percentile). Visual and numerical representation of data and its application (bar diagram, histogram, pie charts). Learning analytics: concept, significance, types, levels, and its applications in educational context.

References:

1. H. S Bhatia, Ageing and Society, The Arya's Book Centre Publishers, 1983
2. A. Bhende, T. Kanitkar, Principles of Population Studies, Himalaya Publishing House, 2019
3. D. Bogue, Principles of Demography, John Wiley and Sons, 1969
4. Heer, David, Society and Population, Prentice-Hall, 1975
5. P. Krishnan, K. Mahadevan, Elderly Population Today: Policies Problems and Prospects, B. R. Publishing House, 2006

ED3604E School Observation

Pre-requisites: Nil

L	T	P	C
0	0	4	2

Total Lecture Sessions: Nil

Course Outcomes:
CO1: describe various schooling systems,
CO2: describe the processes, practices, and overall environment of the school,
CO3: establish rapport with the stakeholders of the school system state the process of conducting different activities in the school,
CO4: describe the available school infrastructure (classrooms, libraries, laboratories, playground, sanitation, drinking water facility, mid-day meal facility, inclusive facilities, safety and security, rainwater harvesting),
CO5: describe the availability and usage of ICT and TLMs,
CO6: summarise the available documents in both physical and digital modes, including UDISE data,
CO7: reflect upon relationships among the stakeholders,
CO8: analyse various assessment processes adopted in different types of schools,
CO9: prepare and present a comprehensive profile of the schools observed (including classroom processes).

Syllabus:
As school is the heart of the teacher education programme, the student teachers need to gain hands-on experiences from various activities organized by the school. School observation offers an opportunity to learn the processes and practices in a school setup. To expose the student teachers to various schooling systems (urban, rural, tribal, residential, non-residential, government, private, affiliated to different school boards like Central Board, State Board, International Board) prevailing in the country. School observation will also prepare the student teachers to build relationships with various stakeholders. The school observation by the student teachers is aimed at helping them build perspective in the schooling system, student needs, pedagogies, and assessment.
The school observation as a field-based activity will cover observation of school and classroom processes. The student teachers under the mentorship of teacher educators will visit schools, interact with teachers and students and other stakeholders, and relate the observation with the courses studied during the previous semesters, i.e. Foundations of Education, Disciplinary Courses, Pedagogy courses and Ability Enhancement & Value-Added Courses.
• Meaning and Nature of school observation process
• Difference between monitoring and observation
• Theory and practices of school observation components such as:
1. Schooling system
2. Rapport with all the stakeholders
3. Office management procedures of different types of schools
4. School environment in all perspectives
5. Process of conducting curricular activities in the schooling process
6. Existing infrastructure available in the school
7. Utility of ICT and TLM facilities

8. Interpersonal relationships among the stakeholders.
9. Various assessment processes adopted in different types of schools.
10. Engagement of parents and other community members in school activities

Activities to be conducted.

- Visit three types of secondary schools with observation formats developed in the institute and get acquainted with various schooling systems. Establish rapport with all stakeholders.
- Collect information about the demography of students in classes IX to XII and understand the linkage of the secondary stage with the middle stage and higher education through interaction with teachers, students and staff.
- Observe school processes and transactions of the curriculum through experiential learning and prepare a report.
- Interact with teachers and students and report on implementing ten bag-less days and internship opportunities to learn vocational subjects.
- Study the available opportunities for learning interdisciplinary subjects.
- Observe the availability and usage of library resources, laboratories (Atal Tinkering Lab, Physics, Chemistry, Biology, Mathematics, Languages, Social Science, Computer), sports facilities, and art and music learning facilities.
- Study the provision of other student support services- guidance and counselling, NCC, NSS, health and wellness programmes.
- Observe the organisation of various activities like classroom teaching-learning processes, laboratory activities, library activities, sports and games, debate-elocution/essay writing and other competitions.
- Interact with School heads and subject teachers to understand how students are evaluated by following different tools and techniques of evaluation, how examinations are conducted, how answers are assessed, and how the result is communicated to parents in at least two different types of schools.

Assessment

Competence/Artifact	Method of assessment	Assessed By	Credits
Involvement and active participation during the school visit	Observations	Teacher Educator	0.5
Comprehensive school profile	Presentation & reflection	Teacher-Educator	1.5

Components for school observation report

- School information (Context, Vision and Mission, Association with the Board)
- School Infrastructure
- Provision for CWSN/Divyang Childre
- Inclusiveness at all levels
- Teacher-Student Ratio
- Teaching-Learning process
  - Academic plan
  - Classroom activities
  - Assessment
- School Development Plan (SDP
- Academic Calendar

- Administrative processes
  - Maintenance of students' records
  - Maintenance of teachers' records
- Cultural activities
- Sports activities
- Annual Day
- National and Social functions
- School Management
- School Discipline
- Interpersonal Relationships
- Understanding different types (socio-economic status, ability) of students and their needs
- Development of ICT and TLMs
- Engagement of parents and community members in the school activity
- Office Management
- The assessment process includes provisions and practices for 360-degree holistic assessment.
- The overall progress of the school (planning, organizing, staffing, directing, motivating and controlling)
- Challenges faced and overcoming them.

Major Electives

CH3601E Solid State Chemistry

Pre-requisites: Nil

L	T	P	C
3	1	0	4

Total Lecture Sessions: 52

Course Outcomes:

CO1: Able to explain the basics of various crystalline solids and their characteristics CO2: Relate the structure materials with its properties

CO3: Understand and analyze the structure-function correlations in materials

Crystal structure-reciprocal lattice - Ewald construction - structure factor - systematic absences - crystal structure solution and refinement - common crystal structure motifs, idea of quasicrystals, Thermal properties - lattice vibrations, phonon spectrum, lattice heat capacity, thermal expansion, thermal conductivity, Preparation method - solid state reaction, precipitative reactions, sol-gel route, precursor method, ion exchange reactions, intercalation / deintercalation reactions, glasses and thin film preparation, Amorphous materials - glasses and refractories Thermal analysis, microscopy and spectroscopy as tools of characterization.

Optical properties- optical reflectance, plasmon frequency, Raman scattering in crystals, photoconduction, photo and electroluminescence, Lasers, Photovoltaic and photoelectrochemical effects. Magnetic properties- classification of magnetic materials, Langevin diamagnetism, Quantum theory of paramagnetism, cooperative phenomena - ferro, antiferro and ferrimagnetism - magnetic domains and hysteresis, superparamagnetism.

High TC materials - Defect perovskites, High TC superconductivity in cuprates, Preparation and characterisation of 1-2-3 and 2-1-4 materials, normal state properties – anisotropy, Applications, Thin films -preparation techniques - evaporation/sputtering, chemical processes, sol-gel, Langmuir-Blodgett technique, Molecular materials -molecular semiconductors and metals, organic superconductors, molecular magnetic materials - single molecule magnets, Fullerenes - doped fullerene superconductors, Nanomaterials- Preparation techniques, Scanning probe and electron microscopy, Novel physical phenomena in the nano domain – size effects, electronic, photonic, magnetic and catalytic applications, nanocomposites, Carbon nanotubes, Graphene, Molecular nanomaterials.

Polymers-molecular shape, structure and configuration, crystallinity, mechanical properties - stress- strain behaviour, Thermal behaviour - glass transition, Polymer types and their applications, Conducting, luminescent and ferroelectric polymers, liquid crystals-mesomorphic behaviour - thermotropic and lyotropic phases, ordering in liquid crystals – the director field and order parameters, nematic and smectic phases - phase transitions, Chiral nematics - cholesteric-nematic transition - optical properties - twisted nematic effect, structure-phase relations.

Reference:

1. L.V. Azaroff, Introduction to Solids, Mc Graw Hill, New York, 1960.
2. A.K. Galwey, Chemistry of Solids, Chapmann and Hall, London, 1967.

3. N.B. Hanna, Solid State Chemistry, Prentice Hall, New Delhi, 1988.
4. A.R. West, Basic Solid State Chemistry, John Wiley and Sons, New York, 1984.
5. W. D. Callister Jr. and D. G. Rethwisch, Materials Science and Engineering-An Introduction, Wiley, 2006.
6. H. V. Keer, Principles of the Solid State, New Age International Private Limited, 2017.
7. L. E. Smart and E. A. Moore, Solid State Chemistry: An Introduction, CRC Press, 2012
8. K. J. Klabunde, Nanoscale Materials in Chemistry, Wiley–Blackwell, 2001

CH3002E Fundamentals of Biochemistry

Pre-requisites: NIL

L	T	P	C
3	1	0	4

Total Lecture Sessions: 52

Course Outcomes:

CO1: Students should be able to apply the basic principles of biochemistry to real-life problems.

CO2: Students must be able to comprehend the biochemical transformation through the principle of organic chemistry.

CO3: Students should be able to demonstrate the link between chemical reactions and biological processes.

Protein structure and functions: amino acids, peptides; primary, secondary, tertiary and quarternary structure of proteins; Enzymes: basic concepts, structure, functions, kinetics, and catalysis.

Structure and functions of nucleic acids: nucleosides, nucleotides; the basic structure of DNA and RNA, DNA replication, recombination and repair, RNA synthesis, processing and modification.

The flow of genetic information: from genes to proteins, transcription, translation, splicing and post- translational modifications.

Carbohydrates: monosaccharides, disaccharides, and polysaccharides, glycoproteins; their structure- function relationship; lipids: structural lipids, storage lipids, physiological significance, bioenergetics; an overview of metabolism and metabolic pathways: representative examples.

Reference:

1. R. H. Garrett and C. M. Grisham, Biochemistry, 6th edition, Brooks/Cole, 2016.

2. D. L. Nelson and M. M. Cox, Lehninger Principles of Biochemistry, 7th Edition, WH Freeman, 2017.

3. J. M. Berg, J. L. Tymoczko and L. Stryer, Biochemistry, 6th edition, WH Freeman, 2007.

4. R. K. Murray, D. A. Bender, K. M. Botham, P. J. Kennelly, V. W. Rodwell and P. A. Weil, Harper's Illustrated Biochemistry, 29th Edition, McGraw Hill, 2012.

CH3603E: Surface Chemistry

Pre-requisites: NIL
Total Lecture Sessions: 52

L	T	P	C
3	1	0	4

Course Outcomes:

CO-1: Basic knowledge of liquid state, gaseous state and boiling point
CO-2: Identify surface chemistry in chemical reactions
CO-3: Understand the theory, predictions and mechanisms for industrially relevant chemical reactions

Introduction and Definition. Liquid state, Features of solid, liquid and gaseous state, Internal pressure and vapour pressure of liquids, variation of boiling point with external pressure. Clausius and Clausius- Clapeyron equation. Surface Tension, Work of cohesion, work of adhesion and condition for spreading, Excess pressure. Formation of bubbles, Vapour pressure over a curved surface. Kelvin equation, Capillarity, Water in U-tube, Measurement and temperature dependence of surface tension.

Surface Activity and Surfactant Structures. Structural Requirements for Surface Activity, Surfactant Structures, Classification, Building Blocks, Surfactant Solubilizing Groups, Economic Importance of Surfactants, Biodegradation of Surfactants. Chemical and Physical Interactions, Coulombic or Electrostatic Interactions, Dipole–Dipole Interactions, Dipole-Induced Dipole Interactions. The London–van der Waals (Dispersion) Force, Interactions between Surfaces and Particles, Dipole, Induced Dipole, and Hydrogen Bonding (Acid–Base) Interactions at Interfaces.

Adsorption. Adsorption, Sorption, Adsorbent and Adsorbate, Difference between adsorption and absorption, Different types of adsorption: Physisorption, Chemisorption, Adsorption of gas on solid surface, Freundlich, Langmuir and BET adsorption isotherm. Determination of surface area of adsorbent. Isosteric heat of adsorption, Adsorption of solid on liquid surface. Gibbs adsorption isotherm. Gibbs Surface Excess. Chemisorption and Heterogeneous Catalysis.

Colloid. Physical properties of colloidal solutions, Preparation and Purifications of colloids, Classification of colloidal systems, Properties of lyophobic and lyophilic colloids. Application of colloids. Gel and Gelation, Emulsions, Classification of Emulsifiers and Stabilizers, Emulsion Formation and Stability, Hydrophile–Lipophile Balance (HLB), Foams, Foam Formation & Stability, Aerosols, Colloidal Interactions in Aerosols, Mists, Fogs, Dust, Smoke. Solubilization, Micellar Catalysis and Microemulsions.

References:

1. A. W. Adamson and A. P. Gast, Physical Chemistry of Surfaces, Wiley, 1997.
2. H. -J. Butt, K. Graf and M. Kappl, Physics and Chemistry of Interfaces, Wiley-VCH, 2006.
3. G. A. Somorjai and Y. Li, Introduction to Surface Chemistry and Catalysis,2nd Edition, 2010.
4. P. C. Hiemenz and R. Rajagopalan, Principles of Colloid and Surface Chemistry, 3rd Edition, 2016.

CH3604E Basic Analytical Chemistry and Instrumental Methods

Pre-requisites: NIL
Total Lecture Sessions: 52

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Learning the appropriate separation, purification and analysis methods for various chemical compounds and their mixtures
CO2: Correlate the principles and methodologies of sophisticated instruments.
CO3: Detail the chemistry of biochemical and water quality analyses methods.

Lab safety protocols. Analytical methods for the separation and analysis of compounds, qualitative and quantitative analysis, theory of gravimetric analysis, gravimetric factor and calculations, solubility product, common ion effect, precipitation methods, inclusion, occlusion, coprecipitation and post- precipitation, solvent extraction - theory and applications, uses of crown ethers and oxine in extraction, electrophoretic methods, capillary electrophoresis.

Chromatography: Stationary and mobile phases, analyte, chromatograph, chromatogram, eluate, eluent and elution and mechanisms, retention volume, retention time, chromatographic performance, column chromatography, Ion exchange chromatography: action of cation and anion exchange resins, applications, size exclusion chromatography, theory and instrumentation of paper, thin layer, liquid and gas chromatography, gel permeation chromatography, high-performance liquid chromatography.

Theory, instrumentation and applications of spectrophotometry, fluorimetry, phosphorimetry, Atomic Absorption Spectroscopy, Scanning Electron Microscopy, Atomic Force Microscopy, Dynamic Light Scattering. Use of Dynamic Mechanical Analyser for material characterisation, Theory, instrumentation and applications of TG, DTA, and DSC, coulometry, amperometry, cyclic voltammetry, cathodic and anodic stripping analysis.
Radiochemical methods: carbon dating, neutron activation analysis, isotope dilution techniques, Estimation of biological fluids: haemoglobin, cholesterol and blood sugar, Water quality parameters, standards and analysis, Chemical pollutants analysis in water.

References:

1. D. A. Skoog, D. M. West, F. J. Holler and S. R. Crouch, Fundamentals of Analytical Chemistry,
Brooks/Cole, Florence, 2013.
2. G. D. Christian, Analytical Chemistry, 7th Edition, John Wiley & Sons, Singapore, 2013.
3. J. Mendham, R. C. Denney, J. D. Barnes, M. Thomas and B. Sivasankar, Vogel's Textbook of Quantitative Chemical Analysis, Pearson Education Ltd., New Delhi, 2009.
4. H. H. Willard, L. L. Merritt, J. A. Dean and F. A. Settle, Instrumental Methods of Analysis, Wadsworth
Publishing Company, Belmont, California, 2004.
5. D. Harvey, Modern Analytical Chemistry, McGraw Hill Higher Education, New York, 2000.

CH3605E: Chemistry of Multiple Bonds

Pre-requisites: NIL

Total Lecture Sessions: 52

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Students will be able to deliver methods for the formation of C-C double bonds.

CO2: Students will be able to propose methods for the functionalization of C-C double bonds.

CO3: Students will be able to apply the concepts of pericyclic and photochemical reactions for the synthesis of new molecules.

CO4: Students will be able to predict the product formation involving rearrangements.

Formation of C-C double bond: β-Elimination reactions, syn and anti -eliminations, fragmentation reactions, alkenes from hydrazones, alkenes from 1,2-diols, alkenes from alkynes, alkenes from sulfones.

Functionalization of alkenes: halogenation, epoxidation, halolactonization.

Asymmetric epoxidation, dihydroxylation, amino-hydroxylation,

Importance of asymmetric molecules in different fields, asymmetric synthesis: control of stereochemistry – chiral pool – chiral auxiliary – methods of asymmetric induction, determination of enantiomeric and diastereomeric excess- enantio-discrimination.

Condensation reactions: Aldol, Claisen, Dieckmann, Knoevenagel, Stobbe, Perkin, Rearrangement reactions: Wagner-Meerwein, Stevens, Sommelet-Hauser, Wittig, Favorskii, and Beckmann.

Pericyclic reactions: classification, Woodward Hoffmann rules, FMO analysis, orbital symmetry correlations and transition state aromaticity methods for electrocyclic, cycloaddition and sigmatropic reactions; pericyclic reactions in organic synthesis – Diels-Alder reactions, 1,3-dipolar additions, Cope, Claisen and Ireland-Claisen rearrangements; cheletropic, group transfer and ene reactions.

Photochemistry: Introduction to photochemistry and photochemical reactions: isomerization, Paterno- Buchi reaction, Norrish Type I, and Norrish Type II reactions.

References:

1. W. Carruthers and I. Coldham, Modern Methods of Organic Synthesis, 4th Edition, Cambridge
University Press, 2004.
2. R. Bruckner, Advanced Organic Chemistry: Reaction Mechanisms, 1st Edition, Academic Press,
California, USA, 2002.
3. F. A. Carey and R. J. Sundberg, Advanced Organic Chemistry, Part A: Structure and Mechanisms, 5th
Edition, Springer, Boston, USA, 2007.
4. J. J. Li, Name Reactions: A Collection of Detailed Mechanism and Synthetic Applications, 5th Edition,
Springer Nature, 2014.
5. S. Sankararaman, Pericyclic reactions – A Textbook: Reactions, Applications and Theory, Wiley-VCH,
Weinheim, Germany, 2005. 83
6. P. Klan and J. Wirz, Photochemistry of Organic Compounds: From Concepts to Practice, John Wiley
and Sons Ltd. 2009.

CH3606E Nuclear Chemistry

Pre-requisites: NIL

L	T	P	C
3	1	0	4

Total Lecture Sessions: 52

Course Outcomes:

CO1: Able to understand the nuclear structure, radioactivity, radioactive decay and growth, nuclear reactions, artificial radioactivity and applications of nuclear chemistry.

CO2: Identify and understand various nuclear reactions easily with modest notations.

CO3: Think innovatively and apply the knowledge in useful applications.

Nuclear structure: Composition of the nucleus, nuclear size, shape and density, theories of nuclear composition, magnetic and electric properties of the nucleus, nuclear spin and parity, and nuclear binding forces.

Measurement of radioactivity, radioactive decay and growth: Measurement of radioactivity, group displacement law, radioactive disintegration series, rate of disintegration, half-life, average life of radioactive elements, unit of radioactivity, nuclear decay, determination of decay constants, decay rates, types of nuclear decay.

Nuclear reactions-Bethe's notation of nuclear processes, types of nuclear reactions, nuclear fission, fission products, theory of nuclear fission, nuclear reactors, classification of reactors including power nuclear reactors, breeder reactor, and nuclear reactors in India.

Artificial radioactivity and applications of nuclear Chemistry-Discovery of artificial radioactivity, synthesis of trans-uranium elements, importance and applications of artificial radioactivity, production and separation of radioactive isotopes, radioactive tracers, applications of tracer element in medical, agriculture and analytical fields, age determination, isotopic dilution analysis, neutron activation analysis, biological effects of radiation, waste disposal and radiation protections.

References:

1. H. J. Arnikar, Essentials of Nuclear Chemistry, 2nd Edition, Wiley; New York, 1987.
2. U. N. Dash, Nuclear Chemistry for B.Sc and M.Sc students, S. Chand Publisher, 2008.
3. G. Choppin, J. Rydberg and J. O. Liljenzin, Radiochemistry and Nuclear Chemistry, 3rd edition, Elsevier, 2002.
4. W. D. Loveland, D. Morrissey and G. T. Seaborg, Modern Nuclear Chemistry, John Wiley & Sons,
2006
5. G. Friedlander, J. W. Kennedy, E. S. Macias and J. M. Miller, Nuclear and Radiochemistry, 3rd Edition,
John Wiley & Sons, 1981.

CH3607E Physical Methods In Inorganic Chemistry

Pre-requisites: NIL

Total Lecture Sessions: 52

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Understanding the principles and applications of different spectroscopic

CO2: Learning different spectroscopic techniques to solve the structure of metal complexes

CO3: Able to develop new metal complexes for different applications

Electronic Spectroscopy: Fundamentals of coordination chemistry, Electronic absorption spectra of transition metal complexes- microstates, term symbols, selection rules, prediction of electronic transitions, Orgel diagrams for octahedral, tetrahedral and square planar complexes, Evaluation of 10Dq and β for octahedral complexes of cobalt and nickel, applications to simple coordination compounds, charge transfer spectra, electronic spectra of trisdiimmineometal(II) complexes, Jahn Teller effect in high spin d4 and d9 ions.

Infrared and Raman Spectroscopy: Basic concepts, group vibrations and the limitations-combined uses of IR and Raman Spectroscopy in the structural elucidation of simple molecules, effect of coordination on ligand vibrations – uses of groups vibrations in the structural elucidation of metal complexes, Effect of isotopic substitution on the vibrational spectra of molecules – vibrational spectra of metal carbonyls concerning the nature of bonding, geometry and number of C-O stretching vibrations (group theoretical treatment). Applications of Raman Spectroscopy – Resonance Raman Spectroscopy.

NMR Spectroscopy: Basic principles of NMR experiment, resonance, spectral parameters-chemical shift, nuclear shielding, spin-spin coupling, origin of coupling, coupling constants, determination of magnetism for transition metal complexes, Dia- and paramagnetic NMR spectra of transition metal complexes.

EPR Spectroscopy: Introduction to EPR/ESR, comparison between NMR and EPR, g factor, electron- nuclear interactions, hyperfine and super hyperfine interactions, spin-spin and spin-lattice relaxations, hyperfine and g anisotropy, zero-field splitting and Kramers degeneracy – Spectra of inorganic complexes with first-row transition metals.

Mössbauer Spectroscopy: Principles, recoil energy, isomer shifts, quadrupole splitting, applications to iron, nickel and tin compounds.

References

1. R. S. Drago, Physical Methods in Inorganic Chemistry, Van Nostrand Reinhold Inc., 1965.
2. R. S. Drago, Physical Methods for Chemistry, 2nd Edition, Saunders College Publishing, 1992.
3. A. B. P. Lever, Inorganic Electronic Spectroscopy, 2nd Sub Edition, Elsevier Science, 1986.
4. D. N. Satyanarayana, Electronic Absorption Spectroscopy, Universities Press, 2000.
5. J. E. Huheey, E. A. Keiter, R. L. Keiter and O. K. Medhi, Inorganic Chemistry –Principles of Structure and Reactivity, 4th Edition, Pearson Education India, 2006.
6. A. K. Das and M. Das, Fundamental concepts of Inorganic Chemistry, 1st Edition, Volume 7, CBS Publishers & Distributors Pvt Ltd., 2014.
7. G. Wulfsberg, Inorganic Chemistry, University Science Books, 2000.
8. K. Nakamoto, Infrared and Raman Spectra of Inorganic and Coordination Compounds, Part B: Applications in Coordination, Organometallic, and Bioinorganic Chemistry, 5th Edition, Wiley Interscience, 1997.
9. E. I. Solomon and A. B. P. Lever, Inorganic Electronic Structure and Spectroscopy, Volume 2 Applications and Case Studies, Wiley-Interscience, 2006.
10. S. F. A. Kettle, Physical Inorganic Chemistry: A Coordination Chemistry Approach, Spectrum

Academic Publishers, Oxford University Press, 1996.

CH3408E: Bioinorganic Chemistry

Pre-requisites: NIL

Total Lecture Sessions: 42

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Understanding the toxicity of certain metal ions.

CO2: Learn the applications of metal ions in biological systems

CO3: Understanding the structure and functions of metalloenzymes

Essential elements in nature, occurrence and its biological roles. Thermodynamic and Kinetic factors of the metal ions. Naturally occurring ligands and their metal binding sites. Proteins, enzymes, cofactors. Principles of coordination chemistry related to bioinorganic chemistry.

Uptake and storage of metal ions (Fe and Cu). Na+/K+-pump and channels. O_2 binding properties of heme and non-heme proteins, their coordination geometry and electronic structure, co-operativity effect, Hill coefficient and Bohr Effect. electron-transfer proteins (cytochromes, Fe-S systems, Cu systems). Activation of O2 by cytochrome P450.

Photosynthesis, chlorophylls, Zn-containing systems (alcohol dehydrogenase, carbonic anhydrase, carboxypeptidase, Zn finger, phosphate transfer systems). N2-fixation and the nitrogen cycle. Co (vitamin B12), Ni enzymes, superoxide dismutase.

Heavy metals in the biosphere, medicinal inorganic chemistry. Metals in medicine: metal-based probes for medical diagnostic. Therapeutic pharmaceuticals; Biomimetic catalysis: artificial metalloenzymes.

References:

1. I. Bertini, H. B. Gray, S. J. Lippard and J. S. Valentine, Bioinorganic Chemistry, University Science
Books, 1994.

2. S. J. Lippard and J. M. Berg, Principles of Bioinorganic Chemistry, University Science Books, 1994.

3. W. Kaim and B. Schwederski, Bioinorganic Chemistry: Inorganic Elements in the Chemistry of Life – An Introduction and Guide, John Wiley & Sons, 1994.

4. R. M. Roat-Malone, Bioinorganic Chemistry – A Short Course, 2nd Edition, John Wiley & Sons,
Inc., Hoboken, New Jersey, 2007.

6. L. Que, Physical Methods in Bioinorganic Chemistry: Spectroscopy and Magnetism, University
Science Books, 2000.

SEMESTER – VII

ED4701E Perspectives on School Leadership and Management

Pre-requisites: Nil

Total Lecture Sessions:26

L	T	P	C
2	0	0	2

Course Outcomes:

CO1: Analyse the diversity of schools and develop a comprehensive understanding of the educational landscape of India

CO2: Explain the concept of school leadership and its various aspects.

CO3: Apply The principles of educational leadership in different contexts.

CO4: Develop the culture of evidence-based decision-making that helps to promote collaboration, teamwork, and cooperation among stakeholders.

Understanding School Leadership:

School Leadership: Definition and practice, Being a School Leader: exploring the multiple roles and responsibilities, issues and challenges of school leadership in the Indian context, best practices on School leadership at National and International levels.

Schools as Learning Organizations: Role of School Leadership:

Schools as motivating learning spaces: Developing inspiring school ethos, Schools as learning organization: promoting personal mastery, examining mental models, and developing a shared vision, team learning and a system's thinking perspective, Development of a shared vision and shaping of the school culture. Use of data for school improvement focused on students' learning, addressing equity challenges, and building an equitable school culture that promotes excellence for all, Nurturing school belongingness: engaging students, teachers, staff, parents, School management committees (SMC), and community in the formulation of a whole school development plan, Designing professional and collaborative learning opportunities for self and others (teachers, parents, and SMC members) and improving teaching and learning.

Reference:

1. T. A. Rank, A. D. Swanson, Fundamental Concepts of Educational Leadership and Management ,3rd
edition, 2010.
2. D. Lewis, N. Kanji, Non-governmental organizations and development, London and New York,
Routledge, 2009.
3. P. Drucker, J. Maciariello, (n.d.). 366 Days of Insight and Motivation for Getting the Right Things
Done, Rutledge.
4. Palgrave Macmillan, The Palgrave Handbook of Educational Leadership and Management Discourse,
2020.
5. E. Camburn, J. P. Spillane, J. Sebastian, Assessing the utility of a daily log for measuring principal
leadership practice, Educational Administration Quarterly, 46(5),707–737, 2010.
6. P. Gronn, Distributed properties: A new architecture for leadership. Educational Management and Administration, 28(3), 317–338, 2000.
7. J. Lumby, Distributed leadership: The uses and abuses of power. Educational Management Administration &. Leadership, 41(5), 581–597, 2013.

ED4702E Curriculum Planning and Development

Pre-requisites: Nil

L	T	P	C
2	0	0	2

Total Lecture Sessions: 26

Course Outcomes:

CO1: Identify the relative merits of different types of curriculums by developing an understanding of curriculum and its different types.

CO2: Explain the principles and stages of curriculum development and its relevance.

CO3: Familiarize with approaches to curriculum construction and identify ways of addressing societal concerns and learner needs.

CO4: Explain the ways of operationalizing a curriculum and appraise the specific role of teachers in it.

Education and Curriculum:

Meaning, need and significance, Types of Curriculum: subject-centered, activity-centered, environmental centered, community-centered, National Education Policy, National Curriculum Framework, State Curriculum framework-Syllabuses: NCERT/ State

Principles and stages of Curriculum development:

Basic principles: Personalization, Breadth, Relevance, Challenge and Enjoyment, Stages: Needs assessment, Planning session, Content development, Pilot delivery, Evaluation and Reporting, Finalizing the refined package.

Approaches to curriculum construction:

Curriculum planning as a cyclic process, Incorporating principles of Integration, Utility, Character formation, Flexibility, Creativity and Conservation, Addressing various aspects-socio-cultural aspects, environmental concerns, values, gender concerns, inclusiveness, technological advancement and impact of globalization.

Curriculum implementation and evaluation:

Process oriented, Learner-centred curriculum for different levels (Secondary and Higher Secondary), Role of State School Boards in implementation of curriculum, Role of teachers in operationalizing and evaluating the curriculum with special reference to: Course books, Teachers' Handbooks, Source books, Workbooks and Manuals, Learning resources, Audio Visuals and digital multimedia materials, Library, Laboratory, Playground, Neighborhood etc.

Reference:

1. Julie Dirksen, Design for How People Learn, 2nd Edition, Pearson, 2015.
2. Julie Harris Stern, Krista Ferraro, Kayla Duncan, Trevor Aleo, Learning That Transfers: Designing Curriculum for a Changing World, Corwin, 2021.
3. C. R. Kilbane, N. B. Milman, Teaching Models: Designing Instruction for 21st Century Learners, 1st Edition, Pearson, 2013.
4. Klien, Julie Thompson, Beyond Interdisciplinarity: Boundary Work, Communication, and Collaboration, Oxford University Press, 2021.
5. R. A. Reiser, J. V. Dempsey, Trends and Issues in Instructional Design and Technology, Pearson, 4th Edition, 2021
6. J. B. Short, Hirsh Stephanie. Transforming Teaching Through Curriculum- Based Professional Learning, Corwin, 2022.

ED4791E Art Education- Performing and Visual

Pre-requisites: Nil
Total Lecture Sessions: 13

L	T	P	C
1	0	2	2

Course Outcomes
CO1: Practice different forms of arts such as visual arts and performing Arts (Drama, Music, & dance).
CO2: Integrate different art forms in the teaching process.
CO3: Construct/design any type of drawing and painting/Drama script/craft on their own.

Visual Arts: Different materials of visual arts– Rangoli, pastels, posters, clay, paintings. Using different methods of visual arts- Paintings, block printing, clay modelling. Listening/viewing performing art forms of music, dance and theatre.
Performing arts in Drama: Drama as a medium of education- Identification of local performing art forms and their integration in teaching – learning. - Listening/viewing performing art skit, mime, one act play or theatre. Evaluation strategies; assessing the different forms of Art.
Fundamentals of Drawing and Painting: Concept and Types of drawing- Colours and Sketching- understanding of various masses and perspectives. Different forms of painting. Use of Drawing and Painting in Education -Chart making, Poster making, match-stick drawing and other forms. Model making – Clay modelling, Origami, Decorative – Rangoli, and any other local art.

References:
1. J. Dewey, Art as experience, Minton, 1934.
2. H. Read, Education through art, Faber and Faber, 1968.
3. E. W. Eisner, Educating artistic vision, Macmillan, 1972.
4. B. John, C. Yogin, R. Chawla, Playing for real: Using drama in the classroom, Macmillan, 2007.
5. B. Jefferson, Teaching art to children – Continental view point, Allyn Bacon, 1969.
6. R. Tagore, Lectures and addresses, Macmillan, 1962.
7. A. K. Coomaraswamy, Christian and oriental philosophy of art, Munshiram Manoharlal,1974.
8. Rupali Tripathi, Teaching of music, Mohit Publication, 2004.
9. B. N. Dash, Teacher and Education in the Emerging India Society (Vol. I & II), 2002. 10. Kalaimani Saraswathi, Bharata Natyakalai, Thirumagal Nilayam, 1994.

ED4792E Sports, Nutrition and Fitness

Pre-requisites: Nil
Total Lecture Sessions: 13

L	T	P	C
1	0	2	2

Course Outcomes

CO1: Explain the concept of holistic health, its various dimensions, and determinants. CO2: Sensitize the need and acquire the skills for physical fitness, learn correct postural habits and activities for its development.

CO3: Create interest for the practice of yogasana and meditations.

CO4: Carry out various ways of effective assessment of health and physical fitness.

Evolution of Health and Physical Education: Health and Physical Education: Conceptual Clarity (locally as well as globally), importance and aims, Place in School Curriculum: Historical Development as a subject, Objectives with special reference to Indian Education and its relationship with other subjects, Status of Health and Physical Education: From primary to secondary education in a global perspective, ayurvedic and yogic concept of Health Education, legal perspective of Health and Health Education in India.

Health Education: Concept, dimensions, and determinants of health with special focus on India, Psycho-social concerns of children and adolescents including differently abled children, Understanding the body system and its functions, Common health problems and diseases: causes, prevention and cure, immunization and first aid, Impact of Physical activities, games, sports and yoga on different body systems, Food and nutrition, nutrients and their functions.

Games and Fitness: Physical fitness and its components: athletics (general physical fitness exercises), games (lead-up games, relays, and major games), Rhythmic activities, gymnastics, and their impact on health, Development of physical fitness: Postures and Importance of relaxation, Fitness tests, Resources and services for games and sports and Health, Fundamentals skills of sports: Sports for recreation and competition, Sports awards and scholarships, sportsmanship, Indigenous and self-defense activities, School and family, health services, policies and major health and physical education- related programmes, blood banks, role of media, Safety and security, First Aid: Need and Principles.

Policies, Programmes and Assessment: Policies, programmes, and services for addressing health needs, School Health Programmes: school health services, health promoting schools, global school health initiatives, Yoga: Meaning, initiation, historicity, classification, streams, and schools of yoga, Need and importance and role of yoga for healthy life and living, Yoga as a Psychotherapy, POCSO (Protection of Children from Sexual Offences Act, 2012), PWD 2016, the Integrated Child Protection Scheme, Assessment of health performance testing in games and sports, reporting of health condition and performance of child in the sport fields.

References:

1. NCERT, Health And Physical Education, A Teachers' Guide for Class VIII, 2016.
2. Harold W. Kohl III and Heather D. Cook, (Ed.), Educating the Student Body: Taking Physical Activity andPhysical Education to School, Committee on Physical Activity and Physical Education in the School Environment, Food and Nutrition Board, Institute of Medicine, 2013.
3. Dean Dudley, Amanda Telford, Louisa Peralta, Claire Stonehouse, Matthew Winslade,

Teaching
Quality Health & Physical Education, 2nd edition, Cengage Learning, 2020

ED4703E School based Research Project

L	T	P	C
0	0	4	2

Pre-requisites: Nil

Total Lecture Sessions: Nil

Course Outcomes:

CO1: Present contextual problems, an appropriate research design and the plan of action for undertaking school-based research,

CO2: demonstrate the tools and techniques used for the collection of relevant data,

CO3: summarise the analysed data used to identify the causes,

CO4: demonstrate the interventions used for addressing the problems,

CO5: present the effectiveness of the intervention(s),

CO6: share the school-based research experiences through reports and presentation.

The student teachers during previous semesters have studied different courses in Foundations of Education, Disciplinary Courses, Stage-specific pedagogy courses, Ability Enhancement and Value Added Courses. The required knowledge of action research and case study includes- the concept and importance of action research/case study, the steps of conducting action research/case study (objectives, methods, research design, design tools, data collection, and data analysis) and report writing.

The research problem will be taken from the day-to-day teaching-learning process of the school. Some of the significant areas may cover:

- Learning progress and outcomes in different subjects
- School-based assessment
- Learners' diversity and inclusion
- Participation in arts, games, sports

Suggestive Mode of Transaction

The following strategies will be used during the school-based research project:

- Discussions with teacher educators, school head, mentors, and peers for identification of problem and development of intervention(s).
- Finalise the school-based research project proposal outline through discussion with mentor teachers/teacher educators.
- Document analysis, interaction with all stakeholders, and field visits.
- Sharing and presentation of the outcomes of school-based research.

ED4704E Internship in Teaching

Pre-requisites: Nil

Total Lecture Sessions: Nil

L	T	P	C
0	0	20	10

Course Outcomes:

CO1: explain the overall functioning of the school.

CO2: describe and appreciate the different roles played by a teacher in the school.

CO3: experience the importance of teacher-student relationships for effective teaching.

CO4: develop age-appropriate pedagogic skills.

CO5: use different pedagogies learnt in real-life classrooms.

CO6: create appropriate teaching-learning materials.

CO7: develop necessary planning and execution skills to conduct school activities (assembly, celebrations, cultural programmes).

CO8: express the school, teacher, parents, and community relationships.

CO9: create rapport with the stakeholders and understand their roles in the school system.

CO10: create student portfolios and comprehensive 360-degree (holistic) progress reports.

CO11: discuss the importance of maintaining different types of records in the school system.

CO12: develop research aptitude and ability to conduct action research for the situations/problems faced during their school internship experience.

Syllabus:

1. Pedagogies: different methods and strategies
2. Scheme of lessons
3. Peer lesson observation
4. Management of substitute classes
5. Various TLMs (including ICT tools) and their uses in teaching-learning
6. Achievement test
7. Diagnostic tests
8. Analysis of the result of the achievement test
9. Assembly activities
10. Action research and case studies.

Activities:

Student teachers are required to undertake the following stage specific activities:

1. Meet the subject-based mentors, collect timetables of classes IX to XII and develop a scheme of lessons from the syllabus to be covered during the internship.
2. Get acquainted with the school within 2-3 days. Observe classroom teaching of school teachers.
3. Plan and transact minimum 80 lessons (40+40), including 4 stray lessons (2+2). Stray lessons are class appropriate lessons on any topic(s) to be transacted by student teachers as per their convenience to build up confidence gradually. The last 5 lessons in each pedagogy course may be transacted using lesson notes.

- Lesson plans should include the components to develop critical and reflective thinking, problem-solving, differential learning, synthesis, and application of knowledge in real-life situations.
- Lesson plans must promote education for sustainability, including equity, environment, global citizenship, pride and rootedness in Indian knowledge systems and character building.

4. Participate in post-lesson discussions with peers, mentor(s) and teacher educators.
5. Observe peer lessons and discuss with the group.

6. Conduct laboratory activities (Atal Tinkering Lab, Physics, Chemistry, Biology, Mathematics, Languages, Social Science, Computer), sports, and arts and crafts activities.

7. Participate in student support services- guidance and counselling, NCC, NSS, health and wellness programme.

8. Create teaching-learning materials, including ICT tools for opted pedagogic courses.

9. Plan assessment, prepare material and formative and summative assessment tools, and analyse the results.

10. Prepare and conduct diagnostic tests to identify learning difficulties, analyse data and prepare learning enhancement plan.

11. Experience classes as a substitute teacher.

12. Participate in library functioning and literary activities.

13. Participate in teacher development and training activities.

14. Organise school assemblies and other events (cultural, sports, yoga, and other development activities).

15. Attend Parents-Teachers Association (PTA) meetings if held during the internship.

16. Attend School Management Committee (SMC) meeting if held during the internship.

17. Study the process of parent and community engagement for the school development programme.

18. Conduct action research /case study.

19. Prepare a sample student portfolio.

20. Write a reflective diary daily and prepare a report of each activity.

SEMESTER – VIII

ED4801E Philosophical and Sociological Perspectives of Education-II

Pre-requisites: Nil

Total Lecture Sessions: 52

L	T	P	C
4	0	0	4

Course Outcomes:

CO1: Identify the relationship between education and society, significance, and aims.

CO2: Explore the meaning, dimensions, and dynamics of social change, and examine the role of education in both facilitating and responding to these changes.

CO3: Examine the relationship between education and culture, emphasizing education as a socialization
process.

CO4: Analyse the impact of various factors on promoting social equality and equity within the educational framework.

CO5: Develop a comprehensive understanding of various types of values, including constitutional values,
and their significance within the educational context.

Education and Society: Conceptual clarity, relationship, significance and aims of studying the relationship between Education and society. Educational sociology and social perspective of education: meaning and functions. Education as a Social System. Conceptual clarity of society, social behaviour, status, institution, ideology, system, sub-system, socialization, social system, social values and norms, conflict, and modernization, Understanding the relation between individual and group behaviour with special reference to the context of education.

Education and Social Change: Meaning, relation, and dimensions of Social Change, Factors affecting Education and Social Change: technology, social and educational movements, curricular innovations, value conflicts, legal provisions, Constitution of India and Education, Education and Modernity, Role of education with reference to social change.

Education, Culture and Socialization: Relationship between Education and Culture, Education as a process of Socialization, Preservation of Culture through Educational Process, Social Welfare, Social Reform Movements, Legal interventions on Child Marriage, Child labor Act, Educational Policies and Acts, Adult Literacy, New Technology of communication, Equality, Constitutional Provisions and Education with special reference to Social Equality and Equity.

Education and Values: Conceptual Clarity, Relationship and Significance. Types of Values, Constitutional Values and its impact on Education, Human Rights and Values, Environment and Education, Pedagogical issues.

Reference:

1. P. Smeyers, International Handbook of Philosophy of Education. Springer, 2018.

2. R. Bailey, R. Barrow, D. Carr, C. McCarthy, (Eds.), The SAGE Handbook of Philosophy of Education. SAGE Publications, 2010.

3. H. Siegel (Ed.) The Oxford Handbook of Philosophy of Education. Oxford University Press, 2009.

4. J. C. Agarwal, Philosophical foundation of education, Shri Vinod Pustak Mandir, 2020.

5. A. S. Thakur, S. Berwal, Education in emerging Indian society. Vikash Publication, 2007.

6. H.K. Rawat, Sociology Basic Concepts. Rawat Publication, 2012.

7. C.N.S. Rao, (eds.). Sociology Principles of Sociology with an Introduction to Social Thought, S. Chand & Company Pvt. Ltd.

ED4802E Education Policy Analysis

Pre-requisites: Nil

Total Lecture Sessions: 26

L	T	P	C
2	0	0	2

Course Outcomes:

CO1: Explain the significance of various policies on education, and their uses.

CO2: Analyse educational policies since Indian independence and identify the modifications made from time to time.

CO3: Familiarize with the ways of implementing an educational policy and explain the challenges in implementation.

Planning an Educational Policy: Meaning and significance of 'Policy on Education', Purpose and Dimensions of an Educational Policy at local and Global level, Philosophical and Sociological Perspective of planning an Educational Policy, Historical development of Educational Policies in India, Basic steps involved in planning, Constitutional provision for Policy on Education, Fundamental principles for analyzing an Educational Policy.

Educational Policies in India: Critical analysis of Policies on Education since Independence: 1968, 1986 (Modified in 1992), 2020 in the context of need and significance, goals and frameworks of educational policies, content of policies, issues raised in policies, constitutional provisions, Issues of modifications.

Implementation of an Educational Policy: Meaning, need and significance, Mechanism of Policy Implementation., Strategies to Implement an Educational Policy, Programme of action and implementation: conceptual clarification and significance, Role of different Organization / Groups: Legislature/ Judiciary/ Political Will and Parties/ Voluntary Organizations/ Non-governmental organizations (NGOs)/ Pressure Groups/ Public, Challenges for Implementation.

References:

1. Birol Akgun, Alpaydin (ed.), Education Policies in the 21st Century : Comparative Perspectives.
Palgrave Macmillan.
2. R.V. Vaidyanatha Ayyar, History of Education Policymaking in India, 1947-2016, Oxford University
Press, 2017.
3. Marilyn Cochran-Smith, Policy Practice and Politics in Teacher Education, Corwin, 2006.

EDUCATION- ELECTIVES

ED4803E Emerging Technologies in Education

Pre-requisites: Nil

L	T	P	C
1	1	0	2

Total Lecture Sessions: 13

Course Outcomes:

CO1: Explain the need and significance of digitalization to social, economic and ethical issues.
CO2: Demonstrate an understanding of ways of employing ICT tools and resources for teaching learners with different needs and abilities.
CO3: Demonstrate the ability to utilize online and offline softwares for teaching different types of contents. CO4: Compare different e-contents based upon their relative merit
CO5: Develop the ability to produce learning aids matching instructional design principles.

Information and Communication Technology:
Historical Development of the use of Technology in Education, Web 2.0, Web 3.0 and Web 4.0 for teaching and learning, Shift from print to digital content and its impact on teaching, learning and cognition, Social, Economic, and Ethical issues associated with the use of ICT.
Technology in Education and Pedagogy:
Universal Design for Learning (UDL), Principles of using Online and Offline tools for teaching and learning, Use of various platforms for Online teaching and learning, Subject specific online resources and their uses in lesson Planning, Use of Technology for children with special needs: Tools and processes.
Online and Offline Software Applications:
Educational applications of Documentation, Presentation, Spreadsheet softwares Drawing tools – diagrams, concept maps, timelines, flow charts. Use of Smart Phone with different AI-based apps for teaching and learning, social media for teaching and learning, Use of OER, free online resources for teaching and learning, Online forums/discussion groups and collaborative learning.
Instructional Design and e-content:
Characteristics of good e-content, Tools for e-content authoring: Open source and proprietary alternatives, Multimedia tools for audio editing, video editing, screen casting, graphic editing, and animation, Reusable learning objects (RLO) – meaning, types and characteristics, RLO repositories, metadata and standards, Design and development of e-content: Need analysis, Identifying learning objectives, Developing a design, Creating a storyboard, Developing a prototype, Testing and evaluating impact.

Reference:
1. Catlin R. Tucker, Tiffany Wycoff, Jason T. Green, Blended Learning in Action: A Practical Guide Toward
Sustainable Change, 1st edition, Corwin, 2016.
2. Centre for Educational Research and Innovation, Open Educational Resources – Conceptual Issues. In Giving Knowledge for Free: The Emergence of Educational Resources, OECD, 2007.
3. I. Cheng, L.V. Safont, A. Basu, Multimedia in Education: Adaptive Learning and Testing,

World Scientific Pub. Co Inc, 2009.

4. J. Collins, M. Hammond, J. J. Wellington, Teaching and Learning with Multimedia, Routledge, 1997.

5. S. D'Antoni, C. Savage, (eds) Open Educational Resources: Conversations in Cyberspace, United Nations Educational, Scientific and Cultural Organization, 2009.

6. Chris Davies, Rebecca Eynon, (ed.) Education and Technology, 1st edition, Routledge and Kegan Paul.

7. D.H. Jonassen, (ed.) Learning to Solve Problems with Technology: A Constructivist Perspective, Merrill, 2003.

8. B.R. Joyce, M. Weil, E. Calhoun, Models of Teaching, Alternative e-Text Formats Series, 8th edition. Pearson/Allyn and Bacon Publishers, 2009.

9. J. I. Krauss, K. Prottsman. Computational Thinking and Coding for Every Student: The Teacher's Getting-Started
Guide, Corwin, 2016.

10. R. E. Mayer, Multimedia Learning, Cambridge University Press, 2009.

11. S. Mishra, R. C. Sharma, (eds). Interactive Multimedia in Education and Training, Idea Group Inc (IGI), 2005.

12. M. D. Roblyer, A. H. Doering, Integrating Educational Technology into Teaching, 6th edition, Pearson New International Edition, 2013.

13. G. Solomon, L. Schrum, Web 2.0: New Tools, New Schools, International Society for Technology in Education.
2007.

14. K. Spencer, The Psychology of Educational Technology and Instructional Media, United Writers Press, 1991.

15. J.N. Timothy, A. S. Donald, D. L. James, D. R. James, Educational Technology for Teaching and Learning, 4th edition, Pearson Education, 2010.

ED4804E Guidance and counselling

Pre-requisites: Nil

L	T	P	C
2	0	0	2

Total Lecture Sessions: 26

Course outcomes

CO1: Explain the fundamental concepts of guidance in the context of education involving meaning, nature, scope and types.

CO2: Explain the need and significance of counselling, different tools and techniques used and its roles within educational settings.

CO3: Identify various types of psychological testing.

CO4: Critically evaluate ethical issues and challenges in the field of counseling and to design, implement, and evaluate effective guidance/counseling programs at school level.

Guidance:

Meaning, need, nature and scope of Guidance, Brief historical background of Guidance movement in India, Individual and Group Guidance, Basic assumptions and principles of Guidance, Need to understand the needs of the individual and group in the context of Guidance, Essential information for Effective Guidance, Vocational Guidance and Role of teachers.

Counselling:

Meaning, importance, areas, and types of Counselling, Approaches to Counselling- directive, non-directive, eclectic, behaviorally oriented, and cognitively oriented, Process of Counselling: initiating counselling, preparation, and intake procedures, establishing rapport, termination of and response to initial interview, Establishing Structure: attending behaviour, observation, non-verbal behaviour, listening, verbal patterning and communication responses, silence, use of questions, transference and countertransference, regarding and respect in counselling relationships, involuntary clients, client expectations, Role of family and community.

Tools and Techniques to Collect Data:

Psychological Testing and Diagnosis: Need and Nature, Test use and interpretation, appraisal techniques, Counselling Interview: Essential aspects, basic procedures, problems, and their handling, Personality Assessment: Historical perspective, Material administration, scoring, interpretation, and evaluation of frequently used personality inventories/ questionnaires and projective tests, Personal Orientation Tests and Rating Scales: Type A behaviour, Locus of Control, Attitude scale, ST AI, other clinical rating scales, Case Study: Need and Importance.

Issues Related to Guidance and Counselling

Factors affecting Guidance and Counselling, Ethical issues in Guidance and Counselling, Limitation of diagnosis with special reference to Counselling, Challenges to organize Guidance and Counselling programmes in schools, Counseling and Guidance of persons with learning disabilities, visual and hearing impairment, Challenges related to counselling services in schools.

Reference

1. J. Ziomek-Daigle, Counseling Children and Adolescents, Taylor & Francis, 2017.

2. Diwakar Singh Sikarwar, Handbook on School Counseling, Notion Press, 2024.

3. S. Rao, Counselling and Guidance, 3rd edition McGraw Hill Education, 2017.

4. Namita Ranganathan, Toolika Wadhwa, Guidance and Counseling for Children and Adolescents in Schools (India), SAGE Publications, 2017.

5. J. Ziomek-Daigle, School Counseling Classroom Guidance: Prevention, Accountability, and Outcomes.

(Counselling and Professional Identity), SAGE Publications, 2015

6. M. Gibson, Introduction to Counselling and Guidance, Pearson Education, 2015.

7. R. Nelson-Jones, Theory and Practice of Counselling and Therapy, SAGE, 2012.

8. R. L. Gibson, Introduction to Counselling and Guidance, 6th edition, Prentice Hall of India, 2005.

9. R.A. Thompson, Professional school counselling: Best Practices for working in the schools, 3rd edition, New York, Routledge, 2012.

10. D. S. Sikarwar, Handbook on School Counseling, Notion Press.

ED4891E Yoga and Understanding Self

Pre-requisites: Nil

L	T	P	C
2	0	0	2

Total Lecture Sessions: 26

Course Outcomes:

CO1: Explain the importance of Yoga for an individual in understanding Self

CO2: Describe the importance of practicing Yoga Asana

CO3: Practice basic Yoga Asanas/ Kriyas

Philosophical and Historical Perspective of Yoga

Concept and Meaning of Yoga, Philosophy of Yoga, Brief history and development of Yoga (Classical Yoga, Post Classical Yoga and Modern Period), Importance of Yoga for healthy living, Yoga and its relevance in modern times, Traditions in Yoga

Schools of Yoga

Different streams/schools of Yoga (Gnana, Bhakthi, Karma), Construction of Yoga Practice for all round development, Principles of Yoga - Ahimsa, Satya, Asteya, Brachmacharya, Aparigraha, Shaucha, Santhosha, Tapas, swadyaya and Isvara Pranidhana.

Modern Principles of Yoga and Meditation

Modern Principles: Human Body is a holistic entity, Individuals and their need are Dhihrna & Dhyāna, etc. meditation and reflective practices, the importance of these aspects in becoming an effective teacher, unique Self-empowering, the quality and state of an individual mind, healing Meditation - Importance, Types, and Process, Pranayama: importance, types and process, Yoga as a Way of life for Peace, Harmony, Health, love and happiness. Yoga in Indian philosophy for understanding Self

References:

1. Swami Vivekananda, The Complete Book of Yoga, Sanage Publishing House LLP, 2022
2. Peter Connolly, A Student's Guide to the History and Philosophy of Yoga, Equinox Publishing Limited,
2014.
3. L. D. Allman, Yogic Wisdom, Page Publishing, 2020.
4. M. A. Kenelpp, Meditation, An Ancient Practice for Modern Time, Robertson Publishing, 2018. 5. N. K. Ford, Principles of Teaching Yoga to Kids, Balboa Press, 2020

ED4893E Citizenship Education, Sustainability and Environment Education

Pre-requisites: Nil

L	T	P	C
2	0	0	2

Total Lecture Sessions: 26

Course Outcomes:

CO1: Explain the concept of citizenship, citizenship education, global citizenship and global Citizenship Education, aims and various approaches to foster active citizenship.

CO2: Investigate the significance of Vasudhaiva Kutumbakam in fostering a holistic perspective.

CO3: Develop a comprehensive understanding of sustainability and emphasize the role of education in promoting a sustainable development.

CO4: Identify the environmental issues, realize the need for environmental education and actively participate in school and community-based environmental activities.

Citizenship Education: Concept of citizenship, citizenship education, Aims of citizenship education and its various approaches, Global Citizenship, Global Citizenship Education, Aims of Global Citizenship Education, and its various approaches. Concept of Vasudhaiva Kutumbakam, its importance in development of a holistic perspective towards local and global communities.

Sustainability: Concept of 'Sustainability' in all fields of human activities, Approaches to achieving sustainable development in economic, social, and environmental dimensions, Sustainable development goals, Sustainable management of natural resources, School- and community-based activities, Education for sustainable development.

Environmental Education: Environmental issues, Actions required for mitigating the effects of climate change, reducing environmental degradation, pollution, Initiatives required for effective waste management, conservation of biological diversity, management of biological/natural resources, forest and wildlife conservation, sustainable development and living, Approaches to delivering Environmental Education, Role of Mass Media and Technology in delivering environmental education, Roles of Governmental and Non- Governmental Organizations in promoting Environmental Education, School and community-based environmental education activities.

References:

1. A. Acharya, Citizenship in Globalising World, Pearson.
2. T. P. Kumar, Environmental Education, A.P.H. Publications.
3. R. K. Khitoliya, Environment Pollution-Management, Control for Sustainable Development, S. Chand and Company.
4. V. Krishnamacharyulu, G. S. Reddy, Environmental Education, Neelkamal Publications.
5. M. A. Chaudhary, S. M. Tripathy, Environmental Education and training – Trends, Traditions and Transformation, Global Vision Publishing House.
6. R. A. Sharma, Environmental Studies, Chand Publication.

ED4508E Post-Internship (Review and Analysis)

Pre-requisites: Nil

L	T	P	C
0	0	3	2

Total Lecture Sessions: Nil

Course Outcomes:

CO1: Develop a comprehensive understanding of the school ecosystem.

CO2: Describe the all-round develop attained during internship.

CO3: Develop effective reflective practices in teaching and learning.

Experience Sharing and Reflective Learning

- Presentation of reflective journal summary
- My Learning Journey: by each student-teacher
- Gallery walks (Exhibition): TLMs, display of participation in school activities (photos stories) and other artefacts created during the internship by student teachers.
- Sharing of best practices (PPTs, Videos.)
- Survey and collect the local stories and rhymes from the parents and community (in the context of the secondary stage)
- Holding a training workshop for the parents and community and encouraging them to act as volunteers.
- Awareness and advocacy programmes in Foundational Literacy and Numeracy FLN for parents and community: Role play with parents and community on conducting specific FLN activities.
- Organising a parents /community mela fair on homemade TLM for secondary stage children.

Submission of Internship Report

- Reflective Journal
- Lesson Plans and TLMs
- Observation records (Teacher Educator, Mentor, school heads, Teachers, Parents)
- Assessment records and Student Portfolio
- Action research report/case study
- Comprehensive internship report

ED4506E Teaching Learning Material/Work Experience

Pre-requisites: Nil
Total Lecture Sessions: Nil

L	T	P	C
0	0	3	2

Course Outcomes:

CO1: Assess the need for Teaching Learning Materials and prepare innovative TLMs.
CO2: Develop an understanding of the importance of work experience and competencies of a local crafts person, artisans and entrepreneurs.

Content

- Understanding how students learn at different stages.
- Knowledge of toys and other TLMs from different parts of the country.
- Addressing the individual differences and Knowing of relevant TLMs for specific groups of children- CWSN, kinesthetic learners, visual learners, auditory learners.

Activities to be conducted:

- Orientation workshop on work experience and development of learning resources.
- Field visit for interaction with local artisans, craftspeople, and entrepreneurs.
- Observe Traditional work practices and their integration into Local Technologies and Ideas.
- Analysis of available local specific, indigenous learning resources, including toys and their use in the learning-teaching process.
- Development of at least two low-cost learning resources as per the local contexts
- (secondary) and presentation/exhibition
- Prepare the manual of TLM highlighting the objectives that will be achieved by its use, the
- material used, the process of its development and its use during classroom transaction.

ED4807E Community Engagement and Service

Pre-requisites: Nil

L	T	P	C
0	0	3	2

Total Lecture Sessions: Nil

Course Outcomes:

CO1: Recognize the socio-economic issues in the community and identify initiatives that could help solve problems faced by the community.

CO2: Demonstrate an awareness of the functions of the community, and explain the measures required for enlisting community participation in school-related activities.

CO3: undertake initiatives that are required to make the community aware of the importance of education to meet various challenges.

CO4: suggest actions in collaboration with community members to address the social, cultural and educational problems in the community.

Approach to curriculum transaction

The student teachers will be provided opportunities to have exposure to community life for ten days.(two days in Preparation for Community Engagement & Service in the institution, seven days working with the community, and the last day in the institution for sharing their experiences and reflections). The activities may be conducted in groups or individually, as appropriate.

Days 1-2: Preparation for community services (In the institution)

- Orientation of student teachers on Community Engagement & Services through discussion and group activities.
- Workshop for developing tools for different activities during the programme.

Days 3-9: Engagement with the community (Mandatory onsite stay with the community). Students will be divided into smaller groups. They would participate in the planned activities with defined roles for seven days on a rotation basis. These activities include:

- Participation of student teachers in activities undertaken under the National Service Scheme (NSS), New India Literacy Programme, Student mentoring initiatives, etc.
- Survey of community resources for supporting school activities.
- Study of the situation regarding school dropout and the reason thereof (stage wise).
- Survey of specific settlement to assess the situation about non-literates in the settlement, including identification of 4-5 non-literate youth and adults who will be supported by student teachers to become literate.
- Training of local youth in First Aid and other relevant interventions.
- Assessment of the situation about Health and wellness of children in a locality.
- Creating awareness of the importance of sustainable development, and making the community members aware of the need to support initiatives to ensure environmental protection, creating awareness of rainwater harvesting, mentoring school students with learning deficits, guidance and counselling to school students etc.
- Visit and interact with local artisans and craftspersons.

The above activities typically will include working with the community, collecting data, playing local games, community awareness programmes like nukkad natak, rallies, organizing and participating in the cultural programmes with the community members etc.

The student teachers shall conduct different pre-scheduled activities throughout the day. Morning sessions will be used for activities with the community and data collection. The afternoon session will be devoted to data analysis and preparation of the report, and participation in games & sports activities. Evening session will involve cultural activities with community members.

Day 10: Feedback session and Reflection (In the Institution)

- Sharing experiences and discussion on activities carried out
- Presentation and submission of report on the activities carried out.
- Evaluation of the activities by collecting feedback on the effectiveness of the campaign from the mentor and the students.
- Reflection of experience (individual/group) of organizing community service

CURRICULUM FOR INTEGRATED TEACHER EDUCATION PROGRAMME LEADING TO B. Sc. B.Ed. DEGREE

Name of Degree	Name of Specialisation	Total Intake (Full-time)	Year of Starting	Duration	Eligibility for Admission
B.Sc. B.Ed. (Secondary)	Science and Education	50	2026	4 years (8 semesters)	The ITEP shall be of four academic years comprising eight semesters including internship (field-based experiences and practice teaching). Candidates with minimum fifty percent marks in Senior Secondary or plus two examination or its equivalent (under 5+3+3+4 pattern) from a recognised board are eligible for admission through the National Common Entrance Test (NCET), conducted by the National Testing Agency (NTA)

COURSE CATEGORIES AND CREDIT REQUIREMENTS:

The structure of B.Sc. B.Ed. Programmes shall have the following Course Categories:

Sl. No	Course Category	No. of Courses	No. of credits
1.	Foundations of Education (FE)	10	30
2.	Disciplinary Major and Minor (MM)	16	64
3.	Stage Specific Content cum Pedagogy (CP)	4	16
4.	Ability Enhancement and Value-added Courses (AE)	12	28
5.	School Experience (SE)	6	20
6.	Community Engagement and Service (CE)	1	2

Total Credits required: 160

PROGRAMME STRUCTURE

Major Disciplinary Subject: PHYSICS

Minor: One discipline to be chosen from amongst Chemistry, Mathematics, and Computer.
The effort to be put in by the student is indicated in the tables below as follows:

L: Lecture (One unit is of 60-minute duration)

T: Tutorial (One unit is of 60-minute duration)

P: Practical (One unit is of one-hour duration)

Subject code:
ED: Education PH: Physics CH: Chemistry
MA: Mathematics CS: Computer

Semester 1							
Sl. No	Course Code	Title	Course Category	L	T	P	Credits
1	ED1100E	Evolution of Indian Education	FE	4	0	0	4
2	ED1190E	Language I – English	AE	4	0	0	4
3	ED1192E	Art Education-Collage Making	AE	1	0	2	2
4	ED1193E	Understanding India – I	AE	2	0	0	2
5	PH1101E	Mechanics and Properties of Matter	MM	3	1	0	4
6	CH1102E	Chemistry Minor – I: Basics of Theoretical Chemistry and Spectroscopy	MM	3	1	0	4
	MA1102E	Mathematics Minor – I: Calculus	MM	3	1	0	4
	CS1101E	Python Programming	MM	3	0	2	4
7	PH1141E	Physics Lab – I	MM	0	0	2	1
						Total	21

Semester 2							
Sl. No	Course Code	Title	Course Category	L	T	P	Credits
1	ED1291E	Language II – Manipuri	AE	4	0	0	4
	ED1292E	Language II – Hindi	AE	4	0	0	4
2	ED1293E	Understanding India – II	AE	2	0	0	2
3	ED1294E	Teacher and Society	AE	2	0	0	2
4	PH1201E	Heat and Thermodynamics	MM	3	1	0	4
5	PH1202E	Electricity and Magnetism	MM	3	1	0	4
6	CH1202E	Chemistry Minor – II: Physical Chemistry	MM	3	1	0	4
	MA1202E	Mathematics Minor – II: Algebra & Differential Equations	MM	3	1	0	4
	CS1201E	Computer Programming with C	MM	3	0	2	4
7	PH1241E	Physics Lab – II	MM	0	0	2	1
						Total	21

Semester 3							
Sl. No	Course Code	Title	Course Category	L	T	P	Credits
1	ED2301E	Child Development and Educational Psychology	FE	4	0	0	4
2	ED2302E	General Pedagogy	CP	3	1	0	4
3	PH2301E	Waves and Optics	MM	3	1	0	4
4	PH2302E	Electronics	MM	3	1	0	4
5	CH2301E	Chemistry Minor – III: Inorganic Chemistry	MM	3	1	0	4
	MA2301E	Mathematics Minor – III: Probability and Statistics	MM	3	1	0	4
	CS2301E	Data Structures with C	MM	3	0	2	4
6	PH2341E	Physics Lab – III	MM	0	0	2	1
						Total	21

Semester 4							
Sl. No	Course Code	Title	Course Category	L	T	P	Credits
1	ED2401E	Philosophical and Sociological Perspectives of Education – I	FE	4	0	0	4
2	ED2402E	Minor Pedagogy (Physical Science)	CP	3	1	0	4
3	PH2401E	Classical and Relativistic Mechanics	MM	3	1	0	4
4	PH2402E	Quantum and Statistical Mechanics	MM	3	1	0	4
5	CH2401E	Chemistry Minor – IV: Organic Chemistry	MM	3	1	0	4
	MA2401E	Mathematics Minor – IV: Mathematical Analysis	MM	3	1	0	4
	CS2401E	Digital Computer Fundamental	MM	3	0	2	4
6	PH2441E	Physics Lab-IV	MM	0	0	2	1
						Total	21

Semester 5							
Sl. No	Course Code	Title	Course Category	L	T	P	Credits
1	ED3391E	ICT in Education	AE	1	0	2	2
2	ED3301E	Major Pedagogy – I (Physical Sciences)	CP	3	1	0	4
3	ED3302E	Pre-internship Practice	SE	0	0	4	2
4	PH3301E	Atomic and Molecular Physics	MM	3	1	0	4
5	PH3302E	Nuclear and Solid State Physics	MM	3	1	0	4
6	PH3351E	Major Project	MM	0	0	8	4
						Total	20

Semester 6							
Sl. No	Course Code	Title	Course Category	L	T	P	Credits
1	ED3601E	Assessment and Evaluation	FE	2	0	0	2
2	ED3602E	Major Pedagogy-II (Physical Sciences)	CP	3	1	0	4
3	ED3603E	Inclusive Education	FE	2	0	0	2
4	ED3691E	Mathematical and Quantitative Reasoning	AE	1	1	0	2
5	ED3604E	School Observation	SE	0	0	4	2
6 & 7	PH3601E	Elementary Particle Physics	MM	3	1	0	4
	PH3602E	Numerical Techniques and Computational Physics	MM	3	0	2	4
	PH3603E	Advanced Electronics	MM	3	1	0	4
	PH3604E	Laser Theory	MM	3	1	0	4
	PH3605E	Astronomy And Astrophysics	MM	3	1	0	4
						Total	20

Semester 7							
Sl. No	Course Code	Title	Course Category	L	T	P	Credits
1	ED4701E	Perspectives on School Leadership and Management	FE	2	0	0	2
2	ED4702E	Curriculum Planning and Development	FE	2	0	0	2
3	ED4791E	Art Education- Performing and Visual	AE	1	0	2	2
4	ED4792E	Sports, Nutrition and Fitness	AE	1	0	2	2
5	ED4703E	School based Research Project	SE	0	0	4	2
6	ED4704E	Internship in Teaching	SE	0	0	20	10
						Total	20

Semester 8							
Sl. No	Course Code	Title	Course Category	L	T	P	Credits
1	ED4801E	Philosophical and Sociological Perspectives of Education-II	FE	4	0	0	4
2	ED4802E	Education Policy Analysis	FE	2	0	0	2
3	ED4803E	Emerging Technologies in Education	FE	4	0	0	4
	ED4804E	Guidance and counselling	FE	4	0	0	4
4	ED4891E	Yoga and Understanding Self	AE	2	0	0	2
5	ED4892E	Citizenship Education, Sustainability and Environment Education	AE	2	0	0	2
6	ED4805E	Post-Internship (Review and Analysis)	SE	0	0	4	2
7	ED4806E	Teaching Learning Material/Work Experience	SE	0	0	4	2
8	ED4807E	Community Engagement and Service	CE	0	0	4	2
						Total	20

Semester-wise distribution of credits:

Semester	1	2	3	4	5	6	7	8
Credits	21	21	21	21	20	20	20	20

Semester wise Detailed Syllabus

Semester-I

ED1101E Evolution of Indian Education

Pre-requisites: Nil

Total Lecture Sessions: 52

L	T	P	C
4	0	0	4

Course Outcomes:

CO1: Understand the evolution of education in India, including its historical, social, and political influences, enabling them to act as effective teachers.

CO2: Analyse the historical development of education in ancient India, identifying key features and comparing it with modern educational practices.

CO3: Assess the genesis, vision, and evolution of education in India from ancient times to the contemporary era, understanding the impact of various educational philosophies and systems.

CO4: Recognise and appreciate the contributions of Indian thinkers to the evolution of the Indian education system and its practices.

Ancient Indian Education: Vedic Period – Vision, objectives and salient features of Vedic Education System- Teaching and Learning Process- Development of educational institutions: Finances and Management- Famous Educational institutions and Guru-Shishya Education at the time of Epics: Ramayana and Mahabharata.

Ancient Indian Education: Buddhist and Jain Period – Vision, objectives and salient features of Buddhist and Jain Education System- Teaching and Learning Process- Finance and Management of Educational Institutions- Educational Institutions: Nalanda, Taxila, Vikramshila, Vallabhi, Nadia- Famous Guru-Shishya.

Post-Gupta Period to Colonial Period: Vision, objectives, brief historical development perspective as well as salient features of Education in India- Teaching and Learning Process- Finance and Management of educational institutions.

Modern Indian Education: Colonial education in India; Woods Despatch, Macaulay Minutes and Westernisation of Indian Education- Shiksha ka Bharatiyakaran (Indigenous Interventions in education); Swadeshi and Nationalist attempts of educational reforms with special reference to general contribution of Indian thinkers to the education systems of India; Savitribai and Jyotiba Phule, Rabindranath Tagore, Swami Vivekananda, Mahatma Gandhi, Sri Aurobindo, Gijubhai Badheka, Pt. Madanmohan Malaviya, Jiddu Krishnamurti and Dr. Bhim Rao Ambedkar. Education in Independent India: Overview of Constitutional values and educational provisions- Citizenship Education: Qualities of a good citizen, Education for fundamental rights and duties- UEE, RMSA, RTE Act 2009: Overview and impact- NEP 2020: vision and implementation for a vibrant India.

References:

1. Mookerji R.K. *Ancient Indian Education: Brahmanical & Buddhist*, Macmillan & Co, 1947.
2. F.E. Keay, *Indian Education: An Enquiry into its Origin, Development, and Ideals.* Oxford University Press, 1918.
3. K.V. Vaidyanatha Iyyer. *History of Education Policymaking in India (1947-2016)*, 4th Edition, University Press, 2017.

ED1191E Language I – English

Pre-requisites: Nil

Total Lecture Sessions: 52

L	T	P	C
4	0	0	4

Course Outcomes:

CO1: Demonstrates a knowledge of the relationship between Language and society.

CO2: Demonstrates the ability to use the conventions of grammar, vocabulary, and pronunciation to communicate effectively in a variety of contexts.

CO3: Develop and deliver effective presentations and speeches on a variety of topics using technology.

CO4: Demonstrates the ability to read and comprehend a variety of text types and write for different purposes.

Language, Society, and learning: Language acquisition and Language learning—Notion of first language, second language and others—Language variation and social variation— Languages, dialects and varieties— Bilingualism, Multilingualism and its advantages—Cultural transmission of language. language and gender, language and identity, language and power—Constitutional provisions and National Education Policy 2020

Grammar in Communication: Verb and Tenses—Conditionals—Multi word verbs: Phrasal verbs, Collocations—Phrase and clause in practice: Relative clauses, adverb clauses, dangling modifiers—Linking devices, Common errors

Speaking and Pronunciation: Pronunciation and intelligibility: Speech sounds, Tone- Stress, Pitch and Intonation —Tone and pitch in communication—Sense groups and connected speech—Speech and discourse markers—Speaking with confidence—Delivering speeches and presentations—Public speaking—Active listening

Critical reading and writing: Skimming and Scanning—Close Reading - Comprehension - Summarising and Paraphrasing - Analysis and Interpretation - Literary Knowledge Texts—Structure of an essay: argumentative, analytical, comparative—Writing as a process: outlining, drafting, revising and proof reading

References:

1. Mark Hancock, *English Pronunciation in Use*. Cambridge UP. 2003.
2. Martin Hewings, *Advanced Grammar in Use: A Reference and Practice Book for Advanced Learners of English*. 2nd edition, Cambridge University Press, 2005.
3. N. Sudarshana, C. Savitha, *English for Technical Communication*, Cambridge English, 2016.
4. J. Merrill, *Culture Bound*, Cambridge University Press. 1988.
5. S. Kumar, P. Lata, *Communication Skills*, Oxford University Press. 2012.
6. Grant Taylor, *English Conversation Practice*. McGraw Hill, 2001.

ED1192E Art Education- Collage Making

Pre-requisites: Nil

Total Lecture Sessions: 13

L	T	P	C
1	0	2	2

Course Outcomes:

CO1: Articulate the importance and the role of aesthetics and art in education.

CO2: Understand the medium of collage and its versatility.

CO3: Design, plan, and create an expressive self-portrait collage by applying a variety of collage techniques.

CO4: Design and set up an interactive visual art exhibition to display the artworks.

CO5: Understand and appreciate art-based learning experiences.

CO6: Develop the ability to reflect and challenge the assumptions and beliefs around art and develop new understandings.

Understand the importance of Art and Aesthetic in Education: Introduction to Art and Aesthetics, Different Artists works, Analysis and interpretation of artworks, Engagement through Art Experiences, Visual Thinking Strategy Exercise, Collective Analysis, Observing art and aesthetics in the surroundings.

Exploring paper collage and its techniques: Introduction to collage making, exploration of various mediums, Learning Visual Textures and Patterns, learning from nature- composition, colors, and textures, Utilizing and exploring various materials, collaborative analysis, and interpretation.

Ideating for an Expressive Self-Portrait: Observation, Sketching, and Self-Portrait Drawing, Exploration of Self-portrait collage using mixed mediums, Creation of paper sculpture compositions using 3D techniques, reflective dialogue.

Creation of an Expressive Self-Portrait Collage: Creation of a large expressive self-portrait using the medium of paper collage.

Designing and setting up an Exhibition: Planning and setting up an exhibition and showcasing the works.

References:

1. J. Berger, *Ways of Seeing*, Penguin Classics, 2008.
2. V. Finlay, *Color: A Natural History of the Palette*, Ballantine Books, 2002.
3. J. Dewey, *Art as Experience*, Perigee Books.
4. J. Ruskin, *The Elements of Drawing: In Three Letters to Beginners*, Dover.
5. Various works of artists such as Deborah Roberts, William Kentridge, Wangechi Mutu, etc.
6. Video: Mitch, Cut paper collage artist - [*https://www.youtube.com/watch?v=WgRZ1W-Ck0*]
7. Video: G. Subramanian, Collage art - [*https://www.youtube.com/watch?v=in8Rd9R46a0*]
8. Video: Amber Fletschock, Collage artist - [*https://www.youtube.com/watch?v=aaJ7p1vBjIo4*]
9. Video: Arturo Herrera, artist - [*https://www.youtube.com/watch?v=Olqpe7_XZSWU*]
10. JR's Face to face project (videos and readings)- [*https://www.youtube.com/watch?v=4a_OYOROg4*]

ED1193E Understanding India

Pre-requisites: Nil

Total Lecture Sessions: 28

L	T	P	C
2	0	0	2

Course Outcomes:

CO1: Develop an understanding of ancient Indian knowledge, tradition and culture and explain its potential benefits in modern times.

CO2: Appreciate ancient Indian art, literary, visual and cultural texts and identify its aesthetic and creative elements.

CO3: Familiarize with ancient Indian ideas of kingship, governance and law and appraise its benefits for individuals and society.

CO4: Gain an understanding of ancient Indian economy, its institutions, trade and revenue and identify its relative merits.

CO5: Demonstrate an understanding of traditional environmental practices and health traditions and justify its relevance in the 21st century.

Introduction to the Knowledge of India: Indian Knowledge Systems- scope and significance, need to revisit our ancient knowledge, traditions, and culture.

Culture - Art and Literature: Ancient Indian aesthetics, Rasa theory, Fine arts (Traditional art forms, Arts and spirituality, Arts and identity), Impact of globalization, Performing Arts (Indian dance systems, traditional Indian music, Dramaturgy, visual arts, folk arts, etc.). Literature with special reference to traditional institutions and value systems found in Sanskrit literature, Religious literature, Oral traditions, Folk literature, Sangam literature of South India and Vernacular literature- Bengali, Marathi etc.

Polity, Law and Economy: Kingship-types of government-Local village administration, Ancient Law: Dharma as basis, Criminal Justice, Courts, Police, Jails and punishments, Chanakyaniti-its relevance for modern day. Overview of Indian Economy from the Stone Age to the Guptas, Arthashastra and its relevance; Caste system and relation to professions, guilds, economic institutions; Harappan civilization- economy, agriculture, growth of new occupations, Temple economy, Internal / external trade and commerce, trade routes, Indo-roman contacts, and maritime trade of South India. Land ownership - land grants and property rights, land revenue systems.

Environment and Health: Equilibrium between society and environment: Traditional Indian perception of natural resources like forests, land, water, and animals, Sustainable architecture and urban planning. Solving today's environmental challenges (best practices from indigenous knowledge, community-led efforts, etc.), India's Health Tradition: Ayurveda, Siddha, Ashtavaidya, Unani, and other schools of Medicine, Lessons from Sushruta Samhita and Charaka Samhita, Mental health in ancient India: Its time-tested concepts of mental wellness (concept of mind, dhyana, mind-body relationship, Ayurveda, yoga darshan, atman, etc.)

References:

(a) Books:

1. A.L. Basham, (ed.), *A Cultural History of India*, 7th edition, Oxford University Press, 2003.

2. A.L. Basham, *The Wonder That Was India*, Volume 1, Picador, 2019.
3. B.Mahadevan, Vinayak Rajat Bhat, R.N. Nagendra Pavana, *Introduction to Indian Knowledge Systems: Concepts and Applications*, PHI Learning, 2022.
4. B. N. Luniya, *Evolution of Indian Culture - From the earliest times to the present day*, 1992
5. Mohan Raghavan, M.S. Harsha Simha, C.R. Ramaswamy, *Elements of Indic Knowledge Systems and Heritage*, NTSR Institute2023

(b) Websites:

1. Indian Culture. *https://www.indianculture.gov.in/*
2. Indian Knowledge Systems, Govt. of India. *https://iksindia.org/*
3. Ministry of Culture, Govt. of India. *https://indianculture.gov.in/*
4. Visual arts. CCRT. *https://ccrtindia.gov.in/resources/visual-arts/*

PH1001E Mechanics and Properties of Matter

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Solve problems in mechanics and oscillations using Newton's equations of motion.

CO2: Describe oscillatory behavior under different conditions.

CO3: Formulate the dynamics of rigid bodies using Euler angles.

CO4: Interpret the dynamics of fluids by treating it as a continuous medium.

CO5: Apply knowledge of material properties and rotational dynamics to torsional oscillations.

Newtons Equations: Review of Newtonian Mechanics: Force, Newton's II law and equations of motion, examples – Motion in a plane, Rotational Motion, angular momentum - Energy and Work, Conservative systems – system of particles, Center of Mass – Central Forces, Kepler's Laws – Collisions, elastic and inelastic collisions.

Non-inertial frames and rigid body motion: Motion in non- inertial frames, Coriolis and Centrifugal forces, Foucault pendulum – independent coordinates for a rigid body, Euler angles – the inertia tensor and moment of inertia – principal axis transformation, parallel and perpendicular axis theorems.

Oscillations and Waves: Oscillations, simple harmonic oscillations, forced oscillations, damping, resonance, coupled oscillators, normal modes – waves, sound waves, elastic waves, superposition of waves.

Properties of Matter: Elasticity, stress and strain, Hooke's law, moduli of elasticity, shear force, Poisson's ratio, torsion, torsional pendulum.

Fluid as a continuum – velocity Field – stress field – viscosity, Newtonian and non-Newtonian fluids – surface tension – continuity equation

References:

1. D. Kleppner and R. J. Kolenkow, *An Introduction to Mechanics*, 1st Edition, McGraw Hill, 2017.
2. D. J. Morin, *Introduction to Classical Mechanics: With Problems and Solutions*, Cambridge University Press, 2008.
3. K. R. Symon, *Mechanics*, 3rd Edition, Pearson, 2018.
4. D. Halliday, R. Resnick and J. Walker, *Fundamentals of Physics*, 10th Edition, John

CH1102E Chemistry Minor – I
Basics of Theoretical Chemistry and Spectroscopy

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Apply the Chemical bonding principles in understanding the structure of molecules.

CO2: Describe the fundamental principles governing various spectroscopic techniques and their relevant applications.

Classical wave equation, Schrödinger equation, particle in a box, applications of particle in a box solutions for describing electronic levels and spectra in conjugated molecules.

Chemical bonding: Valence bond and molecular orbital descriptions of bonding, the linear combination of atomic orbitals (LCAO) approach, hybridization, bonding in H_2^+ and H_2.
Bonding in homonuclear diatomic molecules of the second period, bond orders, bond lengths, and bond strengths, bonding in heteronuclear diatomic molecules, concepts of g and u symmetries of molecular orbitals, polarity and electronegativity, and evidence from photoelectron spectroscopy.

Fundamental aspects of spectroscopy: Electromagnetic radiation, absorption, emission, scattering.

Atomic spectroscopy: Spectra of hydrogenic systems, coupling of orbital and spin angular momenta in many-electron systems, term symbols, fine and hyperfine structure, Zeeman and Stark effects.

Infrared spectroscopy: Harmonic oscillator model for diatomics, energy levels, selection rules, anharmonic effects, dissociation energies, and Morse oscillator.

Raman spectroscopy: Light scattering, Raman effect, classical model of scattering, polarizability, Stokes and anti-Stokes lines, selection rules, mutual exclusion principle, structure determination using IR and Raman spectroscopies.

Electronic Spectroscopy of Molecules: Jablonski diagram, absorption, emission, Franck-Condon principle, Stokes shift, 0-0 band, fluorescence, phosphorescence, and quantum yields.

Reference:

1. D. A. McQuarrie, *Quantum Chemistry*, Viva Student Edition, Viva, 2011.
2. P. Atkins, J. de Paula, J. Keeler, *Atkins' Physical Chemistry*, 11th Edition, O.U.P, 2018.
3. J. Barrett, *Structure and Bonding*, Wiley-Royal Society of Chemistry, 2002.
4. T. Engel and P. Reid, *Physical Chemistry*, 3rd Edition, Pearson, 2013.
5. R. J. Silbey, R. A. Alberty and M. G. Bawendi, *Physical Chemistry*, 4th Edition, Wiley Student Edition, 2006.
6. T. Engel, *Quantum Chemistry and Spectroscopy*, 3rd Edition, Pearson, 2006.
7. J. M. Hollas, *Modern Spectroscopy*, 4th Edition, Wiley, 2004.
8. C. N. Banwell and E. M. McCash, *Fundamentals of Molecular Spectroscopy*, 4th Edition, Tata McGraw- Hill, 2017.
9. N. Levine, *Physical Chemistry*, 6th Edition, Tata McGraw-Hill, 2011.

MA1102E Mathematics Minor – I
Calculus

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Find the limits, check for continuity and differentiability of real valued functions of one variable.

CO2: Find the limits, check for continuity and differentiability of real valued functions of two or more variables.

CO3: Find the maxima and minima of real valued functions of one variable or two variables. CO4: Find the parametric representation of curves and surfaces in space and evaluate integrals over curves and surfaces.

Functions of one variable: Limit, continuity, differentiability, higher derivatives, Leibnitz's theorem. Monotone functions, maxima and minima, Rolle's theorem, Mean value theorem, Taylor's theorem, Indeterminate forms, L'hopital's rule, Integration, Fundamental theorem of calculus, applications: finding volume and area, improper integrals, Gamma and Beta functions.

Function of several variables: Limit, continuity, partial derivatives, partial differentiation of composite functions, directional derivatives, gradient, local maxima and local minima of functions of two variables, critical point, saddle point, Taylor's formula for two variables, Hessian, second derivative test, method of Lagrange multipliers.

Vector calculus: Vector field: divergence, curl, identities involving divergence and curl, scalar potential, Parameterized curves in space, arc length, tangent and normal vectors, curvature and torsion, Line integral, independence of path, irrotational and solenoidal vector fields, Green's theorem for plane, parameterized surface, surface area and surface integral, flux, Gauss' divergence theorem, Stoke's theorem.

References:

1. H. Anton, I. Bivens, S. Davis, *Calculus*, 10th edition, John Wiley & Sons,2013.
2. G. B. Thomas, M.D. Weir, J. Hass, *Thomas' Calculus*, 12th edition, Pearson Education, 2015.
3. E. Kreyszig, *Advanced Engineering Mathematics*, 10th edition, John Wiley & Sons, 2015.
4. Apostol, *Calculus Vol 1*, 1st edition, Wiley, 2004.

CS1301E Python Programming

L	T	P	C
3	0	2	4

Pre-requisites: Nil

Total Lecture Sessions: 39

Course Outcomes:

CO1: Introduce the fundamental concepts of Python.

CO2: Provides a foundation for using the basic building blocks of Python.

CO3: Learn to write Python Scripts.

CO4: Explore various exception-handling mechanisms.

CO5: Develop Python packages.

Introduction to Python: Python variables, Python basic Operators, Python Data Types, variables, Declaring and using Numeric data types: int, float etc., Basic Input-Output Operations, Basic Operators.

Conditionals and loops: Boolean Values, if, else, and else if, Simple for loops in Python, for loop using ranges, string, lists, and dictionaries. Use while loops in Python, Loop manipulation using pass, continue, break and else.

Strings: Assigning values in strings, String manipulations, String special operators, String formatting operators, Triple Quotes, Raw String, Unicode String, Build-in-String methods.

Lists: Lists Introduction, accessing values in a list, List manipulations, List Operations, Indexing, slicing & matrices, use of tuple data type, programming using string, list, and dictionary in-built functions.

Functions: Built-in Functions and methods, Functions, writing functions in Python, returning a result from a function, Pass by value & pass by reference, function arguments & their types.

Laboratory: Programs using

1. Conditional control constructs
2. Loops
3. Strings
4. Lists
5. user defined functions and library functions
6. built-in functions of packages matplotlib

<u>Learning Resources:</u>

Text Books:

1. William Mitchell, Pavel Solin, Martin Novak et al., *Introduction to Python Programming*, NCLab Public Computing, 2012.
2. *Introduction to Python Programming*, ©Jacob Fredslund, 2007.

Reference Books:

1. John C. Lusth, *An Introduction to Python*, The University of Alabama, 2011.
2. *Introduction to Python*, ©Dave Kuhlman, 2008.

PH1141E Physics Lab – I

Pre-requisites: Nil

Total Lecture Sessions: Nil

L	T	P	C
0	0	2	1

Course Outcomes:

CO1: Apply principles of mechanics for experimentation.
CO2: Develop skills for data analysis and interpretation.
CO3: Set up experiments, take observations and relate it with a suitable theory.
CO4: Build ability for group discussion and critical thinking for collaborative work.

List of Experiments: *(A student should complete any seven of these)*

1. Simple pendulum: Study of dependence of time period on length and displacement.

2. Torsional Pendulum.

3. Compound Pendulum.

4. Moment of Inertia of a flywheel.

5. Young's modulus of a bar by non-uniform bending.

6. Searle's double bar: measurement of moduli of elasticity.

7. Cornu's method for measuring Young's modulus.

8. Determination of viscosity of a fluid by rate of flow method.

9. Spring constant of a spring by load-extension method.

10. Vertical motion of a projectile.

References:

1. A. C. Melissinos, J. Napolitano, *Experiments in Modern Physics*, 2nd Edition, Academic Press, 2003.
2. R. A. Dunlap, *Experimental Physics*, Oxford Univ. Press, 1988.

SEMESTER - II

ED1201E Language II – Manipuri

Pre-requisites: Nil

Total Lecture Sessions: 52

L	T	P	C
4	0	0	4

Course Outcomes:

CO1: [illegible]

CO2: [illegible] (Linguistic Harmony) [illegible]

CO3: [illegible]

CO4: [illegible]

[illegible]

[illegible]:

[illegible]

[illegible]:

[illegible]

[illegible]:

[illegible]

[illegible]:

[illegible]

[illegible]:

1. A.R.A. Demers, R.M. Harnish, *Linguistics: An Introduction to Language and Communication*, MIT Press Cambridge, Mass 1979 (2nd ed.)
2. Bhatia, Vijay K. (2012), *Analysing Genre: Language Use in Professional Settings*. London: Routledge (1983), *Pragmatics*. Cambridge: Cambridge University Press

3. Carroll, John B. (ed.), (1956), *Language, Thought and Reality: Selected Writings of Benjamin Lee Whorf*, Cambridge, MA: MIT
4. Dr. K. Bimola, *Manipuri Lonmiti Shahlon Khara*, JN Publication Imphal, 2022Dr. Ismail Singh, *Meeboda*, Imphal: Manipuri Sahitya Parishad, 2009
5. Dr. R.L. Varshney, *An Introductory Text Book of Linguistics and Phonetics* Students' Store, Bareily, 2013
6. From Kin Vand R. Rodman, *An Introduction of Language*, Holt Rinehart and Winston, Inc. New York, 1988
7. Fromkin, Victoria, Robert Rodman and Nina Hyams, 2014 *An Introduction to Language*, (10th Edition), Boston, MA: Wadsworth
8. Hockett, Charles F. (1960), *Origin of Speech*, *Scientific American* 203:88-111
9. Konthoujam Priyokumar Singh, *Nongpi Tavandabara*, Imphal: Writers' Forum, 1993
10. Lyons, John, *Introduction to Theoretical Linguistics*, Cambridge University Press, Cambridge, 1968
11. Levinson, Stephen C. (1983), *Pragmatics*, Cambridge: Cambridge University Press
12. Larson, Richard K., 2010. *Grammar as Science*, Cambridge, MA: MIT Press Svensen Bo, *A Handbook of Lexicography*, Cambridge University, 1998
13. Sharma, Peter, 2005, *Communication Skills*, (13th Edition), New Delhi: Ramesh Publishing House
14. Oinam Bhogeswar Singh (ed.), *Chandrakirti Jila Chongba*, Imphal: Tamra Publications, 1995
15. Oinam Ibochaoba Singh, Ibohal Singh Kangjam (ed.), *Ahhannaba Manipuri Sheireng*, Imphal: Manipur Naharol Sahitya Sabha, 1975
16. Sri Nongmaithem Manaoyaima Singh (ed.), *Numitlon*, Kakching: The Lila Singh Memorial Press, 1980

ED1292E Language II – Hindi

Pre-requisites: Nil

Total Lecture Sessions: 52

L	T	P	C
4	0	0	4

Course Outcomes:

CO1: Enable the students to acquire basic skills in functional language of Hindi

CO2: Develop independent reading skills and appreciate literary works in Hindi

CO3: Internalise grammar rules to facilitate fluency in speech and writing in Hindi

CO4: Develop functional and creative skills in Hindi language

History of Language and Literature: Hindi Bhasha ka Itihas - Aadi kaal, Madhya Kaal aur Aadhunik Kaal, Hindi Grammar Kaal and Kriya, Hindi Sahitya ka Itihas - Aadi kaal, Madhya Kaal, Ritik Kaal aur Aadhunik Kaal

Poetry: Meer ke Pramukh Dohe, Suryakant Tripathi Nirala: Juhi ki Kali, Dhoomil Sudhama Pandey: Proud Shiksha, Nagarjun: Akal Aur Uske Bad, Ramdarash Mishra: Chidiya, Kedarnath Singh: Akal Me Saras (For Extra Reading), Jitendra Srivastava: Main Ek Chidiya Hoon Pappa.

Gadya: Harishankar Parsai: Premchand ke Phate Jutte (Nibandh), Bhagwati Sharan Varma: Sbse Bada Aadmi (Ekanki), Mohan Rakesh Uski Roti (Short Story) (For Extra Reading), Bhisham Sahni: Chief ki Dawat (Short Story), Uday Prakash: Aparadh (Short Story), Chitra Mudgal: Dasmi Kaaki (Laghu katha)

References:

1. Ramchandra Shukla, Hindi Sahitya Ka Itihas, Rajkamal Prakashan.
2. Dr Nagendra, Hindi Sahitya Ka Itihas, Mayoor Paperbacks.
3. Manager Pandey, Bhakti Aandolan aur Surdaska Kavya, Vani Prakashan.
4. Dr Ramdars Mishra, Hindi Kahani- Antarang Pahchan, Vani Prakashan.
5. Namvar Singh, Hindi Ka Gadyaparva, Rajkamal Prakashan.
6. Dr Ramvilas Sharma, Bhasha, Yugbodh aur Kavita, Vani Prakashan.
7. Dr P Ravi, Kavita ka Vartaman, Vani Prakashan.
8. Ramswaroop Chaturvedi, Hindi Kavya ka Itihas, Lokbharti Prakashan.
9. Kailash Nath Pandey, Prayojanmoolak Hindi ki Nayee Bhoomika, Rajkamal Prakashan Samooh.
10. Kamta Prasad Guru, Hindi Vyakaran, Sahitya Sarovar.

ED1293E Understanding India – II

Pre-requisites: Understanding India – I (ED1193E)

Total Lecture Sessions: 26

L	T	P	C
2	0	0	2

Course Outcomes:

CO1: Demonstrate an understanding of ancient Indian knowledge, tradition and culture and evaluate its relevance in present times.

CO2: Analyse key Indian philosophical ideas, ethics and values and explain its position.

CO3: Demonstrate an understanding of ancient Indian linguistic traditions and explain its significance.

CO4: Show an awareness of traditional Indian dress, food and health practices and appraise its potential benefits.

CO5: Appreciate the contribution of Indian science and technology and identify the efficacy of ancient scientific concepts in day-to-day life.

Introduction of Knowledge of India: Recap of the previous semester's definitions and knowledge.

Philosophy, Ethics & Values: Schools of Philosophy: Vaisheshika, Nyaya, Samkhya, Yoga, Purva Mimamsa and Vedanta or Uttara Mimamsa (theory and the major thinkers) – Jain, Buddhist, and Charvak traditions; Vedanta philosophical systems (Advaita, Vishishtadvaita, Dvaita); Ethics, morality, and social dilemma (including self-leadership) and their relevance in today's time; How do Indians value spirituality? Spirituality and Social Responsibility; Importance of Spirituality in current times; Using ethics in a technologically volatile world: leading an ethical and modern life; Practical Vedanta for well-being (mindfulness, inter-connectedness, society-self relationship, etc.).

Culture-Lifestyle: Language as culture and identity, Ancient Indian Linguistics and oral traditions, Evolution of different Indian languages-Ancient grammarians and their contributions, Food (regional cuisines, ayurvedic diet, food and festival, food and hospitality, impact of globalisation), Clothes (traditional Indian clothing, Textile arts- handmade- texture-embroidery, clothing status- for occasions- significance of colour- varieties for gender, impact of globalisation), The lifestyle of Yoga: adapting ancient lifestyle – A path towards longevity, Indian spirituality- Importance of spirituality in current times. Sports (traditional Indian sports, martial arts, sports and gender, impact of globalisation).

Science & Technology: Arithmetic and Logic, Natural sciences: Mathematics, Physics, Chemistry, Metallurgy, Astronomy: India's contributions to the world, Indian notions of time and space, Technology in the economy: agriculture, transportation, etc.

References:

(a) **Books**

1. A.L. Basham, (ed.), *A Cultural History of India*, 7th edition, Oxford University Press, 2003.
2. A.L. Basham, *The Wonder That Was India*, Volume 1, Picador, 2019.
3. B.Mahadevan, Vinayak Rajat Bhat, R.N. Nagendra Pavana, *Introduction to Indian Knowledge Systems: Concepts and Applications*, PHI Learning, 2022.
4. B. N. Luniya, *Evolution of Indian Culture – From the earliest times to the present day*, 1992.
5. Mohan Raghavan, M.S. Harsha Simha, C.R. Ramaswamy, *Elements of India Knowledge Systems and Heritage*, HTSS Institute 2023
6. Samskrita Bharati, *Pride of India: A Glimpse in to India's Scientific Heritage*, 2006.

(b) Websites

7. Indian Culture. https://www.indianculture.gov.in/
8. Indian Knowledge Systems, Govt. of India. https://iksindia.org/
9. Ministry of Culture, Govt. of India. https://indiaculture.gov.in/
10. Visual arts. CCRT. https://ccrtindia.gov.in/[illegible]/visual-arts/

ED1294E Teacher and Society

Pre-requisites: Nil

Total Lecture Sessions: 28

L	T	P	C
2	0	0	2

Course Outcomes:

CO1: Critically examine the relationship between beliefs, values, character, life, social and cultural context of the teacher and teaching.

CO2: Explain the roles and characteristics of the teacher and its significant role in nurturing the posterity.

CO3: Identify the narrow and broad curricular aims of education and explain their role in shaping self, school, and society.

CO4: Develop positive classroom environment through engaging in the ethic of care.

CO5: Critically reflect on personal and collective practice in order to improve learning and teaching. CO6: explain individual, contextual, and structural dimensions of teacher agency and appreciate its impact in education.

Understanding the Teacher: Exploring the Personal and Professional Teacher: Exploring the wider Personal and General Social Context of Teacher: Life History, Teacher Beliefs, Values and Aspirations, Diverse Identities, Social Contexts and Commitment to Learning and Education; Exploring the Professional Teacher: Qualifications, Education in teaching, Attitude, Aptitude, Experience and Exposure. The Charismatic Teacher, the Communicator Teacher, The Missionary Teacher, The Competent Practitioner, The Reflective Practitioner, The Learning Teacher; Reflective Practice: Nurturing the Professional Capital through collaborative and/or collective engagement with self, others, the social context.

Nurturing the Teacher: A Dialogue beyond the curricular goals, for Life and Posterity: Teaching: One profession, many roles; Teaching Character: Nurturing Teachers for Human Flourishing; Holistic Teacher Development: Nurturing the Panchakoshas; Teacher Values, Beliefs, and current Philosophy of Teaching: A Reflective Dialogue; Developing an Ethic of Care in Teacher Education: Nurturing Teachers towards a pedagogy of care.

Understanding and Fostering Teacher Agency: Role in shaping Education Systems of Tomorrow: eacher Agency: meaning and importance; Individual, Cultural and Structural Dimensions of Teacher Agency; Teacher discourses, Philosophy, Relationships, Networks and Professional Development: Shaping teacher agency and Creative insubordination; Challenges and Issues in fostering Teacher Agency: Performativity, Non-academic, engagements, Systemic apathy, Policy and Practice gaps and others; Role of Teacher in shaping the educational policy, practice, and reforms.

Teacher as an Architect of the New India: Shaping the Society of Tomorrow:
Engaging in Critical Education: Dialogues on power relations associated with Gender, Ethnicity, Culture, Disability, Class, Poverty, the reproduction of disadvantage and realising the true human potential; Being a Critical Teacher: Raising debates around rapid technological advancement and impact on individual, family and social life; the growing isolation and impact on mental and social health and well-being; changing relationships between the 'state' and the 'market' and their impact on formal education; the conceptualisation of teacher, teaching and teacher roles; 'globalisation' and the reconstructed nationalism shaping the socio-political milieu and impact on social psyche; growing materialistic urge, sensory drives and the gradual deterioration of the individual and societal character.

References:

1. Julie Ellison Justice, F. Blake Tenore (Ed.) *Becoming Critical Teacher Educators: Narratives of Disruption, Possibility, and Praxis*, Routledge, 2018.
2. Donna Walker Tileston, *10 Best Teaching Practices: How Brain Research and Learning Styles Define Teaching Competencies*, 3rd edition, Corwin Press 2011.
3. Danielle Herro, Cassie Quigley, *An Educator's Guide to STEAM*, Teachers' College Press, 2019.
4. Ellen Nuijten, Fred Korthagen, *The Power of Reflection in Teacher Education and Professional Development: Strategies for In-Depth Teacher Learning*, Routledge, 2022.
5. Becky Zayas, Ian Jukes, et al. *Learner Choice, Learner Voice: A Teacher's Guide to Promoting Agency in the Classroom (Eye on Education)*, Routledge, 2022.
6. Todd Whitaker, *What Great Teachers do differently-Nineteen things that matter most*, 3rd edition, Routledge, 2020.
7. Denise Mifsud, Stephen P. Day (Ed.), *Teacher Education as an ongoing Professional Trajectory*, Springer, 2023
8. N. Entwistle (ed.), *Handbook of educational ideas and practices*, Routledge, 1990.

PH1202E Heat and Thermodynamics

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Identify the relevant variables of a thermodynamic system and set up equations of state.

CO2: Evaluate entropy changes involved and distinguish processes as reversible and irreversible.

CO3: Apply the first and second laws of thermodynamics to thermodynamic systems.

CO4: Analyse the thermodynamic properties of a given system using appropriate thermodynamic potentials.

CO5: Analyse phase transitions using the conditions of phase equilibrium and thermodynamic stability.

Basic Concepts: Microscopic and macroscopic description of a system- thermodynamic systems – types- thermal equilibrium– Zeroth law of thermodynamics – temperature- units- mechanical, chemical, and thermodynamic equilibrium - intensive and extensive parameters- equation of state- ideal gas and real gas- hydrostatic systems- simple example of the thermodynamic description of a stretched wire.

First Law: Work done in a process- quasi-static process- work done in the case of a hydrostatic system- PV diagram- example of a stretched wire- adiabatic work and internal energy- the mechanical equivalent of heat - heat capacity - enthalpy and specific heats of ideal gases- first law of thermodynamics – work done in isothermal and adiabatic processes- consequences of the first law of thermodynamics- energy equation- Gay- Lussac- Joule experiment - Joule- Thomson experiment of free expansion – heat engines - Carnot cycle.

Second Law: Limitations of the first law- definition of entropy – irreversible processes- Carnot's theorem- Clausius inequality– entropy change of pure substances- entropy changes in reversible and irreversible processes- temperature- entropy diagrams - the principle of increase of entropy - refrigerators and heat pumps- Clausius and Kelvin- Planck statement of the second law– equivalence of the two statements – combined first and second laws - T- dS relations – properties of pure substances - ideal gas and van der Waals gas.

Thermodynamic potentials and phase transitions: Thermodynamic potentials– Helmholtz and Gibb's functions- Maxwell's relations- stable and unstable equilibrium- chemical potential - conditions of equilibrium- first-order phase transitions - phase-coexistence - Clausius-Clapeyron equation- third law of thermodynamics- statements- equivalence of the statements- consequences.

References:

1. M. W. Zemansky, R. H. Dittman, *Heat and Thermodynamics*, 8th Edition, McGraw-Hill, 2017.
2. F. W. Sears, G. L. Salinger, *Thermodynamics, Kinetic theory and Statistical Thermodynamics*, Narosa, New Delhi, 1993.
3. H. B. Callen, *Thermodynamics and an Introduction to Thermostatistics*, 2nd Edition, Wiley, 1985.
4. A. H. Carter, *Classical and Statistical Thermodynamics*, 1st Edition, Pearson 1999.

PH1202E Electricity and Magnetism

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Apply concepts of vector calculus to describe electric and magnetic fields.

CO2: Identify simplifying principles like symmetry to compute electric and magnetic fields.

CO3: Formulate and solve problems involving time dependent electromagnetic fields using Maxwell's equations.

CO4: Analyze propagation of electromagnetic waves in vacuum and dielectric media.

Electrostatics: Electrostatic force and field: scalar and vector fields - Coulomb's law - flux of the electric field and Gauss's law - divergence of electric field - electric potential - line integral of the field - curl of the electric field - Poisson and Laplace equation - electrostatic work and energy - conductors and electric fields - field and potential of dipoles - electric polarization vector – Gauss's law for a dielectric medium - electrostatic boundary conditions.

Magnetostatics: Electric current - current density - surface and volume currents - continuity equation - magnetic field - Biot- Savart law - divergence and curl of magnetic field - Ampere's law - field due to a magnetic dipole - magnetic dipole in an external magnetic field - magnetostatic energy - magnetized materials - magnetostatic boundary conditions.

Time dependent Electric and Magnetic fields: Electromotive force - Faraday's law – Lenz's law - electromagnetic induction - mutual and self- inductance - Maxwell's equations - Maxwell's correction to Ampere's law - displacement current - electromagnetic field – energy density - Poynting's theorem.

Electromagnetic Waves: Maxwell's equations in free space - wave equation - plane wave solutions - structure of the electro- magnetic waves - spherical waves - propagation in dielectric medium and refractive index, reflection and transmission at dielectric interfaces, propagation in conducting medium.

References:

1. D. J. Griffiths, *Introduction to Electrodynamics*, 4th Edition, PHI Learning, 2012.
2. E. Purcell and D. Morin, *Electricity and Magnetism* 3rd Edition, Cambridge University Press, 2013.
3. D. Halliday, R. Resnick and J. Walker, *Fundamentals of Physics*, 10th Edition, John Wiley & Sons, 2013
4. R. P. Feynman, R. Leighton and M. Sands, *Feynman Lectures on Physics Vol.-II*, Millenium Edition, Pearson, 2012.
5. J. Edminister, *Schaum's Outline: Theory and Problems in Electromagnetics*, 2nd Edition, McGraw-Hill, 1979.

CH1203E Chemistry Minor – II
Physical Chemistry

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Apply the building models of equations of state and molecular behaviours on experimental observations.

CO2: Comprehend and discriminate the basic concepts of thermodynamics.

CO3: Use analytical methods in chemistry for practical problems.

CO4: Describe the law of chemical equilibrium and electrochemistry.

States of matter: Variables of state, equations of state, Boyle's law, Charles's law, Avogadro's principle, mixtures of gases, ideal and nonideal gases, gas laws, Dalton's law of partial pressures, molecular speeds and translational energies, equations of state for nonideal gases, liquefaction of gases and the critical phenomena, virial coefficients, critical constants, van der Waals equation, physical properties of liquids, vapour pressure, excess pressure, viscosity and Reynold's number, Raoult's law and Henry's law, ideal and nonideal solutions, azeotropic mixtures, distillation, nature of the solid state, anisotropy, amorphous and crystalline solids, space groups, crystal lattices, lattices and unit cells, crystal systems, Bravais lattices, Miller indices, identification of lattice planes, inter planar distances, Bragg's law, X-ray diffraction, X-ray diffraction for cubic system.

Thermodynamics: Definition of thermodynamic terms, first law of thermodynamics, heat capacities at constant volume and at constant pressure & their relationship, standard enthalpy changes, enthalpy of formation, Hess's law, variation of enthalpy of reaction with temperature, Kirchhoff equation, expansion of ideal gas, work done in isothermal expansion and reversible isothermal expansion, second law of thermodynamics, concept of entropy, criteria of spontaneity and equilibrium, third law of thermodynamics, residual entropy.

Chemical Kinetics: rate of reactions, rate law and rate constant, order and molecularity of reaction, methods to determine the order, integration of rate expressions, half-life of reaction, Arrhenius equation, significance of Arrhenius parameters, steady state approximation, parallel reactions, opposing reactions, consecutive reactions and chain reactions with examples (elementary idea only), theories of reaction rates, collision theory, transition state theory.

Equilibria and Adsorption: Chemical equilibrium, law of mass action, thermodynamic derivation, Van't Hoff reaction isotherm, phase equilibrium, phase, component, degrees of freedom, Gibbs phase rule, Clausius-Clapeyron equation, phase diagram for one component systems, with applications, two component systems, simple eutectic system (lead - silver system), Pattinson's process, adsorption by solids, chemisorption and physisorption, types of adsorption isotherms, adsorption isotherms: Freundlich and Langmuir isotherms.

Analytical Principles: Analytical methods for the separation and analysis of compounds, theory of gravimetric analysis, solubility product, common ion effect, principles of volumetric analysis, primary standard, standard solution, calculation of normality, molality and molarity of solutions, theory of acid

- base titrations, redox titrations, chromatography, paper and thin layer chromatography, column chromatography.

Electrochemistry: Arrhenius concept, Bronsted-Lowry concept, Lewis concept, weak and strong electrolytes, dissociation of water, pH scale, Ostwald's dilution law, its uses and limitations – Debye Huckel - Onsager's equation for strong electrolytes.

References:

1. P. Atkins, J. de Paula, *Atkin's Physical Chemistry*, 11th Edition, Oxford university press, 2018.
2. G. K. Vemulapalli, *Physical Chemistry*, PHI Learning Pvt. Ltd., 1996.
3. B. R. Puri, L. R. Sharma, M. S. Pathania, *Principles of Physical Chemistry*, 48th Edition, Vishal Publishing Co., 2021.
4. R. A. Day Junior, A. L. Underwood, *Quantitative Analysis*, 5th Edition, Prentice Hall of India Pvt. Ltd. 1988.
5. J. Mendham, R. C. Denney, J. D. Barnes, M. Thomas, *Vogel's Text Book of Quantitative Chemical Analysis*, 6th Edition, Pearson Education, 2003.
6. D. A. Skoog, D. M. West, F. J. Holler, S. R. Crouch, *Fundamentals of Analytical Chemistry*, Brooks/Cole.

MA1202E Mathematics Minor – II
Algebra and Differential Equations

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Check the consistency and solve the system of linear equations.

CO2: Diagonalize symmetric matrices and use it to find the nature of quadratic forms.

CO3: Acquire sufficient knowledge about vector spaces, linear transformation and theory of matrices.

CO4: Formulate some real world problems as ODEs and hence solve such problems.

CO5: Formulate some real world problems as PDEs and hence solve such problems.

System of Linear equations: Gauss elimination, Rank of a matrix, Consistency of linear system. Vector spaces, Subspaces, Basis and dimension, Linear transformation, Rank-nullity theorem, Inner-product, Gram-Schmidt orthogonalization, Matrix representation of linear transformation. Eigenvalues and Eigenvectors of matrices, Cayley-Hamilton theorem, Similarity of matrices, Diagonalization.

Ordinary Differential Equations: Existence and uniqueness of solution of first order ODE, methods of solutions of first order ODE, linear ODE, orthogonal trajectories, linear homogeneous second order ODEs with constant coefficients, fundamental system of solutions, existence and uniqueness of solutions, Wronskian, method of undetermined coefficients, solution by variation of parameters, Euler-Cauchy equations, applications of first and second order ODEs, system of linear ODEs with constant coefficients.

Partial differential Equations: Basic Concepts, Cauchy's problem for first order equations, Linear Equations of the first order, Nonlinear Partial Differential Equations of the first order, Charpit's Method, Special Types of first order equations, Classification of second order partial differential equations, Method of Separation of variables.

References:

1. H. Anton, I. Bivens, S. Davis, *Calculus*, 10th edition, John Wiley & Sons, 2013.
2. G. B. Thomas, M.D. Weir, J. Hass, *Thomas' Calculus*, 12th edition, Pearson Education, 2015.
3. E. Kreyszig, *Advanced Engineering Mathematics*, 10th edition, John Wiley &Sons, 2015.
4. V. I. Arnold, *Ordinary Differential Equations*, Springer, 2006.
5. G. Strang, *Introduction to Linear Algebra*, Cambridge Press, 2016.
6. I. N Sneddon, *Elements of Partial Differential Equations*, Dover Publications, 2006.
7. T. Amarnath, *An Elementary Course in Partial Differential Equations*, Narosa Publishing House,2003.

CS1201E Computer Programming with C

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	0	2	4

Course Outcomes:

CO1: Implement programs using classes and objects.
CO2: Able to understand the overloading concept.
CO3: Specify the forms of inheritance and use them in programs.
CO4: Analyze polymorphic behavior of objects and polymorphism.
CO5: Understand virtual functions.

C Fundamentals: The C character set identifiers and keywords, data type & sizes, variable names, declaration, statements.

Operators & Expressions: Arithmetic operators, relational and logical operators, type, conversion, increment and decrement operators, bit wise operators, assignment operators and expressions, precedence and order of evaluation. Input and Output: Standard input and output, formatted output – printf, formatted input scanf. C pre-processor, command line arguments.

Flow of Control: Statement and blocks, if – else, switch, loops - while, for, do while, break and continue, go to and labels.

Functions: Basic of functions, function types, functions returning values, functions not returning values, auto, external, static and register Variables, scope rules, recursion

Arrays and Pointers: One-dimensional, two-dimensional arrays, pointers and functions, multidimensional arrays.

Structures Union and File: Structure, union, structures and functions, arrays of structures, file read, file write.

Laboratory:

1. Programs on expression evaluation.
2. Programs on conditional branching, iterations, pattern matching.
3. Programs on function, recursion.
4. Programs on arrays, pointers, parameter passing.
5. Programs on string using array and pointers. 6. Programs on structures, union.

Learning Resources:

Text Books:

1. B. S. Gottfried, "Programming with C", McGraw Hill Education, Fourth edition, 2018.
2. B. W. Kernighan, D. Ritchie, "The C Programming Language", Pearson Education India, Second edition, 2015.

Reference Books:

1. E. Balagurusamy, "Computing Fundamentals and C Programming", McGraw Hill Education, Second edition, 2017.
2. Y. Kanetkar, "Let Us C", BPB Publications, Sixteenth edition, 2017.
3. E. Balagurusamy, "Programming in ANSI C", McGraw Hill Education India Private Limited, Seventh edition, 2017.

PH124E Physics Lab – II

Pre-requisites: Nil

Total Lecture Sessions: Nil

L	T	P	C
0	0	2	1

Course Outcomes:

CO1: Apply principles of electromagnetics and thermodynamics for experimentation.

CO2: Develop skills for data analysis and interpretation.

CO3: Set up experiments, take observations and relate it with a suitable theory.

CO4: Build ability for group discussion and critical thinking for collaborative work.

List of Experiments: *(A student should complete any seven of these)*

1. Newton's law of Cooling.

2. Latent heat of fusion of ice.

3. Jolly's bulb (a) Verification of Gay-Lussac's law; (b) Verification of T and P relation.

4. Determination of horizontal component of earth's magnetic field using a tangent galvanometer.

5. Determination of time constants for RL and RC circuits.

6. Variation of magnetic field along axis of a circular coil.

7. Specific resistance of a material of a given wire using meter bridge.

8. Mapping of the magnetic field of a solenoid.

9. Measurement of the saturated vapour pressure using J- tube/ Jolly's bulb.

10. Lee's disc – thermal conductivity measurement.

References:

1. 1. B.L.Flint & H.T.Worsnop, Advanced Practical Physics for students, Asia Publishing House, 1971.
2. E.Armitage, Practical Physics, John Murray
3. S.Panigrahi & B.Mallick, Engineering Practical Physics, Cengage Learning India Pvt. Ltd., 2015
4. R. A. Dunlop, Experimental Physics, Oxford Univ. Press, 1988

SEMESTER – III

ED2301E Child Development and Educational Psychology

Pre-requisites: Nil

Total Lecture Sessions: 52

L	T	P	C
4	0	0	4

Course Outcomes:

CO1: Understand and articulate the meaning, concept, characteristics, factors affecting growth and Development and use the knowledge of Indian concept of self.

CO2: Analyse the process and factors that affect development and use proper tools and technique to identify learner with different abilities.

CO3: Conceptualize the advance theories of learning to design classroom practice, apply various problem solving and learning strategies in real classroom settings.

CO4: Analyse the need and importance of motivation and implement suitable classroom management strategies that promote effective teaching and learning.

Child Development: Child Development-Meaning and process: Biological, cognitive, socio-emotional, and moral, Significance of understanding the process of Child Development, Developmental characteristics of a child during: Infancy stage, Early Childhood stage, Middle to Late Childhood stage, Adolescence stage. The Indian concept of self: Mind, Intellect, Memory, Panch-koshiya Vikas. Educational Implications.

Developmental Process: Development across domains: Physical Development, Cognitive Development, Language Development, Socio-Emotional Development, Aesthetic Development, Moral Development Factors affecting development (During each of the above-mentioned developmental stages of a child) Individual differences, Children with special needs including developmental disorders, Tools and Techniques for Identifying Learner with different abilities. Teachers' role and strategies to address the needs of learners with different learning abilities.

Process of Learning: Conceptual Clarity and significance, Approaches- Behaviorist, Cognitivist, Constructivist, and Developmental. Information processing Model of learning. Shri Aurobindo's Integral approach, Problem Solving and Learning Strategies: Inquiry and problem-based learning, Steps and Strategies in problem solving, Factors hindering problem solving, How to Learn: Significance and Strategies.

Motivation and Classroom Management: Motivation: Conceptual clarity, nature, and significance, Intrinsic and Extrinsic Motivation, Strategies for Motivation, Classroom management: Creating a positive learning environment, Planning space for learning, Managing behavioral problems, Group dynamics: Classroom as a social group, Characteristics of group, Understanding group interaction-Sociometry, Strategies to facilitate group learning.

References:

1. E. B. Hurlock, *Child Growth and Development*, Tata Mc Graw - Hill Education, 2013.
2. S. K. Mangal, *Advance educational psychology*, 2nd edition, PHI Learning Pvt. Limited, 2019.
3. C. S. Hall, L. Gardner, B. C. John, *Theories of personality*, Agarwal Printing Press, 2010.
4. W. Buskist, S. F. Davis (Eds.), *Handbook of the teaching of psychology*, Blackwell Publication, 2006.

5. E. E. Smith, S. M. Kosslyn, *Cognitive psychology mind and brain*, Prentice Hall of India Pvt. Ltd, 2008.
6. E. B. Hurlock, *Developmental psychology: A life-span approach*, McGraw-Hill, 1980.
7. A. Woolfolk, *Educational psychology*, Pearson PubLication, 2008.

ED2302E General Pedagogy

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Develop an understanding and appreciation of factors that influence learning ability.

CO2: Gain a knowledge of pedagogical strategies for multidisciplinary learning.

CO3: Demonstrate an ability to identify teaching methods and strategies that are appropriate for different contexts.

CO4: Explore ways of updating current trends in education and identify strategies for developing professionally.

The physical, mental, social, and emotional growth of learners, Thought processes and cognitive skills of learners, Characteristics of secondary stage learners: Unique capabilities, Conflicts and challenges. Relationship between Aims and Values of Education, Curriculum and Pedagogy, Concept, characteristics and functions of teaching, Teaching- learning process as a behavioral change, knowledge domains and cognitive processes, action words. Anderson and Krathwohl's revised Bloom's taxonomy. Dale's cone of experiences and its implications in the classroom teaching learning process.

Pedagogical approaches: Role of prior knowledge in constructing new knowledge (Ausubel), Piaget's theories of learning (schema- disequilibrium), Vygotsky's theories of role of language and context in learning, Von Glasersfeld's theory. Concept Attainment Model (Bruner), collaborative approach, reflective approach, integrative approach, inquiry- based approach, other contemporary approaches, art-integrated learning, sports- integrated learning. Building values through art integrated activities, community engagement etc.

Types of pedagogy: social pedagogy, critical pedagogy, culturally responsive pedagogy, Socratic pedagogy in inclusive setup, Role of pedagogy in effective learning: how does pedagogy impact the learner.

Teaching and Microteaching, Meaning and Definition of Teaching, Teacher-Training Programme Before Microteaching, Meaning and Concept of Microteaching, Definitions of Microteaching, Objectives of Microteaching, Microteaching at Work, Propositions of Microteaching - Phases, Activities and Components of Microteaching, Knowledge Acquisition Phase - Skill Acquisition Phase - Transfer Phase of Microteaching, Evaluation of Microteaching Teaching Skills, Core Teaching Skills, Organization of Microteaching Cycle, Development of Microteaching, Assumptions of Microteaching, Principles of Microteaching Technique, Skill of Probing Questions, Skill of Explaining, Skill of Illustrating with Examples, Skill of Reinforcement, Skill of Stimulus Variation, Skill of Classroom Management, Skill of Using Blackboard.

Importance of planning, unit plan and lesson plan. Elements of unit plan and lesson plan, developing lesson plans on different topics and through various approaches taking examples from secondary stage. Development of constructivist practices in science teaching, 5E learning model, 7E model, making abstract concepts enjoyable by relating them to real life situations, promoting learner participation and engagement in learning, promoting multidisciplinary learning through integration of different disciplines.

Differences between occupation and profession, Teaching as a profession, professional and ethical competencies and need for updating content and pedagogical competencies to develop their professional competencies.

References:

1. R. W. Canestrari, B. A. Marlowe, *Educational Foundations: An Anthology of Critical Readings*, 4th Edition, Sage, 2020.
2. N. Denby (ed.), *Training to Teach: A Guide for Students*, Sage Publications Ltd., 2015.
3. C. Kyriacou, *Essential Teaching Skills*, Oxford University Press.
4. R. P. Pathak, *Teaching Skills*, Pearson Education India, 2012.
5. J. Loughran, M. L. Hamilton, *International Handbook of Teacher Education*, Vol 2, Springer, 2016.
6. W. W. Murawski, K. L. Gandhi, *What Really Works in Secondary Education*, Corwin, 2015.
7. *National Curriculum Framework for School Education*, 2023.
8. *Mandate documents: Guidelines for the development of National Curriculum Frameworks*, National Council of Educational Research and Training, 2022.
9. *National Education Policy* 2020, Ministry of Education, Government of India, 2020.
10. *National Policies on Education* 1968, 1986 and 2020.
11. G. Petty, *Teaching Today*, 3rd edition, Oxford University Press, 2004.
12. J. Scrivener, *Learning Teaching*, Macmillan, 1994.

PH2301E Waves and Optics

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Apply wave mechanics to describe the behavior of waves, interference, diffraction, etc.

CO2: Employ the principles of interference, diffraction and polarization, for modulating the optical fields in different systems.

CO3: Analyze the ray paths and aberrations in different optical systems using the principles of ray optics.

CO4: Apply the concepts of ray optics, electromagnetic theory, interference, diffraction and polarization to design basic optical instruments.

Waves: Waves - longitudinal and transverse waves - wave equation - solutions – harmonic waves – plane and spherical waves - electromagnetic waves - superposition principle - interference of waves – standing waves and beats.

Interference and diffraction of light waves: Light as a wave - Young's double slit experiment - fringe pattern - visibility - coherence – diffraction - interferometry - Michelson interferometer - Mach-Zehnder interferometer - Spectral bandwidth of source and coherence time – Diffraction – Fresnel and Fraunhofer diffraction effects – Single slit diffraction – Beam spreading – Rectangular and circular apertures – Rayleigh's criterion of resolution of optical instruments.

Polarization: Polarized and unpolarized light – plane, circularly and elliptically polarized light – Stokes parameters – Matrix representation of polarized light and polarizers – Production of polarized light – Dichroism – Birefringence – Quarter wave plate and half wave plate – Brewster's law – Optical activity.

Ray optics: Geometrical and physical optics – Fermat's principle and applications – Principle of reversibility – Image formation – Beam expanders - Design considerations – Ray equation and solution in inhomogeneous media – Mirage and ray paths in optical fibers – Matrix methods in paraxial optics – Aberrations – Classifications and correction methods.

References:

1. F. L. Pedrotti, and L. S. Pedrotti, *Introduction to Optics*, 3rd Edition, Cambridge University Press, 2017.
2. E. Hecht, *Optics*, Pearson Education, 2003.
3. A. Ghatak, *Optics*, Tata-McGraw-Hill, 2010.

PH2302E Electronics

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Describe the structure, operation, and applications of diodes and transistors (BJTs).

CO2: Design and analyze op-amp based amplifier and sinusoidal oscillator circuits.

CO3: Apply binary system and logic gate principles to design combinational circuits.

CO4: Interpret and analyze data obtained from electronic measurements.

Semiconductor Physics and Devices: *Semiconductors*: Types of Charge Carriers; Energy Band Theory; Intrinsic and Extrinsic semiconductors; Doping - *n*-type and *p*-type semiconductors; Carrier Concentration; Carrier Transportation.

Diodes: Barrier Formation in *p*- *n* Junction Diodes; Current Flow Mechanism under Forward and Reverse Biased *p*- *n* Junction Diodes; Current- Voltage (I- V) Characteristics; Principle and structure of (1) LEDs, (2) Solar Cells, and (3) Photodetectors.

Bipolar Junction transistors: *n*- *p*- *n* Junction; Transistor Action; Active, cut off, and Saturation mode of operations; Common Base (CB), Common Emitter (CE), and Common Collector (CC) configurations; Current gains- α and β; DC Load line and Q point; Voltage Divider Bias Circuit for CE Amplifiers, h-parameter Equivalent Circuit, Analysis of a single- stage CE amplifier using Hybrid Model, Input and Output Impedance, Current, Voltage and Power Gains.

Operational Amplifiers (Black Box approach): *Amplifier*: Characteristics of an Ideal and Practical Op-Amp (IC 741); Open-loop & Closed-loop Configurations; Concept of Virtual Ground; Op-Amps as (i) an Inverting Amplifier (ii) Non-inverting Amplifier, (iii) a Summing amplifier, (iv) a Difference Amplifier, (v) a Differentiator, (vi) an Integrator, and (vii) a Zero Crossing Detector.

Sinusoidal Oscillators: Barkhausen's Criterion for Self-Sustained Oscillations; RC Phase Shift Oscillator.

Digital Circuits: Difference between Analog and Digital Circuits, Binary Numbers, Decimal to Binary and Binary to Decimal Conversion, Binary Addition, Binary Subtraction using 1's and 2's Complement Method; AND, OR and NOT Gates (Realization using Diodes); NAND and NOR Gates as Universal Gates; XOR and XNOR Gates; De Morgan's Theorems; Boolean Laws; Simplification of Logic Circuits using Boolean Algebra; Fundamental Products: - Minterms and Maxterms; Conversion of a Truth Table into an Equivalent Logic Circuit by (1) Sum of Products /Product of Sum Method and (2) Karnaugh Map Method; Half Adders and Full Adders; Half Subtractor and Full Subtractor; 4- bit binary Adder-Subtractor.

Electronic measurements and power supplies: Function generators for waveform generations, Cathode Ray Oscilloscope (CRO) to Study of Waveforms, Measurement of Voltage, Current, Frequency, and Phase Difference; Multimeter- applications and usage.

Power supplies: Half- Wave Rectifiers, Centre- Tapped and Bridge Full- Wave Rectifiers, Ripple Factor and Rectification Efficiency; Zener Diode as a Voltage Regulator.

References:

1. J. Millman, C.C. Halkias, *Integrated Electronics*, Tata Mc-Graw Hill.
2. A.S. Sedra, K.C. Smith, A.N. Chandorkar, *Microelectronic circuits*, 6th Edition, Oxford University Press.
3. R. A. Gayakwad, *OP-Amps and Linear Integrated Circuit*, 4th edition, Prentice Hall.
4. Albert Malvino, Electronic Principle, Tata Mc-Graw Hill.
5. A.P. Malvino, D.P. Leach, Saha, *Digital Principles & Applications*, 7th Edition, Tata McGraw Hill.
6. Elfrick, Cooper, *Modern Electronic Instrumentation & Measurement Tech.*, PHI Learning.

CH2303E Chemistry Minor – III
Inorganic Chemistry

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Apply the concepts of inorganic chemistry to real-life problems.

CO2: Correlate the chemical bonding and structure.

CO3: Apply the organometallic chemistry concepts for the catalysis applications.

Elements and periodicity, classification of elements, concepts of atomic, ionic, and covalent radii, oxidation state, ionization energy, electronegativity, electron affinity, polarizability, inert pair effect, lanthanoid contraction.

Structure and bonding, crystal lattices and unit cell, crystal packing and defects, structures of NaCl, CsCl, and wurtzite, lattice enthalpy, Born-Haber cycle, structures of elemental B, C, Si, P, and S, bonding in boron halides, PF_5, SF_4, interhalogens, and xenon fluorides, Bent's rule, Berry pseudo rotation, Molecular orbital diagrams of selected molecules: N_2, O_2, HF, BeH_2, and CO_2.

Oxidation and reduction, reduction potential, electrochemical series, redox reactions, balancing of redox equations, factors affecting redox stability, Frost diagrams for redox reactions, Ellingham diagrams and extraction of elements.

Acids and bases: Arrhenius concept, solvent systems (in H_2O, NH_3, SO_2, and HF), Brønsted concept, Lux- Flood concept, and Lewis's concept, HSAB principle, superacids, relative strengths of acids; acid-base neutralization curves and indicators.

Main group chemistry, structure and bonding of compounds of boron, carbon, and noble gas elements.

Coordination compounds, geometries and isomerism of coordination compounds, crystal field theory, spectrochemical series, weak field and strong field ligands, spinel, and inverse spinel structures, Jahn-Teller effect, thermodynamic stability and kinetic lability of coordination complexes, optical activity of coordination complexes.

Organometallic chemistry and catalysis, introduction to organometallic compounds, structure and bonding, 18-electron rule, concepts and applications of catalysis in homogeneous and heterogeneous processes such as Wilkinson hydrogenation, Wacker oxidation, and Ziegler-Natta polymerization.

References:

1. P. Atkins, T. Overton, J. Rourke, F. Armstrong, M. Hagerman, *Shriver and Atkins' Inorganic Chemistry*, 5th edition, W. H. Freeman and Company, 2009.
2. G. L. Miessler, D. A. Tarr, *Inorganic Chemistry*, 3rd Edition, Pearson, 2008.
3. J. E. House, *Inorganic Chemistry*, 3rd edition, Academic Press, 2019.
4. J. E. Huheey, E. A. Keiter, R. L. Keiter, *Inorganic Chemistry – Principles of Structure and Reactivity*, 4th edition, Pearson Education, 2006.
5. C. E. Housecroft, A. G. Sharpe, *Inorganic Chemistry*, 4th edition, Pearson, 2012.

MA2303E Mathematics Minor – III
Probability and Statistics

L	T	P	C
3	1	0	4

Pre-requisites: Nil

Total Lecture Sessions: 39

Course Outcomes:

CO1: Develop the basic concepts of one- and two-dimensional random variables and apply in Real life applications.

CO2: Use techniques of statistical inferences and their applications.

CO3: Apply regression and correlation for analyzing real life problems.

CO4: Apply sampling distributions and statistical techniques to various fields.

Probability Distributions: Random Variables: Introduction to discrete and continuous random variables, quantify spread and central tendencies of discrete and continuous random variables, Chebyshev's inequality, Some important discrete distributions, Properties and applications of Normal, Student's t, Chi-Square and F distributions, Transformation of a random variable, Probability distribution of a function of a random variable, Jointly distributed random variables, Marginal and conditional distributions, Bi-variate Normal distribution, Joint probability distribution of functions of random variables.

Statistical Inference: Point and interval estimates of population parameters: Point Estimation of the population mean, distribution of the sample means, confidence Intervals on the population mean, optimal sample size to obtain precision and confidence in interval estimates of mean, maximum likelihood parameter estimation, Hypothesis Testing: Formulation of null and alternate hypotheses, errors in hypothesis tests, power of hypothesis tests, hypothesis tests on population means, variances and ratios of variances. Estimation of proportions, Hypothesis tests concerning one proportion and several proportions, Analysis of $r \times c$ contingency tables, Chi-square test for goodness of fit.

Regression and ANOVA: Curve fitting, Method of least squares, Estimation of simple regression models and hypotheses concerning regression coefficients, Correlation coefficient, Estimation of correlation coefficient, Hypothesis concerning correlation coefficient, Analyse single factor experiments: Introduction to Analysis of Variance (ANOVA).

References:

1. S. Ross, *A First Course in Probability*, 9th Edition, Pearson, 2014.
2. R. A. Johnson, *Miller and Freund's Probability and Statistics for Engineers*, 8th edition, Prentice Hall of India, 2011.
3. W. W. Hines, D. C. Montgomery, D. M. Goldsman, C. M. Borror, *Probability and Statistics in Engineering*, 4th Edition, John Wiley & Sons, Inc., 2003.
4. D.C. Montgomery, G. C. Runger, *Applied statistics and probability for engineers*, 7th Edition, Wiley, 2019.
5. Walpole, *Probability and statistics for engineers and scientists*, Pearson Education India; 9th edition, 2013.

CS2301E Data Structures with C

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Understand the concept of data structure and create new data structure and also analysing the efficiency of the same.

CO2: Identify and differentiate different types of data structures and implement the appropriate data structure and analyse the same.

CO3: Understand and implement stack, queue and dequeue by selecting appropriate methods.

CO4: Understand and implement different non-linear data structures by selecting appropriate methods.

CO5: Understand different factors of sorting and searching algorithm and select the appropriate algorithm and also implement and analyse the algorithm.

Array: Introduction to sequential representation, Linearization of multidimensional array. Application of array- representation of polynomial using array, Representation of Sparse matrix using array.

Sorting and searching: Definition and need of sorting, different types of sorting algorithm (Bubble sort, Insertion sort, Selection sort, Quick sort, Merge sort, Radix sort, Sequential search, Binary search

Linked List: Introduction to linked representation, Implementation of different types of linked listSingly linked list, Doubly linked list, Circular linked list, Circular Doubly Linked List. Application of Linked list- Representation of polynomial.

Stack: Definition of Stack, implementations of stack using array and linked list Applications of stack- infix to postfix conversion, Postfix Evaluation Recursion: Principles of recursion - use of stack, tail recursion. Tower of Hanoi using recursion.

Queue: Definition of Queue, Implementation of queue using array- physical, linear and circular model. Implementation of queue using linked list.

Dequeue- Definition and different types of dequeue

Laboratory:

- Implementation of Bubble sort, selection sort, Insertion sort, Quick sort, Merge Sort and Radix sort using appropriate data structure.
- Implementation of list as data structure using linked list of different types.
- Implementation of polynomial as data structure using array and linked list.
- Implementation of sparse matrix as data structure using array.
- Implementation of stack as data structure using array and linked list.
- Implementation of queue as data structure using array (physical, linear and circular model) and linked list.
- Converting infix to post-fix and evaluating post-fix expression using stack.

- Implementing Tower-of-Hanoi problem

Learning Resources:

Text Books:

1. Fundamentals of Data Structures of C by Ellis Horowitz, Sartaj Sahni, Susan Anderson-freed 2nd Edition, Universities Press
2. Data Structures and Program Design In C by Robert L. Kruse, Bruce P. Leung 2nd Edition, Pearson

Reference Books:

1. Samiran Chattopadhyay, Debabrata Ghosh Dastidar, Matangini Chattopadhyay, *Data Structures Through 'C' Language*, BPB Publications, 2001
2. S. Lipschutz, *Data Structures*, Special Indian Edition, Tata McGraw Hill Education (India) Private Limited
3. Aaron M. Tenenbaum, *Data Structures in C*, 1st Edition, Pearson

PH2341E Physics Lab – III

Pre-requisites: Nil

Total Lecture Sessions: Nil

L	T	P	C
0	0	2	1

Course Outcomes:

CO1: Apply principles of optics for experimentation.
CO2: Develop skills for data analysis and interpretation.
CO3: Set up experiments, take observations and relate it with a suitable theory.
CO4: Build ability for group discussion and critical thinking for collaborative work.

List of Experiments: (*Any Seven of the following experiments*)

1. Spectrometer- Refractive index of the material of a solid prism
2. Spectrometer- Dispersive power of a prism
3. Spectrometer- i-d curve
4. Spectrometer- Cauchy's constants
5. Spectrometer- i-i' curve
6. Spectrometer- Grating, minimum deviation
7. Spectrometer- Grating, Dispersive power
8. Spectrometer- Grating- Resolving power
9. The Air Wedge
10. Newton's Rings
11. Liquid Lens
12. Edser-Butler fringes

References:

1. B.L. Flint, H.T. Worsnop, *Advanced Practical Physics for students*, Asia Publishing House, 1971.
2. E. Armitage, *Practical Physics*, John Murray.
3. S. Panigrahi & B. Mallick, *Engineering Practical Physics*, Cengage Learning India Pvt. Ltd., 2015.

SEMESTER – IV

ED2401E Philosophical and Sociological Perspectives of Education – I

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
4	0	0	4

Course Outcomes:

CO1: Understand the philosophical schools of thought from both Bharatiya and Western traditions, and their implications for education.

CO2: Understand how various philosophies influence educational practices and theories.

CO3: Critically reflect on the visions of prominent Indian and global educators.

CO4: Develop a comprehensive understanding of concepts of the Indian value system in contemporary society, with a special focus on effectively addressing pedagogical challenges.

Philosophical Schools and Education: Conceptual Clarity of the following schools of thoughts with their implications for educational practices: Bharatiya: Samakhya, Yoga, Nyaya, Vaisheshika, Mimamsa, Vedanta. Western: Idealism, Naturalism, Pragmatism, Progressivism.

Educational Thinkers: Deliberations on aims, process and educational institutions developed on thoughts of following thinkers and practitioners: Bharatiya: Swami Vivekananda, Sri Aurobindo Ghosh, Gurudev Rabindra Nath Tagore, J. Krishnamurti, Mahamana Madan Mohan Malaviya, Mahatma Gandhi, Gijubhai Badheka. Western: J. Rousseau, Maria Montessori, Friedrich Froebel, John Dewey.

Value Education: Conceptual Clarity, Significance and Types of Values, Indian Traditional Values, Guru-Shishya-Parampara and Educational Values, Convocation message in Taittriya Upanishad, Values enshrined in Indian Constitution, NEP- 2020 and Values with special reference to 21st Century, Pedagogical Issues.

References:

1. P. Smeyers, *International Handbook of Philosophy of Education*, Springer, 2018.
2. R. Bailey, R. Barrow, D. Carr, C. McCarthy (Eds.), *The SAGE Handbook of Philosophy of Education*, SAGE Publications, 2010.
3. H. Siegel, (Ed.) *The Oxford Handbook of Philosophy of Education*, Oxford University Press, 2009.
4. A.S. Thakur, S. Berwal, *Education in emerging Indian society*, Vikash Publication, 2007.
5. H.K. Rawat, *Sociology: Basic Concepts*, Rawat Publication, 2012.
6. C.N.S. Rao (eds.), *Sociology: Principles of Sociology with an Introduction to Social Thought*, S.Chand & Company Pvt. Ltd. 2007.

ED2402E Minor Pedagogy (Physical Sciences)

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Explain the nature of science and specify the goals and objectives of science teaching.

CO2: Apply various theories of science learning and analyse the implications for teaching science.

CO3: Create unit plans, lesson plans in an artistic and scientific way and explore the inter-relation between science and other subjects.

CO4: Explore various assessment strategies for evaluating learning in Physical sciences.

CO5: Explain the necessity of the professional development of a teacher and identify various means for it.

Nature and scope of science, Scientific method, steps, historical development of physical science with illustrations from suitable topics, various branches of physical science, science and technology, science and society, aims of teaching physical science in the school curriculum, development of process skills, basic and advanced process skills, scientific attitude, values through science teaching. The school science curriculum with regard to NCF 2005, recommendation of NEP 2020, Brief study of famous curricular reform projects such as Nuffield, STEM, PSSC, and CHEMSTUDY. Major pedagogical shifts. Various approaches in teaching Science. Teacher's role as a facilitator, scaffolding.

Knowledge domains and cognitive processes Types of knowledge- factual, conceptual, procedural and metacognitive knowledge. Various stages of learning, Bloom's Taxonomy of Educational Objectives, action words, Revised Bloom's Taxonomy by Anderson and Krathwohl, Importance of planning, unit plan and lesson plan. Elements of physical science unit plan and lesson plan, content analysis, learning objective writing, and developing lesson plans on different topics of secondary stage such as Atoms and Molecules, Chemical Reactions and Equations, Acids, Bases and Salts, Metals and Non-Metals, Motion, Work and Energy, Sound, Light – Reflection and Refraction, Electricity, Magnetic Effects of Electric Current etc., Development of constructivist practices in science teaching, 5E model, 7E model. Characteristics of an ideal lesson plan.

Developing core teaching skills- Writing instructional objectives, Organizing the content, Creating set for introducing the lesson, Structuring classroom questions, Question delivery and its distribution, Response management, Explaining, Illustrating with examples, Using teaching aids (selection of suitable learning resources, and developing low cost/ no cost teaching aids), Stimulus variation, Pacing of the lesson, Promoting pupil participation, Use of blackboard, Achieving closure of the lesson, Giving assignment, Evaluating the pupil's progress, Diagnosing pupil learning difficulties and taking remedial measures, Management of the class. Science laboratories: designing, management, and safe practices. ICT integration in physical science teaching: different forms of ICT and its application in science education.

Importance of feedback in facilitating learning, difference between test, examination, measurement, assessment and evaluation, Continuous and Comprehensive Evaluation (CCE) and its features, making a question paper, blue print, measurement of students' achievement, marks and grading. Various tools and techniques of assessment- assessment of written and oral work, project work, laboratory work, Use of observation, questioning, rubrics, and portfolio assessment in Physical Sciences, diagnosing learning difficulties and misconception in Physical Sciences, Use of ICT in assessment. Teaching as a profession and the professional competencies of a physical science teacher. Need for updating content and pedagogical competencies, preservice and in-service courses and initiatives.

References:

1. Pedagogy of Science: Physical Science, Part I, NCERT, 2013.
2. Pedagogy of Science Physical Science, Part II, NCERT, 2013.
3. National Curriculum Framework -2005, NCERT,2005
4. S. Alsop, K. Hicks, *Teaching Science : A Handbook for Primary and Secondary School Teachers,* Kogan Page, 2007.
5. J. Bennett, *Teaching and Learning Science : A guide to recent research and its applications,* Continuum, 2003.
6. N. S. Washton, *Teaching Science Creatively,* Saunders Company, 1967.
7. A. Carin, R. B. Sund, *Teaching Science through Discovery,* Charles E. Merrill Books Inc., 1964.
8. R. Martin, C. Sexton, J. Gerlovich, *Science for All Children: Methods for Constructing Understanding,* Allyn and Bacon, 2002.

PH2401E Classical and Relativistic Mechanics

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Apply the concepts of Calculus of Variations and Lagrangians to solve problems in Classical Mechanics.

CO2: Utilize the symmetry properties of systems to simplify the description of a system.

CO3: Describe oscillatory behaviour under different conditions.

CO4: Implement special relativity and identify the discerning features.

Lagrange Equations and Calculus of Variations: Constraints – Generalized Coordinates – Virtual Displacements – D'Alembert's Principle – Calculus of Variations, examples – Lagrangian, Euler – Lagrange Equations, examples – Central force motion – Orbits and Scattering.

Hamiltonian and Hamilton's Equations of Motion: Legendre transformations – Hamilton's equations and examples – Cyclic coordinates – Symmetry – Conservation principles and Noether's theorem – Canonical transformations – Poisson bracket formulation.

Coupled Oscillators and Normal Modes: System of oscillators – eigenvalue problem and normal modes – damping – forced oscillations and resonance – Dynamical stability.

Special Theory of Relativity: Special theory of relativity – Lorentz transformation – Consequences of Special Relativity – Relativistic mechanics and dynamics – Four-vectors, tensors, metric – Space-time diagrams.

References:

1. H. Goldstein, C. Poole and J. Safko, *Classical Mechanics*, 3rd Edition, Narosa Publishers, 2001.
2. D. Kleppner and R. J. Kolenkow, *An Introduction to Mechanics*, 1st Edition, McGraw Hill, 2017.
3. D. J. Morin, *Introduction to Classical Mechanics: With Problems and Solutions*, Cambridge University Press, 2008.
4. Spiegel M. R., *Theoretical mechanics*, Schaum Series, McGraw Hill, 1992.

PH2402E Quantum and Statistical Mechanics

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Compute probability distribution for observables of a system in a given quantum state.

CO2: Analyse simple quantum mechanical systems.

CO3: Apply the concepts of statistical ensemble theory to connect thermodynamic properties of systems to the statistical distribution of the microstates of the system.

CO4: Apply concepts of quantum statistical physics to various problems such as free electrons and photon gas.

Basic formalism of Quantum mechanics: Postulates of Quantum Mechanics - states and operators - eigenvalues and eigenvectors- measurement theory- Born interpretation - basis transformations - expectation values - uncertainty principle - position and momentum representation - time evolution - Hamiltonian operator – time dependent and time independent Schrodinger equation.

Some exactly solvable Quantum mechanical systems: One dimensional systems: infinite and finite potential well - simple harmonic oscillator - Hydrogen atom - Angular momentum.

Classical Statistical mechanics: Microstates and macrostates - postulate of equal a priori probability - microcanonical, canonical and grand canonical ensembles - partition function - classical ideal gas - Maxwell Boltzmann distribution - equipartition theorem.

Quantum statistical mechanics: Indistinguishable particles – Symmetric and anti-symmetric wave functions – Pauli's exclusion principle – Fermi Dirac distribution, free electron theory – Bose-Einstein distribution, black body radiation, Bose-Einstein condensation.

References:

1. David. J. Griffiths, *Introduction to Quantum Mechanics*, 2nd Edition, Pearson Education, 2005.
2. Nouredine Zettili, *Quantum Mechanics: Concepts and Applications* 2nd Edition, John Wiley, 2009.
3. F Reif, *Statistical Physics: Berkeley Physics Course – Vol.5*, 1st Edition, McGraw Hill Education, 2017.
4. K. Huang, *Introduction to Statistical Physics*, 2nd Edition, CRC press, 2019.

CH2403E Chemistry Minor – IV
Organic Chemistry

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Apply the principles of organic stereochemistry to real time problems.

CO2: Demonstrate and apply the fundamental concepts of reaction mechanisms.

CO3: Develop competency to work with biomolecules and apply the understanding of the reactivity and bonding features to address problems in industries.

Optical isomerism - concept of chirality and elements of symmetry, enantiomers, stereogenic centres, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres, diastereomers, meso compounds, resolution of enantiomers, inversion, retention, racemization, racemic modifications, R and S nomenclature, E and Z nomenclature, conformational analysis of ethane, n-butane cyclohexane and monosubstituted cyclohexane derivatives.

Definition of reaction mechanism, thermodynamic and kinetics data, substituent effects, linear free energy relationships, Hammett equation and related modifications, basic mechanistic concepts like kinetic vs thermodynamic control, electrophilic and nucleophilic substitutions, formation of carbocations, stability and rearrangements.

Chemistry of alkanes, alkenes and alkynes, mechanism of hydroboration oxidation, ozonolysis, *syn* and *anti*- hydroxylation (oxidation), Diels-Alder reaction, hydration of alkynes, catalytic hydrogenation and alkylation of terminal alkynes. Hückel's rule of aromaticity, aromatic electrophilic and nucleophilic substitutions, Introduction to heterocyclic compounds, their synthesis and reactivity.

Introduction to biomolecules, Carbohydrates- depicting stereochemistry using Fischer projections, Osazone formation, classification and properties of amino acids, Zwitter ion, Isoelectric point, Strecker and Gabriel phthalimide synthesis of amino acids, formation of peptide bonds, nucleotides and nucleic acids, base pairing in DNA, replication, transcription and translation.

References:

1. R. T. Morrison, R. N. Boyd, S. K. Bhattacharjee, *Organic Chemistry*, 7th Edition, Pearson Education, 2010.
2. J. McMurry, *Introduction to Organic Chemistry*, Cengage Learning, 2007.
3. M. A. Fox, J. K. Whitesell, *Organic Chemistry*, 7th Edition, Jones and Bartlett Publishers, 2019.
4. B. S. Bahl, A. Bahl, *Advanced Organic Chemistry*, 5th Edition, S. Chand Publisher, 2012.
5. T. W. G. Solomons, C. B. Fryhle, S. A. Snyder, *Organic Chemistry*, 12th Edition, Wiley Student Edition, 2016.
6. J. Clayden, N. Greeves, S. Warren, *Organic Chemistry*, 2nd Edition, Oxford Publisher, 2014.

MA2402E Mathematics Minor – IV
Mathematical Analysis

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Test for convergence of sequences and series.

CO2: Find the Fourier series representations of periodic functions.

CO3: Check for analyticity of complex functions and find conjugates of given harmonic functions.

CO4: Find images of regions under standard complex functions.

CO5: Make use of residue theorem to evaluate contour integrals.

Sequences and Series: Real sequences, Convergent, divergent and Oscillatory sequences, Bounded sequences, Cauchy's general principle of convergence, Cauchy sequences, Monotonic sequences, Limit superior and limit inferior of a sequence, Infinite Series, Convergence of series, Cauchy's general principle of Convergence for Series, Series of positive terms, Geometric series, Comparison test, Cauchy's root test, D'Alembert's Ratio test, Raabe's test, Maclaurin's integral test, power series, radius of convergence, Taylor series, periodic functions and Fourier series expansions, half-range expansions.

Complex Numbers and Functions: Complex functions, Derivatives, Analytic functions, Cauchy-Riemann equations, Harmonic functions, Geometry of Analytic functions: Conformal mapping, Linear fractional Transformations, Transformation by other elementary functions.

Complex Integration: Line integral in the Complex plane, Cauchy's integral theorem, Cauchy's integral formula, Power series, Taylor series and Maclaurin series, Laurent series, Singularities and Zeros, Residue theorem, Evaluation of real Integrals.

References:

1. S. Ponnusamy, H Silverman, *Complex variables with applications*, Birkhauser, Boston, 2006.
2. E. Kreyszig, *Advanced Engineering Mathematics*, John Wiley and Sons, 9 th Edn, 2012.
3. L.V Ahlfors, Complex Analysis, McGraw Hill International Edition.
4. B.P Palka, *Introduction to the Complex Function theory*, Springer Verlag, 1991. 5. Serge Lang, *Complex Analysis*, Springer Verlag
6. J. M. Howie, *Real Analysis*, Springer 2007.
7. S.C Malik, *Real Analysis*, Wiley Eastern.
8. Shanthinarayan, *Mathematical Analysis*, S. Chand and Co. Ltd.
9. Royden, *Real Analysis*, Prentice Hall of India Pvt. Ltd.
10. T M Apostol, *Mathematical Analysis*, 2nd Edition, Addison Wesley.

CS2401E Digital Computer Fundamental

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Identify the logic gates and their functionality.

CO2: Perform number conversions from one system to another system

CO3: Understand the functions of combinational circuits

CO4: Perform number conversions.

CO5: Perform Counter design and learn its operations.

Number Systems and Codes: Number System–Base Conversion – Binary Codes – Code Conversion. Digital Logic: Logic Gates – Truth Tables – Universal Gates.

Boolean Algebra: Laws and Theorems – SOP, POS Methods – Simplification of Boolean Functions–Using Theorems, K-Map, Prime – Implicant Method–Binary Arithmetic: Binary Addition – Subtraction – Various Representations of Binary Numbers– Arithmetic Building Blocks – Adder – Subtractor

Combinational Logic: Multiplexers – Demultiplexers – Decoders – Encoders –Code Converters–Parity Generator and Checker.

Sequential Logic: RS, JK, D, and T Flip-Flops – Master-Slave Flip-Flops.

Registers: Shift Registers–Types of Shift Registers.

Counters: Asynchronous and Synchronous Counters - Ripple, Mod, Up-Down Counters– Ring Counters. Memory: Basic Terms and Ideas –Types of ROMs –Types of RAMs.

Learning Resources:

Text Books:

1. V. Rajaraman and T.Radhakrishnan, *Digital Computer Design*, Prentice Hall of India, 2001
2. D.P. Leach and A. P. Malvino, *Digital Principals and Applications*, TMH, Fifth Edition, 2002
3. M. Moris Mano, *Digital Logic and Computer Design*, PHI, 2001.

Reference Books:

1. T.C. Bartee, *Digital Computer Fundamentals*, 6th Edition, Tata McGraw Hill, 1991.

Web Resources:

1. *https://onlinecourses.swayam2.ac.in/cec19_cs06/preview*
2. *https://onlinecourses.swayam2.ac.in/cec21_cs17/preview*

PH2441E Physics Lab – IV

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
0	0	2	1

Course Outcomes:

CO1: Apply principles of electronics and modern physics for experimentation.

CO2: Develop skills for data analysis and interpretation.

CO3: Set up experiments, take observations and relate it with a suitable theory.

CO4: Build ability for group discussion and critical thinking for collaborative work.

List of Experiments: *(Any Seven of the following experiments)*

1. Photoelectric effect
2. Planck's constant using LED's
3. e/m of electron
4. Study of the normal probability distribution using Galton board
5. Franck-Hertz experiment
6. Characteristics of a normal diode and a Zener diode
7. Charging & Discharging of a Capacitor
8. Transistor characteristics and transfer characteristics in Common Emitter configuration (current gain).
9. CE Transistor Amplifier-Frequency response
10. Basic operational amplifier
11. Measurement of susceptibility of a paramagnetic solution (Quincke's Tube Method)
12. Determination of Hall coefficient in semiconductors
13. GM Counter characteristics
14. GM Counter- Absorption coefficient

Reference:

1. B. L. Flint, H. T. Worsnop, *Advanced Practical Physics for students*, Asia Publishing House, 1971.
2. E Armitage, *Practical Physics*, John Murray.
3. S. Panigrahi, B. Mallick, *Engineering Practical Physics*, Cengage Learning India Pvt. Ltd., 2015.

SEMESTER – V

ED3891E ICT in Education

Pre-requisites: Nil

Total Lecture Sessions: 13

L	T	P	C
1	0	2	2

Course Outcomes:

CO1: Explain various aspects of communication and identify strategies for effective classroom communication.

CO2: Appraise the relative advantages of different technological tools and strategies for teaching and learning.

CO3: Choose appropriate web-based technologies for providing multi-sensory learning experience in the online and offline mode.

CO4: Explain ethical and safety issues in the use of web-based technology for education.

CO5: Identify the ways of using ICT tools for teaching, learning and assessment of different subjects.

Aspects of Communication: Communication-definition, Communication cycle, Verbal and non-verbal communication, Factors affecting communication, Components of effective classroom communication- Classroom interaction analysis- Flander's Interaction Analysis Category System (FIACS).

Technology in education: Use of technology for education –Edgar Dale's Cone of Experience- Visual aids, audio aids, Multimedia aids. Advancements in World Wide Web and the changing role of teacher in the Digital era, Use of Tools: Smart Phone, Apps, Social Media, and Generative AI (ChatGPT, Gemini) for teaching and learning, Strategies: Blended learning, Collaborative learning, Flipped classroom, Synchronous and Asynchronous learning.

Web technologies for education: Learning Management Systems (LMS), Computer Assisted Instruction (CAI), Massive Open Online Courses (MOOCs), "anytime anywhere learning", Challenges in use of technology for education- Ethical issues, Safety issues- Cyber bullying, Hacking, Data protection- theft, Misuse, Deepfake technology, Wise use of web resources, Netiquette.

ICT in Teaching- Learning and Assessment: Techno-Pedagogy- Techno Pedagogical Content Knowledge Analysis (TPACK), Discipline specific ICT tools- Geogebra, PhET, Stellarium, Open Street Map, Marble, Turtle Art, Technological tools for Mind mapping,Virtual learning experiences: Augmented reality, Gamification, Simulations, Virtual labs, Technological tools for assessment- e-portfolio, Online and offline assessment tools-Rubrics, Test generators.

Reference:

1. A. M. Bissonette, *Cyber Law- Maximizing Safety and Minimizing risk in classrooms*, Sage Publications India Pvt. Ltd, 2009.
2. C. R. Tucker, T. Wycoff, J. T. Green, *Blended Learning in Action: A Practical Guide Toward Sustainable Change*, 1st edition, Corwin, 2016.
3. E. Dale, *Audiovisual Methods in Teaching*, Dryden Press, 1969.
4. C. Davies, R. Eynon (ed.), *Education and Technology*, 1st Edition, Routledge and Kegan Paul, 2013.
5. K. Cennamo, J. Ross, P. Ertmer, *Technology Integration for Meaningful Classroom Use: A Standards-Based Approach*, Cengage Publishers, 2013.

6. W. Kist, *The Socially Networked Classroom: Teaching in the New Media Age*, Sage Publications Pvt Ltd, 2012.
7. R. S. Johnson, J. S. Mims-Cox, A. Doyle-Nichols, *Developing Portfolios in Education: A Guide to Reflection, Inquiry & Assessment*, 2nd edition, Sage Publications Pvt. Ltd, 2012.
8. J. K. Parker, *Teaching Tech-Savvy Kids- Bringing Digital Media into the Classroom, Grade 5-12*, Sage Publications. Pvt. Ltd, 2012.
9. M. D. Roblyer, A. H. Doering, *Integrating Educational Technology into Teaching*, 6th edition, Pearson, 2013.

ED3601E Major Pedagogy – I: (Physical Sciences)

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Explain the nature of science as an important subject for human development and identify the aims and objectives of teaching science.

CO2: Critically analyse the current place of science in the school curriculum and recommend ways to improve the current situation.

CO3: Select suitable approaches and methods that are suitable for teaching science topics in a way ensuring participation from the learners.

CO4: Develop various skills that are essential for teaching science and demonstrate these skills.

Nature of Physical Sciences, Science as an empirical body of knowledge: structure of knowledge, facts, concepts, principles, generalizations, theories, Science both as a process and a product. Science as a way of thinking: inquiry, Science as an intellectual quest, Science as a way of investigation: scientific method, process skills of science, Aims and objectives of teaching Physical Sciences at secondary stage, Aims of Learning Physical Science, developing scientific attitude, Development of scientific attitude and scientific temper, Nurturing the natural curiosity, creativity and aesthetic sense, open mindedness, objectivity, truthfulness, critical thinking, logical thinking, development of problem solving skill, observation, problem-solving, rational thinking, reasoning, scientific attitude, critical thinking, Imbibing the values through science teaching, nurturing curiosity, creativity and aesthetic sense, Development of problem solving skills.

Science and Society, Physical science and society, Linkages of Physical Sciences with other school subjects and place of the Physical Sciences in school curriculum, relating Science to daily life, Relating physical science education to natural and social environment, technology and society, Contributions of some eminent scientists, School Curriculum in Physical Science, Curriculum framework, curriculum and syllabus, Recommendations of NCFs on science curriculum, Role of the teacher, Teacher as curriculum developer Recommendations suggestions of various committees, commissions, and policies in reference to Physical Sciences. NCF 2005, NEP 2020.

Exploring Learners, uniqueness, Approaches and Strategies for Learning Physical Science, From subject-centered to behaviorist to constructivist approach to curriculum development, Pedagogical Shift in Physical Science, shift from science as fixed body of knowledge to the process of constructing knowledge, Scenario from 1950-1980 Post 1980 scenario, Democratizing science learning: Critical pedagogy, Inclusion, social learning, Involving learners in teaching-learning process, Role of learners in negotiating and mediating learning in physical science, linking the previous knowledge, Encouraging learners to raise and ask questions, Encouraging learners to collect materials from local, resources, Process of concept formation. Development of conceptions in science: conceptions, alternate conceptions and misconceptions in science, Various approaches - inductive deductive, constructivist, experiential learning, art integrated learning, Methods of teaching learning Physical Sciences: lecture and lecture cum demonstration, activity, discussion, problem-solving, laboratory, project, scientific inquiry

Approaches and strategies for learning physical Science, Constructivist approach, 7E learning model, Collaborative Learning Approach (CLA), Problem Solving Approach (PSA), Concept mapping, Experiential learning, Cognitive conflict, Inquiry approach, Analogy strategy, Facilitating learners for self-study. Communication in science, consolidating students' ideas, questioning-techniques and strategies, higher order and metacognitive questioning. Cooperative and Collaborative learning approach, problem solving approach, concept mapping, experiential learning, cognitive conflict, inquiry approach, analogy strategy. grouping students, multiple learning experiences, discussing and negotiating ideas, Concept mapping: role and procedure, studying linkages between concepts, within the same subject, and across subjects. Teaching concepts and generalizations: inductive, deductive, approaches, using advance organisers, problem solving approach, investigatory approach, project method, cooperative learning method, Laboratory approaches. Field trips.

References:

1. *Pedagogy of Physical Science*, Text book for B.Ed. Part I, NCERT 2. *Pedagogy of Physical Science*, Text book for B.Ed. Part II, NCERT
3. National Curriculum Framework 2005, NCERT, New Delhi.
4. Steve Alsop, Keith Hicks, *Teaching Science: A Handbook for Primary and Secondary School Teachers*, Kogan Page, 2007.
5. Judith Bennett, *Teaching and Learning Science: A guide to recent research and its applications*, Continuum, 2003.
6. Robin Millar, *Doing Science: Images of Science in Science Education*, The Falmer Press, 1984
7. *State Textbook in Physics and Chemistry for classes VIII, IX and X*
8. Nathan S Washton, *Teaching Science Creatively*, Saunders Company, 1967.
9. *History of Physics in the 20th Century*, Internet Browsing.
10. D J Novak, D Bob Gowin, *Learning how to learn*, Press Syndicate of the University of Cambridge, Ohio.1111984
11. Carin A. B R Sund, *Teaching Science through Discovery*, Charles E. Merrill Books Inc., 1964
12. Columbus Ohio II, Ralph Martin, Colleen Sexton, Kay Wagner, Jack Gerlovich, *Science for All Children: Methods for Constructing Understanding*, Allyn and Bacon, 2000.
13. *School Science Review*, The Association for School Education, College Lane, Hatfield, Hertfordshire, AL 109 AA, UK.
14. *Physics Education*, Institute of Physics Publishing, Dirac House, Temple Back, Bristol BS1 6BE, UK.
15. *Physics Teacher*, American Association of Physics Teachers, Department of Physics and Astronomy, University of Maryland.
16. Kamala Mukunda, *What did you ask at school today? A Handbook on Child Learning*, 2009

ED3802E Pre-internship Practice

Pre-requisites: Nil

Total Lecture Sessions: 8

L	T	P	C
0	0	4	2

Course Outcomes:

CO1: acquainted with various pedagogic practices, classroom management skills, assessment tools and learning standards.

CO2: get experience of conducting classes by observing lessons transacted by teacher educators (demonstration lessons).

CO3: develop lesson plans to transact them using appropriate pedagogies and learning resources.

CO4: develop and practice teaching skills in a guided environment to be an effective teacher.

Activities to be conducted:

- Observation of a minimum of 3 lessons transacted by teacher educators to identify pedagogic skills, followed by a critical analysis of the classes observed.
- Content analysis and development of a unit plan.
- Preparation of a minimum of 2 types of lesson plans under two different topics. Develop concept map of the each of the lessons.
- Practice on the skills of introduction, questioning and black board writing.
- Development of at least one Teaching Learning Materials (TLMs).
- Observation of the lesson demonstrated by teacher educators/experts in the institute.

PH3601E Atomic and Molecular Physics

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Analyse one-electron atoms quantum mechanically.

CO2: Interpret the spectrum of one-electron atoms in static magnetic and electric fields.

CO3: Examine the spectrum of diatomic and polyatomic molecules.

Atomic physics: Inadequacy of Bohr atomic model, correction due to finite mass of the nucleus, Rydberg constant in terms of reduced mass, Excitation and Ionization potentials, Franck-Hertz experiment, Stern-Gerlach experiment, Bohr-Sommerfeld Model of atom, relativistic mass correction, vector model of an atom.

Schrodinger equation for one - electron atoms - Quantum numbers – degeneracy, eigenfunctions of bound states - expectation values and virial theorem - electronic spectra of one electron atoms - orbital magnetic dipole moments –electron spin and spin wave functions - Pauli exclusion principle - shell structure - periodic table, Hund's rule.

Brief mention of L-S and J-J coupling for multi electron atoms. Fine structure lines of Sodium, Zeeman effect. Explanation of Zeeman effect on the basis of vector model of atom, Expression for Zeeman shift and experimental details. Mention on anomalous Zeeman effect. A qualitative mention of Paschen – Back and Stark effects.

Molecular Spectra: Rotation, vibration and electronic spectra of molecules, associated quantum numbers and selection rules. The spectrum of non-rigid rotator, e.g. of HF, spectrum of symmetric top molecule e.g. of CH_3Cl, Instrumentation for Microwave Spectroscopy, I.R. Spectroscopy: Born – Oppenheimer approximation, Effect of Breakdown of Born Oppenheimer approximation. Normal modes and vibration of H_2O and CO_2.

Instrumentation for I.R. Spectroscopy – Fourier transformation I.R. Spectroscopy, Raman and Infrared (IR) spectra, Rotational Raman Spectrum of Symmetric top molecules, e.g. of $CHCl_3$, Combined use of Raman & IR Spectroscopy in structure determination e.g. of CO_2 and NO_3, Instrumentation for Raman Spectroscopy.

References:

1. David. J. Griffiths, *Introduction to Quantum Mechanics*, 2nd Edition, Pearson Education, 2005
2. R. Eisberg, R. Resnick, *Quantum physics of atoms, molecules, solids, nuclei and particles*, 2nd Edition, John Wiley and sons,1985.
3. C. N. Banwell, *Fundamentals of molecular spectroscopy* (III Ed.), McGrawHill, 1983.
4. C. J. Foot, *Atomic Physics, Oxford university press*, 2005
5. Introduction to atomic spectra by H E White
6. Molecular structure and Spectroscopy by G. Aruldhas

PH3602E Nuclear and Solid State Physics

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Identify the properties of nuclei by using various models

CO2: Analyze the radioactive decays and explain the working of nuclear detectors

CO3: Differentiate different lattice types and vibrational properties of lattice using different models

CO4: Apply free electron model and energy band theory to interpret the properties of materials.

Properties of Nuclei: Basic nuclear properties: size, shape and charge distribution, spin and parity. Binding energy, semiempirical mass formula, liquid drop model. Nature of the nuclear force, form of nucleon-nucleon potential, charge - independence and charge - symmetry of nuclear forces. Evidence of shell structure, single - particle shell model - validity and limitations.

Nuclear Decays and Detection: Elementary ideas of alpha, beta and gamma decays - selection rules. Fission and fusion. Nuclear reactions. Particle accelerators: Electrostatic and cyclotrons. Interaction of radiation with matters, Radiation detectors: gas filled counters, scintillation detectors, and semiconductor detectors.

Crystal Structure and Lattice vibrations: Overview of crystal structure, Miller indices, types of bonding, Bragg's law of diffraction, reciprocal lattice, structure factor. Lattice vibrations, dispersion curves, phonons and density of states, Specific heat: Einstein and Debye models, monoatomic and diatomic lattices, thermal conductivity. Umklapp process.

Free electron model and Band theory: Free Electron theory, E-k diagram, electrical and thermal conductivity, electronic specific heat, Fermi surface, Hall effect, failure of free electron theory, Bloch theorem, nearly free electron model and origin of energy bands, concept of effective mass.

References:

1. K. S. Krane, *Introductory Nuclear Physics*, John Wiely & Sons, 1988
2. K. Heyde, *Basic Ideas and Concepts in Nuclear Physics: An Introductory Approach (III Ed.)*, IOP publishing, 2004
3. Ali Omar, Elementary Solid State Physics, Pearson India (2002)
4. S. O. Pillai, Solid State Physics, New Age International Pvt. Ltd. (2022)
5. M. Vijaya, Rangarajan G, Materials Science, McGraw Hill Education (2004)

PH3802E Major Project

L	T	P	C
0	0	8	4

Pre-requisites: Nil

Total Lecture Sessions: Nil

Course Outcomes:

CO1: Identify a domain specific and contemporary topic

CO2: Review literature to identify gaps and define objectives & scope of the work.

CO3: Develop a prototype model, experimental set-up or software systems to meet the objectives

CO4: Analyse the results to draw valid conclusions

Description:

Students are expected to choose real-world contemporary problem and apply the engineering principles learned, to solve the problem through building prototypes or simulations or writing codes or establishing processes/synthesis/correlations etc. The department constituted panel will decide the suitability and worthiness of the project.

The students are required to submit a report showing that plagiarism is within 20%. The B.Tech. Project work will be evaluated for 100 marks, with the following weightages:

Component	Weightage
Periodic evaluation by Guide	40 marks
Mid-term review	20 marks
End Semester viva-voce examination	40 marks
Total	100 marks

The midterm review and the end semester viva-voce examination will be conducted by a committee constituted by the Head of the Department. If the performance of a student is not satisfactory, he/ she can be awarded 'F' grade. Such a student will be given a maximum time of three months to improve his/her performance. If the performance of such a student is not satisfactory even after the extended time period, he/ she will have to repeat the project work in the next academic year.

Evaluation Criteria:

The student will be evaluated by the panel based on the below criteria. Weightage for each criterion will be determined by the panel and will be informed to the students.

Criteria	Description	Weightages
I	Selection of Topic	10
II	Literature Survey	10
III	Objectives and Solution Methodology	20
IV	Performance of the Task and clarity on the work	40
V	Report Preparation	10
VI	Presentation and Response to questions	10

SEMESTER – VI

ED3601E Assessment and Evaluation

Pre-requisites: Nil

Total Lecture Sessions: 28

L	T	P	C
2	0	0	2

Course Outcomes:

CO1: Explain the importance of assessment in education and understand different forms of assessment.

CO2: Select and implement students with diverse assessment approaches to comprehensively evaluate students performance.

CO3: Select and implement various tools and techniques to evaluate attitudes, interests, social, and personal behavior, with a focus on fostering self-assessment and peer assessment.

CO4: Perform suitable technique of analysis of the students' performance scores and provide constructive feedback.

Assessment in Education: Meaning and significance of assessment and evaluation in educational field, Conceptual Clarity and purpose of Measurement, Assessment, Examination, Appraisal and Evaluation in Education, Learning outcomes across the stages and assessment, revised taxonomy of Objectives and Implications, Forms of Assessment: Formative, Summative, diagnostic, prognostic, Internal and External assessment, Assessment for learning, Assessment of learning and Assessment as learning

Process of Assessment and Evaluation: Formative and Summative Assessment: Concept and Characteristics, Approaches to assess and evaluate student performance such as time-constrained examinations, closed/open-book tests, problem-based assignments, practical assignment reports, observation of practical skills, individual and group project reports, oral presentations, viva-voce interviews, computerised adaptive testing, online assessment.

Assessing Higher Order Thinking Abilities: Problem solving, critical thinking, creative thinking, communication skills, judgement and decision making, ethical and moral reasoning, Tools and Techniques: Observation, rating scale, check list, anecdotes, interviews, Assessment of attitudes and interests, Socio-metric techniques, Criteria for assessment of social and personal behaviour.

Analysis and Interpretation: Analysis of students' performance and scores, credit and grading, Graphical representation- Histogram,

Frequency Curve, Interpretation of student's performance based on the analysis, constructive feedback, Reporting student's performance, 360-degree progress reports, cumulative records and their uses, portfolios, PTA meetings, qualitative reporting based on the observations, descriptive indicators in report-cards.

References:

1. R. N. Patel, *Educational Evaluation: Theory and Practice*, Himalaya Publishing House, 2011
2. J. C. Aggarwal, *Essentials of Examination System: Evaluation, Tests and Measurement*, Vikas Publishing House Pvt. Ltd, 2008.
3. Tom Diamond, Mark Sanders. Reference Assessment and Evaluation. Routledge, 2006.
4. M. David Miller, Robert L. Linn, and Norman Gronlund, *Measurement and Assessment in Teaching*, 11th edition, Pearson, 2012.
5. E. G. Norman, *How to Make Achievement Tests and Assessments* , 5th edition, Allyn& Bacon, 1992.
6. E. G. Norman, *How to Write and Use Instructional Objectives*, 6th edition, Pearson, 1999.

7. R. L. Ebel, D. A. Frisbie, *Essentials of Educational Measurement*. 5th Edition, Prentice-Hall, 1991.

ED3602E Major Pedagogy – II (Physical Sciences)

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Formulate objectives based on learning outcomes for science teaching.

CO2: Develop unit plans and lesson plans that are suitable for a constructivist teaching learning of various topics in science.

CO3: Explain various technological tools for teaching and learning of science and integrate technology judiciously to facilitate teaching learning.

CO4: Determine role of teacher in facilitating learning by selecting suitable learning materials, and judiciously using it for teaching various topics in science.

CO4: Design and develop innovative strategies and techniques for successful in teaching and learning science.

An analysis of content taking examples from topics of physical sciences textbooks at secondary stage (facts, concepts, laws, theories), identification of concepts, content analysis, listing learning outcomes and competencies, learning objectives and action verbs, learning as a behavioural change, Revised Bloom's Taxonomy, learning objective of physical science, Meaning of learning objectives, Developing learning objectives, contexts, Anderson and Krathwohl's taxonomy, Writing learning objectives, Illustrations on learning objectives for secondary and higher secondary stages, Learning objectives in the constructivist perspective, Planning for Teaching-learning of physical science, planning in teaching, concept, and importance of planning, unit plan, developing unit plans of the selected topics from textbooks of physical sciences at secondary stage, lesson planning, concept, types and importance of lesson planning, various types, 5E and 7E models of lesson planning, Elements of a physical science lesson, Making groups, Planning and organising activities in physical science, Planning laboratory work, developing lesson plans of the selected topics from textbooks of physical sciences at secondary stage.

Teaching learning aids/materials: concept, definition, role and importance in classroom teaching learning the physical sciences, Dale's cone of experiences, Types of teaching learning aids/ materials, Identification and use of learning resources in physical sciences from the local environment, Print and ICT Resources in Learning Physical Science, Print resources, Different forms of ICT and its application in science education Using and selecting appropriate media, Skills to be developed in students in interconnected world, Social networking sites and their use in education Integrating, ICT in teaching learning process: An example, Scope and importance of ICT in physical sciences, Community Resources, Using community resources. Pooling of learning resources Improvisation of apparatus, Handling hurdles in utilisation of resources, Some inexpensive sources of chemicals, Science kits, Laboratory as a learning resource, Imparting process skills through laboratory activities, Basic and advanced process skills, Importance of experiments in science teaching learning, Designing and developing a laboratory, Safety aspects in a physical science laboratory, Assessment of laboratory work.

Tools and Techniques of Assessment for Learning Physical Science, Test, examination, measurement, assessment and evaluation, Need for the assessment and importance of the assessment in the teaching learning process, formative and summative assessment, formal, informal assessments, Assessment based on learning outcomes, Continuous and Comprehensive Evaluation (CCE), strategies for continuous assessment, qualitative assessment, 360° assessment, Performance assessment, assessment of group activities, creating platform and portfolio management, assessment of assignments, projects, and presentations, Tools and techniques of assessment and evaluation - unit test based on Table of Specification (TOS) and its importance, basic steps of question paper setting, blue print, types of test items, preparing answer key, criteria for assessment, Assessment framework, Assessment of learning of students with special needs.

Qualities of a Physical Science teacher as professional for enhancing teaching learning skills, Lifelong learning in physical science, Developing lifelong learning attributes through teaching- learning of science, Professional Development of Physical Science Teachers Teaching as a profession, Difference between occupation and profession, pre-service professional development programmes, in-service professional development programmes, Reflective practices in professional development, Teacher as a Researcher, Recent trends in research related to teaching learning of Physical Sciences, Action research vs. research, Need and importance of 21st century skills for learners and teachers of physical sciences.

References:

1. *Pedagogy of Physical Science*, Text book for B.Ed, Part I, NCERT
2. *Pedagogy of Physical Science*, Text book for B.Ed, Part II, NCERT
3. *National Curriculum Framework 2005*, NCERT, New Delhi.
4. Steve Alsop, Keith Hicks, *Teaching Science: A Handbook for Primary and Secondary School Teachers*, Kogan Page, 2007.
5. Judith Bennett, *Teaching and Learning Science: A guide to recent research and its applications*, Continuum, 2003.
6. Robin Millar, *Doing Science: Images of Science in Science Education*, The Falmer Press, 1994.
7. *State Textbook in Physics and Chemistry for classes VIII, IX and X*
8. Nathan S Washton, *Teaching Science Creatively*, Saunders Company, 1967.
9. *History of Physics in the 20th Century*, Internet Browsing.
10. D J Novak, D Bob Gowin, *Learning how to learn*, Press Syndicate of the University of Cambridge, Ohio.1111984
11. Carin A, B R Sund, *Teaching Science through Discovery*, Charles E. Merrill Books Inc., 1964
12. Columbus Ohio II, Ralph Martin, Colleen Sexton, Kay Wagner, Jack Gerlovich, *Science for All Children: Methods for Constructing Understanding*, Allyn and Bacon, 2000.
13. *School Science Review*, The Association for School Education, College Lane, Hatfield, Hertfordshire, AL 109 AA, UK.
14. *Physics Education*, Institute of Physics Publishing, Dirac House, Temple Block, Bristol BS1 6BE, UK.
15. *Physics Teacher*, American Association of Physics Teachers, Department of Physics and Astronomy, University of Maryland.
16. Kamala Mukunda, *What did you ask at school today? A Handbook on Child Learning*, 2009

ED3603E Inclusive Education

Pre-requisites: Nil

Total Lecture Sessions: 28

L	T	P	C
2	0	0	2

Course Outcomes:

CO1: Understand various terms and phrases associated with Inclusive Education and create an inclusive learning environment.

CO2: Understand the paradigm shift in Inclusive education and analyse related policies and acts in India and abroad.

CO3: Identify the diverse learning needs of students with disabilities and children belonging to marginalised groups and adapt suitable teaching learning processes.

CO4: Identify the pedagogical, issues in connection with children with special needs and design and implement suitable ways to address them.

Inclusion and Education: Various terms and phrases associated with Inclusive Education: Integrated Education, Special Education, Impairment and Disability, Assessment and Evaluation, Curriculum adaptation, modification and differentiation, universal design of learning, shifting from Disability to the Inclusive view, Shifting Paradigms from Bio centric to Human Rights, Introductory reference of Policies/Acts with reference to educational implications for Children with Disabilities: Right to Education Act- 2009/ 2012, RPWD Act- 2016, UNCRPD2006, National Trust Act- 1999, National Educational Policy -2020.

Children with Disabilities and Marginalized Groups: Nature and needs of children with sensory impairments: cognitive impairments and intellectual disability, physical disabilities, cerebral palsy, multiple disabilities, Specific needs of children with behavioral, emotional learning disabilities, Health Problems, Educational needs of children belonging to Marginalized Groups.

Pedagogical Issues: The specific needs of Children with various disabilities, meeting the challenge of providing equal opportunities in classroom teaching learning process, arts, sports, and vocation-related activities, making the school buildings and compounds barrier free and accessible, Provision for supporting learning activities and resources for individualized learning environment, Need for and ways to implement assistive devices and technology-based tools, language-appropriate teaching-learning materials, suitable assessment strategies.

Reference:

1. M. Ainscow, T. Booth, *Index for Inclusion: Developing Learning and Participation in Schools*, Bristol: CSIE, 2002.
2. M. Ainscow, A. Dyson, T. Booth, *Improving Schools, Developing Inclusion*, Routledge, 2006.
3. M. Alur, M. Bach, *The Journey for Inclusive Education in the Indian Sub- Continent*, Vol. 23, Routledge, 2009.
4. A. C. Armstrong, D. Armstrong, I. Spandagou, *Inclusive Education, International Policy & Practice*, Sage, 2009.
5. D. Mitchell, D. Sutherland, *What Really Works in Special and Inclusive Education: Using Evidence-Based Teaching Strategies*, Routledge, 2020.
6. S. J. Pijl, C. J. Meijer, S. Hegarty (Eds.) *Inclusive Education: A Global Agenda*, Psychology Press, 1997.

7. M. Puri, G. Abraham, (Eds.) *Handbook of Inclusive Education for Educators, Administrators and Planners: Within Walls, Without Boundaries*, Sage, 2004.
8. Geetha Gopinath, Hemalatha, *Diversifying teaching, New Era of Inclusive Education*. Authors press.

ED3691E Mathematical and Quantitative Reasoning

Pre-requisites: Nil

Total Lecture Sessions: 13

L	T	P	C
1	1	0	2

Course Outcomes:

CO1: Adopt mathematical reasoning to solve problems in the real world and explain the fundamental ideas and tenets in this field.

CO2: Interpret & deduce the right conclusions from numerical representations like formulas, graphs, or tables.

CO3: Demonstrate critical thinking and problem-solving skills using mathematical and quantitative reasoning methods.

CO4: Analyse mathematical, quantitative and reasoning problems and evaluate the solutions.

Introduction to mathematical and quantitative reasoning: Meaning, nature and scope of mathematical and quantitative reasoning, Importance of mathematical and quantitative reasoning in various fields, Types of quantitative reasoning, Usage of mathematical and quantitative reasoning, Concept of mathematisation.

Introduction to data in Education: Data requirement, different sources of data, School enrolment: gross enrolment ratios, net enrolment ratios, educational progression: dropout rate, literacy: measures of literacy, Indian censuses, details of different items on which Indian censuses collect data, Nationwide sample surveys, National family health survey, District level household survey, UDISE.

Data Analysis & Interpretation: Concept of data interpretation (equation, diagram, graph, tables), Statistical analysis of data in educational context and its applications (measures of central tendency, measures of variability, percentile), Visual and numerical representation of data and its application (bar diagram, histogram, pie charts), Learning analytics: concept, significance, types, levels, and its applications in educational context.

References:

1. H. S Bhatia, *Ageing and Society*, The Arya's Book Centre Publishers, 1983.
2. A. Bhende, T. Kanitkar, *Principles of Population Studies*, Himalaya Publishing House, 2019.
3. D. Bogue, *Principles of Demography*, John Wiley and Sons, 1969.
4. Heer, David, *Society and Population*, Prentice-Hall, 1975.
5. P. Krishnan, K. Mahadevan, *Elderly Population Today: Policies Problems and Prospects*, B. R. Publishing House, 2008.

ED3604E School Observation

Pre-requisites: Nil

Total Lecture Sessions: Nil

L	T	P	C
0	0	4	2

Course Outcomes:

CO1: describe various schooling systems,

CO2: describe the processes, practices, and overall environment of the school,

CO3: establish rapport with the stakeholders of the school system state the process of conducting different activities in the school,

CO4: describe the available school infrastructure (classrooms, libraries, laboratories, playground, sanitation, drinking water facility, mid-day meal facility, inclusive facilities, safety and security, rainwater harvesting),

CO5: describe the availability and usage of ICT and TLMs,

CO6: summarise the available documents in both physical and digital modes, including UDISE data,

CO7: reflect upon relationships among the stakeholders,

CO8: analyse various assessment processes adopted in different types of schools,

CO9: prepare and present a comprehensive profile of the schools observed (including classroom processes).

Syllabus:

As school is the heart of the teacher education programme, the student teachers need to gain hands-on experiences from various activities organised by the school. School observation offers an opportunity to learn the processes and practices in a school setup. To expose the student teachers to various schooling systems (urban, rural, tribal, residential, non-residential, government, private, affiliated to different school boards like Central Board, State Board, International Board) prevailing in the country. School observation will also prepare the student teachers to build relationships with various stakeholders. The school observation by the student teachers is aimed at helping them build perspective in the schooling system, student needs, pedagogies, and assessment.

The school observation as a field-based activity will cover observation of school and classroom processes. The student teachers under the mentorship of teacher educators will visit schools, interact with teachers and students and other stakeholders, and relate the observation with the courses studied during the previous semesters, i.e. Foundations of Education, Disciplinary Courses, Pedagogy courses and Ability Enhancement & Value-Added Courses.

- Meaning and Nature of school observation process
- Difference between monitoring and observation
- Theory and practices of school observation components such as:
    1. Schooling system
    2. Rapport with all the stakeholders
    3. Office management procedures of different types of schools
    4. School environment in all perspectives
    5. Process of conducting curricular activities in the schooling process
    6. Existing infrastructure available in the school
    7. Utility of ICT and TLM facilities
    8. Interpersonal relationships among the stakeholders
    9. Various assessment processes adopted in different types of schools.
    10. Engagement of parents and other community members in school activities

Activities to be conducted.

- Visit three types of secondary schools with observation formats developed in the institute and get acquainted with various schooling systems. Establish rapport with all stakeholders.
- Collect information about the demography of students in classes IX to XII and understand the linkage of the secondary stage with the middle stage and higher education through interaction with teachers, students and staff.
- Observe school processes and transactions of the curriculum through experiential learning and prepare a report.
- Interact with teachers and students and report on implementing ten bag-less days and internship opportunities to learn vocational subjects.
- Study the available opportunities for learning interdisciplinary subjects.
- Observe the availability and usage of library resources, laboratories (Atal Tinkering Lab, Physics, Chemistry, Biology, Mathematics, Languages, Social Science, Computer), sports facilities, and art and music learning facilities.
- Study the provision of other student support services- guidance and counselling, NCC, NSS, health and wellness programme.
- Observe the organization of various activities like classroom teaching-learning processes, laboratory activities, library activities, sports and games, debate/elocution/essay writing and other competitions.
- Interact with School heads and subject teachers to understand how students are evaluated by following different tools and techniques of evaluation, how examinations are conducted, how answers are assessed, and how the result is communicated to parents in at least two different types of schools.

Assessment

Competence Artifact	Method of assessment	Assessed By	Credits
Involvement and active participation during the school visit	Observations	Teacher Educator	0.5
Comprehensive school profile	Presentation & reflection	Teacher-Educator	1.5

Components for school observation report

- School information (Context, Vision and Mission, Association with the Board)
- School Infrastructure
- Provision for CWSN/Divyang Children
- Inclusiveness at all levels
- Teacher-Student Ratio
- Teaching-Learning process
  - Academic plan
  - Classroom activities
  - Assessment
- School Development Plan (SDP
- Academic Calendar
- Administrative processes
  - Maintenance of students' records
  - Maintenance of teachers' records
- Cultural activities
- Sports activities

- Annual Day
- National and Social functions
- School Management
- School Discipline
- Interpersonal Relationships
- Understanding different types (socio-economic status, ability) of students and their needs
- Development of ICT and TLMs
- Engagement of parents and community members in the school activity
- Office Management
- The assessment process includes provision and practices for 360-degree holistic assessment
- The overall progress of the school (planning, organising, staffing, directing, motivating and controlling)
- Challenges faced and overcoming them.

PH3601E Elementary Particle Physics

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Identify the properties of fundamental particles and their interactions.

CO2: Explain the working of particle accelerators and detectors.

CO3: Analyze collision processes and conservation laws.

CO4: Elaborate symmetry breaking and interpret the consequences.

Elementary particles: Classification and Interactions: Fundamental interactions in nature, elementary particles, particle classification: leptons and hadrons, mesons and baryons, bound states and resonance states, quantum numbers and conservation laws, concept of isospin, quarks and colors, quark model, the eightfold way, hadron structure, Gell-Mann-Okubo mass formula.

Relativistic Kinematics: Lorentz transformations, four vectors, energy and momentum, collisions: classical and relativistic, examples and applications, particle accelerators and colliders, detectors.

Symmetries:

Space time and internal symmetries, Lie groups: algebra and generators, SU(2) irreducible representation, isospin and SU(2), weight diagram, SU(3) generators, U and V spin, root diagram, dimensionality multiplets of SU(N), baryons and mesons in quark model, Discrete symmetries: parity (P), charge conjugation (C) and time reversal (T), CPT theorem.

Weak interactions and Neutrinos: Parity violation, Cobalt-60 experiment, Neutral kaons, CP violation in kaon decay, Neutrinos: solar neutrino puzzle, oscillations, masses and mixing.

References:

1. D. Griffiths, *Introduction to Elementary Particles*, 2nd Edition, Wiley, 2008.
2. W. E. Burcham, M. Jobes, *Nuclear and Particle Physics*, 2nd Edition, Pearson, 1994.
3. F. Halzen, A. D. Martin, *Quarks and Leptons*, 2nd Edition, Wiley, 2008.
4. D. H. Perkins, *Introduction to High Energy Physics*, 4th Edition Cambridge, 2000.

PH3902E Numerical Techniques and Computational Physics

Pre-requisites: Nil

Total Lecture Sessions: 28L + 13P

L	T	P	C
3	0	2	4

Course Outcomes:

CO1: Acquire basic programming skills for solving complex physics problems.

CO2: Apply numerical methods for solving systems of linear, and non-linear equations relevant to physical science.

CO3: Apply interpolation and curve fitting methods for analyzing and interpreting scientific data.

CO4: Implement numerical methods for evaluating integrals and solving ordinary differential equations relevant to physical science.

Programming with Python/Matlab: variables, operators, if-else statements, for- and while-loops, arrays and matrices, functions, plotting and graphics, good programming practices, testing and debugging. Roots of functions: bisection, Newton-Raphson, and secant methods – Applications: particle in a finite potential well, non-ideal gas laws etc. – Systems of linear equations: Gauss and Gauss-Jordan elimination methods – System of non-linear equation: Newton-Raphson method – Applications: electrical networks, spring-mass systems, non-linear dynamics etc.

Interpolation: Newton's interpolation, Lagrange's interpolation – Curve fitting: linear regression, polynomial regression – Applications: Diffraction pattern (Airy disc), evaluation of diffusion constant etc.

Numerical integration: Trapezoidal rule, Simpson's rule, Romberg integration – Ordinary differential equations: Euler methods, Runge- Kutta methods – Applications to classical and quantum physics.

List of Numerical experiment: (13 Lab Sessions)

1) Finding roots of equations – Bisection, Newton-Raphson and secant methods.
2) Linear Algebra – Solving system of linear equations using Gauss and Gauss-Jordan elimination.
3) Numerical integration – Trapezoidal rule and Simpsons' 1/3 rule.
4) Solving ordinary differential equations – Euler methods, Runge-Kutta method.
5) Interpolation – Newton's interpolation and Lagrange interpolation.
6) Curve fitting – Least square method.

References:

1. Paul DeVries, Javier Hasbun, *A First Course in Computational Physics*, 2nd Edition, Jones and Bartlett, 2010.
2. Steven C. Chapra, *Applied Numerical Methods*, 3rd Edition, McGraw Hill, 2011.
3. S. S. Sastry, *Introductory Methods of Numerical Analysis*, 3rd Edition, Prentice-Hall of India, 2002.
4. Tao Pang, *An Introduction to Computational Physics*, 2nd Edition, Cambridge University Press, 2006.
5. Richard L. Burden, J. Douglas Faires, *Numerical Analysis*, 9th Edition, Cengage Learning, 2011.

PH3603E Advanced Electronics

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Describe the structure, operation, and applications of MOSFET as an amplifier

CO2: Design and analyze op-amp based amplifier circuits

CO3: Design and analyze active rectifier and oscillator circuits

CO4: Design and analyze combinational and sequential circuits

Field Effect Transistor (FET): Enhancement-Type MOSFET: Structure and Operation, Current-Voltage Characteristics; MOSFET as an Amplifier; Biasing in MOSFET Amplifiers; Basic MOSFET Amplifier Configuration: Common Source, Common Gate, and Common Drain Types; High Frequency Model of MOSFET Amplifier; Depletion- Type MOSFET; Junction Field- Effect Transistor (JFET).

Advanced Operation Amplifier Circuits: Differential Amplifier: Differential and Common Mode Operation, Common Mode Rejection Ratio (CMRR); Op-amp Based Amplifier Circuits: Weighted Summer, Instrumentation Amplifier, Logarithmic Amplifiers, Anti-Logarithmic Amplifiers; Active Rectifier: Precision Rectifier, Full Wave Rectifier; Active Filters: High Pass, Low Pass, Band Pass, and Band Reject Filters; Oscillators: Barkhausen Criterion for Sustained Oscillations, Phase Shift Oscillator, Wien-Bridge Oscillator, Colpitt and Hartley Oscillators, Schmitt Trigger, Astable Multivibrator, Monostable Multivibrator, 555 Timer IC.

Advanced Digital Circuits (15 hrs): Combinational Logic Circuits: Simplification of Boolean Expressions Using K-Map for 3 and 4 variables, 4-Bit Parallel Binary Adder, 2-Bit and 4-Bit Magnitude Comparator, Encoder, Decoder, Multiplexer, Demultiplexer; Sequential Logic Circuits: SR Latch, Level and Edge Triggered Concept, Clocked R-S, D, J-K, and T FlipFlops, Preset and Clear Operations, Race-Around Conditions in JK Flip-Flop, Master-Slave JK Flip-Flops, Asynchronous Counters, Synchronous Counters.

References:

1. David A. Bell, *Electronic Devices and Circuits*, 5th Edition, Oxford University Press, 2015.
2. David A. Bell, *Operational Amplifiers and Linear ICs*, 3rd Edition, Oxford University Press, 2011.
3. A.S. Sedra, K.C. Smith, A.N. Chandorkar, *Microelectronic circuits*, 6th Edition, Oxford University Press, 2014.
4. Ramakant A. Gayakwad, *Operational Amplifiers with Linear Integrated Circuits*, 4th Edition, Prentice Hall, 2004.
5. S.K. Mandal, *Digital Electronics*, 1st Edition, McGraw Hill, 2010.
6. Venugopal, *Digital Circuits and systems*, Tata McGraw Hill, 2011.

PH3604E Laser Theory

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Acquire the fundamental knowledge of lasers and their characteristics.

CO2: Describe the working of various optical resonators and the process of selecting frequency range of Lasers.

CO3: Explain the working of various types of lasers and appreciate their multidisciplinary applications in science and engineering.

CO4: Design and develop stable optical laser cavities and predict their performance.

Light Matter Interactions: Interaction of Radiation with Matter: Einstein's coefficients and their relations - Optical gain - Line shape function, Line-broadening mechanisms: Homogeneous and inhomogeneous broadening, natural-, Doppler- and collision broadening - Pumping schemes - Laser rate equations: two-level, three-level and four-level laser systems.

Optical Resonators: Plane mirror resonator: resonance frequencies, cavity loss, cavity lifetime, Quality factor - Spherical mirror resonators - Cavity Stability criteria - Optical cavity containing amplifying media: threshold population inversion, variation of laser power around threshold, optimum output coupling - CW and transient laser operations: Q-switching, techniques for Q-switching, Mode-locking mechanism, active and passive mode locking.

Types of Lasers: Solid state Lasers: Ruby laser, Nd-YAG, Atomic gas lasers: He-Ne laser, Argon-ion laser - Molecular gas laser: CO_2 laser - Semiconductor laser - Free electron laser - Excimer laser.

Characteristics & Application of Lasers: Characteristics of Laser Beams: Monochromaticity, Spatial & temporal coherence, pulse width, Directionality, Brightness - Applications of lasers in various fields: General Applications of Lasers including Research & Development, Industry, Defense, Medicine, Entertainment, etc., Laser safety.

References:

1. K. Thyagarajan, A. Ghatak, *Lasers: Fundamentals and Applications*, 2nd Edition, Springer, 2011.
2. W. T. Silfvast, *Laser Fundamentals*, Cambridge University press, 2005.
3. A.E. Siegman, *Lasers*, University, Science Books Mill Valley, C. A, 1986.
4. A. Yariv, *Quantum Electronics*, 3rd Edition, John Wiley and Sons, 1988.

PH3608E Astronomy and Astrophysics

Pre-requisites: Nil

Total Lecture Sessions: 39

L	T	P	C
3	1	0	4

Course Outcomes:

CO1: Analyse basic astronomical motions.

CO2: Explain spectral classification of stars.

CO3: Analyse the stability condition and equilibria based upon various stellar models.

CO4: Discuss the types and salient features of different Galaxies.

Overview of the universe: celestial objects and celestial sphere, constellations – Solar system and exoplanets – Basic astronomical motions: two-body problem, planetary motions – Stellar distances: Trigonometric parallaxes of stars – Astronomical instruments: telescopes and their usages.

Apparent and absolute magnitudes, luminosity, distance modulus – Blackbody radiation, temperatures and colors of stars - Masses and radii of stars - Spectral classification of stars - Hertzsprung-Russell diagram – Spectral lines: Boltzmann excitation equation, Saha's theory of thermal ionization.

Basics of radiative transfer, line strength and source function - Stellar atmosphere – Equations for stellar structure: energy of stars, PP and CNO cycles, hydrostatic equilibrium, stability conditions for convection and radiative equilibrium - Stellar models: polytropic model, Lane-Emden equation - Stellar evolution: main sequence stars, supernovae, neutron stars, dwarfs and black holes.

Milky Way: distribution of stars, interstellar gases and dusts, luminosity function, star counts - External galaxies: Hubble classification of galaxies, spiral galaxies, elliptical galaxies, irregular galaxies - Active galaxies - Cosmology: Theoretical foundation, specific cosmological models (big-bang model, steady state theory), big bang nucleosynthesis, cosmic microwave background.

References:

1. B. W. Carrol and D. A. Ostlie: *An Introduction to Modern Astrophysics*, 2nd Edition, Pearson Addison Wesley, 2006.
2. W. M. Smart and R. M. Green: *Textbook on Spherical Astronomy*, 6th Edition, Cambridge University Press, 1977.
3. K. D. Abhyankar: *Astrophysics - Stars and Galaxies*, Universities Press, 2001.
4. F. H. Shu: *The Physical Universe – An Introduction to Astronomy*, University Science Books, 1982.
5. S. Chandrasekhar: *An Introduction to the study of the stellar structure*, Dover Publications Inc., 2003.
6. R. Kippenhahn , A. Weigert , A. Weiss, *Stellar Structure and Evolution* (2nd Edition), Springer, 2012.

SEMESTER – VII

ED4701E Perspectives on School Leadership and Management

Pre-requisites: Nil

Total Lecture Sessions: 28

L	T	P	C
2	0	0	2

Course Outcomes:

CO1: Analyse the diversity of schools and develop a comprehensive understanding of the educational landscape of India.

CO2: Explain the concept of school leadership and its various aspects.

CO3: Apply The principles of educational leadership in different contexts.

CO4: Develop the culture of evidence-based decision-making that helps to promote collaboration, teamwork, and cooperation among stakeholders.

Understanding School Leadership: School Leadership: Definition and practice, Being a School Leader: exploring the multiple roles and responsibilities, issues and challenges of school leadership in the Indian context, best practices on School leadership at National and International levels.

Schools as Learning Organizations: Role of School Leadership: Schools as motivating learning spaces: Developing inspiring school ethos, Schools as learning organization: promoting personal mastery, examining mental models, and developing a shared vision, team learning and a system's thinking perspective, Development of a shared vision and shaping of the school culture, Use of data for school improvement focused on students' learning, addressing equity challenges, and building an equitable school culture that promotes excellence for all, Nurturing school belongingness: engaging students, teachers, staff, parents, School management committee (SMC), and community in the formulation of a whole school development plan, Designing professional and collaborative learning opportunities for self and others (teachers, parents, and SMC members) and improving teaching and learning.

Reference:

1. T. A. Kasik, A. D. Swanson, *Fundamental Concepts of Educational Leadership and Management* 3rd edition, 2008.
2. D. Lewis, N. Kanji, *Non-governmental organizations and development*, London and New York, Routledge, 2009.
3. P. Drucker, J. Maciariello, (n.d.). *366 Days of Insight and Motivation for Getting the Right Things Done*, Routledge.
4. Palgrave Macmillan, *The Palgrave Handbook of Educational Leadership and Management Discourse*, 2020.
5. E. Camburn, J. P. Spillane, J. Sebastian, *Assessing the utility of a daily log for measuring principal leadership practice. Educational Administration Quarterly*, 46(5), 707–737, 2010.
6. P. Gronn, *Distributed properties: A new architecture for leadership. Educational Management and Administration*, 28(3), 317–338, 2000.
7. J. Lumby, *Distributed leadership: The uses and abuses of power. Educational Management Administration & Leadership*, 41(5), 581–597, 2013.

ED4702E Curriculum Planning and Development

Pre-requisites: Nil

Total Lecture Sessions: 28

L	T	P	C
2	0	0	2

Course Outcomes:

CO1: Identify the relative merits of different types of curriculums by developing an understanding of curriculum and its different types.

CO2: Explain the principles and stages of curriculum development and its relevance.

CO3: Familiarize with approaches to curriculum construction and identify ways of addressing societal concerns and learner needs.

CO4: Explain the ways of operationalizing a curriculum and appraise the specific role of teachers in it.

Education and Curriculum: Meaning, need and significance, Types of Curriculum: subject-centered, activity-centered, environmental centered, community-centered, National Education Policy, National Curriculum Framework, State Curriculum framework-Syllabuses: NCERT/ State.

Principles and stages of Curriculum development: Basic principles: Personalization, Breadth, Relevance, Challenge and Enjoyment, Stages: Needs assessment, Planning session, Content development, Pilot delivery, Evaluation and Reporting, Finalizing the refined package.

Approaches to curriculum construction: Curriculum planning as a cyclic process, Incorporating principles of Integration, Utility, Character formation, Flexibility, Creativity and Conservation. Addressing various aspects- socio-cultural aspects, environmental concerns, values, gender concerns, inclusiveness, technological advancement and impact of globalization.

Curriculum implementation and evaluation: Process oriented, Learner-centred curriculum for different levels (Secondary and Higher Secondary), Role of State School Boards in implementation of curriculum, Role of teachers in operationalizing and evaluating the curriculum with special reference to: Course books, Teachers' Handbooks, Source books, Workbooks and Manuals, Learning resources, Audio Visuals and digital multimedia materials, Library, Laboratory, Playground, Neighborhood etc.

References:

1. Julie Dirksen, *Design for How People Learn*, 2nd Edition, Pearson, 2015.
2. Julie Harris Stern, Krista Ferraro, Kayla Duncan, Trevor Aleo, *Learning That Transfers: Designing Curriculum for a Changing World*, Corwin, 2021.
3. C. R. Kilbane, N. B. Milman, *Teaching Models: Designing Instruction for 21st Century Learners*, 1st Edition, Pearson, 2013.
4. Klein, Julie Thompson, *Beyond Interdisciplinarity: Boundary Work, Communication, and Collaboration*, Oxford University Press, 2021.
5. R. A. Reiser, J. V. Dempsey, *Trends and Issues in Instructional Design and Technology, Pearson*, 4th Edition, 2021.
6. J. B. Short, Hirsh Stephanie, *Transforming Teaching Through Curriculum-Based Professional Learning*, Corwin, 2022.

ED4791E Art Education-Performing and Visual

Pre-requisites: Nil

Total Lecture Sessions: 13

L	T	P	C
1	0	2	2

Course Outcomes:

CO1: Practice different forms of arts such as visual arts and performing Arts (Drama, Music, & dance).

CO2: Integrate different art forms in the teaching process.

CO3: Construct/design any type of drawing and painting Drama script craft on their own.

Visual Arts: Different materials of visual arts– Rangoli, pastels, posters, clay, paintings. Using different methods of visual arts- Paintings, block printing, clay modelling. Listening/viewing performing art forms of music, dance and theatre.

Performing arts in Drama: Drama as a medium of education- Identification of local performing art forms and their integration in teaching – learning. - Listening/viewing performing art skit, mime, one act play or theatre. Evaluation strategies, assessing the different forms of Art.

Fundamentals of Drawing and Painting: Concept and Types of drawing- Colours and Sketching- understanding of various means and perspectives, Different forms of painting. Use of Drawing and Painting in Education -Chart making, Poster making, matchstick drawing and other forms. Model making – Clay modelling, Origami, Decorative – Rangoli, and any other local art.

References:

1. J. Dewey, Art as experience, Minton, 1934.
2. H. Read, *Education through art*, Faber and Faber, 1958.
3. E. W. Eisner, *Educating artistic vision*, Macmillan, 1972.
4. B. John, C. Yogin, R. Chawla, *Playing for real: Using drama in the classroom*, Macmillan, 2007.
5. B. Jefferson, *Teaching art to children – Continental view point*, Allyn Bacon, 1969.
6. R. Tagore, *Lectures and addresses*, Macmillan, 1962.
7. A. K. Coomaraswamy, *Christian and oriental philosophy of art*, Munshiram Manoharlal, 1974.
8. Rupali Tripathi, *Teaching of music*, Mohit Publication, 2004.
9. B. N. Dash, Teacher and Education in the Emerging India Society (Vol. I & II), 2002.
10. Kalaimani Saraswathi, *Bharata Natyakalai*, Thirumagal Nilayam, 1994.

ED4702E Sports, Nutrition and Fitness

Pre-requisites: Nil

Total Lecture Sessions: 13

L	T	P	C
1	0	2	2

Course Outcomes:

CO1: Explain the concept of holistic health, its various dimensions, and determinants.

CO2: Sensitize the need and acquire the skills for physical fitness, learn correct postural habits and activities for its development.

CO3: Create interest for the practice of yogasanas and meditations.

CO4: Carry out various ways of effective assessment of health and physical fitness.

Evolution of Health and Physical Education: Health and Physical Education: Conceptual Clarity (locally as well as globally), importance and aims, Place in School Curriculum: Historical Development as a subject, Objectives with special reference to Indian Education and its relationship with other subjects, Status of Health and Physical Education: From primary to secondary education in a global perspective, ayurvedic and yogic concept of Health Education, legal perspective of Health and Health Education in India.

Health Education: Concept, dimensions, and determinants of health with special focus on India, Psycho-social concerns of children and adolescents including differently abled children, Understanding the body system and its functions, Common health problems and diseases: causes, prevention and cure, immunization and first aid, Impact of Physical activities, games, sports and yoga on different body systems, Food and nutrition, nutrients and their functions.

Games and Fitness: Physical fitness and its components: athletics (general physical fitness exercises), games (lead-up games, relays, and major games), Rhythmic activities, gymnastics, and their impact on health, Development of physical fitness: Postures and Importance of relaxation, Fitness tests, Resources and services for games and sports and Health, Fundamentals skills of sports: Sports for recreation and competition, Sports awards and scholarships, sportsmanship, Indigenous and self-defense activities, School and family, health services, policies and major health and physical education- related programmes, blood banks, role of media, Safety and security, First Aid: Need and Principles.

Policies, Programmes and Assessment: Policies, programmes, and services for addressing health needs, School Health Programmes: school health services, health promoting schools, global school health initiatives, Yoga: Meaning, initiation, historicity, classification, streams, and schools of yoga, Need and importance and role of yoga for healthy life and living.

Yoga as a Psychotherapy, POCSO (Protection of Children from Sexual Offences Act, 2012), PWD 2016, the Integrated Child Protection Scheme, Assessment of health performance testing in games and sports, reporting of health condition and performance of child in the sport fields.

References:

1. NCERT, *Health And Physical Education, A Teachers' Guide for Class VIII*, 2016.
2. Harold W. Kohl III and Heather D. Cook, (Ed.), *Educating the Student Body: Taking Physical Activity and Physical Education to School*, Committee on Physical Activity and Physical Education in the School Environment, Food and Nutrition Board, Institute of Medicine, 2013.

5. Dean Dudley, Amanda Telford, Louisa Peralta, Claire Stonehouse, Matthew Winslade, *Teaching Quality Health & Physical Education*, 2nd edition, Cengage Learning, 2020

ED4703E School based Research Project

Pre-requisites: Nil

Total Lecture Sessions: Nil

L	T	P	C
0	0	4	2

Course Outcomes:

CO1: Present contextual problems, an appropriate research design and the plan of action for undertaking school-based research,

CO2: demonstrate the tools and techniques used for the collection of relevant data,

CO3: summarize the analyzed data used to identify the causes,

CO4: demonstrate the interventions used for addressing the problems,

CO5: present the effectiveness of the intervention(s),

CO6: share the school-based research experiences through reports and presentation.

The student teachers during previous semesters have studied different courses in Foundations of Education, Disciplinary Courses, Stage-specific pedagogy courses, Ability Enhancement and Value Added Courses. The required knowledge of action research and case study includes- the concept and importance of action research/case study, the steps of conducting action research/case study (objectives, methods, research design, design tools, data collection, and data analysis) and report writing.

The research problem will be taken from the day-to-day teaching-learning process of the school. Some of the significant areas may cover:

- Learning progress and outcomes in different subjects
- School-based assessment
- Learners' diversity and inclusion
- Participation in arts, games, sports

Suggestive Mode of Transaction

The following strategies will be used during the school-based research project:

- Discussions with teacher educator, school head, mentors, and peers for identification of problem and development of intervention(s).
- Finalize the school-based research project proposal outline through discussion with mentor teachers/teacher educators.
- Document analysis, interaction with all stakeholders, and field visits.
- Sharing and presentation of the outcomes of school-based research.

ED4704E Internship in Teaching

Pre-requisites: Nil

Total Lecture Sessions: Nil

L	T	P	C
0	0	20	10

Course Outcomes:

CO1: explain the overall functioning of the school.

CO2: describe and appreciate the different roles played by a teacher in the school.

CO3: experience the importance of teacher-student relationships for effective teaching.

CO4: develop age-appropriate pedagogic skills.

CO5: use different pedagogies learnt in real-life classrooms.

CO6: create appropriate teaching-learning materials.

CO7: develop necessary planning and execution skills to conduct school activities (assembly, celebrations, cultural programmes).

CO8: express the school, teacher, parents, and community relationships.

CO9: create rapport with the stakeholders and understand their roles in the school system.

CO10: create student portfolios and comprehensive 360-degree (holistic) progress reports.

CO11: discuss the importance of maintaining different types of records in the school system.

CO12: develop research aptitude and ability to conduct action research for the situations/problems faced during their school internship experience.

Syllabus:

1. Pedagogies' different methods and strategies
2. Scheme of lessons
3. Peer lesson observation
4. Management of substitute classes
5. Various TLMs (including ICT tools) and their uses in teaching-learning
6. Achievement test
7. Diagnostic tests
8. Analysis of the result of the achievement test
9. Assembly activities
10. Action research and case studies.

Activities:

Student teachers are required to undertake the following stage specific activities:

1. Meet the subject-based mentors, collect timetables of classes IX to XII and develop a scheme of lessons from the syllabus to be covered during the internship.
2. Get acquainted with the school within 2-3 days. Observe classroom teaching of school teachers.
3. Plan and transact minimum 80 lessons (40*40), including 4 stray lessons (2*2). Stray lessons are class appropriate lessons on any topic(s) to be transacted by student teachers as per their convenience to build up confidence gradually. The last 5 lessons in each pedagogy course may be transacted using lesson notes.
   - Lesson plans should include the components to develop critical and reflective thinking, problem-solving, differential learning, synthesis, and application of knowledge in real-life situations.
   - Lesson plans must promote education for sustainability, including equity, environment, global citizenship, pride and rootedness in Indian knowledge systems and character building.

4. Participate in post-lesson discussions with peers, mentor(s) and teacher educators.
5. Observe peer lessons and discuss with the group.
6. Conduct laboratory activities (Atal Tinkering Lab, Physics, Chemistry, Biology, Mathematics, Languages, Social Science, Computer), sports, and arts and crafts activities.
7. Participate in student support services: guidance and counselling, NCC, NSS, health and wellness programmes.
8. Create teaching-learning materials, including ICT tools for opted pedagogic courses.
9. Plan assessment, prepare material and formative and summative assessment tools, and analyse the results.
10. Prepare and conduct diagnostic tests to identify learning difficulties, analyse data and prepare learning enhancement plan.
11. Experience classes as a substitute teacher.
12. Participate in library functioning and literary activities.
13. Participate in teacher development and training activities.
14. Organise school assemblies and other events (cultural, sports, yoga, and other development activities).
15. Attend Parents-Teachers Association (PTA) meetings if held during the internship.
16. Attend School Management Committee (SMC) meeting if held during the internship.
17. Study the process of parent and community engagement for the school development programme.
18. Conduct action research/case study.
19. Prepare a sample student portfolio.
20. Write a reflective diary daily and prepare a report of each activity.

SEMESTER – VIII

ED4801E Philosophical and Sociological Perspectives of Education – II

Pre-requisites: Nil

Total Lecture Sessions: 52

L	T	P	C
4	0	0	4

Course Outcomes:

CO1: Identify the relationship between education and society, significance, and aims.

CO2: Explore the meaning, dimensions, and dynamics of social change, and examine the role of education in both facilitating and responding to these changes.

CO3: Examine the relationship between education and culture, emphasizing education as a socialization process.

CO4: Analyze the impact of various factors on promoting social equality and equity within the educational framework.

CO5: Develop a comprehensive understanding of various types of values, including constitutional values, and their significance within the educational context.

Education and Society: Conceptual clarity, relationship, significance and aims of studying the relationship between Education and society. Educational sociology and social perspective of education: meaning and functions. Education as a Social System. Conceptual clarity of society, social behaviour, status, institution, ideology, system, sub-system, socialization, social system, social values and norms, conflict, and modernization. Understanding the relation between individual and group behaviour with special reference to the context of education.

Education and Social Change: Meaning, relation, and dimensions of Social Change, Factors affecting Education and Social Change: technology, social and educational movements, curricular innovations, value conflicts, legal provisions, Constitution of India and Education, Education and Modernity, Role of education with reference to social change.

Education, Culture and Socialization: Relationship between Education and Culture, Education as a process of Socialization, Preservation of Culture through Educational Process, Social Welfare, Social Reform Movements, Legal interventions on Child Marriage, Child labor Act, Educational Policies and Acts, Adult Literacy, New Technology of communication, Equality, Constitutional Provisions and Education with special reference to Social Equality and Equity.

Education and Values: Conceptual Clarity, Relationship and Significance. Types of Values, Constitutional Values and its impact on Education, Human Rights and Values, Environment and Education, Pedagogical issues.

References:

1. P. Smeyers, *International Handbook of Philosophy of Education*. Springer, 2018.
2. R. Bailey, R. Barrow, D. Carr, C. McCarthy, (Eds.), *The SAGE Handbook of Philosophy of Education*. SAGE Publications, 2010.
3. H. Siegel (Ed.) *The Oxford Handbook of Philosophy of Education*. Oxford University Press, 2009.
4. J. C. Agarwal, Philosophical foundation of education, Shri Vinod Pustak Mandir, 2020.
5. A. S. Thakur, S. Berwal, *Education in emerging Indian society*. Vikash Publication, 2007.
6. H.K. Rawat, *Sociology Basic Concepts*. Rawat Publication, 2012.

7. C.N.S. Rao, (eds.). *Sociology Principles of Sociology with an Introduction to Social Thoughts*, S. Chand & Company Pvt. Ltd.

ED4802E Education Policy Analysis

Pre-requisites: Nil

Total Lecture Sessions: 28

L	T	P	C
2	0	0	2

Course Outcomes:

CO1: Explain the significance of various policies on education, and their uses.

CO2: Analyse educational policies since Indian independence and identify the modifications made from time to time.

CO3: Familiarize with the ways of implementing an educational policy and explain the challenges in implementation.

Planning an Educational Policy: Meaning and significance of 'Policy on Education', Purpose and Dimensions of an Educational Policy at local and Global level, Philosophical and Sociological Perspective of planning an Educational Policy, Historical development of Educational Policies in India, Basic steps involved in planning, Constitutional provision for Policy on Education, Fundamental principles for analysing an Educational Policy.

Educational Policies in India: Critical analysis of Policies on Education since Independence: 1968, 1986 (Modified in 1992), 2020 in the context of: need and significance, goals and frameworks of educational policies, content of policies, issues raised in policies, constitutional provisions, Issues of modifications.

Implementation of an Educational Policy: Meaning, need and significance, Mechanism of Policy Implementation, Strategies to Implement an Educational Policy, Programme of action and implementation: conceptual clarification and significance, Role of different Organization / Groups: Legislature/ Judiciary/ Political Will and Parties/ Voluntary Organizations/ Non-governmental organizations (NGOs)/ Pressure Groups/ Public, Challenges for Implementation.

References:

1. Birol Akgun, Alpaydin (ed.), *Education Policies in the 21st Century: Comparative Perspectives*, Palgrave Macmillan.
2. R.V. Vaidyanatha Ayyar, *History of Education Policymaking in India, 1947-2016*, Oxford University Press, 2017.
3. Marilyn Cochran-Smith, *Policy, Practice and Politics in Teacher Education*, Corwin, 2006.

EDUCATION: ELECTIVES

ED4801E Emerging Technologies in Education

Pre-requisites: Nil

Total Lecture Sessions: 52

L	T	P	C
4	0	0	4

Course Outcomes:

CO1: Explain the need and significance of digitalization in social, economic and ethical issues.

CO2: Demonstrate an understanding of ways of employing ICT tools and resources for teaching learners with different needs and abilities.

CO3: Demonstrate the ability to utilize online and offline softwares for teaching different types of contents.

CO4: Compare different e-contents based upon their relative merit.

CO5: Develop the ability to produce learning aids matching instructional design principles.

Information and Communication Technology: Historical Development of the use of Technology in Education, Web 2.0, Web 3.0 and Web 4.0 for teaching and learning, Shift from print to digital content and its impact on teaching, learning and cognition, Social, Economic, and Ethical issues associated with the use of ICT.

Technology in Education and Pedagogy: Universal Design for Learning (UDL), Principles of using Online and Offline tools for teaching and learning, Use of various platforms for Online teaching and learning, Subject specific online resources and their uses in lesson Planning, Use of Technology for children with special needs: Tools and processes.

Online and Offline Software Applications: Educational applications of Documentation, Presentation, Spreadsheet softwares Drawing tools – diagrams, concept maps, timelines, flow charts. Use of Smart Phone with different AI-based apps for teaching and learning, social media for teaching and learning. Use of OER, free online resources for teaching and learning. Online forums/discussion groups and collaborative learning.

Instructional Design and e-content

Characteristics of good e-content, Tools for e-content authoring: Open source and proprietary alternatives, Multimedia tools for audio editing, video editing, screen casting, graphic editing, and animation, Reusable learning objects (RLO) – meaning, types and characteristics, RLO repositories, metadata and standards, Design and development of e-content: Need analysis, Identifying learning objectives, Developing a design, Creating a storyboard, Developing a prototype, Testing and evaluating impact.

References:

1. Catlin R. Tucker, Tiffany Wycoff, Jason T. Green, *Blended Learning in Action: A Practical Guide Toward Sustainable Change*, 1st edition, Corwin, 2016.
2. Centre for Educational Research and Innovation, *Open Educational Resources – Conceptual Issues. In Giving Knowledge for Free: The Emergence of Educational Resources*. OECD, 2007.
3. I. Cheng, L.V. Befort, A. Basu, Multimedia *in Education: Adaptive Learning and Testing*, World Scientific Pub Co Inc, 2009.

4. J. Collins, M. Hammond, J. J. Wellington, Teaching *and Learning with Multimedia, Routledge,* 1997.
5. S. D'Antoni, C. Savage, (eds) Open *Educational Resources: Conversations in Cyberspace,* United Nations Educational, Scientific and Cultural Organization, 2009.
6. Chris Davies, Rebecca Eynon, (ed.) Education *and Technology*, 2nd edition, Routledge and Kegan Paul.
7. D.H. Jonassen, (ed.) *Learning to Solve Problems with Technology: A Constructivist Perspective,* Merrill, 2003.
8. B.R. Joyce, M. Weil, E. Calhoun, *Models of Teaching, Alternative e-Text Formats Series,* 8th edition, Pearson/Allyn and Bacon Publishers, 2009.
9. J. L. Krauss, K. Prottsman, *Computational Thinking and Coding for Every Student: The Teacher's Getting-Started Guide,* Corwin, 2016.
10. R. E. Mayer, *Multimedia Learning*, Cambridge University Press, 2009.
11. S. Mishra, R. C. Sharma, (eds). *Interactive Multimedia in Education and Training,* Idea Group Inc (IGI), 2005.
12. M. D. Roblyer, A. H. Doering, *Integrating Educational Technology into Teaching*, 6th edition, Pearson New International Edition, 2013.
13. G. Solomon, L. Schrum, Web *2.0: New Tools, New Schools,* International Society for Technology in Education, 2007.
14. K. Spencer, *The Psychology of Educational Technology and Instructional Media*, United Writers Press, 1991.
15. J. N. Timothy, A. S. Donald, D. L. James, D. R. James, *Educational Technology for Teaching and Learning,* 4th edition, Pearson Education, 2010.

ED4804E Guidance and Counselling

Pre-requisites: Nil

Total Lecture Sessions: 28

L	T	P	C
2	0	0	2

Course Outcomes:

CO1: Explain the fundamental concepts of guidance in the context of education involving meaning, nature, scope and types.

CO2: Explain the need and significance of counselling, different tools and techniques used and its roles within educational settings.

CO3: Identify various types of psychological testing.

CO4: Critically evaluate ethical issues and challenges in the field of counseling and to design, implement, and evaluate effective guidance counseling programs at school level.

Guidance: Meaning, need, nature and scope of Guidance, Brief historical background of Guidance movement in India, Individual and Group Guidance, Basic assumptions and principles of Guidance, Need to understand the needs of the individual and group in the context of Guidance, Essential information for Effective Guidance, Vocational Guidance and Role of teachers.

Counselling: Meaning, importance, areas, and types of Counselling, Approaches to Counselling- directive, non-directive, eclectic, behaviorally oriented, and cognitively oriented. Process of Counselling: initiating counselling, preparation, and intake procedures, establishing rapport, termination of and response to initial interview, Establishing Structure: attending behaviour, observation, non-verbal behaviour, listening, verbal patterning and communication responses, silence, use of questions. transference and countertransference, regarding and respect in counselling relationships. involuntary clients, client expectations, Role of family and community.

Tools and Techniques to Collect Data: Psychological Testing and Diagnosis: Need and Nature, Test use and interpretation, appraisal techniques, Counselling Interview: Essential aspects, basic procedures, problems, and their handling, Personality Assessment: Historical perspective, Material administration, scoring, interpretation, and evaluation of frequently used personality inventories/ questionnaires and projective tests. Personal Orientation Tests and Rating Scales: Type A behaviour, Locus of Control, Attitude scale, STAI, other clinical rating scales, Case Study: Need and Importance.

Issues Related to Guidance and Counselling: Factors affecting Guidance and Counselling, Ethical issues in Guidance and Counseling, Limitation of diagnosis with special reference to Counselling, Challenges to organize Guidance and Counselling programmes in schools, Counselling and Guidance of persons with learning disabilities, visual and hearing impairment, Challenges related to counselling services in schools.

Reference:

1. J. Ziomek-Daigle, *Counseling Children and Adolescents*, Taylor & Francis, 2017.
2. Diwakar Singh Sikarwar, *Handbook on School Counseling*, Notion Press, 2020.
3. S. Rao, *Counselling and Guidance*, 3rd edition McGraw Hill Education, 2017.
4. Namita Ranganathan, Toolika Wadhwa, *Guidance and Counselling for Children and Adolescents in Schools (India)*, SAGE Publications, 2017.

5. J. Ziomek-Daigle, *School Counseling Classroom Guidance: Prevention, Accountability, and Outcomes (Counseling and Professional Identity)*, SAGE Publications, 2015
6. M. Gibson, *Introduction to Counselling and Guidance*, Pearson Education, 2015.
7. R. Nelson-Jones, *Theory and Practice of Counselling and Therapy*, SAGE, 2012.
8. R. L. Gibson, *Introduction to Counselling and Guidance*, 6th edition, Prentice Hall of India, 2005.
9. R.A. Thompson, *Professional school counselling: Best Practices for working in the schools*, 3rd edition, New York, Routledge, 2012.
10. D. S. Sikarwar, *Handbook on School Counseling*, Notion Press.

ED4891E Yoga and Understanding Self

Pre-requisites: Nil

Total Lecture Sessions: 28

L	T	P	C
2	0	0	2

Course Outcomes:

CO1: Explain the importance of Yoga for an individual in understanding Self.
CO2: Describe the importance of practicing Yoga Asana. CO3: Practice basic Yoga Asanas/ Kriyas.

Philosophical and Historical Perspective of Yoga: Concept and Meaning of Yoga, Philosophy of Yoga, Brief history and development of Yoga (Classical Yoga, Post Classical Yoga and Modern Period), Importance of Yoga for healthy living, Yoga and its relevance in modern times, Traditions in Yoga.

Schools of Yoga: Different streams/schools of Yoga (Gyana, Bhakti, Karma), Construction of Yoga Practice for all round development, Principles of Yoga: - Ahimsa, Satya, Asteya, Brahmacharya, Aparigraha, Shoucha, Santhosha, Tapas, swadyaya and Iswara Pranidhana.

Modern Principles of Yoga and Meditation: Modern Principles: Human Body is a holistic entity, Individuals and their need are Dharana & Dhyana, etc., meditation and reflective practices, the importance of these aspects in becoming an effective teacher, unique Self-empowering, the quality and state of an individual mind, healing Meditation: - Importance, Types, and Process, Pranayama: importance, types and process, Yoga as a Way of life for Peace, Harmony, Health, love and happiness. Yoga in Indian philosophy for understanding Self.

References:

1. Swami Vivekananda, *The Complete Book of Yoga*, Sanage Publishing House LLP, 2022.
2. Peter Connolly, *A Student's Guide to the History and Philosophy of Yoga*, Equinox Publishing Limited, 2014.
3. L. D. Allman, *Yogic Wisdom*, Page Publishing, 2020.
4. M. A. Kessipp, *Meditation, An Ancient Practice for Modern Time*, Robertson Publishing, 2018.
5. N. K. Ford, *Principles of Teaching Yoga to Kids*, Balboa Press, 2020.

ED4892E Citizenship Education, Sustainability, and Environment Education

Pre-requisites: Nil

Total Lecture Sessions: 28

L	T	P	C
2	0	0	2

Course Outcomes:

CO1: Explain the concept of citizenship, citizenship education, global citizenship and global Citizenship Education, aims and various approaches to foster active citizenship.

CO2: Investigate the significance of Vasudhaiva Kutumbakam in fostering a holistic perspective.

CO3: Develop a comprehensive understanding of sustainability and emphasize the role of education in promoting a sustainable development.

CO4: Identify the environmental issues, realize the need for environmental education and actively participate in school and community-based environmental activities.

Citizenship Education: Concept of citizenship, citizenship education, Aims of citizenship education and its various approaches, Global Citizenship, Global Citizenship Education, Aims of Global Citizenship Education, and its various approaches, Concept of Vasudhaiva Kutumbakam, its importance in development of a holistic perspective towards local and global communities.

Sustainability: Concept of "Sustainability" in all fields of human activities, Approaches to achieving sustainable development in economic, social, and environmental dimensions, Sustainable development goals, Sustainable management of natural resources, School- and community-based activities, Education for sustainable development.

Environmental Education: Environmental issues, Actions required for mitigating the effects of climate change, reducing environmental degradation, pollution, Initiatives required for effective waste management, conservation of biological diversity, management of biological natural resources, forest and wildlife conservation, sustainable development and living. Approaches to delivering Environmental Education, Role of Mass Media and Technology in delivering environmental education, Roles of Governmental and Non-Governmental Organizations in promoting Environmental Education, School and community-based environmental education activities.

References:

1. A. Acharya, *Citizenship in Globalizing World*, Pearson.
2. T. P. Kumar, *Environmental Education*, A.P.H. Publications.
3. R. K. Khitoliya, *Environment Pollution-Management, Control for Sustainable Development*, S. Chand and Company.
4. V. Krishnamacharyulu, G. S. Reddy, *Environmental Education*, Neelkamal Publications.
5. M. A. Chaudhary, S. M. Tripathy, *Environmental Education and training – Trends*, Traditions and Transformation, Global Vision Publishing House.
6. R. A. Sharma, *Environmental Studies*, Chand Publication.

ED4805E Post – Internship (Review and Analysis)

Pre-requisites: Nil

Total Lecture Sessions: Nil

L	T	P	C
0	0	4	2

Course Outcomes:

CO1: Develop a comprehensive understanding of the school ecosystem.

CO2: Describe the all-round develop attained during internship.

CO3: Develop effective reflective practices in teaching and learning.

Experience Sharing and Reflective Learning

- Presentation of reflective journal summary
- My Learning Journey: by each student-teacher
- Gallery walks (Exhibition): TLMs, display of participation in school activities (photo stories) and other artefacts created during the internship by student teachers.
- Sharing of best practices (PPTs, Videos.)
- Survey and collect the local stories and rhymes from the parents and community (in the context of the secondary stage)
- Holding a training workshop for the parents and community and encouraging them to act as volunteers.
- Awareness and advocacy programme in Foundational Literacy and Numeracy FLN for parents and community. Role play with parents and community on conducting specific FLN activities.
- Organizing a parents /community mela fair on homemade TLM for secondary stage children

Submission of Internship Report

- Reflective Journal
- Lesson Plans and TLMs
- Observation records (Teacher Educator, Mentor, school heads, Teachers, Parents)
- Assessment records and Student Portfolio
- Action research report/case study
- Comprehensive internship report.

ED4806E Teaching Learning Material/Work Experience

Pre-requisites: Nil

Total Lecture Sessions: Nil

L	T	P	C
0	0	4	2

Course Outcomes:

CO1: Assess the need for Teaching Learning Materials and prepare innovative TLMs.

CO2: Develop an understanding of the importance of work experience and competencies of a local crafts person, artisans and entrepreneurs.

Content:

- Understanding how students learn at different stages.
- Knowledge of toys and other TLMs from different parts of the country
- Addressing the individual differences and knowing of relevant TLMs for specific groups of children- CWSN, kinesthetic learners, visual learners, auditory learners.

Activities to be conducted:

- Orientation workshop on work experience and development of learning resources
- Field visit for interaction with local artisans, craftspeople, and entrepreneurs.
- Observe Traditional work practices and their integration into Local Technologies and Ideas.
- Analysis of available local specific, indigenous learning resources, including toys and their use in the learning-teaching process
- Development of at least two low-cost learning resources as per the local contexts (secondary) and presentation exhibition
- Prepare the manual of TLM highlighting the objectives that will be achieved by its use, the material used, the process of its development and its use during classroom transaction.

ED4807E Community Engagement and Service

Pre-requisites: Nil

Total Lecture Sessions: Nil

L	T	P	C
0	0	4	2

Course Outcomes:

CO1: Recognize the socio-economic issues in the community and identify initiatives that could help solve problems faced by the community.

CO2: Demonstrate an awareness of the functions of the community, and explain the measures required for enlisting community participation in school-related activities.

CO3: undertake initiatives that are required to make the community aware of the importance of education to meet various challenges.

CO4: suggest actions in collaboration with community members to address the social, cultural and educational problems in the community.

Approach to curriculum transaction

The student teachers will be provided opportunities to have exposure to community life for ten days. (two days in Preparation for Community Engagement & Service in the institution, seven days working with the community, and the last day in the institution for sharing their experiences and reflections). The activities may be conducted in groups or individually, as appropriate.

Days 1-2: Preparation for community services (In the institution)

- Orientation of student teachers on Community Engagement & Services through discussion and group activities.
- Workshop for developing tools for different activities during the programme.

Days 3-9: Engagement with the community (Mandatory onsite stay with the community). Students will be divided into smaller groups. They would participate in the planned activities with defined roles for seven days on a rotation basis. These activities include:

- Participation of student teachers in activities undertaken under the National Service Scheme (NSS), New India Literacy Programme, Student mentoring initiatives, etc.
- Survey of community resources for supporting school activities.
- Study of the situation regarding school dropout and the reason thereof (stage wise).
- Survey of specific settlement to assess the situation about non-literates in the settlement, including identification of 4-5 non-literate youth and adults who will be supported by student teachers to become literate.
- Training of local youth in First Aid and other relevant interventions.
- Assessment of the situation about Health and wellness of children in a locality.
- Creating awareness of the importance of sustainable development, and making the community members aware of the need to support initiatives to ensure environmental protection, creating awareness of rainwater harvesting, mentoring school students with learning deficits, guidance and counselling to school students etc.
- Visit and interact with local artisans and craftsperson.

The above activities typically will include working with the community, collecting data, playing local games, community awareness programmes like nukkad natak, rallies, organizing and participating in the cultural programmes with the community members etc.

The student teachers shall conduct different pre-scheduled activities throughout the day. Morning sessions will be used for activities with the community and data collection. The afternoon session will be devoted to data analysis and preparation of the report, and participation in games & sports activities. Evening session will involve cultural activities with community members.

Day 10: Feedback session and Reflection (In the Institution)

- Sharing experiences and discussion on activities carried out.
- Presentation and submission of report on the activities carried out.
- Evaluation of the activities by collecting feedback on the effectiveness of the campaign from the mentor and the students.
- Reflection of experience (individual/group) of organizing community service

ANNEXURE III

Minutes of meeting of the Board of Studies (BoS) of Mechanical Engineering Department held on [illegible]

Date: [illegible] Time: [illegible]
Venue: [illegible]

Members present:

1. Dr. [illegible] Kumar, Associate Professor & HOD, ME - Chairman
2. Prof. [illegible], Professor, ME - Member
3. Dr. Anil Kumar [illegible], Associate Professor, ME - Member
4. Dr. [illegible] Singh, Assistant Professor, ME - Member
5. Dr. [illegible], Assistant Professor, ME - Member
6. Dr. [illegible], Assistant Professor, ME - Member
7. Dr. [illegible] Singh, Assistant Professor, ME - Member
8. Dr. [illegible], Assistant Professor, ME - Member
9. Dr. [illegible], Assistant Professor, ME - Member
10. Prof. A. [illegible], Professor (HAG), ME, NIT Warangal - BOS external member
11. Prof. [illegible], Professor, ME, MANIT, Bhopal - BOS external member
12. Mr. [illegible], Dy. General Manager, Indian Oil Corporation Ltd., [illegible] - BOS external member

Agenda: Discussion regarding finalization of the curriculum & syllabus for the proposed M. Tech program in Intelligent Mechanical Systems in the Department of Mechanical Engineering.

Opening:

The meeting commenced under the chairmanship of the HOD, [illegible] members and emphasized the timely importance of introducing the proposed M. Tech. programme in Intelligent Mechanical Systems, highlighting its relevance to emerging technologies through the integration of computational intelligence, smart sensors, cyber-physical systems and sustainable technologies, which the BOS members also evaluated [illegible] considerations.

Resolutions: The conclusions made in the meeting are as follows:

1. [illegible]
2. **Program Outcomes (POs):** In accordance with [illegible] guidelines, the PG program will have only 3 Program Outcomes (POs) [illegible].
3. **Course Articulation Matrix:** [illegible]
4. **Qualifying Degree:** It was resolved to keep the qualifying degree as B.E./B. Tech. [illegible] under the B.E./B. Tech. Degree category.
5. **Eligibility via GATE:** It was suggested and agreed [illegible] the proposed M. Tech program in Intelligent Mechanical Systems if they have qualified the GATE [illegible] in the following streams:

1. Mechanical Engineering	8. Textile Engineering & Fibre Science
2. Aerospace Engineering	9. Agricultural Engineering
3. Production & Industrial Engineering	10. [illegible]
4. Metallurgical Engineering	11. Instrumentation Engineering
5. Chemical Engineering	12. Electronics & Communication Engineering
6. Data Science and Artificial Intelligence	13. Computer Science & Information Technology
7. Naval Architecture and Marine Engineering	

Based on resolutions made in the meeting, the curriculum & syllabus for the proposed M. Tech program in Intelligent Mechanical Systems has been revised and attached in annexure I.

Dr. [illegible] Prasad
(External Member from [illegible])

Prof. A. L. Bhagoria
(External Member from MANIT Bhopal)

Prof. A. Venu Gopal
(External Member from NIT Warangal)

Dr. Shahnawaz Ahmed
(Member)

Dr. [illegible]
(Member)

Dr. [illegible] Kumar Singh
(Member)

Dr. [illegible]
(Member)

Dr. Anil Kumar Birru
(Member)

Dr. [illegible]
(Member)

Dr. H. [illegible] Singh
(Member)

Prof. (Dr.) Rajesh Kumar Bhushan
(Member)

Dr. Prabhat Kumar
(Chairman)

Annexure-I

CURRICULUM & SYLLABI

for

M. Tech Programme

in

Mechanical Engineering
(Intelligent Mechanical Systems)

(2026 Onwards)

DEPARTMENT OF MECHANICAL ENGINEERING

National Institute of Technology Manipur
Langol, Imphal- 795004
India

DEPARTMENT OF MECHANICAL ENGINEERING
राष्ट्रीय प्रौद्योगिकी संस्थान मणिपुर
NATIONAL INSTITUTE OF TECHNOLOGY, MANIPUR

M. Tech in Intelligent Mechanical Systems

Semester-I

Sl. No.	Course Code	Course Name	L	T	P	Credits
1	ME511	Computational Methods in Engineering	3	0	0	6
2	ME513	Introduction to Artificial Intelligence and Machine Learning	3	0	0	6
3	ME517	Smart Sensors	3	0	0	6
4	ME519	Intelligent Control Systems	3	0	0	6
5	ME5xx	Elective I	3	0	0	6
6	ME531	Computational Engineering Lab	0	0	3	3
7	ME533	Artificial Intelligence and Machine Learning Lab	0	0	3	3
		Total	15	0	6	36

Semester-II

Sl. No.	Course Code	Course Name	L	T	P	Credits
1	ME510	Cyber Physical Security in Mechanical Systems	3	0	0	6
2	ME512	Additive and Hybrid Manufacturing Processes	3	0	0	6
3	ME516	Swarm Intelligent Systems	3	0	0	6
4	ME5xx	Elective II	3	0	0	6
5	ME536	Intelligent Systems Lab	0	0	3	3
6	ME534	Seminar	0	0	2	2
		Total	12	0	5	29

Semester-III

Sl. No.	Course Code	Course Name	L	T	P	Credits
1	[illegible]	M. Tech Dissertation Phase I	0	0	24	24
		Total	0	0	24	24

Semester-IV

Sl. No.	Course Code	Course Name	L	T	P	Credits
1	[illegible]	M. Tech Dissertation Phase II	0	0	24	24
		Total	0	0	24	24

Total credits: 113

DEPARTMENT OF MECHANICAL ENGINEERING
NATIONAL INSTITUTE OF TECHNOLOGY, MANIPUR

List of Departmental Electives

[illegible]	[illegible]	[illegible]	L	T	P	Credits	[illegible]
1	[illegible]	Finite Element Method	3	0	0	6	Department Elective I
2	[illegible]	Advanced Mechanics of Solids	3	0	0	6	
3	[illegible]	Condition Monitoring Techniques	3	0	0	6	
4	[illegible]	Advanced Heat Transfer	3	0	0	6	
5	[illegible]	Engineering Design with Advanced Materials	3	0	0	6	
6	[illegible]	Special Topics in Design and Smart Manufacturing	3	0	0	6	
7	[illegible]	Manufacturing Automation	3	0	0	6	
8	[illegible]	Viscous Fluid Flows	3	0	0	6	
9	[illegible]	MEMS and Microsystems	3	0	0	6	
10	[illegible]	Machine Vision and Image Processing	3	0	0	6	
11	[illegible]	Optimization in Engineering Systems	3	0	0	6	
12	[illegible]	Thermal Design and Energy Management	3	0	0	6	
13	ME587	Ethics of AI	3	0	0	6	
14	[illegible]	Smart Materials and Structures	3	0	0	6	Department Elective II
15	[illegible]	Intelligent Refrigeration and Air Conditioning Systems	3	0	0	6	
16	[illegible]	Non-Linear Finite Element Methods	3	0	0	6	
17	[illegible]	Turbulent Flows	3	0	0	6	
18	[illegible]	Bio-inspired Design	3	0	0	6	
19	[illegible]	Advanced Mechanical Vibrations	3	0	0	6	
20	[illegible]	Human-Machine Interaction	3	0	0	6	
21	[illegible]	Instrumentation and Measurement Systems	3	0	0	6	
22	[illegible]	Mechatronics System Design	3	0	0	6	
23	[illegible]	Computational Fluid Dynamics	3	0	0	6	
24	[illegible]	Rotor Dynamics	3	0	0	6	
25	[illegible]	Industrial Machine Learning	3	0	0	6	

CURRICULUM & SYLLABI

for

M. Tech Programme

in

Mechanical Engineering
(Intelligent Mechanical Systems)

(2026 Onwards)

DEPARTMENT OF MECHANICAL ENGINEERING

National Institute of Technology Manipur

Langol, Imphal- 795004

India

M. Tech in Intelligent Machanical Systems

Semester-I

Sl. No.	Course Code	Course Name	L	T	P	Credits
1	ME513	Computational Methods in Engineering	3	0	0	6
2	ME515	Introduction to Artificial Intelligence and Machine Learning	3	0	0	6
3	ME517	Smart Sensors	3	0	0	6
4	ME519	Intelligent Control Systems	3	0	0	6
5	ME5xx	Elective I	3	0	0	6
6	ME533	Computational Engineering Lab	0	0	3	3
7	ME535	Artificial Intelligence and Machine Learning Lab	0	0	3	3
		Total	**15**	**0**	**6**	**36**

Semester-II

Sl. No.	Course Code	Course Name	L	T	P	Credits
1	ME510	Cyber-Physical Security in Mechanical Systems	3	0	0	6
2	ME512	Additive and Hybrid Manufacturing Processes	3	0	0	6
3	ME516	Green Intelligent Systems	3	0	0	6
4	ME5xx	Elective II	3	0	0	6
5	ME536	Intelligent Systems Lab	0	0	3	3
6	ME534	Seminar	0	0	2	2
		Total	**12**	**0**	**5**	**29**

Semester-III

Sl. No.	Course Code	Course Name	L	T	P	Credits
1	ME633	M. Tech Dissertation Phase I	0	0	24	24
		Total	**0**	**0**	**24**	**24**

Semester-IV

Sl. No.	Course Code	Course Name	L	T	P	Credits
1	ME634	M. Tech Dissertation Phase II	0	0	24	24
		Total	**0**	**0**	**24**	**24**

Total credits: 113

List of Departmental Electives

Sl. No.	Course Code	Course Name	L	T	P	Credits	Category
1	ME563	Finite Element Method	3	0	0	6	Department Elective I
2	ME565	Advanced Mechanics of Solids	3	0	0	6	
3	ME567	Condition Monitoring Techniques	3	0	0	6	
4	ME569	Advanced Heat Transfer	3	0	0	6	
5	ME571	Engineering Design with Advanced Materials	3	0	0	6	
6	ME573	Internet of Things and Smart Manufacturing	3	0	0	6	
7	ME575	Manufacturing Automation	3	0	0	6	
8	ME577	Viscous Fluid Flows	3	0	0	6	
9	ME579	MEMS and Microsystems	3	0	0	6	
10	ME581	Machine Vision and Image Processing	3	0	0	6	
11	ME583	Optimization in Engineering Systems	3	0	0	6	
12	ME585	Thermal design and Hotspot Management	3	0	0	6	
13	ME587	Ethics of AI	3	0	0	6	
14	ME580	Smart Materials and Structures	3	0	0	6	Department Elective II
15	ME582	Intelligent Refrigeration and Air Conditioning Systems	3	0	0	6	
16	ME584	Non-Linear Finite Element Methods	3	0	0	6	
17	ME586	Turbulent flows	3	0	0	6	
18	ME588	Bio-inspired Designs	3	0	0	6	
19	ME590	Advanced Mechanical Vibrations	3	0	0	6	
20	ME592	Human–Machine Interaction	3	0	0	6	
21	ME594	Instrumentation and Measurement Systems	3	0	0	6	
22	ME596	Mechatronics System Design	3	0	0	6	
23	ME598	Computational Fluid Dynamics	3	0	0	6	
24	ME600	Rotor Dynamics	3	0	0	6	
25	ME602	Scientific Machine Learning	3	0	0	6	

DEPARTMENT OF MECHANICAL ENGINEERING
राष्ट्रीय प्रौद्योगिकी संस्थान मणिपुर
NATIONAL INSTITUTE OF TECHNOLOGY, MANIPUR
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An Autonomous Institute under Ministry of Education, Govt. of India.

Syllabus of Core Courses

ME513 3-0-0-6

Computational Methods in Engineering

Course Outcomes:

CO1	Solve engineering problems with accuracy and efficiency using various computational methods.
CO2	Apply numerical techniques for solving linear, nonlinear, ODE, and PDE-based engineering models.
CO3	Develop computational models using MATLAB/Python for mechanical and intelligent systems.
CO4	Apply optimization and data-driven techniques for engineering design and prediction.
CO5	Conduct simulation-based projects to solve real-world mechanical problems.

Course Articulation Matrix:

COs	POs		
	PO1	PO2	PO3
CO1	3	-	3
CO2	3	-	3
CO3	3	-	3
CO4	3	-	3
CO5	3	-	3

1 – Low 2 – Medium 3 – High

Detailed Syllabus:

Fundamentals of Numerical Methods: Error analysis, stability, convergence; Solutions of linear and nonlinear algebraic equations; Modelling and simulation concepts.

Numerical Linear Algebra: Solution of linear systems: Gauss elimination, LU decomposition; Iterative methods: Jacobi, Gauss-Seidel, SOR; Eigenvalue problems: Power method, QR method. Applications in robotics, control systems, and structural analysis.

Differential Equations in Engineering: Initial value problems: Euler, RK family, multi-step methods; Boundary value problems: Shooting, Finite difference; PDEs: Heat, wave, Laplace equations.

Optimization Techniques: Unconstrained optimization: Gradient descent, Newton method; Constrained optimization: Lagrange multipliers, KKT conditions; Engineering optimization: design optimization, parameter tuning; Evolutionary algorithms (GA, PSO) for intelligent systems

Applications in Intelligent Mechanical Systems: Computational modelling of mechatronic systems; Digital twins & real-time simulation; Case studies: robotics, thermal systems, structural health monitoring

Text Books:

1. Numerical Methods for Engineers, Chapra, S.C., and Canale, R.P., McGraw-Hill Publishing Co., 8th Edition, 2021.
2. Numerical Analysis for Engineers: Methods and Applications, Ayyub, B.M., and McCuen R.H., Routledge, 3rd Edition, 2020.

Reference Books:

1. Applied Numerical Analysis Using MATLAB, Fausett, L.V., Pearson Education.
2. Mathematical Methods in the Physical Sciences, Boas, M.L., Wiley.

Online Resources:

1. https://nptel.ac.in/courses/103106118

ME615 **Introduction to Artificial Intelligence and Machine Learning** 3-0-0-6

Course Outcomes:

CO1	Analyze role of AI & ML in intelligent mechanical systems.
CO2	Apply mathematical and statistical foundations to develop ML models.
CO3	Implement supervised and unsupervised ML algorithms using Python.
CO4	Design and implement neural networks for intelligent mechanical applications.
CO5	Integrate AI/ML solutions in robotics, manufacturing, and predictive maintenance.

Course Articulation Matrix:

COs	POs		
	PO1	PO2	PO3
CO1	2	-	2
CO2	3	-	3
CO3	3	-	3
CO4	3	1	3
CO5	3	2	3

1 – Low 2 – Medium 3 – High

Detailed Syllabus:

Foundations of AI: History and evolution of AI; AI in mechanical engineering applications; Problem-solving and search techniques (uninformed & informed search); Intelligent agents and decision-making

Machine Learning Basics: Linear algebra for ML: vectors, matrices, eigenvalues; Probability & statistics: distributions, Bayes rule; Optimization: gradient descent, stochastic gradient descent; Loss functions, overfitting, regularization; Bias–variance tradeoff

Supervised and Unsupervised Learning: Classification and Regression; Algorithms: Linear & Polynomial Regression, Logistic Regression, K-Nearest Neighbors, Decision Trees, Random Forest, Support Vector Machines; Clustering: K-means, Hierarchical clustering, DBSCAN; Dimensionality reduction: PCA, t-SNE; Anomaly detection (applications in machine faults)

Neural Networks and Deep Learning: Perceptron and multilayer neural networks; Backpropagation algorithm; Introduction to Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs)

AI & ML for Intelligent Mechanical Systems: AI in robotics and autonomous systems; Predictive maintenance using ML; Digital twins, Industry 4.0 and smart manufacturing.

Text Books:

1. Artificial Intelligence: A Modern Approach, Russell, S., and Norvig, P., 4th Edition, 2020.
2. Machine Learning, Animated, Liu, M, CRC Press, 1st Edition, 2024.

Reference Books:

1. Artificial Intelligence Basics: A Non-Technical Introduction, Tom Taulli, 1st Edition, 2019.
2. Pattern Recognition and Machine Learning, Bishop, C.M., 1st Edition, 2006.

Online Resources:

1. https://nptel.ac.in/courses/[illegible]
2. https://nptel.ac.in/courses/[illegible]

ME517 Smart Sensors 3-0-0-6

Course Outcomes:

CO1	Analyze the principles, characteristics, and classifications of smart sensors and actuators.
CO2	Analyze sensor signals, perform signal conditioning, and interface sensors with embedded

	systems.
CO3	Evaluate smart actuator technologies and their application in intelligent mechanical systems.
CO4	Apply MEMS and IoT concepts to design modern sensing systems.
CO5	Integrate and implement intelligent sensor–actuator systems using AI/ML for real-world applications.

Course Articulation Matrix:

COs	POs		
	PO1	PO2	PO3
CO1	2	-	2
CO2	3	-	3
CO3	3	-	3
CO4	3	1	3
CO5	3	2	3

1 – Low 2 – Medium 3 – High

Detailed Syllabus:

Fundamentals of Smart Sensors: Classification of sensors: displacement, force, strain, piezoelectric, thermal, proximity, flow, chemical sensors; Static & dynamic characteristics: accuracy, repeatability, resolution, sensitivity, bandwidth; Smart sensor architecture: Self-calibration, self-diagnosis, and intelligent features.

Sensor Interfacing and Signal Conditioning: Analog and digital signal conditioning; Wheatstone bridge, instrumentation amplifiers, filters (active/passive); ADC/DAC, sampling, anti-aliasing; Communication protocols: I2C, SPI, UART, CAN, LIN; Embedded data acquisition using microcontrollers.

Smart Actuators and Actuation Technologies: Types of actuators: electromagnetic, hydraulic, pneumatic; Smart materials: shape memory alloys (SMA), piezoelectric actuators, magnetostrictive actuators, electroactive polymers; Micro-actuators and micro-positioning; Actuator modeling and characteristics: response time, torque, force production, hysteresis.

MEMS and IoT-Enabled Sensing Systems: MEMS sensor principles: accelerometers, gyroscopes, pressure sensors, micro-thermal sensors; Fabrication basics: lithography, etching, thin-film deposition; Sensor miniaturization and integration; IoT and wireless sensor networks (WSN).

Applications in Intelligent Mechanical Systems: Robotics: proprioceptive and exteroceptive sensors, Autonomous systems: LIDAR, ultrasonic, inertial navigation sensors, Automotive applications: pressure, oxygen, knock, ABS wheel sensors, Industrial automation: proximity, force, flow and smart actuators

Text Books:

1. Smart Sensors: Design, Challenges, and Applications, Shukla, M.K., Malik, P.K., Jain, A., Mishra, N.K., CRC Press, 1st Edition, 2025.

Reference Books:

1. Sensors and Actuators: Engineering System Instrumentation, Raghuwanshi, M., and Raghuwanshi, R., 1st Edition, 2015.
2. Sensor Technology Handbook, Wilson, J.S., 1st Edition, 2005.

Online Resources: https://onlinecourses.nptel.ac.in/noc25_ee41/preview

ME519 | 3-0-0-3

Intelligent Control Systems

Course Outcomes:

CO1	Analyze the architecture of intelligent control systems.
CO2	Design and analyze fuzzy logic and neural network controllers for dynamic mechanical systems.
CO3	Apply adaptive and robust control strategies to uncertain and nonlinear systems.
CO4	Utilize evolutionary and optimization algorithms for intelligent controller design.
CO5	Integrate intelligent control techniques in robotics, autonomous systems, and intelligent mechanical systems.

Course Articulation Matrix:

COs	POs		
	PO1	PO2	PO3
CO1	2	1	2
CO2	3	-	3
CO3	3	-	3
CO4	3	1	3
CO5	3	2	3

1 – Low 2 – Medium 3 – High

Detailed Syllabus:

Langol, Imphal-795004. Email:- hodmechanical@nitmanipur.ac.in
An Autonomous Institute under Ministry of Education, Govt. of India.

Introduction to Intelligent Control: Review of classical control theory; Architecture of intelligent controllers; Intelligent mechanical systems: examples and applications; Review of linear and nonlinear systems; state-space representation.

Fuzzy Logic Control: Fuzzy sets and membership functions; Linguistic variables and rule-based systems; Fuzzy inference systems (Mamdani, Sugeno); Design of fuzzy controllers for mechanical systems; Adaptive fuzzy controllers.

Adaptive and Robust Control: Parameter adaptation and model reference adaptive control (MRAC); Self-tuning regulators; Introduction to sliding mode control; Robustness considerations (disturbances – uncertainties).

Evolutionary and Optimization-Based Control: Genetic algorithms (GA) for controller tuning; Particle Swarm Optimization (PSO); Model Predictive Control (MPC) – fundamentals; Reinforcement Learning (RL) basics for control; Optimization of controller parameters.

Intelligent Control Applications: Intelligent control of robots, autonomous vehicles, drones; Smart actuators and sensors in intelligent control loops; Digital twin and real-time adaptive control.

Text Books:

1. Intelligent Control Systems: Theory and Applications, Passino, K.M., and Yurkovich, S.
2. Adaptive Control, Astrom, K. J., Wittenmark, B.

Reference Books:

1. Fuzzy Control, Passino, K.M., and Yurkovich, S., 1st Edition, 1998.
2. Neural Networks and Fuzzy Logic Systems, Mendel, J.M., 1st Edition, 1995.

Online Resources:

1. https://nptel.ac.in/courses/108104049
2. https://nptel.ac.in/courses/127105006

ME533 — 0-0-3-2

Computational Engineering Lab

Sl. No.	List of Experiments
1	MATLAB/Python for solving linear algebra problems
2	ODE/PDE simulation of mechanical systems
3	Computational modelling of robotic/manipulator dynamics
4	Sensor data analytics
5.	Simulation of control algorithms (PID, state feedback) for electromechanical systems
6.	Finite element-based simulation of solid and structural mechanics
7.	Numerical solution of nonlinear algebraic systems arising in engineering models

ME5[illegible] **Artificial Intelligence and Machine Learning Lab** 0-0-3-3

Sl. No.	List of Experiments
1	Python basics for AI/ML: data types, Numpy, Pandas, Matplotlib
2	Implement search algorithms: BFS, DFS, A* with heuristic
3	Data preprocessing: normalization, encoding, missing data handling
4	Implement Linear Regression and evaluate performance
5	Decision Trees and Random Forests on mechanical datasets
6	Implement K-Means clustering and visualize clusters
7	Implement a simple neural network (MLP) using Keras/PyTorch
8	Introduction to CNNs for visual inspection tasks

ME 520 **Cyber-Physical Security in Mechanical Systems** 3-0-0-6

Course Outcomes:

CO1	Analyze the architecture and fundamental components of Cyber-Physical Systems.
CO2	Develop mathematical models for continuous physical dynamics and discrete computational logic (Hybrid Systems).
CO3	Implement embedded systems for real-time CPS applications.
CO4	Design and implement sensing, actuation, and communication protocols for intelligent machines.
CO6	Analyze CPS stability, performance, and security against cyber-attacks.

Course Articulation Matrix:

COs	POs		
	PO1	PO2	PO3
CO1	3	1	3
CO2	3	-	3
CO3	3	-	3
CO4	3	1	3
CO5	3	2	3

1 – Low 2 – Medium 3 – High

Detailed Syllabus:

Introduction to CPS Architecture: Definition and characteristics of CPS; The 5C architecture: Connection, Conversion, Cyber, Cognition, and Configuration; Difference between Embedded Systems, IoT, and CPS.

Modeling Physical and Cyber Components: Physical Modeling: Differential equations; State-space models of mechanical systems; Cyber Modeling: Finite State Machines (FSM), Extended State Machines; Hybrid Systems: Modeling systems with both continuous and discrete behaviors using Hybrid Automata.

Embedded Computing and Real-Time Systems: Embedded processors and CPS hardware platforms; Real-time operating systems (RTOS) concepts; Task scheduling and timing constraints; Sensing, actuation, and I/O handling; Hardware-in-the-loop (HIL) and software-in-the-loop (SIL); Fault tolerance and reliability.

Communication and Networking: Networked Control Systems (NCS); Communication protocols: MQTT, CoAP, CAN Bus (for automotive), and Industrial Ethernet; Impact of network delay, packet loss, and jitter on mechanical performance.

Security and Reliability: Cyber-physical security: Vulnerabilities in mechanical hardware; Attack models: Denial of Service (DoS), False Data Injection (FDI); Safety-critical design and Fault-tolerant control.

Text Books:

1. Introduction to Embedded Systems: A Cyber-Physical Systems Approach by Edward A. Lee and Sanjit A. Seshia.

Reference Books:

1. Cyber-Physical Systems Security, Rawat, D.B., Bajracharya, C., and Yan, G., 1st Edition, 2015.
2. Security and Privacy in Cyber-Physical Systems, Humayed, A., Lin, J., Li, F., and Luo, B., 1st Edition, 2017.

Online Resources:

1. http://nptel.ac.in/courses/106105241

ME512	Additive and Hybrid Manufacturing Processes	3-0-0-4

Course Outcomes:

CO1	Demonstrate in-depth knowledge of additive manufacturing (AM) processes, materials, and applications

CO2	Analyse various AM processes and their suitability for mechanical applications.
CO3	Categorize the materials involved in additive manufacturing.
CO4	Explain hybrid manufacturing processes and evaluate their advantages for precision applications.
CO5	Apply DfAM principles, topology optimization, and design automation for AM.

Course Articulation Matrix:

COs	POs		
	PO1	PO2	PO3
CO1	3	1	3
CO2	3	1	3
CO3	3	-	3
CO4	3	-	3
CO5	3	2	3

1 – Low 2 – Medium 3 – High

Detailed Syllabus:

Fundamentals of Additive Manufacturing: Evolution of manufacturing technologies; Principles of additive manufacturing; **AM workflow: CAD → STL → Slicing → Printing → Post**-processing.

Additive Manufacturing Processes: Vat photo-polymerization (SLA, DLP); Material extrusion (FDM); Powder bed fusion (SLS, SLM, EBM); Directed energy deposition; Binder jetting and sheet lamination.

Materials for Additive Manufacturing: Polymers, metals, ceramics, composites; Material properties and processing challenges; Microstructure and mechanical performance; Recycling and sustainability in AM.

Hybrid Manufacturing Processes: Additive + subtractive systems (laser metal deposition + CNC machining); Metal AM with post-machining for accuracy; Ultrasonic AM + machining; Friction stir additive manufacturing; Applications in repair, remanufacturing, tooling; Hybrid robotics-based systems.

Applications: AM in mechanical industries, biomedical implants, aerospace defense, robotics, Smart materials & functionally graded materials through AM; Large-scale AM (WAAM, concrete printing).

Text Books:

1. Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, Gibson, I., Rosen, D., & Stucker, B.
2. Hybrid Manufacturing: Emerging Processes, Materials, and Applications, Dubey, [illegible], and Bag, S.

Reference Books:

1. Additive and Subtractive Manufacturing, Liou, F.W., 1st Edition, 2017.
2. Additive Manufacturing Technologies, Gibson, I., Rosen, D.W., and Stucker, B., 3rd Edition, 2021.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc22_me119/preview

ME 538 Credits: 3-0-0-6

Green Intelligent Systems

Course Outcomes:

CO1	Evaluate the environmental impact of mechanical systems using Life Cycle Assessment (LCA) and digital twin simulations.
CO2	Design intelligent control strategies for energy-efficient operations in industrial and robotic systems.
CO3	Apply Generative Design and AI-driven optimization to minimize material usage and maximize recyclability.
CO4	Implement Green-IoT (G-IoT) frameworks for real-time monitoring of resource consumption and carbon emissions.
CO5	Develop strategies for Circular Economy in mechanical systems, focusing on remanufacturing and end-of-life intelligence.

Course Articulation Matrix:

COs	POs		
	PO1	PO2	PO3
CO1	3	1	3
CO2	3	1	3
CO3	3	1	3
CO4	3	1	3
CO5	3	3	3

1 – Low 2 – Medium 3 – High

Detailed Syllabus:

Foundations of Eco-Intelligence: The transition from Lean to Green to Eco-Intelligent Manufacturing; Key Sustainability Indicators: Carbon Footprint, Water Footprint, and Embodied Energy; Introduction to Sustainable Intelligence (SI).

Life Cycle Engineering and Eco-Design Methods: Life Cycle Assessment (LCA): cradle-to-grave approach; Environmental impact metrics (carbon footprint, energy intensity); Design for environment (DfE), design for sustainability (DfS); Circular economy and resource efficiency; Materials selection for eco-intelligent systems.

Energy-Aware Intelligent Systems: Machine Learning for Predictive Energy Management; Intelligent HVAC and Thermal Management in Industrial Systems; Optimization of Power Consumption in Robotics and Autonomous Mobile Robots (AMRs); Integration of renewable energy sources with intelligent mechanical grids.

Real-time Eco-Monitoring & G-IoT: Deploying low-power sensors for environmental auditing; Digital Twins for Sustainability: Real-time simulation of wear-and-tear to extend product life; Edge Computing vs. Cloud Computing: The carbon trade-off of AI computations.

Circular Economy & Remanufacturing Intelligence: Predictive Maintenance (PdM) as a tool for product life extension; Blockchain for tracking material provenance and "Product Passports." AI-based sorting and disassembly robots for waste management; Ethical considerations in the trade-off between technological performance and environmental health.

Text Books:
1. Environmentally Conscious Manufacturing, Gungor, A., Gupta, S.M.

Reference Books:

1. Sustainable Intelligent Systems, Abraham, A., and Corchado, J.M., 1st Edition, 2018.
2. Artificial Intelligence for Sustainable Development, Vinuesa, R., Azizpour, H., Leite, I., Balaam, M., Dignum, V., Domisch, S., Felländer, A., Langhans, S.D., Tegmark, M., and Fuso Nerini, F., 1st Edition, 2020.

Online Resources: https://nptel.ac.in/courses/105105157

ME536 Credits: 0-0-3-2

Intelligent Systems Lab

Sl. No.	Experiments (Intelligent Systems Lab)
1	Python/Matlab refresher for SciML (NumPy, PyTorch/TensorFlow, SciPy)
2	SINDy for identifying equations of motion of a robotic arm or vibration system
3	Closed-loop control of electromechanical systems
4	IoT-based mechatronic system monitoring
5	Gaussian Process surrogate model for structural or thermal problem
6	Neural ODE for mechanical dynamics
7	AI-based fault classification using vibration data
8	Create a digital model of the printed rotor and compare simulated vs. experimental behavior
9	Real-time monitoring and predictive maintenance simulation using IoT-enabled sensors
10	Operator learning demo using DeepONet/FNO for a PDE

Syllabus of Department Elective I Courses

ME562 | **Finite Element Method** | Credits: 3-0-0-6

Course Outcomes:

CO1	Apply the mathematical foundations, element formulations, and solution strategies of FEM
CO2	Formulate and solve 1D and 2D engineering problems using FEM
CO3	Analyse 3D mechanical systems using FEM techniques
CO4	Apply FEM for heat transfer, thermal stresses, and multiphysics problems in mechanical systems
CO5	Use modern FEM tools to model, simulate, and analyse intelligent mechanical systems and develop engineering solutions

Course Articulation Matrix:

COs	POs		
	PO1	PO2	PO3
CO1	3	-	3
CO2	3	-	3
CO3	3	-	3
CO4	3	1	3
CO5	3	2	3

1 – Low 2 – Medium 3 – High

Detailed Syllabus:

Introduction to Finite Element Method: Steps in FEM: discretization, element formulation, assembly, solution; Types of elements: 1D, 2D, 3D, higher-order elements; Boundary conditions (essential & natural); Weighted residual methods: collocation, Galerkin method.

One-Dimensional Finite Elements: Bar, truss, beam, and frame elements; Shape functions, interpolation & approximation; Stiffness matrix formulation; Assembly and boundary application; Axial loading, bending, torsion problems.

Two-Dimensional and Three-Dimensional Elements: Plane stress, plane strain, and axisymmetric problems; Triangular and quadrilateral elements; Isoparametric formulation; Numerical integration and Gauss quadrature.

FEM for Heat Transfer and Thermal-Structural Analysis: 1D & 2D heat conduction FEM; Transient heat transfer formulation; Thermal stresses and coupled thermo-mechanical problems; Applications in hotspot analysis, battery & electronics cooling.

FEM Software Applications: Introduction to commercial FEM tools: ANSYS, ABAQUS, COMSOL; Mesh generation techniques and mesh convergence; Adaptive meshing and error estimation; Multi-physics FEM (thermal-fluid, electro-mechanical, piezoelectric).

Text Books:

1. The Finite Element Method: Its Basis and Fundamentals, Zienkiewicz, O.C.
2. Concepts and Applications of Finite Element Analysis, Cook, R.D.

Reference Books:

1. A First Course in the Finite Element Method, Logan, D.L., 6th Edition, 2016.
2. Concepts and Applications of Finite Element Analysis, Cook, R.D., Malkus, D.S., Plesha, M.E., and Witt, R.J., 4th Edition, 2001.

Online Resources: https://onlinecourses.nptel.ac.in/noc22_me43/preview

ME505 3-0-0-6

Advanced Mechanics of Solids

Course Outcomes:

CO1	Analyze advanced stress, strain, and constitutive relations in 3D mechanical systems.
CO2	Apply elasticity theory to solve complex engineering boundary value problems.
CO3	Use energy and variational methods for modelling and approximate solutions in solid mechanics.
CO4	Analyse plasticity, viscoelasticity, and creep behaviour for advanced and smart materials.
CO5	Evaluate fracture and fatigue behaviour and apply advanced mechanics concepts in intelligent mechanical systems.

Course Articulation Matrix:

COs	POs		
	PO1	PO2	PO3
CO1	3	1	3
CO2	3	-	3
CO3	3	-	3
CO4	3	2	3
CO5	3	3	3

1 – Low 2 – Medium 3 – High

Detailed Syllabus:

Fundamentals of Stress and Strain: 3D stress and strain tensors; Principal stresses, Mohr's circle in 3D; Transformation of stress/strain; Generalized Hooke's law; Elastic constants and anisotropy; Energy functions and stability criteria.

Elasticity Theory: Governing equations of elasticity; Compatibility conditions; Boundary value problems; Plane stress and plane strain; Torsion of prismatic bars.

Energy Methods: Total potential energy; Virtual work and virtual displacement; Rayleigh–Ritz method; Galerkin's method; Weighted residual methods.

Plasticity, Viscoelasticity & Creep: Yield criteria: von Mises, Tresca; Flow rules and hardening laws; Elastoplastic stress–strain relations; Viscoelasticity models: Maxwell, Voigt, Standard Linear Solid; Creep laws and time-dependent deformation.

Fracture Mechanics & Fatigue: Stress concentration and crack-tip fields; Modes of fracture: Mode I, II, III; Griffith theory, energy release rate, stress intensity factor; Paris law for fatigue crack growth; Dynamic fracture.

Text Books:

1. Advanced Mechanics of Materials, Boresi, A.P., Schmidt, R.J., and Sidebottom, O.M., 6th Edition, 2003.
2. Theory of Elasticity, Timoshenko, S.P., and Goodier, J.N., 3rd Edition, 1970.

Reference Books::

1. Elasticity, Sadd, M.H., 3rd Edition, 2014.
2. Advanced Strength and Applied Elasticity, Ugural, A.C., and Fenster, S.K., 5th Edition, 2012.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc22_me43/preview

ME567 **Condition Monitoring Techniques** 3-0-0-4

Course Outcomes:

CO1	Analyze principles of condition monitoring, failure modes, and predictive maintenance.
CO2	Perform vibration-based fault diagnosis of rotating and mechanical systems.
CO3	Apply acoustic, ultrasonic, thermal, lubrication, and electrical CM methods for detecting faults.
CO4	Use signal processing tools for feature extraction and fault characterization.
CO5	Implement intelligent diagnostic and prognostic techniques using AI/ML and digital twins.

Course Articulation Matrix:

COs	POs		
	PO1	PO2	PO3
CO1	2	1	2
CO2	3	-	3
CO3	3	-	3
CO4	3	2	3
CO5	3	3	3

1 – Low 2 – Medium 3 – High

Detailed Syllabus:

Introduction to Condition Monitoring: Need for CM & Predictive Maintenance (PdM); Failure modes, mechanisms, and degradation behaviour; Reliability centered maintenance (RCM); Types: Periodic, continuous, online, remote CM.

Vibration Monitoring: Vibration signatures of common faults: unbalance, misalignment, looseness, bearing faults, gear faults; Time-domain, frequency-domain, and time–frequency analyses; FFT, PSD, cepstrum, envelope demodulation; Order analysis for rotating machinery.

Acoustic, Ultrasonic & Noise Monitoring: Acoustic emission fundamentals; Ultrasonic leak detection; High-frequency stress wave analysis; Noise and sound signature analysis.

Thermal, Lubrication & Electrical Monitoring: IR thermography principles and hotspot detection, Thermocouples, MEMS temperature sensors, Lubricant analysis: wear debris, viscosity, chemical composition.

Intelligent Monitoring Systems: IoT-enabled sensors and wireless monitoring, Machine learning and AI in fault diagnosis, Digital twins for predictive maintenance.

Text Books:

1. Condition Monitoring and Control for Intelligent Manufacturing, Wang, L., and Gao, R.

Reference Books:

1. Practical Machinery Vibration Analysis and Predictive Maintenance, Mobley, R.K., 2nd Edition, 2001.
2. Mechanical Condition Monitoring, Harris, C.M., and Piersol, A.G., 2nd Edition, 2002.

Online Resources:

1. https://nptel.ac.in/courses/112105232

ME590 | Advanced Heat Transfer | 3-0-0-6

Course Outcomes:

CO1	Model advanced conduction, convection, and radiation heat transfer mechanisms.
CO2	Solve complex thermal problems using numerical and computational methods.
CO3	Analyze multiphase and phase-change heat transfer relevant to heat exchanger systems.
CO4	Evaluate microscale and nanoscale heat transfer phenomena in modern intelligent mechanical systems.

Course Articulation Matrix:

COs	POs		
	PO1	PO2	PO3
CO1	3	1	3
CO2	3	1	3
CO3	3	-	3
CO4	3	-	3
CO5	3	2	3

1 – Low 2 – Medium 3 – High

Detailed Syllabus:

Advanced Conduction Heat Transfer: General conduction equation in Cartesian, cylindrical, spherical coordinates; Use of Green's functions, Bessel functions for conduction; Transient conduction: lumped, semi-infinite, finite domains; Heisler charts revisited, Duhamel's theorem; Multidimensional conduction in composite structures; Heat spreading & thermal resistance in intelligent mechanical systems.

Advanced Convection Heat Transfer: Exact solutions of Navier–Stokes for simple geometries; Boundary layer theory, similarity solutions; Turbulent convection, turbulence modelling basics (k–ε, LES overview); Forced and natural convection at high Rayleigh/Reynolds numbers; Convective heat transfer in confined and electronics cooling flows; Jet impingement cooling & microchannel cooling.

Radiation Heat Transfer: Radiation exchange between non-grey surfaces; Configuration factors, radiation shields, view factor algebra; Radiative heat transfer in participating media; Gas radiation models: Hottel charts, weighted-sum-of-grey-gases (WSGG); Radiation in high-temperature and combustion systems.

Heat Exchangers & Applications: Design and analysis of heat exchangers (LMTD, NTU methods); Compact heat exchangers and microchannel systems; Intelligent monitoring and optimization of heat exchangers using IoT and AI.

Microscale & Nanoscale Heat Transfer: Ballistic vs diffusive heat conduction; Phonon transport & Boltzmann transport equation; Thermal interface materials (TIMs); Nanofluids – theory & applications; Microfabricated heat exchangers; Heat transfer in MEMS, robotic sensors, microactuators; Thermoelectric cooling & Peltier devices.

Text Books:

1. Convection Heat Transfer, Bejan, A.
2. Radiative Heat Transfer, Modest, M., F.

Reference Books:

1. Heat Transfer, Incropera, F.P., DeWitt, D.P., Bergman, T.L., and Lavine, A.S., 7th Edition, 2011.
2. Advanced Heat and Mass Transfer, Kaviany, M., 2nd Edition, 2014.

Online Resources: https://onlinecourses.nptel.ac.in/noc25_ch00/preview

ME771 3-0-0-6

Engineering Design with Advanced Materials

Course Outcomes:

CO1	Analyze classifications, properties, and design considerations of advanced engineering

	materials
CO2	Apply design principles for advanced structural materials, composites, and ceramics
CO3	Design and evaluate smart and adaptive material systems for intelligent mechanical applications
CO4	Analyse architected and additive-manufactured materials using computational tools
CO5	Perform material modelling, optimization, and data-driven selection for engineering design.

Course Articulation Matrix:

COs	POs		
	PO1	PO2	PO3
CO1	2	-	2
CO2	3	-	3
CO3	3	-	3
CO4	3	1	3
CO5	3	2	3

1 – Low 2 – Medium 3 – High

Detailed Syllabus:

Introduction to Advanced Materials: Classification of advanced materials: structural, functional, smart, metamaterials; Material indices, Ashby charts, performance-based material selection; Property–process–performance relationships; Lightweighting and design for high-performance systems.

Advanced Structural Materials: High-strength alloys: titanium, aluminium-lithium, maraging steels; Superalloys for extreme environments; Design with ceramics and glass–ceramics; High-temperature materials and thermal barrier coatings; Mechanical behaviour: creep, fatigue, fracture, impact resistance.

Smart and Functional Materials: Piezoelectric, magnetostrictive, shape-memory alloys (SMA), electroactive polymers; Constitutive modelling & actuation principles; Design of adaptive/smart structures; Vibration control, morphing structures, soft robotics applications.

Additive Materials, Architected Materials & Metamaterials: Lattice materials, auxetics, graded materials; Mechanical & thermal behaviour of architected materials; AM-enabled materials: topology-optimized microstructures, cellular metals; Design for multi-functional performance (thermal + structural + damping).

Material Modelling, Simulation & Data-Driven Design: Multiscale material modelling; microstructure-property relations; FEM for composite and smart material structures; Material optimization: topology, size, and material distribution; Machine learning for material prediction, surrogate models; Material databases (CES Selector, JMATPRO).

Text Books:

1. Materials Selection in Mechanical Design, Ashby, M., F.

Reference Books:

1. Advanced Materials and Design for Engineering Applications, Banerjee, M.K., 1st Edition, 2014.
2. Introduction to Materials Science for Engineers, Shackelford, J.F., 8th Edition, 2015.

Online Resources: https://onlinecourses.nptel.ac.in/noc20_mm06/preview

ME573 | **Internet of Things and Smart Manufacturing** | 3-0-0-3

Course Outcomes:

CO1	Analyze IoT concepts, architectures, and Industry 4.0 principles in manufacturing
CO2	Design IoT-based sensing and data acquisition systems for intelligent mechanical applications
CO3	Develop IoT-enabled solutions for predictive maintenance and condition monitoring
CO4	Develop secure, intelligent, and sustainable IoT solutions for smart manufacturing
CO5	Analyze smart manufacturing systems using IoT, analytics, and digital twins

Course Articulation Matrix:

COs	POs		
	PO1	PO2	PO3
CO1	2	1	2
CO2	3	-	3
CO3	3	-	3
CO4	3	1	3
CO5	3	1	3

1 – Low   2 – Medium   3 – High

Detailed Syllabus:

Introduction to IoT and Industry 4.0: Evolution from automation to Industry 4.0; IoT definition, characteristics, and enabling technologies; Cyber-Physical Systems (CPS) in manufacturing; Smart factory concepts and reference architectures (RAMI 4.0).

IoT Architecture and Hardware Systems: IoT architecture: perception, network, middleware, application layers; Sensors and actuators for manufacturing systems; Embedded platforms: Arduino, ESP32, Raspberry Pi; Industrial IoT (IIoT) hardware and PLC integration; Edge computing vs cloud computing.
IoT Applications in Mechanical Systems: Predictive maintenance using IoT. Condition monitoring of machines. Energy management in manufacturing systems.

Smart Manufacturing Systems: Smart sensors and smart machines; IoT-enabled CNC, robotics, and additive manufacturing; Flexible and reconfigurable manufacturing systems; Manufacturing Execution Systems (MES) and ERP integration; Digital thread and smart supply chains; Vulnerability management in smart manufacturing.

Data Analytics, AI & Digital Twins for Manufacturing: Data analytics for manufacturing intelligence; Predictive maintenance and condition monitoring using IoT data; Machine learning for quality prediction and process optimization; Digital twins for machines and manufacturing systems.

Text Books:

1. Internet of Things: A Hands-On Approach, Bahga, A., and Madisetti, V.

Reference Books:

1. Industrial Internet of Things, Gilchrist, A., 1st Edition, 2016.
2. Cyber-Physical Systems: Foundations, Principles and Applications, Rajkumar, R., Lee, I., Sha, L., and Stankovic, J., 1st Edition, 2017.

Online Resources: https://nptel.ac.in/courses/106105195

ME575 **Manufacturing Automation** 3-0-0-3

Course Outcomes:

CO1	Analyze the architecture of manufacturing automation systems.
CO2	Design automated production lines and material handling systems.
CO3	Apply robotics, PLCs, sensors, and actuators for manufacturing automation.
CO4	Evaluate flexible, computer-integrated, and smart manufacturing systems.
CO5	Design intelligent and sustainable automated manufacturing solutions.

Course Articulation Matrix:

COs	POs		
	PO1	PO2	PO3
CO1	2	1	2
CO2	3	-	3
CO3	3	-	3
CO4	3	1	3
CO5	3	2	3

1 – Low 2 – Medium 3 – High

Detailed Syllabus:

Introduction to Manufacturing Automation: Evolution of manufacturing systems; Types of automation: fixed, programmable, flexible; Automation strategies and justification; Automation pyramid and CIM architecture.

Automated Production Systems & Transfer Lines: Components of automated production systems; Transfer lines and automated flow lines; Analysis of production rate, availability, and reliability; Line balancing and bottleneck analysis.

Robotics and Automated Material Handling: Industrial robots: types, configurations, and applications; Robot kinematics and dynamics basics; Automated Guided Vehicles (AGVs) and Autonomous Mobile Robots (AMRs); Material handling systems: conveyors, automated storage and retrieval systems (AS/RS).

CNC and Flexible Manufacturing System: CNC machine tools: structure, programming, and operation; Computer-Aided Manufacturing (CAM) integration; Flexible Manufacturing Systems (FMS): components, layout, and scheduling.

Advanced & Intelligent Automation: AI and ML in manufacturing automation; Predictive maintenance and condition monitoring; Vision systems and intelligent inspection; Human-robot collaboration (cobots)

Text Books:

1. Manufacturing Automation: Metal Cutting Mechanics, Machine Tool Vibrations, and CNC Design, Altintas, Y.

Reference Books:

1. Automation, Production Systems, and Computer-Integrated Manufacturing, Groover, M.P., 4th Edition, 2015.
2. Robotics and Automation Handbook, Nilss, S.B., 1st Edition, 2001.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc22_me58/preview

ME577 3-0-0-3

Viscous Fluid Flows

Course Outcomes:

CO1	Derive and interpret governing equations for viscous fluid flows.
CO2	Solve laminar flow problems using analytical methods.
CO3	Apply boundary layer theory to practical engineering problems.
CO4	Evaluate low-Reynolds-number and lubrication flows for micro/precision systems.
CO5	Apply viscous flow concepts to lubrication, microfluidics, and manufacturing systems.

Course Articulation Matrix:

COs	POs		
	PO1	PO2	PO3
CO1	3	1	3
CO2	3	1	3
CO3	3	-	3
CO4	3	2	3
CO5	3	3	3

1 – Low 2 – Medium 3 – High

Detailed Syllabus:

Fundamentals of Viscous Flows: Continuum hypothesis; kinematics of fluids; Stress tensor; Newtonian and non-Newtonian fluids; Conservation laws: mass, momentum, energy; Navier–Stokes equations (incompressible/compressible); Non-dimensionalization; Reynolds, Mach, Prandtl numbers; Boundary and initial conditions; well-posedness.

Laminar Flow Analysis: Exact solutions of Navier–Stokes equations for simple geometries; Hagen–Poiseuille flow in pipes; Couette and Poiseuille flows between parallel plates; Flow in annuli and between rotating cylinders.

Boundary Layer Theory: Boundary-layer approximations, scaling analysis; Laminar boundary layers over flat plates; Similarity solutions (Blasius); Momentum-integral methods (von Kármán–Pohlhausen); Flow separation and control concepts.

Low-Reynolds-Number & Creeping Flows: Stokes flow assumptions and linearization; Flow past spheres and cylinders; drag laws; Oseen correction; Particle motion in viscous fluids.

Applications of Viscous Flows: Lubrication theory and thin film flows, Microfluidics and MEMS applications, Heat transfer in viscous flows

Text Books:

1. Viscous Fluid Flow, White, F., M.

Reference Books:

1. Boundary-Layer Theory, Schlichting, H., and Gersten, K., 9th Edition, 2017.
2. Advanced Engineering Fluid Mechanics, Kundu, P.K., Cohen, I.M., and Dowling, D.R., 6th Edition, 2016.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc23_me67/preview

ME579 — MEMS and Microsystems — 3-0-0-4

Course Outcomes:

CO1	Analyze fundamentals, materials, and scaling laws governing MEMS and microsystems.
CO2	Explain and apply microfabrication processes for MEMS device realization.
CO3	Design and model MEMS sensors and actuators for mechanical applications.
CO4	Integrate MEMS devices with electronics and explore advanced applications.
CO5	Evaluate reliability, packaging, and integration issues in practical MEMS systems.

Course Articulation Matrix:

COs	POs		
	PO1	PO2	PO3
CO1	2	1	2
CO2	3	-	3
CO3	3	-	3
CO4	3	1	3
CO5	3	2	3

1 – Low 2 – Medium 3 – High

Detailed Syllabus:

Introduction to MEMS and Microsystems: Evolution and scope of MEMS and microsystems; Scaling laws; surface-to-volume effects; MEMS materials: silicon, polymers, metals, ceramics; Transduction mechanisms: mechanical, electrical, thermal, optical.

Microfabrication Technologies: Cleanroom concepts and safety; Bulk and surface micromachining; Thin-film deposition: CVD, PVD, epitaxy; Lithography: photolithography, e-beam (overview); Etching: wet, dry (RIE, DRIE), release processes; Wafer bonding and packaging basics.

MEMS Devices and Design: MEMS sensors: pressure, acceleration, temperature, chemical, biosensors; MEMS actuators: electrostatic, piezoelectric, thermal, magnetic; Microsystems design principles and modeling.

Microsystems Integration and Applications: Integration of MEMS with electronics (ASICs, CMOS); Microfluidics and lab-on-chip systems; RF MEMS and optical MEMS.

Modelling & Reliability: Lumped and distributed modelling of MEMS; FEM/CFD for MEMS (structural, thermal, electrostatic coupling); Failure modes and reliability (stiction, fatigue, wear); Packaging and testing.

Text Books:

1. Microsystem Design, Senturia, S. D.

Reference Books:

1. Fundamentals of Microfabrication and Nanotechnology, Madou, M.J., 3rd Edition, 2011.
2. MEMS and Microsystems: Design and Manufacture, Tai-Ran Hsu, 2nd Edition, 2008.

Online Resources:

1. https://nptel.ac.in/courses/117105082

ME581 | **Machine Vision and Image Processing** | 3-0-0-6

Course Outcomes:

CO1	Analyze fundamentals of machine vision systems and image acquisition.
CO2	Apply image processing techniques for enhancement, segmentation, and analysis.
CO3	Extract features and perform object recognition for mechanical applications.
CO4	Implement 3D vision and motion analysis for robotics and automation.
CO5	Develop intelligent vision systems using machine learning and deep learning.

Course Articulation Matrix:

COs	POs		
	PO1	PO2	PO3
CO1	2	1	2
CO2	3	-	3
CO3	3	-	3
CO4	3	1	3
CO5	3	2	3

1 – Low 2 – Medium 3 – High

Detailed Syllabus:

Introduction to Machine Vision Systems: Role of vision in intelligent mechanical systems; Human vision vs machine vision; Components of a machine vision system; Imaging sensors: CCD, CMOS; Optics and illumination techniques; Image formation and camera models.

Digital Image Fundamentals: Image representation and sampling; Gray-level transformations; Spatial resolution, histogram analysis; Noise models and image degradation; Image enhancement techniques; Color models and color image processing.

Image Processing Techniques: Spatial filtering: smoothing and sharpening; Frequency-domain processing (DFT, FFT); Edge detection: Sobel, Prewitt, Canny; Image segmentation: thresholding, region-based methods; Morphological operations; Binary image analysis.

Feature Extraction and Object Recognition: Feature descriptors: shape, texture, moments; Keypoint detection: Harris, SIFT, SURF (overview); Template matching; Pattern recognition techniques; Object classification methods.

3D Vision, Motion & Robotics Applications: Stereo vision and depth estimation; Camera calibration and pose estimation; Optical flow and motion analysis; Vision-based robot guidance and manipulation; Visual servoing concepts.

Text Books:

1. Machine Vision: Theory, Algorithms, Practicalities, Davies, E. R.

Reference Books:

1. Computer Vision: Algorithms and Applications, Szeliski, R., 2nd Edition, 2022.
2. Image Processing and Analysis, Sonka, M., Hlavac, V., and Boyle, R., 2nd Edition, 2008.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc23_me[illegible]/preview

ME503 **Optimization in Engineering Systems** Credit: 3-0-0-6

Course Outcomes:

CO1	Model the optimization problems using mathematical formulation.
CO2	Apply linear, nonlinear, and constrained optimization techniques to engineering systems.
CO3	Use gradient-based methods for efficient optimization in dynamic and complex mechanical systems.
CO4	Implement evolutionary and metaheuristic algorithms for multi-objective and global optimization.
CO5	Integrate optimization techniques with intelligent mechanical systems, robotics, control, and Industry 4.0 applications.

Course Articulation Matrix:

COs	POs		
	PO1	PO2	PO3
CO1	3	1	3
CO2	3	-	3
CO3	3	-	3
CO4	3	-	3
CO5	3	2	3

1 – Low 2 – Medium 3 – High

Detailed Syllabus:

Introduction to Optimization: Types of optimization problems; Optimality conditions, convexity, feasibility; Formulation of engineering optimization problems.

Linear and Nonlinear Programming: Linear Programming (LP): Simplex method, duality; Integer Programming, Mixed-Integer Programming; Nonlinear Programming (NLP): unconstrained and constrained; Lagrange multipliers, KKT conditions; Quadratic programming.

Gradient-Based Optimization Methods: Steepest descent, Newton's method, quasi-Newton methods (DFP, BFGS); Conjugate gradient method; Line search strategies; Multi-variable optimization with constraints.

Evolutionary and Metaheuristic Optimization: Genetic algorithms (GA); Particle swarm optimization (PSO); Differential evolution (DE); Simulated annealing.

Advanced Optimization Tools & Applications: Surrogate modelling: RSM, Kriging, Gaussian Processes; Bayesian optimization; Machine learning-assisted optimization; Large-scale optimization using numerical solvers.

Text Books:

1. Optimization for Engineering Design: Algorithms and Examples, Deb, K.
2. Engineering Optimization: Theory and Practice, Rao, S. S.

Reference Books:

1. Practical Optimization, Gill, P.E., Murray, W., and Wright, M.H., 1st Edition, 1981.
2. Numerical Optimization, Nocedal, J., and Wright, S.J., 2nd Edition, 2006.

Online Resources:

1. https://nptel.ac.in/courses/[illegible]

ME5[illegible] | **Thermal design and Hotspot Management** | Credits: 3-0-0-6

Course Outcomes:

CO1	Analyze the fundamentals of thermal design and heat transfer for mechanical and electronic systems.
CO2	Analyze mechanisms and impact of hotspot formation in high-power devices and mechanical systems.
CO3	Evaluate advanced cooling techniques for hotspot suppression and system reliability.
CO4	Apply computational tools for thermal modelling, transient simulation, and design optimization.
CO5	Implement intelligent thermal management strategies using sensing, control, and AI-based prediction.

Course Articulation Matrix:

COs	POs		
	PO1	PO2	PO3
CO1	2	1	2
CO2	3	1	3
CO3	3	1	3
CO4	3	1	3
CO5	3	2	3

1 – Low 2 – Medium 3 – High

Detailed Syllabus:

Fundamentals of Thermal Design: Review of conduction, convection & radiation; Extended surfaces / fins and fin optimization; Thermal resistances and heat spreading; Thermal material properties: metals, ceramics, polymers, composites.

Hotspot Formation and Analysis: Sources of hotspots in mechanical and electronic systems; Thermal stresses and reliability issues; Analytical and numerical methods for hotspot detection.

Cooling Techniques for Hotspot Reduction: Air cooling: fans, blowers, heat sinks; Liquid cooling: cold plates, pump loops, microchannel cooling; Phase-change cooling: heat pipes, vapor chambers, two-phase systems; Jet impingement cooling; Boiling and condensation mechanisms; Emerging cooling technologies: nano-fluids, PCM cooling, thermoelectric coolers.

Computational Thermal Analysis: Finite Difference, Finite Volume, and Finite Element thermal modelling; Heat sink and cold plate CFD analysis; Transient thermal simulation for hotspot prediction.

Thermal Design for Intelligent Mechanical Systems: Thermal management in robotics, actuators, motors; High-performance mechatronic systems: servo drives, power electronics, sensors; Thermal challenges in additive manufacturing, welding & hybrid manufacturing; Thermal interfaces: TIMs, bonding, thermal vias; System-level thermal integration in autonomous vehicles and drones.

Text Books:

1. Fundamentals of Heat and Mass Transfer, Incropera, F.P., & Dewitt, D.P.
2. Thermal Management for Electronics, Lasance, C.J.M.

Reference Books::

1. Thermal Design and Thermal Behaviour of Electronic Systems, Bar-Cohen, A., and Kraus, A.D., 2nd Edition, 1995.

2. Hot Air Rises and Heat Sinks, Ellison, G.N., 1st Edition, 2002.

Online Resources:

1. https://nptel.ac.in/courses/112103313

ME587 3-0-0-6

Ethics of AI

Course Outcomes:

CO1	Analyse fundamental ethical theories and their application to autonomous mechanical systems.
CO2	Evaluate risks related to algorithmic bias and safety in automated manufacturing and robotics.
CO3	Apply frameworks for "Value Sensitive Design" (VSD) in the engineering lifecycle.
CO4	Navigate the legal and regulatory landscape (GDPR, AI Act) concerning intellectual property and liability in AI-driven engineering.
CO5	Formulate ethical solutions for human-robot collaboration and workforce displacement.

Course Articulation Matrix:

COs	POs		
	PO1	PO2	PO3
CO1	2	2	2
CO2	3	2	3
CO3	3	2	3
CO4	3	2	3
CO5	3	3	3

1 – Low 2 – Medium 3 – High

Detailed Syllabus:

Foundations of AI Ethics: Introduction to Ethics: Deontology, Utilitarianism, and Virtue Ethics; The evolution from "Asimov's Laws" to Modern AI Principles; Distinction between "narrow AI" in machines vs. "Artificial General Intelligence."

Safety and Liability in Autonomous Systems: The "Trolley Problem" in Autonomous Vehicles and UAVs; Machine Failures vs. Algorithmic Errors; Determining liability in accidents; Control Dilemmas: Human-in-the-loop, on-the-loop, and out-of-the-loop.

Fairness, Bias, and Accountability in AI Systems: Sources of bias in data and algorithms; Algorithmic fairness and discrimination; Accountability and responsibility in autonomous systems; Explainable AI (XAI) concepts; Transparency and trust in intelligent machines; Ethical implications of AI decision-making.

Human-Machine Interaction & Labor: The impact of Industry 4.0/5.0 on employment in the mechanical sector; Psychological impact of Human-Robot Collaboration (Cobots); Transparency and Explainability (XAI) in complex mechanical diagnostics.

Governance, Law, and Sustainability: Global AI Regulations: EU AI Act, IEEE Standards, and India's NITI Aayog guidelines; Intellectual Property (IP) rights for AI-generated designs/patents; Environmental Ethics: The carbon footprint of training large models for fluid dynamics and structural optimization.

Text Books:

1. Ethics of Artificial Intelligence by S. Matthew Liao.

Reference Books:

1. Artificial Intelligence Ethics, Coeckelbergh, M., 1st Edition, 2020.
2. Ethics of Artificial Intelligence and Robotics, Lin, P., Abney, K., and Bekey, G.A., 1st Edition, 2017.

Online Resources:

1. https://nptel.ac.in/courses/106106472

Syllabus of Department Elective II Courses

ME590 — Smart Materials and Structures — 3-0-0-3

Course Outcomes:

CO1	Analyse principles, classifications, and applications of smart materials and structures.
CO2	Analyse constitutive behaviour and transduction mechanisms of smart materials.
CO3	Design smart structures integrating sensing, actuation, and control.
CO4	Model and simulate smart material systems using computational tools.
CO5	Evaluate advanced applications and emerging trends in intelligent smart structures.

Course Articulation Matrix:

COs	POs		
	PO1	PO2	PO3
CO1	2	1	2
CO2	3	1	3
CO3	3	1	3
CO4	3	2	3
CO5	3	3	3

1 – Low 2 – Medium 3 – High

Detailed Syllabus:

Smart Materials and Structures: Definition and characteristics of smart materials; Classification: passive, active, adaptive, and intelligent materials; Smart structures: sensing–actuation–control paradigm; Scaling effects and multifunctionality.

Piezoelectric and Ferroelectric Materials: Piezoelectric effect and constitutive equations; Piezoelectric materials: PZT, PVDF; Sensors and actuators using piezoelectric materials; Energy harvesting applications; Modelling and FEM implementation of piezoelectric structures.

Shape Memory Alloys and Smart Polymers: Shape memory effect and superelasticity; Constitutive behaviour of SMAs (NiTi); SMA actuators and design considerations; Electroactive polymers (EAPs) and magnetorheological elastomers.

Magnetostrictive, ER & MR Materials: Magnetostriction and magnetostrictive materials; Electrorheological (ER) and magnetorheological (MR) fluids; Semi-active vibration and shock control; Design of dampers and adaptive systems.

Modelling, Simulation & Emerging Trends: Coupled-field modelling of smart materials; FEM and multiphysics simulation (ANSYS/COMSOL); Reliability, fatigue, and durability of smart materials; Energy-efficient and sustainable smart systems; Emerging trends: self-healing materials, 4D printing, AI-enabled smart structures.

Text Books:

1. Smart Structures: Analysis and Design. Parres, M., and Gupta, N.

Reference Books::

1. Piezoelectric Sensorics, Jaffe, B., Cook, W.R., and Jaffe, H., 1st Edition, 1971.
2. Introduction to Smart Materials, Schwartz, M., 1st Edition, 2002.

Online Resources:

1. https://nptel.ac.in/courses/112104173

ME592	Intelligent Refrigeration and Air Conditioning Systems	3-0-0-6

Course Outcomes:

CO1	Develop advanced understanding of refrigeration and air-conditioning systems and their performance characteristics.
CO2	Analyze intelligent sensing, control, and automation techniques for HVAC&R systems.
CO3	Apply modelling, simulation, and optimization techniques for energy-efficient HVAC systems.
CO4	Integrate AI/ML, IoT, and digital twins for smart refrigeration and air-conditioning applications.
CO5	Design intelligent RAC systems integrating sensors, automation, and smart algorithms.

Course Articulation Matrix:

COs	POs		
	PO1	PO2	PO3
CO1	2	1	2
CO2	3	1	3
CO3	3	1	3
CO4	3	2	3
CO5	3	2	3

1 – Low 2 – Medium 3 – High

Detailed Syllabus:

Advanced Refrigeration Systems: Review of vapor compression refrigeration systems; Advanced refrigeration cycles: multi-stage, cascade, economized cycles; Refrigerants: low-GWP refrigerants, natural refrigerants (CO_2, NH_3, hydrocarbons); System performance analysis and COP improvement.

Advanced Air Conditioning & HVAC Systems: Centralized and decentralized HVAC systems; Variable Refrigerant Flow (VRF/VRV) systems; Chillers, cooling towers, and district cooling; Psychrometric analysis for complex air-conditioning processes; Indoor air quality (IAQ) and thermal comfort standards.

Sensors, Instrumentation & Control in HVAC&R: Temperature, pressure, humidity, flow, and air-quality sensors; Actuators, valves, dampers, compressors, and drives; Control strategies: on-off, PID, adaptive and model-based control; Building Management Systems (BMS).

Intelligent & Smart HVAC Systems: IoT-enabled HVAC systems; Smart thermostats and distributed sensing; Predictive maintenance and condition monitoring; Demand-response and load management; Integration with smart grids and renewable energy sources.

Energy Efficiency, Modelling & Optimization: Energy analysis and benchmarking of HVAC systems; Exergy analysis of refrigeration and AC systems; HVAC system modelling (lumped and distributed models); Optimization techniques for system sizing and operation.

Text Books:

1. Advanced Refrigeration and Air Conditioning Systems, Hafiz, A.

Reference Books:

1. Refrigeration and Air Conditioning Technology, Whitman, W.C., Johnson, W.M., Tomczyk, J.A., and Silberstein, E., 8th Edition, 2017.
2. HVAC Systems and Equipment, McQuiston, F.C., Parker, J.D., and Spitler, J.D., 6th Edition, 2005.

Online Resources: https://onlinecourses.nptel.ac.in/noc19_me58/preview

ME504 | Non-Linear Finite Element Methods | 3-0-0-3

Course Outcomes:

CO1	Analyze nonlinear behavior in engineering systems.
CO2	Formulate nonlinear finite element equations for solids and structures.
CO3	Apply numerical solution strategies for nonlinear FEM problems.
CO4	Analyze geometric, material, and contact nonlinearities using FEM.
CO5	Solve advanced nonlinear Multiphysics problems relevant to intelligent mechanical systems.

Course Articulation Matrix:

COs	POs		
	PO1	PO2	PO3
CO1	2	1	2
CO2	3	1	3
CO3	3	-	3
CO4	3	-	3
CO5	3	2	3

1 – Low 2 – Medium 3 – High

Detailed Syllabus:

Fundamentals of Nonlinear Analysis: Classification of nonlinearities: material, geometric, boundary, contact; Review of linear FEM assumptions and limitations; Kinematics of large deformation; Stress and strain measures (Green-Lagrange, Almansi); Virtual work and weak form for nonlinear problems; Total Lagrangian vs Updated Lagrangian formulations.

Nonlinear Material Models: Elasto-plastic behaviour: yield criteria, flow rules, hardening laws; Hyperelastic materials: Mooney-Rivlin, Neo-Hookean, Ogden models; Viscoelastic and viscoplastic models; Damage and failure models (introductory).

Solution Techniques for Nonlinear FEM: Incremental-iterative methods; Newton-Raphson and modified Newton methods; Line search and arc-length methods; Convergence criteria and numerical stability; Time integration schemes for nonlinear dynamics.

Geometric Nonlinearity and Stability: Large displacement and large rotation problems; Nonlinear truss, beam, plate, and shell elements; Buckling and post-buckling analysis; Snap-through and snap-back behaviour.

Contact and Constraint Nonlinearities: Contact kinematics and constraint enforcement; Penalty method, Lagrange multipliers, augmented Lagrangian; Frictional contact models; Self-contact and multi-body contact.

Text Books:

1. Nonlinear Finite Elements for Continua and Structures, Belytschko, T., Liu, W.K., Moran, B.

Reference Books::

1. Nonlinear Solid Mechanics, Holzapfel, G.A., 1st Edition, 2000.
2. Nonlinear Finite Element Analysis of Solids and Structures, Crisfield, M.A., 2nd Edition, 1997.

Online Resources: https://nptel.ac.in/courses/112106130

ME506 — **Turbulent Flows** — 3-0-0-6

Course Outcomes:

CO1	Analyse physical mechanisms and statistical nature of turbulent flows.
CO2	Analyse turbulent flows using statistical and theoretical frameworks.
CO3	Apply RANS-based turbulence models for engineering flow problems.
CO4	Evaluate advanced turbulence modeling approaches such as LES and DNS.
CO5	Solve real-world turbulent flow problems using CFD techniques.

Course Articulation Matrix:

COs	POs		
	PO1	PO2	PO3
CO1	2	-	2
CO2	3	1	3
CO3	3	-	3
CO4	3	-	3
CO5	3	1	3

1 – Low 2 – Medium 3 – High

Detailed Syllabus:

Introduction to Turbulence: Characteristics of turbulent flows; Energy cascade and Kolmogorov hypotheses; Engineering relevance of turbulent flows.

Statistical Description of Turbulence: Reynolds decomposition; Time and ensemble averaging; Turbulence statistics: mean, RMS, correlations; Reynolds stresses and closure problem; Homogeneous and isotropic turbulence; Turbulent kinetic energy and dissipation.

Turbulent Boundary Layers & Shear Flows: Turbulent boundary layers over flat plates; Law of the wall and velocity profiles; Turbulent mixing layers, jets, and wakes; Free shear flows; Applications in propulsion, cooling, and mixing systems.

Turbulence Modeling – RANS Approaches: Need for turbulence models; Eddy viscosity concept; Algebraic models; One-equation and two-equation models (k-ε, k-ω, SST); Reynolds Stress Models (RSM); Model limitations and validation.

Advanced Turbulence Modeling – LES & DNS: Large Eddy Simulation (LES) concepts; Sub-grid scale (SGS) models; Direct Numerical Simulation (DNS); Hybrid RANS-LES approaches; Computational requirements and challenges; Applications in intelligent and high-fidelity simulations.

Text Books:
1. Turbulent Flows, Pope, S. B.

Reference Books:
1. Turbulence: An Introduction for Scientists and Engineers, Davidson, P.A., 2nd Edition, 2015.
2. Turbulence Modeling for CFD, Wilcox, D.C., 3rd Edition, 2006.

Online Resources: https://nptel.ac.in/courses/101106060

ME508 — 3-0-0-6

Bio-inspired Design

Course Outcomes:

CO1	Analyze principles of biological systems relevant to engineering design.
CO2	Analyze biological materials, structures, and mechanisms for engineering applications.
CO3	Apply bio-inspired design methodologies to intelligent mechanical systems.
CO4	Model, simulate, and optimize bio-inspired designs using computational tools.
CO5	Design innovative, sustainable, and intelligent systems inspired by nature.

Course Articulation Matrix:

COs	POs		
	PO1	PO2	PO3
CO1	2	1	2
CO2	3	1	3
CO3	3	-	3
CO4	3	2	3
CO5	3	3	3

1 – Low 2 – Medium 3 – High

Detailed Syllabus:

Introduction to Bio-Inspired Design & Biomimicry: Evolution of bio-inspired engineering; Biomimicry, bio-inspiration, and bio-integration; Biological systems vs engineered systems; Levels of bio-inspiration: organism, behavior, ecosystem; Design challenges in intelligent mechanical systems.

Biological Materials and Structures: Hierarchical structures in nature; Natural materials: bone, wood, nacre, spider silk; Structure–property relationships; Lightweight and high-strength bio-structures; Bio-inspired composites and metamaterials.

Bio-Inspired Mechanisms and Locomotion: Biological joints, muscles, and compliant mechanisms; Bio-inspired actuators and soft mechanisms; Locomotion strategies: walking, flying, swimming, crawling; Bio-inspired robotics and mechatronic systems.

Bio-Inspired Fluid and Thermal Systems: Flow control inspired by birds, fish, and insects; Drag reduction and turbulence control in nature; Heat transfer mechanisms in biological systems; Passive cooling and thermal regulation.

Design Methodologies & Computational Tools: Bio-inspired design process and abstraction; TRIZ and bio-TRIZ; Generative and evolutionary design; FEM/CFD modelling of bio-inspired systems; Optimization techniques for bio-inspired designs.

Text Books:

1. Biomimetics: Biologically Inspired Technologies, Cohen, Y.

Reference Books:

1. Bio-Inspired Design: Computational Methods and Applications, Habib, M., Vattam, S., and Goel, A.K., 1st Edition, 2009.
2. Nature-Inspired Design of Smart Materials, Bhushan, B., 1st Edition, 2016.

Online Resources: https://nptel.ac.in/courses/107104078

ME590 **Advanced Mechanical Vibration** **3-0-0-6**

Course Outcomes:

CO1	Evaluate advanced vibration theory and modelling of mechanical systems.
CO2	Analyze multi-degree-of-freedom and continuous vibrating systems.
CO3	Evaluate nonlinear and random vibration behavior in engineering systems.
CO4	Apply vibration control and monitoring techniques for intelligent systems.
CO5	Use computational and experimental tools for vibration analysis and diagnostics.

Course Articulation Matrix:

COs	POs		
	PO1	PO2	PO3
CO1	3	1	3
CO2	3	1	3
CO3	3	1	3
CO4	3	1	3
CO5	3	3	3

1 – Low 2 – Medium 3 – High

Detailed Syllabus:

Fundamentals and Review: Review of single and multi-degree-of-freedom systems; Free and forced vibration analysis.; Damping models and energy methods.

Advanced Analytical Methods: Matrix methods in vibration analysis; Modal analysis and orthogonality conditions; Approximate methods: Rayleigh's method, Dunkerley's method, Holzer's method.

Continuous Systems and Wave Propagation: Vibration of strings, rods, beams, and plates; Longitudinal, torsional, and transverse vibrations; Wave propagation in elastic media.

Nonlinear Vibrations: Sources of nonlinearity in mechanical systems; Perturbation methods, harmonic balance, and numerical techniques; Chaos and bifurcation in mechanical vibrations.

Vibration Measurement and Control: Experimental techniques: FFT analyzers, modal testing, sensors. Active and passive vibration control. Smart materials and intelligent damping systems.

Text Books:

1. Mechanical Vibrations, Rao, S.S., 6th Edition.

Reference Books::

1. Engineering Vibration, Inman, D.J., 4th Edition, 2013.
2. Advanced Vibrations, Thompson, W.T., 1st Edition, 1993.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc21_me15/preview

ME592 — 3-0-0-4

Human–Machine Interaction

Course Outcomes:

CO1	Analyze principles of human–machine interaction and human factors engineering.
CO2	Analyze human cognitive, physical, and perceptual aspects in mechanical systems.
CO3	Design ergonomic and safe interfaces for intelligent mechanical systems.
CO4	Apply sensing, control, and AI techniques to develop adaptive HMI systems.
CO5	Evaluate advanced HMI applications considering ethics, safety, and sustainability.

Course Articulation Matrix:

COs	POs		
	PO1	PO2	PO3
CO1	2	1	2
CO2	3	1	3
CO3	3	-	3
CO4	3	-	3
CO5	3	2	3

1 – Low 2 – Medium 3 – High

Detailed Syllabus:

Introduction to Human–Machine Interaction: Evolution of HMI and human-centered design; Human–machine systems in mechanical engineering; Role of HMI in intelligent mechanical systems; Safety, usability, and reliability.

Human Factors & Ergonomics: Anthropometry and biomechanics; Cognitive ergonomics and mental workload; Human perception: vision, hearing, touch, proprioception; Human error, fatigue, and stress; Ergonomic design of workstations and machines.

Sensors, Interfaces & Feedback Modalities: Human input devices: switches, joysticks, touch, gesture; Biosignals: EMG, EEG, ECG (introductory); Output modalities: visual, auditory, haptic feedback; Multimodal interfaces.

Human–Robot and Human–Automation Interaction: Levels of automation and autonomy; Shared control and supervisory control; Human–robot collaboration (HRC) and cobots; Trust, transparency, and explainability.

Intelligent & Adaptive HMI Systems: AI-based user modeling and personalization; Context-aware and adaptive interfaces; Machine learning for intent recognition; Digital twins and virtual interfaces.

Text Books:

1. Human–Computer Interaction, Turk, M., & Medioni, G.

Reference Books:

1. The Handbook of Human–Machine Interaction, Boy, G.A., 1st Edition, 2011.
2. Designing the User Interface, Shneiderman, B., Plaisant, C., Cohen, M., Jacobs, S., Elmqvist, N., and Diakopoulos, N., 6th Edition, 2016.

Online Resources:

1. https://nptel.ac.in/courses/110105162

ME504 | Instrumentation and Measurement Systems | 3-0-0-6

Course Outcomes:

CO1	Analyze principles, characteristics, and performance of measurement systems.
CO2	Analyze measurement errors, uncertainty, and experimental data statistically.
CO3	Apply appropriate sensors and transducers for mechanical system measurements.
CO4	Design signal conditioning and data acquisition systems for accurate measurements.
CO5	Develop intelligent and IoT-enabled instrumentation systems for modern applications.

Course Articulation Matrix:

COs	POs		
	PO1	PO2	PO3
CO1	2	1	3
CO2	3	-	3
CO3	3	-	3
CO4	3	1	3
CO5	3	2	3

1 – Low 2 – Medium 3 – High

Detailed Syllabus:

Fundamentals of Measurement Systems: Measurement philosophy and terminology; Functional elements of measurement systems; Static and dynamic characteristics of instruments; Accuracy, precision, resolution, sensitivity; Calibration standards and traceability; Errors and error sources in measurements.

Measurement Uncertainty and Data Analysis: Types of errors: systematic and random; Uncertainty analysis and propagation of errors; Statistical treatment of experimental data; Regression and curve fitting; Standards for uncertainty evaluation (ISO-GUM – overview); Reliability and repeatability in measurements.

Sensors and Transducers for Mechanical Systems: Measurement of displacement, velocity, acceleration; Force, torque, pressure, and flow measurement; Temperature and heat flux sensors; Strain gauges and piezoelectric sensors; Smart and MEMS-based sensors; Sensor selection and integration.

Signal Conditioning and Data Acquisition: Signal conditioning: amplification, filtering, isolation; Analog-to-digital and digital-to-analog conversion; Sampling theory and aliasing; Data acquisition systems (DAQ); Noise sources and noise reduction techniques; Instrumentation interfaces and communication protocols.

Intelligent Instrumentation and Measurement Systems: Virtual instrumentation (LabVIEW/MATLAB); Embedded measurement systems; IoT-based measurement and monitoring; Sensor fusion and multi-sensor systems; Intelligent sensors with onboard processing.

Text Books:

1. Measurement Systems: Application and Design, Doebelin, E., O.

Reference Books:

1. Principles of Measurement Systems, Bentley, J.P., 4th Edition, 2005.

2. Electronic Instrumentation and Measurements, Raghuwanshi, M., and Raghuwanshi, R., 1st Edition, 2014.

Online Resources: https://onlinecourses.nptel.ac.in/noc26_ee01/preview

ME506 | 3-0-0-6

Mechatronics System Design

Course Outcomes:

CO1	Analyze and model complex multi-domain systems (mechanical, electrical, fluidic) using a unified approach.
CO2	Select and integrate advanced sensors and smart actuators for specific intelligent system requirements.
CO3	Design and implement embedded control logic using microcontrollers, PLCs, or Real-Time Operating Systems (RTOS).
CO4	Apply optimization techniques and AI-based decision-making to mechatronic system architectures.
CO5	Develop a functional mechatronic prototype addressing real-world industrial or societal challenges.

Course Articulation Matrix:

COs	POs		
	PO1	PO2	PO3
CO1	3	1	3
CO2	3	-	3
CO3	3	-	3
CO4	3	-	3
CO5	3	1	3

1 – Low 2 – Medium 3 – High

Detailed Syllabus:

Introduction to System Design Modeling: Evolution of Mechatronics; The "V-Model" of system design; Modeling of Physical Systems: Bond Graph modeling, State-space representation; Electromechanical analogies and thermal-fluidic system modeling.

Sensing and Perception: High-precision sensors: Lidar, Ultrasonic, Vision-based sensing; Signal Conditioning: Operational Amplifiers, Filtering (Analog & Digital); Data Acquisition Systems (DAQ) and Sensor Fusion algorithms (Kalman Filters).

Actuation and Drive Systems: Smart Actuators: Piezoelectric, SMA (Shape Memory Alloys); Drive Electronics: PWM techniques, H-Bridge circuits, Brushless DC

(BLDC) motor control; Fluid power systems and proportional valves in mechatronics.

Control Architecture & Embedded Systems: Real-time systems and RTOS fundamentals; Communication Protocols: I2C, SPI, CAN bus, and Industrial Ethernet; PLC programming (Ladder logic) vs. Microcontroller-based control (Arduino/STM32/Raspberry Pi).

Intelligent Systems & Integration: Introduction to Soft Computing in Mechatronics: Fuzzy Logic and Neural Networks; Case Studies: Autonomous Mobile Robots, Quadcopters, and Smart Manufacturing Cells; Design for Manufacturability (DfM) and Reliability in Mechatronic products.

Text Books:
1. Design of Mechatronic Systems, Janschek, K.

Reference Books:

1. Mechatronic Systems: Devices, Design, Control, Operation and Monitoring, Alciatore, D.G., and Histand, M.B., 2nd Edition, 2011.
2. Introduction to Mechatronics and Measurement Systems, Alciatore, D.G., and Histand, M.B., 4th Edition, 2011.

Online Resources: https://onlinecourses.nptel.ac.in/noc21_me27/preview

ME598 | **Computational Fluid Dynamics** | Credits: 3-0-0-6

Course Outcomes:

CO1	Derive and categorize the governing equations of fluid flow and heat transfer (Navier-Stokes equations).
CO2	Apply discretization techniques (FDM, FVM) to transform partial differential equations into solvable algebraic forms.
CO3	Evaluate and select appropriate turbulence models and boundary conditions for complex industrial flows.
CO4	Utilize commercial CFD software (ANSYS Fluent/OpenFOAM) to conduct high-fidelity simulations.
CO5	Integrate intelligent data-driven approaches (like Reduced Order Modeling) to optimize fluid system designs.

Course Articulation Matrix:

COs	POs		
	PO1	PO2	PO3
CO1	3	1	3
CO2	3	-	3
CO3	3	-	3
CO4	3	2	3
CO5	3	3	3

1 – Low 2 – Medium 3 – High

Detailed Syllabus:

Governing Equations and Mathematical Behavior: Review of Fluid Mechanics: Continuity, Momentum, and Energy equations; Navier-Stokes equations. Conservation form vs. Non-conservation form; Mathematical classification of PDEs: Elliptic, Parabolic, and Hyperbolic equations.

Discretization Techniques: Finite Difference Method (FDM): Derivation of forward, backward, and central difference schemes; Accuracy and truncation errors; Finite Volume Method (FVM): Discretization of diffusion and convection-diffusion problems; Pressure-Velocity Coupling: SIMPLE, SIMPLER, and PISO algorithms.

Gridding and Convergence: Mesh Generation: Structured, Unstructured, and Polyhedral meshes; Mesh quality metrics (Aspect ratio, Skewness); Stability Analysis: Von Neumann stability, CFL condition; Convergence criteria and error estimation (Iteration error vs. Discretization error).

Turbulence Modeling and Advanced Topics: Characteristics of Turbulence: Reynolds Averaged Navier-Stokes (RANS) equations.; Turbulence Models: k-ε, k-ω SST, and Large Eddy Simulation (LES) overview; Boundary Layer Modeling: Wall functions and y+ requirements.

Intelligent CFD and Applications: Data-Driven Fluid Dynamics: Introduction to Physics-Informed Neural Networks (PINNs); Reduced Order Modeling (ROM) for real-time fluid simulation in intelligent systems.

Text Books:

1. Computational Fluid Dynamics: The Basics with Applications, Anderson, J. D.

Reference Books:

1. An Introduction to Computational Fluid Dynamics: The Finite Volume Method, Versteeg, H.K., and Malalasekera, W., 2nd Edition, 2007.
2. Computational Methods for Fluid Dynamics, Ferziger, J.H., Peric, M., and Street, R.L., 4th Edition, 2020.

Online Resource: https://nptel.ac.in/courses/112105045

ME600 3-0-0-6

Rotor Dynamics

Course Outcomes:

CO1	Explain the fundamentals of rotor–bearing interaction, flexural vibration, and critical speeds of shafts.
CO2	Analyze the effects of anisotropic bearings, asymmetric shafts, gyroscopic forces, and aerodynamic influences on rotor stability.
CO3	Model rotor systems using equivalent discrete methods, geared and branched configurations, and evaluate fluid film bearing characteristics.
CO4	Apply balancing techniques for rigid and flexible rotors and demonstrate practical approaches to vibration control.
CO5	Evaluate condition monitoring strategies and utilize measurement techniques for fault diagnosis and predictive maintenance of rotating machinery.

Course Articulation Matrix:

COs	POs		
	PO1	PO2	PO3
CO1	3	1	3
CO2	3	-	3
CO3	3	-	3
CO4	3	-	3
CO5	3	3	3

1 – Low 2 – Medium 3 – High

Detailed Syllabus:

Fundamentals of Rotor Dynamics: Introduction to rotor dynamics covering rotor–bearing interaction, flexural vibration of shafts, and determination of critical speeds.

Advanced Rotor-Bearing Effects: Study of anisotropic bearings, unbalanced response of asymmetric shafts, gyroscopic effects in high-speed rotors, and aerodynamic influences on stability.

System Modeling & Bearings: Modeling of rotor systems using equivalent discrete methods, geared and branched configurations, and analysis of fluid film bearings with steady state characteristics.

Rotor Balancing & Control: Balancing of rotors including rigid rotor balancing with single- and two-plane methods, flexible rotor balancing using modal techniques, and nonlinear rotor dynamics with vibration control strategies.

Condition Monitoring & Intelligent Applications: Condition monitoring of rotating machinery with measurement techniques, signal processing methods, AI-based fault diagnosis, predictive maintenance, digital twin concepts, and IoT-enabled real-time monitoring.

Text Books:

1. Rajiv Tiwari, Rotor Systems: Analysis and Identification, CRC Press, Boca Raton, 2017.
2. J. S. Rao, Rotor Dynamics, Third ed., New Age, New Delhi, 1996.

Reference Books:

1. 1. M. J. Goodwin, Dynamics of Rotor-Bearing Systems, Unwin Hyman, Sydney, 1989.
2. 2. Agnieszka Muszynska, Rotordynamics, CRC Press, Boca Raton, 2005.

Online Resources:

1. https://nptel.ac.in/courses/112103024

ME402 3-0-0-4

Scientific Machine Learning

Course Outcomes:

CO1	Examine the foundations of scientific machine learning that blend physics-based modelling with modern ML approaches.
CO2	Develop deep understanding of data-driven modelling of dynamical systems and mechanical processes.
CO3	Explore physics-informed neural networks (PINNs), operator learning, and surrogate modelling.
CO4	Quantify uncertainty and ensure robustness in SciML models.
CO5	Implement SciML techniques in real-world mechanical systems.

Course Articulation Matrix:

COs	POs		
	PO1	PO2	PO3
CO1	2	1	2
CO2	3	-	3
CO3	3	-	3
CO4	3	1	3
CO5	3	2	3

1 – Low 2 – Medium 3 – High

Detailed Syllabus:

Introduction to Scientific Machine Learning: ML vs Scientific ML vs Traditional Numerical Analysis; Workflow: data, physics priors, simulation, model learning; Applications: fluid dynamics, structural mechanics, thermal systems, robotics.

Data-Driven Modelling of Dynamical Systems: Black-box, gray-box, and hybrid modelling; State estimation and system identification; Sparse Identification of Nonlinear Dynamics (SINDy); Koopman operator theory & dynamic mode decomposition (DMD); Time-series modelling for mechanical systems.

Physics-Informed Neural Networks: Concept of embedding physical laws into neural networks; Training PINNs for ODEs and PDEs; Applications in fluid mechanics, structural dynamics, and thermal systems.

Surrogate Modelling & Reduced-Order Models: Polynomial chaos expansion (PCE); Gaussian Process Regression (GPR) & Kriging; Projection-based ROMs: POD, Galerkin projection; Nonlinear ROMs and ML-based ROMs.

Scientific Deep Learning & Operator Learning: DeepONet, Fourier Neural Operators, Neural ODEs; Learning solution operators for PDEs; Neural differential equations; Multi-fidelity & transfer learning in scientific models.

Text Books:

1. Scientific Machine Learning: Theory & Applications, Kutz, J.N., and Brunton, S., Cambridge English, 2019.
2. Data-Driven Science and Engineering: Machine Learning, Dynamical Systems, and Control, Brunton, S., and Kutz, J.N.

Reference Books:

1. Physics-Informed Machine Learning, Karniadakis, G.E., Kevrekidis, I.G., Lu, L., Perdikaris, P., Wang, S., and Yang, L., 1st Edition, 2024.
4. Machine Learning for Modeling and Control of Dynamical Systems, Brunton, S.L., and Kutz, J.N., 1st Edition, 2019.

Online Resources:

1. https://nptel.ac.in/courses/106106198

ANNEXURE – IV

1. RELATIVE GRADING

a) **Minimum Passing Requirement**: The minimum passing requirement for a course shall normally be the maximum of **(Class Average ÷ 2)** or **35% of the total weightage** , subject to securing at least **20% in the final assessment**.

b) **Applicability**: The Institute follows a **Relative Grading System** for all courses, including Project Work.

c) **Award of Letter Grades** : Based on the student's overall performance, a final letter grade shall be assigned for each course at the end of the semester.

d) **Letter Grades and Corresponding Grade Points**

The letter grades and corresponding grade points are as follows:

Letter Grade	Ex	A	B	C	D	E	F	X	FA	I
Grade Point	10	9	8	7	6	5	0	-	-	-

'F' – Fail

'X' – Debarred

'FA' – Failure due to attendance

'I' – Transitional

e) **Award of 'Ex' Grade** (Theory Course): For theory courses, the 'Ex' grade shall be awarded to **not more than** 10% of the students appearing for the course.

f) **Award of 'Ex' Grade (Laboratory / Industrial Lecture / Project Work)**: For laboratory courses, Industrial Lecture, and Project Work, the 'Ex' grade shall be awarded to **not more than 20%** of the students appearing for the course.

2. SGPA and CGPA Calculation

a) **Semester Grade Point Average (SGPA)**: The SGPA for a semester is calculated as the weighted average of the grade points earned in all courses taken during that semester.

$$SGPA = \frac{\sum_{i=1}^{n} C_i \times GP_i}{\sum_{i=1}^{n} C_i}$$

b) Cumulative Grade Point Average (CGPA): The CGPA is the weighted average of grade points earned in all courses successfully completed from the first semester up to the current semester.

$$CGPA = \frac{\sum_{i=1}^{N} C_i \times GP_i}{\sum_{i=1}^{N} C_i}$$

where:

- C_i = Credits of the i_{th} course
- GP_i = Grade points obtained in the i_{th} course
- n = Total number of courses taken in the semester
- N = Total number of courses taken in the program up to the semester

ANNEXURE - V

Indian Institute of Technology Madras
Chennai - 600 036

भारतीय प्रौद्योगिकी संस्थान मद्रास
चेन्नई - 600 036

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प्रो. वी. कामकोटि
Prof. V. Kamakoti
निदेशक
Director

As discussed, a committee will be constituted to discuss the matter. Pls put up.

05-12-2023

To
Prof. (Dr.) D.N.H. Somayajulu
Director
National Institute Of Technology, Manipur

Greetings from IIT Madras

I am writing to seek your kind consideration for recognizing IIT Madras' non-campus 4-year BS degrees as eligible undergraduate qualifications for admission to M.Tech, M.S. (by Research), and Ph.D. programs at your esteemed institution. Currently, IIT Madras offers two non-campus BS programs: BS in Data Science and Applications and BS in Electronic Systems. These programs have been carefully designed in alignment with the National Education Policy (NEP) 2020 and are equivalent in academic rigor, credit load, and learning outcomes to conventional B.Tech programs.

Although content delivery for these programs is online, we would like to emphasize that the IIT Madras BS in Data Science and Applications program, launched in 2020, and the BS in Electronic Systems, launched in 2023, do not follow the typical online degree or distance education model. As the first batch graduated with the 4-year BS in Data Science and Applications last year, we are reaching out to you to detail how these BS degrees differ from other online and distance-mode programs and why these BS degrees should be considered as one of the eligible degrees for admission to the master's programs offered at your institution.

1. **Eligibility in other premier institutions:** Several foreign universities and leading Indian institutions, such as IISc, IIT Bombay ([illegible]), IIT Guwahati, IIT Roorkee, IIT Gandhinagar, IIT [illegible], IIT Ropar, etc., recognize this BS program as an eligible degree for admission to their research programs.

2. **Program Structure:** Each program requires completion of 142 credits, which is comparable to the B.Tech curriculum at IITs. These programs are designed with multiple levels, viz., foundation level, diploma level, and degree level. Upon clearing a qualifier exam, the students are admitted to the foundation level of the program. Students can progress to the next level of the program only upon completing each level. This ensures only the students of strong academic standing graduate with the BS degree.

3. **Continuous in-person evaluation:** Although the program's content delivery is online, all assessments are conducted in person at designated exam centers. The course includes continuous in-person evaluation in the form of monthly quizzes. Through this rigorous process, the program is designed to ensure that only the most exceptional students progress to earn the BS degree. The program structure and assessment processes are detailed in Annexure I for your reference.

4. **Practical lab and project components:** These programs have significant lab and hands-on components. The BS in Data Science and Applications curriculum has 11 core courses with in-built lab components and 3 courses with course projects related to programming, ML, and data analysis. Students can pass these courses only if they successfully complete the practical and theory components independently. Additionally, students must complete 4 projects at the diploma level individually. The BS in Electronic Systems curriculum includes 8 lab courses and 2 projects, which are completed in person at IIT Madras. The details of these lab and project courses are included in Annexure II for your reference.

5. **Extended selection mechanism:** The program adopts a model that is comparable to the Chartered Accountancy (CA) course. The program is designed to admit a large number of students to the foundation level of the program through a qualifier exam. However, students must complete each level before entering the next level of the program. Our data shows that *roughly 27% of the applicants qualify for admission to the foundation level, and less than 2.5% of the students who join the program (i.e., roughly 0.5% of the applicants) complete the BS degree within 4 years*. The data for the students who joined in January 2021 is given in Annexure III for your reference.

6. **Outcome in national exams:** Our BS students have secured 3 of the top 10 ranks (AIR 3, 7, and 10) in the Data Science and Artificial Intelligence (DA) paper of the GATE 2025 exam. It is important to note that none of these 3 students has a BE/BTech degree. Also, one of these students (AIR #10) has pursued the BS degree as his sole undergraduate degree.

7. **Alignment with NEP 2020 Vision:** These programs exemplify NEP's emphasis on flexible, multidisciplinary, and technology-enabled education with multiple entry/exit points and pathways to lifelong learning. Graduates are well-prepared for research and higher studies.

8. **Pursuing two degrees:** The UGC has approved that two degrees (one physical and one online) can be pursued by students simultaneously. Several students in these programs will have multi-domain expertise, such as an engineering/science major and data science.

The Ministry of Education's D.O. Letter (No. 13-9/2024-IC dated 20.03.2024), issued by the Secretary (Higher Education), also explicitly recommends that institutions treat 4-year BS degrees as eligible for admission to postgraduate and research programs, recognizing them as standard undergraduate degrees in accordance with the NEP 2020 guidelines.

We also would like to note that all IITs and NITs admit students who come from open schooling for BTech admission, as long as students clear JEE Advanced. Similarly, we **believe good students who graduate from IIT Madras' BS programs and successfully clear the GATE exam deserve to be considered for admission to postgraduate programs at IITs and NITs.** Considering these aspects, we request that IIT Madras' BS be considered an eligible degree for admission to your postgraduate programs. Such recognition would align institutional admission policies with the NEP framework and the Ministry's vision of expanding pathways to research and innovation for deserving students.

If you have any queries or would like to discuss them with us further, we will be happy to meet you online or visit you in person.

With regards,

V. Kamakoti

Prof. V. Kamakoti
Director, IIT Madras

राष्ट्रीय प्रौद्योगिकी संस्थान मणिपुर
NATIONAL INSTITUTE OF TECHNOLOGY, MANIPUR
[illegible]
An Autonomous Institute under MHRD, Govt. of India

Minutes of the meeting of the committee on fee refund of [illegible]

Venue: Dean Academic's Chamber

Date and Time: [illegible]

Members present:

1. Dr. [illegible] — Dean(AA)
2. Dr. [illegible] — [illegible]
3. Dr. [illegible] Kumar — [illegible]

Agenda:

1. Fee refund policy for cancellation of final admission for 1st year and also for withdrawal after admission

Discussions:

The following points were discussed:
1. The total fees paid by the students for each category during [illegible] counselling.
2. The fee structure for B.Tech programme.

Resolutions:
The members discussed the above agenda in details and came to the following conclusions:
The committee recommends the following points:
1. The following fee components shall be [illegible]: Admission [illegible], Tuition Fees and Institution Development Fees.
2. The following fee components shall be [illegible]:

Sl. No.	FEE COMPONENTS	[illegible]
1	Students Activity Fees	-
2	Technical And Cultural Activity Fees	[illegible]
3	Sports Fees	[illegible]
4	Medical Insurance And OPD Facility Fees	[illegible]
5	Caution Money	[illegible]
6	Identity Card Fees	[illegible]
7	Smart ID Fees	[illegible]
8	Library Fees	
9	Prospectus Fees	
10	Internet Fees	[illegible]
11	Examination Fees	[illegible]
12	Laboratory Fees	[illegible]
	TOTAL	[illegible]

(Dr. [illegible]) (Dr. [illegible]) (Dr. [illegible] Kumar)

ANNEXURE – VII

Seat Matrix (Academic Year 2006-07)

[illegible]

Risk Matrix (Academic Year [illegible]) [illegible]

[illegible]