New Prince Shri Bhavani College of Engineering and Technology

(An Autonomous Institution)

CURRICULUM

&

SYLLABUS

(SEMESTER 1 - 8)

(REGULATION 2023)

FOR

B.E. – MECHANICAL ENGINEERING

(CHOICE BASED CREDIT SYSTEM)

Applicable to the students admitted from the Academic Year (2023 – 2024)

DEPARTMENT OF MECHANICAL ENGINEERING

SEMESTER – I

Sl. No.	Course Category	Course Code	Course Title	L	T	P	Total Contact Periods	Credits
THEORY COURSES								
1	HS	U23EN101	Technical English – I	3	0	0	3	3
2	BS	U23MA101	Engineering Mathematics	3	1	0	4	4
3	BS	U23PH101	Engineering Physics	3	0	0	3	3
4	ES	U23EG101	Engineering Graphics	2	0	4	6	4
5	ES	U23CP101	Programming in C	3	0	2	5	4
6	ES	U23BE102	Basics of Electrical and Electronics Engineering	3	0	2	5	4
7	HS	U23TA101	தமிழர் மரபு /Heritage of Tamils	1	0	0	1	1
PRACTICAL COURSES								
8	ES	U23EP101	Engineering Practices Laboratory	0	0	3	3	1.5
9	HS	U23EN102	Professional Communication Laboratory	0	0	3	3	1.5
10	SIP	U23IP101	Student Induction Programme	0	0	0	2 Weeks	0
TOTAL CREDITS								**26**

SEMESTER – II

Sl. No.	Course Category	Course Code	Course Title	L	T	P	Total Contact Periods	Credits
THEORY COURSES								
1	HS	U23EN201	Technical English – II	3	0	0	3	3
2	BS	U23MA201	Vector Calculus and Complex Functions	3	1	0	4	4
3	BS	U23PH202	Physics for Material Technology	3	0	0	3	3
4	BS	U23CY101	Engineering Chemistry	3	0	0	3	3
5	ES	U23PY201	Problem Solving and Python Programming	3	0	2	5	4
6	PC	U23ME201	Engineering Mechanics	3	0	0	3	3
7	HS	U23TA201	தமிழரும் தொழில் நுட்பமும் / Tamils and Technology	1	0	0	1	1
PRACTICAL COURSES								
8	BS	U23PC101	Physics and Chemistry Laboratory	0	0	3	3	1.5
9	PC	U23ME202	Computer Aided Machine Drawing	0	0	3	3	1.5
TOTAL CREDITS								**24**

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SEMESTER – III								
Sl. No.	Course Category	Course Code	Course Title	L	T	P	Total Contact Periods	Credits
THEORY COURSES								
1	BS	U23MA301	Transforms Partial Differential Equations	3	1	0	4	4
2	PC	U23ME302	Engineering Thermodynamics	3	0	0	3	3
3	ES	U23ME303	Fluid Mechanics and Machinery	3	0	2	5	4
4	ES	U23ME304	Engineering Materials and Metallurgy	3	0	0	3	3
5	PC	U23ME305	Manufacturing Technology – I	3	0	0	3	3
6	MNC	U23MX01	Personal Values	2	0	0	2	0
PRACTICAL COURSES								
7	PC	U23ME306	Manufacturing Technology Laboratory	0	0	3	3	1.5
EMPLOYABILITY ENHANCEMENT COURSES								
8	EEC	U23EEC301	Employability Skills – I	0	0	2	2	1
TOTAL CREDITS								**19.5**

SEMESTER – IV								
Sl. No.	Course Category	Course Code	Course Title	L	T	P	Total Contact Periods	Credits
THEORY COURSES								
1	PC	U23ME401	Theory of Machines	3	0	0	3	3
2	PC	U23ME402	Thermal Engineering – I	3	0	0	3	3
3	PC	U23ME403	Hydraulics and Pneumatics	3	0	0	3	3
4	PC	U23ME404	Manufacturing Technology – II	3	0	0	3	3
5	PC	U23ME405	Strength of Materials	3	0	0	3	3
6	PC	U23ME406	Metrology and Measurement	3	0	2	5	4
PRACTICAL COURSES								
7	PC	U23ME407	Strength of Materials Laboratory	0	0	3	3	1.5
8	PC	U23ME408	Dynamics Laboratory	0	0	3	3	1.5
EMPLOYABILITY ENHANCEMENT COURSES								
9	EEC	U23EEC401	Employability Skills – II	0	0	2	2	1
TOTAL CREDITS								**23**

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SEMESTER - V								
Sl. No.	Course Category	Course Code	Course Title	L	T	P	Total Contact Periods	C
THEORY COURSES								
1	PC	U23CB501	Cyber security	3	0	2	5	4
2	PC	U23ME501	Design of Machine Elements	3	0	0	3	3
3	PC	U23ME502	Thermal Engineering – II	3	0	2	5	4
4	HS	U23MG501	Professional Ethics and IPR	3	0	0	3	2
5	PE	U23PEMEXX	Professional Elective - I	-	-	-	-	3
6	PE	U23PEMEXX	Professional Elective - II	-	-	-	-	3
7	MNC	U23MX02	Environmental Sciences and Sustainability	2	0	0	2	0
PRACTICAL COURSE								
8	EEC	U23ME503	Mini Project	0	0	3	3	1.5
EMPLOYABILITY ENHANCEMENT COURSE								
9	EEC	U23EEC501	Employability Skills - III	0	0	3	3	1
TOTAL CREDITS								21.5

SEMESTER - VI								
Sl. No.	Course Category	Course Code	Course Title	L	T	P	Total Contact Periods	C
THEORY COURSES								
1	PC	U23ME601	Heat & Mass Transfer	3	0	2	5	4
2	PC	U23ME602	Design of Transmission systems	3	0	0	3	3
3	PC	U23ME603	Computer aided Design & Manufacturing	3	0	0	3	3
4	HS	U23PEMEXX	Professional Elective - III	-	-	-	-	3
5	PE	U23PEMEXX	Professional Elective - IV	-	-	-	-	3
6	PE	U23OEXX	Open Elective - I	-	-	-	-	3
7	MNC	U23FLXX	Foreign language	-	-	-	-	2
PRACTICAL COURSE								
8	PC	U23ME604	CAD/CAM Laboratory	0	0	3	3	1.5
EMPLOYABILITY ENHANCEMENT COURSE								
9	EEC	U23EEC601	Employability Skills - IV	0	0	3	3	1
10	EEC	U23EEC602	Internship	0	0	0	0	1
TOTAL CREDITS								24.5

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SEMESTER - VII								
Sl. No.	Course Category	Course Code	Course Title	L	T	P	Total Contact Periods	C
THEORY COURSES								
1	PC	U23ME701	Power Plant Engineering	3	0	0	3	3
2	PC	U23ME702	Automobile Engineering	3	0	0	3	3
3	PC	U23ME703	Mechatronics	3	0	2	5	4
4	HS	U23MG701	Project Management and Finance	2	0	0	2	2
5	PE	U23PEMEXX	Professional Elective-V	-	-	-	-	3
6	PE	U23PEMEXX	Professional Elective-VI	-	-	-	-	3
7	OE	U23MXXX	Open Elective-II	-	-	-	-	3
PRACTICAL COURSE								
8	PC	U23ME704	Simulation and Analysis Laboratory	0	0	3	3	1.5
EMPLYABILITY ENCHANCEMENT COURSES								
9	EEC	U23ME705	Comprehensive Review	0	0	2	2	1
TOTAL CREDITS								23.5

SEMESTER - VIII								
Sl. No.	Course Category	Course Code	Course Title	L	T	P	Total Contact Periods	C
PRACTICAL COURSE								
1	EEC	U23ME801	Project Work	0	0	16	16	8
TOTAL CREDITS								8

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Course Code	Vertical I Thermal	Course Code	Vertical II Energy	Course Code	Vertical III Design	Course Code	Vertical IV Manufacturing	Course Code	Vertical V Automation	Course Code	Vertical VI Materials	Course Code	Vertical VII Emerging Technologies	Course Code	Vertical VIII Diverse Field Courses
U23PEME01	Gas Dynamics and Jet Propulsion	U23PEME07	Sustainable Energy Sources	U23PEME13	Design for Manufacturing	U23PEME19	Digital Manufacturing and IoT	U23PEME25	Industrial Robotics	U23PEME31	Failure analysis & NDT Techniques	U23PEME37	Fundamentals of Nano Science	U23PEME43	Electrical Drives and Control
U23PEME02	Refrigeration and Air Conditioning	U23PEME08	Energy Conservation and Industry	U23PEME14	Design of Jigs and Fixtures	U23PEME20	New Product Development	U23PEME26	Drone Technology and its Applications	U23PEME32	Composite Materials	U23PEME38	Additive Manufacturing	U23PEME44	Industrial Health Measurements
U23PEME03	Computational Fluid Dynamics	U23PEME09	Energy Storage Devices	U23PEME15	Design for X	U23PEME21	Unconventional Machining Process	U23PEME27	Industrial Layout Design	U23PEME33	Smart Materials	U23PEME39	Industrial Tribology	U23PEME45	Production Planning and Control
U23PEME04	Advanced IC Engines	U23PEME10	Equipment for Pollution Control	U23PEME16	Design of Pressure Vessels	U23PEME22	Lean Manufacturing	U23PEME28	Product Life Cycle Management	U23PEME34	Mechanical Behavior of Materials	U23PEME40	Surface Engineering	U23PEME46	Maintenance Engineering
U23PEME05	Turbo Machines	U23PEME11	Bio Energy Conservation Technologies	U23PEME17	Ergonomics in Automotive Design	U23PEME23	Welding Technology	U23PEME29	Automation in Manufacturing	U23PEME35	Metal and Powder Forming Techniques	U23PEME41	Hybrid and Electrical Vehicles	U23PEME47	Artificial Intelligence
U23PEME06	Combustion Engineering	U23PEME12	Solar Thermal Technology	U23PEME18	Design Concepts In Engineering	U23PEME24	Casting Process	U23PEME30	Digital Twin and industry 5.0	U23PEME36	Materials for Green energy	U23PEME42	IOT for Manufacturing Industry	U23PEME48	Metal Cutting and CNC Machines

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VERTICAL-I THERMAL								
Sl. No.	**Course Category**	**Course Code**	**Course Title**	**L**	**T**	**P**	**Total Contact Periods**	**C**
THEORY COURSES								
1	PE	U23PEME01	Gas Dynamics and Jet Propulsion	3	0	0	3	3
2	PE	U23PEME02	Refrigeration and Air Conditioning	3	0	0	3	3
3	PE	U23PEME03	Computational Fluid Dynamics	2	0	2	4	3
4	PE	U23PEME04	Advanced IC Engines	3	0	0	3	3
5	PE	U23PEME05	Turbo Machines	3	0	0	3	3
6	PE	U23PEME06	Combustion Engineering	3	0	0	3	3

VERTICAL-II ENERGY								
Sl. No.	**Course Category**	**Course Code**	**Course Title**	**L**	**T**	**P**	**Total Contact Periods**	**C**
THEORY COURSES								
1	PE	U23PEME07	Sustainable Energy Sources	3	0	0	3	3
2	PE	U23PEME08	Energy Conservation and Industry	2	0	2	4	3
3	PE	U23PEME09	Energy Storage Devices	3	0	0	3	3
4	PE	U23PEME10	Equipment for Pollution Control	3	0	0	3	3
5	PE	U23PEME11	Bio Energy Conservation Technologies	3	0	0	3	3
6	PE	U23PEME12	Solar Thermal Technology	3	0	0	3	3

VERTICAL-III DESIGN								
Sl. No.	**Course Category**	**Course Code**	**Course Title**	**L**	**T**	**P**	**Total Contact Periods**	**C**
THEORY COURSES								
1	PE	U23PEME13	Design for Manufacturing	2	0	2	4	3
2	PE	U23PEME14	Design of Jigs and Fixtures	3	0	0	3	3
3	PE	U23PEME15	Design for X	3	0	0	3	3
4	PE	U23PEME16	Design of Pressure Vessels	3	0	0	3	3
5	PE	U23PEME17	Ergonomics in Automotive Design	3	0	0	3	3
6	PE	U23PEME18	Design Concepts In Engineering	3	0	0	3	3

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VERTICAL-IV MANUFACTURING								
Sl. No.	**Course Category**	**Course Code**	**Course Title**	**L**	**T**	**P**	**Total Contact Periods**	**C**
THEORY COURSES								
1	PE	U23PEME19	Digital Manufacturing and IOT	2	0	2	4	3
2	PE	U23PEME20	New Product Development	3	0	0	3	3
3	PE	U23PEME21	Unconventional Machining Process	3	0	0	3	3
4	PE	U23PEME22	Lean Manufacturing	3	0	0	3	3
5	PE	U23PEME23	Welding Technology	3	0	0	3	3
6	PE	U23PEME24	Casting Process	3	0	0	3	3
VERTICAL-V AUTOMATION								
Sl. No.	**Course Category**	**Course Code**	**Course Title**	**L**	**T**	**P**	**Total Contact Periods**	**C**
THEORY COURSES								
1	PE	U23PEME25	Industrial Robotics	3	0	0	3	3
2	PE	U23PEME26	Drone Technology and Its Applications	3	0	0	3	3
3	PE	U23PEME27	Industrial Layout Design	2	0	2	4	3
4	PE	U23PEME28	Product Life Cycle Management	3	0	0	3	3
5	PE	U23PEME29	Automation in Manufacturing	3	0	0	3	3
6	PE	U23PEME30	Digital Twin and industry 5.0	3	0	0	3	3
VERTICAL-VI MATERIALS								
Sl. No.	**Course Category**	**Course Code**	**Course Title**	**L**	**T**	**P**	**Total Contact Periods**	**C**
THEORY COURSES								
1	PE	U23PEME31	Failure analysis &NDT Techniques	2	0	2	4	3
2	PE	U23PEME32	Composite Materials	3	0	0	3	3
3	PE	U23PEME33	Smart Materials	3	0	0	3	3
4	PE	U23PEME34	Mechanical Behavior of Materials	3	0	0	3	3
5	PE	U23PEME35	Metal and Powder Forming Techniques	3	0	0	3	3
6	PE	U23PEME36	Materials for Green energy	3	0	0	3	3

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VERTICAL-VII EMERGING TECHNOLOGIES								
Sl. No.	**Course Category**	**Course Code**	**Course Title**	**L**	**T**	**P**	**Total Contact Periods**	**C**
THEORY COURSES								
1	PE	U23PEME37	Fundamentals of Nano Science	2	0	2	4	3
2	PE	U23PEME38	Additive Manufacturing	2	0	2	4	3
3	PE	U23PEME39	Industrial Tribology	3	0	0	3	3
4	PE	U23PEME40	Surface Engineering	3	0	0	3	3
5	PE	U23PEME41	Hybrid and Electrical Vehicles	3	0	0	3	3
6	PE	U23PEME42	IOT for Manufacturing Industry	3	0	0	3	3
VERTICAL-VIII DIVERSE FIELD COURSES								
Sl. No.	**Course Category**	**Course Code**	**Course Title**	**L**	**T**	**P**	**Total Contact Periods**	**C**
THEORY COURSES								
1	PE	U23PEME43	Electrical Drives and Control	2	0	2	4	3
2	PE	U23PEME44	Industrial Health Measurements	3	0	0	3	3
3	PE	U23PEME45	Production Planning and Control	3	0	0	3	3
4	PE	U23PEME46	Maintenance Engineering	3	0	0	3	3
5	PE	U23PEME47	Artificial Intelligence	3	0	0	3	3
6	PE	U23PEME48	Metal Cutting and CNC Machines	3	0	0	3	3

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SET I - Open Electives for the Department of Mechanical Engineering							
Sl. No.	Course Code	Course Title	L	T	P	Total Contact Periods	Credits
1	U23OE101	Algebra and Number Theory	3	0	0	3	3
2	U23OE102	Probability and Queueing Theory	3	0	0	3	3
3	U23OE103	Probability and Random Processes	3	0	0	3	3
4	U23OE104	Linear Algebra	3	0	0	3	3
5	U23OE105	Everyday Physics	3	0	0	3	3
6	U23OE106	Consumer Awareness on Appliances	3	0	0	3	3
7	U23OE107	Bio Physics	3	0	0	3	3
8	U23OE108	Astrophysics	3	0	0	3	3
9	U23OE109	Introduction to Nanoscience and Nanotechnology	3	0	0	3	3
10	U23OE110	Green Technology	3	0	0	3	3
11	U23OE111	The Environment and Society	3	0	0	3	3
12	U23OE112	Industrial corrosion and Prevention	3	0	0	3	3
13	U23OE113	English Through Media	3	0	0	3	3
14	U23OE114	English for Employability Skills	3	0	0	3	3
15	U23OE115	Inventions and Applications	3	0	0	3	3
16	U23OE116	Public Policy and Governance	3	0	0	3	3
17	U23OE117	Introduction to Mobile Communication	3	0	0	3	3
18	U23OE118	Basics of Signals and its Processing	3	0	0	3	3
19	U23OE119	Introduction to Communication Systems	3	0	0	3	3
20	U23OE120	Drone Technologies	3	0	0	3	3
21	U23OE121	Geographical Information System	3	0	0	3	3
22	U23OE122	Fundamentals of Electric and Hybrid Vehicle	3	0	0	3	3
23	U23OE123	Introduction to PLC Programming	3	0	0	3	3
24	U23OE124	Energy Management and Auditing	3	0	0	3	3
25	U23OE125	Fundamentals of Robotics	3	0	0	3	3
26	U23OE126	Medical Instrumentation	3	0	0	3	3
27	U23OE127	Program Language Principles	3	0	0	3	3
28	U23OE128	Data Warehousing and Data Mining	3	0	0	3	3
29	U23OE129	Foundations of Soft Computing Techniques	3	0	0	3	3
30	U23OE130	Fundamentals of Cloud Computing	3	0	0	3	3
31	U23OE131	Human Computer Interaction	3	0	0	3	3
32	U23OE132	Web Development Fundamentals	3	0	0	3	3
33	U23OE133	Network Management Systems	3	0	0	3	3
34	U23OE134	Fundamentals of Mobile Computing	3	0	0	3	3
35	U23OE135	Electronic Commerce	3	0	0	3	3
36	U230E136	Machine Learning using Python	2	0	2	4	3

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SET II - Open Electives for the Department of Mechanical Engineering							
Sl. No.	Course Code	Course Title	L	T	P	Total Contact Periods	Credits
1	U23OE201	Statistics and Numerical Methods	3	0	0	3	3
2	U23OE202	Resource Management Techniques	3	0	0	3	3
3	U23OE203	Graph Theory	3	0	0	3	3
4	U23OE204	Operations Research	3	0	0	3	3
5	U23OE205	Scientific Principles in Historical Monuments	3	0	0	3	3
6	U23OE206	Non-Conventional Energy Sources	3	0	0	3	3
7	U23OE207	Environmental Physics	3	0	0	3	3
8	U23OE208	Entrepreneurship Development	3	0	0	3	3
9	U23OE209	Basics of Bioenergy and Biofuels	3	0	0	3	3
10	U23OE210	Food Science	3	0	0	3	3
11	U23OE211	Fundamentals of Crop Production	3	0	0	3	3
12	U23OE212	Water Pollution and Control Management	3	0	0	3	3
13	U23OE213	Personality Development	3	0	0	3	3
14	U23OE214	Workplace Communication	3	0	0	3	3
15	U23OE215	English for Competitive Examinations	3	0	0	3	3
16	U23OE216	English for Professional Excellence	3	0	0	3	3
17	U23OE217	Tools for Computing and Design Platform	3	0	0	3	3
18	U23OE218	Introduction to Sensors and Actuators	3	0	0	3	3
19	U23OE219	Underwater Communication	3	0	0	3	3
20	U23OE220	Consumer Electronics	3	0	0	3	3
21	U23OE221	Basics of Embedded Systems and IoT	3	0	0	3	3
22	U23OE222	Industrial Safety	3	0	0	3	3
23	U23OE223	Renewable Energy Technologies	3	0	0	3	3
24	U23OE224	Introduction to Smart Grid	3	0	0	3	3
25	U23OE225	Basics of Power Plant Engineering	3	0	0	3	3
26	U23OE226	Automotive Electronics	3	0	0	3	3
27	U23OE227	Foundation of AI & Problem solving	3	0	0	3	3
28	U23OE228	Introduction to R Programming	3	0	0	3	3
29	U23OE229	Foundations of NLP	3	0	0	3	3
30	U23OE230	Foundations of Speech Recognition	3	0	0	3	3
31	U23OE231	Essentials of Data Science and Analytics	3	0	0	3	3
32	U23OE232	Fundamentals of Network Security	2	0	2	4	3
33	U23OE233	Cyber Laws and Ethics	3	0	0	3	3
34	U23OE234	Trust Management in E-Commerce	3	0	0	3	3
35	U23OE235	Linux Fundamentals	2	0	2	4	3
36	U23OE236	Cyber Threat Intelligence	3	0	0	3	3

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KOVRIVAKK..., CHENNAI - ...

U23EN101	TECHNICAL ENGLISH - I	L	T	P	C
	(Common to all branches)	3	0	0	3

Prerequisites: **Fundamentals of Analytical Skills in English**

COURSE OBJECTIVES:

- To enhance reading comprehension skills for technical articles to grasp and interpret complex concepts.
- To prepare students' for effective communication and writing in technical and professional contexts.
- To develop the ability to write persuasive job applications and structured resumes effectively.

UNIT I **INTRODUCTION** 9

Reading – Requirement for Reading – reading short technical texts from journals and newspapers; **Writing** –Compare and Contrast Essay; Email Writing; **Grammar** – Parts of Speech, Mixed Tenses, Prepositional phrases; **Vocabulary Development** – Contextual meaning of words.

UNIT II **READING AND LANGUAGE DEVELOPMENT** 9

Reading – Reading Advertisements, User Manuals, Brochures; **Writing** - Process Writing, Interpreting charts & graphs; **Grammar** – Active and Passive Voice transformations, Infinitive and Gerunds; **Vocabulary Development** – Vocabulary used in formal & informal letters / emails and reports.

UNIT III **TECHNICAL WRITING AND GRAMMAR** 9

Reading – Reading Longer texts both general and technical, practice in speed reading; **Writing** – Writing responses to complaints, Letter to the Editor, Checklists, Problem solution essay / Argumentative Essay; **Grammar** – Error correction; If Clauses, Compound Words, Punctuation; **Vocabulary Development** – Sentence Completion.

UNIT IV **REPORT WRITING** 9

Reading – Reading for detailed comprehension: Skimming and Scanning; **Writing**- Recommendations, Writing Reports – Accident Report, Survey Report, Minutes of a meeting; **Grammar** – Reported Speech, Modals; **Vocabulary Development** – Technical Vocabulary.

UNIT V **GROUP DISCUSSION AND JOB APPLICATIONS** 9

Reading – Reading and understanding Technical Articles; **Writing** – Writing Job Application – Resume Preparation (via email and hard copy); **Grammar** – Numerical Adjectives, Relative Clauses, Idioms and Phrases; **Vocabulary Development** – Verbal Analogies.

TOTAL: 45 PERIODS

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TEXT BOOKS:

1 Veena Selvam, "English for Science and Technology", Cambridge University Press, 2021.

2 N P Sudharshana,m, C Saveetha, "English for Technical Communication", Cambridge University Press, New Delhi, 2016.

REFERENCES:

1 E Suresh Kumar, "Engineering English", Orient Black swan, Hyderabad, 2015.

2 Meenakshi Raman, Sangeetha Sharma, "Technical Communication Principles and Practice", Oxford University Press, New Delhi, 2014.

3 Marion Grussendorf, "English for Presentations", Oxford University Press, 2007.

ONLINE RESOURCES:

1 https://iimskills.com/coursera-technical-writing-course/

2 https://www.udemy.com/course/easy-english-grammar-course

3 https://www.coursera.org/learn/introduction-to-research-for-essay-writing

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Write essays and emails.

CO2 Describe any process, interpretation of charts and graphs both general and technically.

CO3 Write letters and responses to complaints.

CO4 Write Recommendations, minutes and reports of events.

CO5 Write Job application with Resume.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	3	-	3	-	1
CO2	3	-	-	-	-	-	-	3	-	3	-	1
CO3	3	-	-	-	-	-	-	3	-	3	-	1
CO4	3	-	-	-	-	-	-	3	-	3	-	1
CO5	3	-	-	-	-	-	-	3	-	3	-	1

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U23MA101	ENGINEERING MATHEMATICS (Common to all branches)	L T P C 3 1 0 4

Prerequisites: Fundamental Concepts on Matrices and Calculus

COURSE OBJECTIVES:

- To enhance the utilization of matrix algebra techniques that is needed by engineers for practical applications in engineering.
- To familiarize the students with differential calculus and functions of several variables.
- To acquaint the students with the mathematical tools required for the assessment of multiple integrals and their practical applications.

UNIT I **MATRICES** **12**

Symmetric and orthogonal matrices – Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley – Hamilton theorem (Without proof) Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

UNIT II **DIFFERENTIAL CALCULUS** **12**

Representation of functions – Limit of a function – Continuity – Derivatives – Differentiation rules (sum, product, quotient, chain rules) – Implicit differentiation – Logarithmic differentiation – Applications: Maxima and Minima of functions of one variable.

UNIT III **FUNCTIONS OF SEVERAL VARIABLES** **12**

Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Applications: Maxima and minima of functions of two variables and Lagrange's method of undetermined multipliers.

UNIT IV **INTEGRAL CALCULUS** **12**

Definite and Indefinite integrals – Substitution rule – Techniques of Integration: Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions – Improper integrals.

UNIT V **MULTIPLE INTEGRALS** **12**

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals.

TOTAL: 60 PERIODS

TEXT BOOKS:

1 S K Pundir, Bhupander Singh, "Differential Calculus", Pragathi Prakashan Publishers Pvt. Ltd., 2023.

2 B S Grewal, "Higher Engineering Mathematics", 45th Edition, Khanna Publishers, 2018.

REFERENCES:

1 R K Jain, S R K Iyengar, "Advanced Engineering Mathematics", 6th Edition, Narosa Publications, 2021.
2 Ravish R Singh, Mukul Bhatt, "Advanced Engineering Mathematics", 2nd Edition, Tata McGraw Hill, 2020.
3 H C Taneja, "Advanced Engineering Mathematics", Dreamtech Press, 2019.
4 T K V Iyengar, M V A A N Prasad, B Krishna Gandhi, "Engineering Mathematics", Special Edition, S. Chand & Company Ltd., 2023.

ONLINE RESOURCES :

1 http://nptel.ac.in/courses/111105035/10

2 http://nptel.ac.in/courses/111105035/5

3 http://nptel.ac.in/courses/111105035/17

COURSEOUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Apply Cayley-Hamilton theorem and orthogonal transformation for different process of matrices.
CO2 Analyze the differentiation rules to find the extreme values of functions.
CO3 Apply the concepts of partial derivatives and total derivatives in Taylor's series, Jacobians and maxima and minima of functions.
CO4 Evaluate definite and improper integrals using techniques of integration
CO5 Evaluate area and volume using double and triple integrals.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	-	-	-	-	-	-	-	-
CO2	3	3	1	2	-	-	-	-	-	-	-	-
CO3	3	2	1	2	-	-	-	-	-	-	-	-
CO4	3	3	2	3	-	-	-	1	-	-	-	1
CO5	3	3	2	3	-	-	-	1	-	-	-	1

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U23PH101	ENGINEERING PHYSICS (Common to all branches)	L	T	P	C
		3	0	0	3

Prerequisites: Fundamentals of Mechanics and Optics

COURSE OBJECTIVES:

- To enable the students effectively understand concepts of mechanics and elastic properties of materials.
- To gain knowledge about thermal physics, ultrasonics, lasers, optical fibres with applications.
- To introduce the basics of quantum mechanics, crystal structures and imperfections.

UNIT I **MECHANICS AND ELASTICITY** 9

Center of mass (CM) – Rotational kinematics – Moment of Inertia (M.I.) – Theorems of M.I.:parallel and perpendicular axes theorems – M.I. of continuous bodies – Conservation of angular momentum – Elasticity – Hooke's law – Stress-Strain diagram – Poisson's ratio – Factors affecting elasticity – Bending moment – Depression of a cantilever –Young's modulus by uniform bending – I-shaped girders.

UNIT II **THERMAL PHYSICS AND ULTRASONICS** 9

Modes of heat transfer – Thermal conductivity – Newton's law of cooling – Lee's disc method – Radial heat flow – Rubber tube method – Characteristics and Production of ultrasonics by magnetostriction and piezoelectric methods – Acoustic grating – Non-destructive testing – Medical applications: Sonogram.

UNIT III **LASERS AND FIBRE OPTICS** 9

Laser: characteristics and properties – Einstein's coefficients derivation – Population inversion –Types of lasers: Nd-YAG laser, CO_2 laser, semiconductor laser – Applications of lasers – Principle and propagation of light in optical fibres – Numerical aperture and Acceptance angle – Classification of optical fibres (material, refractive index, mode) – Optical-fibre communication system (Block diagram only).

UNIT IV **QUANTUM MECHANICS** 9

Black body radiation – Photons and light waves – Electrons and matter waves – Compton effect: Theory and experimental verification – The Schrodinger equation: Time dependent and time independent forms – Physical significance of wave function –Particle in an infinite potential well:1D – Electron microscopes: Scanning Electron Microscope and Transmission Electron Microscope.

UNIT V **CRYSTAL PHYSICS** 9

Lattice – Bravais lattice – Lattice planes – Miller indices – d-spacing in cubic lattice– Calculation of number of atoms per unit cell – Atomic radius – Coordination number – Packing factor for SC, BCC, FCC and HCP crystal structures – Crystal imperfections: point, line and surface defects.

TOTAL: 45 PERIODS

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TEXT BOOKS:

1 D. Kleppner, R Kolenkow, "An Introduction to Mechanics", Tata McGraw Hill, 2017.

2 Arthur Beiser, Shobhit Mahajan, S Rai Choudhury, "Concepts of Modern Physics", Tata McGraw Hill, 2017.

REFERENCES:

1 R. Wolfson, "Essential University Physics", Volume 1 & 2, 4th Edition, Pearson Education, 2020.

2 K Thyagarajan, A Ghatak, "Lasers: Fundamentals and Applications", 2nd Edition, Laxmi Publication, 2019.

3 P K Palanisamy, "Materials Science", Scitech Publication India Pvt. Ltd., 2015.

ONLINE RESOURCES:

1 https://www.coursera.org/courses?query=physics

2 https://archive.nptel.ac.in/courses/115/102/115102124/

3 https://onlinecourses.nptel.ac.in/noc24_ph17/preview

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Comprehend the basics of mechanics and elastic properties of materials.

CO2 Explain the thermal physics concepts, production and applications of ultrasonic waves.

CO3 Apply the basic concepts of lasers and optical fibre in various fields.

CO4 Describe the basics of quantum mechanical phenomenon and electron microscopes.

CO5 Explain the fundamentals of crystal structures and imperfections.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	-	-	-	-	-	-	-	-	-	-
CO2	2	2	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	1	1	1	-	-	-	1
CO4	2	2	-	-	-	-	-	-	-	-	-	-
CO5	2	2	-	-	-	-	-	-	-	-	-	-

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U23EG101	ENGINEERING GRAPHICS (Common to all branches)	L T P C 2 0 4 4

Prerequisites: Nil

COURSE OBJECTIVES:

- To prepare the students for drawing freehand sketch of simple objects and engineering curves.
- To prepare the students for drawing orthographic projection of solids, section of solids and development of lateral surfaces of various solids.
- To prepare the students for drawing pictorial projections like isometric and perspective projection of simple solids.

UNIT I **PLANE CURVES** **6+12**

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves.

UNIT II **PROJECTION OF POINTS, LINES AND PLANE SURFACES** **6+12**

Orthographic projection- principles – Principal planes – First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes – Determination of true lengths and true inclinations by rotating line method. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT III **PROJECTION OF SOLIDS AND FREE HAND SKETCHING** **6+12**

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes and parallel to the other by rotating object method. Visualization concepts and Free Hand sketching: Visualization principles – Representation of Three-Dimensional objects – Layout of views – Freehand sketching of multiple views from pictorial views of objects.

UNIT IV **SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES** **6+12**

Sectioning of simple solids in vertical position when the cutting plane is inclined to one of the principal planes and perpendicular to the other — obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids (without Cut out) — Prisms, pyramids cylinders and cones.

UNITV **ISOMETRIC AND PERSPECTIVE PROJECTIONS** **6+12**

Principles of isometric projection — isometric scale - isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method.

TOTAL: 90 PERIODS

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TEXT BOOKS:

1 Bhatt N D, Panchal V M, "Engineering Drawing", Charotar Publishing House, 54th Edition, 2023.
2 Natrajan K V, "A Text Book of Engineering Graphics", 36th Edition, Dhanalakshmi Publishers, 2023.

REFERENCES:

1 Gopalakrishna K R, "Engineering Drawing" (Vol. I&II Combined), Subhas Publications, 27th Edition, 2017.
2 Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International Private Limited, 2008.
3 Parthasarathy N S, Vela Murali, "Engineering Graphics", Oxford University Press, 2015.
4 Basant Agarwal and Agarwal C. M, "Engineering Drawing", Tata McGraw Hill, 2nd Edition, 2019.

ONLINE RESOURCES:

1 https://archive.nptel.ac.in/courses/112/102/112102304/
2 https://nptel.ac.in/courses/112103019
3 https://onlinecourses.nptel.ac.in/noc24_ar02/preview

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Draw the various curves used in engineering practices.
CO2 Draw the projections of straight lines which are inclined to both the planes.
CO3 Draw the projections of solids inclined to one plane and parallel to other plane.
CO4 Draw the projections of sectioned solids and draw the development of lateral surfaces of a solid.
CO5 Draw the isometric projections and perspective projections of simple solids.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	-	-	-	1	-	1	-	-
CO2	3	3	3	3	-	-	-	1	-	1	-	-
CO3	3	3	3	3	-	-	-	1	-	1	-	-
CO4	3	3	3	3	-	-	-	1	-	1	-	-
CO5	3	3	3	3	-	-	-	1	-	1	-	-

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U23CP101	PROGRAMMING IN C (Common to all Branches)	L T P C 3 0 2 4

Prerequisites: **Mathematical Fundamentals**

COURSE OBJECTIVES:

- To understand the basic construct of C Language and develop C programming of these construct.
- To develop C program using arrays, strings and modular applications using functions.
- To develop applications in C using pointers, structures and union.

UNIT I **BASICS OF C PROGRAMMING** **9**

Introduction to programming paradigms – Applications of C Language - Structure of C program – C programming: Data Types – Constants – Enumeration Constants – Keywords – Operators: Precedence and Associativity – Expressions – Input/ Output statements, Assignment statements. Illustrative Programs: Use of Variables in expression and their evaluation, Temperature Conversion (Fahrenheit to Celsius) Problem.

UNIT II **DECISION MAKING AND LOOPING** **9**

Simple if Statements, The if.else statements, Nesting of if...else statements, else...if Ladder, switch Statements, goto Statements, while, do...while, for Statements , Illustrative Problems: EB Bill Computations, Determination of Average Cost and the range of the values , and Square root of a Series , Student Grade System.

UNIT III **ARRAYS AND STRINGS** **9**

Introduction to Arrays: Declaration, Initialization – One dimensional array – Two dimensional arrays – String operations: length, compare, concatenate, copy – Selection sort, linear and binary search. Illustrative Programs: palindrome Checking using arrays and String, Concatenation of strings.

UNIT IV **FUNCTIONS AND POINTERS** **9**

Modular programming - Function prototype, function definition, function call, Built-in functions (string functions, math functions) – Recursion, Binary Search using recursive functions – Pointers – Pointer operators, Parameter passing: Pass by value, Pass by reference. Illustrative Program: Fibonacci Series, Towers of Hanoi.

UNIT V **STRUCTURES AND UNION** **9**

Structure - Nested structures – Array of structures – Self-referential structures – Dynamic memory allocation - Singly linked list – typedef – Union - Storage classes and Visibility. Illustrative Program: To Print name and address of Employee, Generate Student Mark List.

45 PERIODS

PRACTICAL EXERCISES:

1. I/O statements, operators, expressions.
2. Decision-making constructs: if-else, goto, switch-case, break-continue.
3. Loops: for, while, do-while
4. Arrays: 1D and 2D, multi-dimensional arrays, traversal.
5. Strings: operations.

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6. Functions and Pointers: Passing parameters by (value, reference), passing arrays to function, Recursion using pointers.
7. Structures and Unions: Nested Structures, Arrays of Structures and Unions

30 PERIODS
TOTAL: 75 PERIODS

TEXT BOOKS:

1 Reema Thareja, "Programming in C", Oxford University Press, 2nd Edition, 2018.

2 Brian W Kernighan, Dennis M Ritchie, "The C Programming language", 3rd Edition, Prentice Hall of India, 2019.

REFERENCES:

1 Paul Deitel, Harvey Deitel, "C How to Program with an Introduction to C++", 8th Edition, Pearson Education, 2018.

2 Yashwant Kanetkar, "Let us C", 17th Edition, BPB Publications, 2020.

3 Pradip Dey, Manas Ghosh, "Computer Fundamentals and Programming in C", 2nd Edition, Oxford University Press, 2013.

4 Anita Goel, Ajay Mittal, "Computer Fundamentals and Programming in C", 1st Edition, Pearson Education, 2016.

ONLINE RESOURCES:

1 https://onlinecourses.nptel.ac.in/noc22_cs40/preview

2 https://onlinecourses.swayam2.ac.in/cec24_cs05/preview

3 https://onlinecourses.swayam2.ac.in/nou24_cs06/preview

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Describe knowledge on C Programming constructs.

CO2 Apply the simple applications in C using decision making and looping.

CO3 Design the various applications using arrays and strings.

CO4 Write and implement modular applications in C using functions and Pointers.

CO5 Apply the User defined concept in C using Structures and Unions.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	-	-	1	1	1	-	1
CO2	3	3	3	3	-	-	-	1	1	1	-	1
CO3	3	3	3	3	-	-	-	1	1	1	-	1
CO4	3	3	3	3	1	-	-	1	1	1	-	1
CO5	3	3	3	3	1	-	-	1	1	1	-	1

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U23BE102 **BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING** L T P C

Prerequisites: 3 0 2 4

COURSE OBJECTIVES:

- To understand and gain the knowledge of Electric Circuits and Analysis.
- To understand and gain the knowledge Electrical Machines and its Applications.
- To understand and gain the knowledge of Analog Devices, Digital Electronics and Measuring Instruments.

UNIT I **ELECTRICAL CIRCUITS** 9

DC Circuits: Ohm's Law – Kirchhoff's Laws – Simple problems – Nodal Analysis, Mesh analysis with independent sources only, AC Circuits: Average value-RMS Value – Instantaneous power, real power, reactive power and apparent power – power factor.

UNIT II **ELECTRICAL MACHINES** 9

DC Generator: Construction and Working principle-EMF equation – Types – Applications. DC motor: Working Principle – Torque Equation-Types-Applications, Transformer: Construction – Working principle – Types – Applications, Induction motor: Construction and Working principle of Single phase and Three phase Induction motor – Types – Applications.

UNIT III **ANALOG ELECTRONICS** 9

Semiconductor Materials – Operation and Characteristics of PN Junction Diodes, Zener Diode, Bipolar Junction Transistors, JFET, MOSFET – Half wave and Full wave Rectifier circuits.

UNIT IV **DIGITAL ELECTRONICS** 9

Review of Number Systems – Representation of logic functions – SOP and POS forms- minimization using K maps (Simple Problems only) – Combinational logic circuits: Adder and Subtractor.

UNIT V **MEASUREMENTS AND INSTRUMENTATION** 9

Elements of a generalized measurement system – Static and Dynamic Characteristics – Classification of instruments – moving coil and moving iron meters – Dynamometer type watt meters – Induction type Energy meter – Measurement of Resistances using Megger- DSO.

45 PERIODS

PRACTICAL EXERCISES:

1. Verification of Ohm's Law and Kirchhoff's Laws.
2. OCC and Load Characteristics of Separately and Self excited DC shunt Generator
3. Load Test on DC Shunt motor and DC Series motor.
4. Load Test on 3 Phase Induction Motor.
5. VI Characteristics of PN Junction Diode and Zener Diode
6. Verification of Half and Full Wave Rectifier.
7. Measurement of Power and Power Factor.

30 PERIODS

TOTAL: 75 PERIODS

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TEXT BOOKS:

1 Kothari D P, I. J Nagrath, "Basic Electrical and Electronics Engineering", 2nd Edition, Tata McGraw Hill, 2020.
2 S K Bhattacharya "Basic Electrical and Electronics Engineering", 2nd Edition, Pearson Education, 2017.

REFERENCES:

1 Thomas L Floyd, "Digital Fundamentals", 11th Edition, Pearson Education, 2017.
2 Kothari D P, I J Nagrath, "Basic Electrical Engineering", 4th Edition, Tata McGraw Hill Education, 2019.
3 Sedha R S, "A textbook book of Applied Electronics", S. Chand & Co., 2017.

ONLINE RESOURCES:

1 https://nptel.ac.in/courses/108105112.
2 https://www.udemy.com/course/basic-electrical-engineering-electrical-engineering.
3 https://www.coursera.org/learn/electronics.

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Solve and verify the circuits using basic electrical laws and theorems.
CO2 Explain the working principle and gain practical knowledge of electrical machines.
CO3 Explain the characteristics and gain practical experience for Analog electronic devices.
CO4 Design and verification of Combinational Logic Circuits.
CO5 Comprehend the operating principles and implementation of measuring instruments.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	3	-	1	2	2	2	-	1
CO2	2	2	1	1	-	-	1	-	-	-	-	1
CO3	2	2	1	1	3	-	-	2	2	2	-	-
CO4	3	3	3	3	3	-	-	2	2	2	-	2
CO5	2	2	1	1	-	-	1	-	-	-	-	-

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U23TA101	தமிழர் மரபு	L	T	P	C
	(Common to all Branches)	1	0	0	1

நோக்கம்:

- பாரம்பரியக் கலாச்சாரத்தின் நுண்ணறிவையும் மற்றும் கட்டிடக்கலையின் அற்புதங்களில் நடைபெறும் பொறியியல் நுட்பங்களை எடுத்துரைப்பதாகும்.
- தமிழ்மொழி, பண்பாடு, கலைகள், மரபுகளின் வரலாற்றைப் பற்றி எடுத்துரைப்பதன் நோக்கமாகும்.
- அந்தணர்க்கும் அரசர்க்கும் கல்வியையும், வணிகர்களுக்கு வியாபாரத்தையும், வேளாண் மக்களுக்கு உழவுத்தொழிலையும் தமிழர் மரபின் எடுத்துரைப்பதாகும்.

அலகு – 1 **மொழி மற்றும் இலக்கியம்** 3

இந்திய மொழிக் குடும்பங்கள் - திராவிட மொழிகள் - தமிழ் ஒரு செம்மொழி - தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை - சங்க இலக்கியத்தில் பகிர்தல் அறம் - திருக்குறளில் மேலாண்மைக் கருத்துக்கள் - தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் - சிற்றிலக்கியங்கள் - தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி - தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு – 2 **மரபு - பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை - சிற்பக் கலை** 3

நடுகல் முதல் நவீன சிற்பங்கள் வரை - ஐம்பொன் சிலைகள் - பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் - தேர் செய்யும் கலை - சுடுமண் சிற்பங்கள் - நாட்டுப்புறத் தெய்வங்கள் - குமரிமுனையில் திருவள்ளுவர் சிலை - இசைக் கருவிகள் - மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் - தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு – 3 **நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்** 3

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

அலகு – 4 **தமிழர்களின் திணைக்கோட்பாடுகள்** 3

தமிழகத்தின் தாவரங்களும், விலங்குகளும் - தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் - தமிழர்கள் போற்றிய அறக்கோட்பாடு - சங்க காலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் - சங்ககால நகரங்களும் துறை முகங்களும் - சங்க காலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி - கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு – 5 **இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு** 3

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு - இந்தியாவின் பிறபகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் - சுய மரியாதை இயக்கம் - இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு - கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

TOTAL: 15 PERIODS

TEXT BOOKS:

1. முனைவர் ஆ. பூபாலன் "தமிழர் மரபு", வி.ஆர்.பி. வெளியீடு புதிய பாடத்திட்டம் 2023 – 24 அண்ணா பல்கலைக்கழகம்.

2. முனைவர் ஆ. ஹேமமாலினி "தமிழர் மரபு", வி.ஆர்.பி. வெளியீடு புதிய பாடத்திட்டம் 2023 – 24 அண்ணா பல்கலைக்கழகம்.

REFERENCES:

1. முனைவர் கே.கே. பிள்ளை "தமிழக வரலாறு, மக்களும், பண்பாடும்,", வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம், 1972.
2. முனைவர் இல. சுந்தரம், "பொருநை, ஆற்றங்கரை நாகரிகம்,", வெளியீடு: தொல்லியல் துறை மற்றும் தமிழ்நாடு அரசுத் துறை, 2022.
3. Dr. S. V. சுப்பிரமணியன், னுச.மு.னு. திருநாவுக்கரசு "தமிழர்களின் வரலாற்று பாரம்பரியம்", சர்வதேச தமிழ் ஆய்வு நிறுவனம், 2022.

ONLINE RESOURCES:

1. https://unacademy.com/lesson/introduction-and-administrative-system-of-cultural-heritage-of-tamil-in-tamil/ATMT6TK4
2. https://unacademy.com/lesson/society-and-sangam-literature-in-tamil/ C5QL4L0Q
3. https://unacademy.com/lesson/classical-tamil-literature-epigraphy-and-hero-stones-in-tamil/817FIREX

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 மொழிகள், இலக்கியங்கள் மற்றும் காப்பியங்கள் பற்றி தொகுக்க இயலும்.
Summarize about languages, literatures and scripts.

CO2 நடுகற்கள், நவீன சிற்பங்கள், ஐம்பொன் சிலைகள், மற்றும் இசைக் கருவிகள் பற்றி விளக்க இயலும்.
Explain middle stone, modern sculptures, panchaloga idols and musical instruments.

CO3 நாட்டுப்புறத் தெய்வங்கள், கலைகள் மற்றும் வீர விளையாட்டுகள் பற்றி விளக்க இயலும்.
Explain about the folk gods, arts and heroic sports.

CO4 தமிழர்களின் திணைக்கோட்பாடுகள் பற்றி தொகுக்க இயலும்.
Summarize the political theories of tamils.

CO5 இந்திய தேசிய இயக்கம், மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு பற்றி தொகுக்க இயலும்.
Summarize Indian national movement contribution of Tamils to Indian culture.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	-	-	-	-	-	-	-	-	-	-
CO2	1	-	-	-	-	-	-	-	-	-	-	-
CO3	1	-	-	-	-	-	-	-	-	-	-	-
CO4	1	-	-	-	-	-	-	-	-	-	-	-
CO5	1	-	-	-	-	-	-	-	-	-	-	-

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U23EP101	ENGINEERING PRACTICES LABORATORY (Common to all branches)	L	T	P	C
		0	0	3	1.5

Prerequisites: Nil

COURSE OBJECTIVES:

- Drawing pipeline plan; laying and connecting various pipe fittings used in common household plumbing work; Sawing; planning; making joints in wood materials used in common household woodwork.
- Welding various joints in steel plates using arc welding work; Machining various simple processes like turning, drilling, tapping In parts; Assembling simple mechanical assembly of common household equipment's; Making a tray out of metal sheet using sheet metal work.
- Wiring various electrical joints in common household electrical wire work. Soldering and testing simple electronic circuits; Assembling and testing simple electronic components on PCB.

GROUP – A (CIVIL & MECHANICAL)

PART I CIVIL ENGINEERING PRACTICES

I. PLUMBING WORK:

1. Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in household.
2. Preparing plumbing line sketches.
3. Laying pipe connection to the delivery side of a pump.
4. Connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

II. WOOD WORK:

1. Sawing,
2. Planing
3. Making joints like T-Joint Mortise joint, Tenon joint, and Dovetail joint.
4. Studying joints in door panels and wooden furniture.
5. Studying common industrial trusses using models.

PART II MECHANICAL ENGINEERING PRACTICES

I. WELDING WORK:

a) Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.
b) Practicing gas welding.

II. BASIC MACHINING WORK:

a) (Simple) Turning.
b) (Simple) Drilling.
c) (Simple) Tapping.

III. ASSEMBLY WORK:

a) Assembling a centrifugal pump.
b) Assembling a household mixer.
c) Assembling an air conditioner.

IV. SHEET METAL WORK:

a) Making of a square tray.

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V. FOUNDRY WORK:

a) Demonstrating basic foundry operations.

GROUP B (ELECTRICAL AND ELECTRONICS)

PART III ELECTRICAL ENGINEERING PRACTICES

a) Introduction to switches, fuses, indicators and lamps - Basic switch board wiring with lamp, fan and three pin socket.
b) Staircase wiring.
c) Fluorescent Lamp wiring with introduction to CFL and LED types.
d) Energy meter wiring and related calculations/ calibration.
e) Study of Iron Box wiring and assembly.
f) Study of Fan Regulator (Resistor type and Electronic type using Diac/ Triac/ quadrac).
g) Study of emergency lamp wiring/Water heater.

PART IV ELECTRONICS ENGINEERING PRACTICES

I. SOLDERING WORK:

a) Soldering simple electronic circuits and checking continuity.

ELECTRONIC ASSEMBLY AND TESTING WORK:

a) Assembling and testing electronic components on a small PCB.

II. ELECTRONIC EQUIPMENT STUDY:

a) Study an element of smart phone.
b) Assembly and dismantle of LED TV.
c) Assembly and dismantle of computer/ laptop.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Apply the basic concept of Plumbing and carpentry in various Residential buildings.
CO2 Apply the concept of arc welding in welding of steel plate.
CO3 Analyze the basics of machining operations and sheet metal works.
CO4 Apply the various electrical joints in common household electrical wire work.
CO5 Apply the basic concept of assemble and testing of simple electronic components on PCB.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	-	1	-	1	1	1	-	-
CO2	3	2	1	2	-	1	-	1	1	1	-	-
CO3	3	3	2	2	-	1	-	1	1	1	-	-
CO4	3	2	1	2	-	1	-	1	1	1	-	-
CO5	3	2	1	2	-	1	-	1	1	1	-	-

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U23EN102	PROFESSIONAL COMMUNICATION LABORATORY (Common to all branches)	L	T	P	C
		0	0	3	1.5

Prerequisites: Basic Communication Skills

COURSE OBJECTIVES:

- To enhance their employability and career prospects by equipping them with soft skills.
- To emphasize the importance of interview etiquette and prepare for job interviews.
- To cultivate a general awareness of current affairs to engage in a professional world.

UNIT I 9

Introduction to basic Communication Skills of learning – Listening – Empathetic Listening- Key role in Organizational communication; Speaking – role plays – asking about routine actions and expressing opinions.

UNIT II 9

Introduction to Soft Skills – Hard skills & soft skills - employability and career Skills – Grooming as a professional with values – Time Management – General awareness of Current Affairs.

UNIT III 9

Self-Introduction-organizing the material - Introducing oneself to the audience – introducing the topic – answering questions – individual presentation practice – presenting the visuals effectively – 5 minute presentations.

UNIT IV 9

Introduction to Group Discussion – Participating in group discussions – understanding group dynamics – brainstorming the topic – questioning and clarifying – GD strategies- activities to improve GD skills.

UNIT V 9

Interview etiquette – dress code – body language – attending job interviews – telephone/Skype interview -one to one interview & panel interview – FAQs related to job interviews.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Apply communication proficiency by mastering empathetic listening and speaking skills.

CO2 Apply soft skills fostering comprehensive competence.

CO3 Apply effective techniques to deliver presentations in all aspects.

CO4 Apply effective strategies for active participation in Group Discussion.

CO5 Apply interview etiquette to navigate various interview formats for Job Interviews.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	-	-	1	-	-	1	1	1	-	1
CO2	1	-	-	-	1	-	-	1	1	1	-	1
CO3	1	-	-	-	1	-	-	1	1	1	-	1
CO4	1	-	-	-	1	-	-	1	1	1	-	-
CO5	1	-	-	-	1	-	-	1	1	1	-	1

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U23EN201	TECHNICAL ENGLISH - II (Common to all branches)	L	T	P	C
		3	0	0	3

Prerequisites: Basics of Communication discourse

COURSE OBJECTIVES:

- To develop a high level of proficiency in the English language, encompassing LSRW skills to engage effectively.
- To equip students with a strong foundation in English grammar and vocabulary to understand technical texts.
- To foster critical thinking skills including the ability to evaluate texts critically.

UNIT I **GENERAL READING AND FREE WRITING** 9

Listening –Short texts (Listening to Audio & Video) Types of Listening – formal and informal conversations – Telephone conversation; Listening to voicemail & messages; **Speaking** – Basics in speaking – speaking on given topics & situations – recording speeches and strategies to improve; **Reading** – Critical Reading – finding key information in a given text – shifting facts from opinions; **Writing** – free writing on any given topic – autobiographical writing, developing hints, Note – Making; **Grammar** – Tenses; **Vocabulary Development** – Word Formation.

UNIT II **LISTENING AND SUMMATION** 9

Listening – Listening to podcasts / anecdotes / event narration, documentaries and interviews with celebrities; **Speaking** – Narrating personal experiences / events / Reporting and summarizing documentaries / podcasts / interviews; **Reading** – Reading biographies, travelogues, newspaper reports, Excerpts from literature and travel & technical blogs. **Writing** –Short Report on an event (field trip etc.) **Grammar** – Question types: Wh / Yes or No; **Vocabulary Development** – One word substitution.

UNIT III **SPEAKING AND ANALYSIS SKILLS** 9

Listening – Dialogues & Conversations, focused audio track – **Speaking** – Role Play – Asking about routine actions and Expressing Opinions – Group Interaction – Speaking in formal situations (teachers, officials, foreigners); **Reading** – Reading longer texts & Making a Critical Analysis of the given text; **Writing** – Types of Paragraphs and Essays – Rearrangement of Jumbled sentences; **Grammar** - Cause & Effect Expressions; **Vocabulary Development** – Synonyms & Antonyms.

UNIT IV **READING AND LANGUAGE PROGRESSION** 9

Listening – Listening to Dialogues or conversations and completing exercises based on them; **Speaking** – Speaking about one – speaking about one's friend; **Reading** – Comprehension, Reading Different Types of Texts – magazines; **Writing** – Letter Writing - formal or informal letters – E Mails – Conventions of personal email; **Grammar** – Discourse Markers (connectives & sequence words); **Vocabulary development** – Homonyms and Homophones.

UNIT V **COMPREHENSIVE WRITING** 9

Listening –Listening to Speeches / Presentations, Listening to broadcast and telecast from

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Radio and TV; **Speaking** – Participating in Conversations – short group conversations – Making presentations on given topics; **Reading** –Email communication – Reading the attachment files having a poem / joke / proverb; **Writing** – Creative writing, Poster making, dialogue writing; **Grammar** – Degrees of Comparison, Fixed / Semi-Fixed Expressions; **Vocabulary Development** Abbreviations & Acronyms (as used in technical contexts).

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Venkatraman G, "Effective Technical Communication" 1st Edition, Pearson Education, 2022.

2 Lakshminarayanan K R, "English for Communication", Scitech Publications, 2022.

REFERENCES:

1 Raman, Meenakshi, Sharma, Sangeetha, "Technical Communication Principles and Practice", Oxford University Press, New Delhi, 2015.

2 Sharma Sangeetha, Mishra Binod, "Communication Skills for Engineers and Scientists", 2nd Edition, Prentice Hall of India, 2023.

3 Ruchi Agarwal, "Academic Writing for Students: A Practical Guide", Eliva Press, 2024.

ONLINE RESOURCES:

1 https://onlinecourses.nptel.ac.in/noc22_hs05/preview
2 https://www.coursera.org/specializations/creative-writing
3 https://www.coursera.org/courses-writing

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Apply the concepts of writing in an effective way.

CO2 Write concise reports in a professional context.

CO3 Write different kinds of Paragraphs and Essays.

CO4 Write Email and formal / informal letters without grammatical errors.

CO5 Analyze collaborative work through writing process.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	3	-	3	-	1
CO2	3	-	-	-	-	-	-	3	-	3	-	1
CO3	3	-	-	-	-	-	-	3	-	3	-	1
CO4	3	-	-	-	-	-	-	3	-	3	-	1
CO5	3	-	-	-	-	-	-	3	-	3	-	1

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U23MA201	VECTOR CALCULUS AND COMPLEX FUNCTIONS (Common to all branches)	L	T	P	C
		3	1	0	4

Prerequisites: Engineering Mathematics

COURSE OBJECTIVES:

- To make the student acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems
- To make the students to understand the vector calculus such as divergence, curl needed, for problems in all engineering disciplines.
- To develop an understanding of the standard techniques of complex variable theory so as to enable the student to apply them with confidence, in application areas.

UNIT I DIFFERENTIAL EQUATIONS 12

Higher order linear differential equations with constant coefficients – Method of variation of parameters – Linear differential equation with variable coefficients – Euler's and Legendre's type – System of simultaneous linear differential equations with constant coefficients – Undetermined coefficients.

UNIT II BASICS OF VECTOR CALCULUS 12

Gradient and directional derivative – Divergence and curl – Vector identities – Irrotational and solenoidal vector fields – Work done by a force – Conservative force field.

UNIT III APPLICATIONS OF VECTOR CALCULUS 12

Line integral over a plane curve – Surface integral – Area of a curved surface – Volume integral – Green's, Gauss divergence and Stoke's theorems – Verification and application in evaluating line, surface and volume integrals.

UNIT IV ANALYTIC FUNCTIONS 12

Analytic functions – Necessary and sufficient conditions for analyticity in cartesian and polar coordinates – Properties – Harmonic conjugates – Construction of analytic function – Conformal mapping – Mapping by functions $(z + a, az, z^2, 1/z)$ – Bilinear transformation

UNIT V COMPLEX INTEGRATION 12

Line integral – Cauchy's integral theorem – Cauchy's integral formula – Taylor's and Laurent's series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semi – circular contour (without poles on real axis).

TOTAL: 60 PERIODS

TEXT BOOKS:

1 B S Grewal, "Higher Engineering Mathematics", Khanna Publishers, 45th Edition, 2020.

2 E. Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 10th Edition, 2020.

REFERENCES:

1 H K Dass, "Advanced Engineering Mathematics", S. Chand & Company Ltd., 20th Edition, 2019.
2 Ravish R Singh, Mukul Bhatt, "Advanced Engineering Mathematics", 2nd Edition, Tata McGraw Hill, 2020.
3 H C Taneja, "Advanced Engineering Mathematics", Dreamtech Press, 2019.
4 T K V Iyengar, M V A A N Prasad, B Krishna Gandhi, "Engineering Mathematics", Special Edition, S. Chand & Company Ltd., 2023.

ONLINE RESOURCES:

1 https://nptel.ac.in/courses/111105134
2 https://nptel.ac.in/courses/111107111
3 https://nptel.ac.in/courses/111103070

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Solve higher order differential equations of different types for engineering applications.

CO2 Explain the concepts of vector calculus.

CO3 Evaluate line, surface and volume integrals in various vector fields using Greens, Stokes and Gauss theorems.

CO4 Analyze the properties and mappings for constructing analytic functions.

CO5 Evaluate the complex and contour integral using Cauchy's theorem.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	-	-	-	1	-	-	-	-
CO2	3	2	1	1	-	-	-	1	-	-	-	-
CO3	3	3	2	3	-	-	-	1	-	-	-	-
CO4	3	3	2	2	-	-	-	1	-	-	-	-
CO5	3	3	2	3	-	-	-	1	-	-	-	-

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U23PH202	PHYSICS FOR MATERIAL TECHNOLOGY	L	T	P	C
Prerequisites:	**Engineering Physics**	3	0	0	3

COURSE OBJECTIVES:

- To gain knowledge and effectively understand the characteristics, and properties of the conductors and semiconductors
- To inculcate ideas about magnetic and superconducting materials
- To understand the properties of new engineering materials and acoustical phenomena and their importance in device applications

UNIT I **CONDUCTORS** **9**

Conductors – Classical free electron theory of metals – Electrical and thermal conductivity – Wiedemann-Franz law – Lorentz number – Success and failures of classical theory – Quantum theory – Fermi distribution function – Effect of temperature on Fermi Function – Density of energy states – Carrier concentration in metals – Theory of energy bands in solids.

UNIT II **SEMICONDUCTORS** **9**

Intrinsic semiconductor – Carrier concentration derivation – Fermi level – Variation of Fermi level with temperature – Compound semiconductors – Direct and indirect band gap – n–type and p–type semiconductor: derivation of carrier concentration – Variation of Fermi level with temperature and impurity concentration – Hall effect – Determination of Hall-coefficient – Experimental verification of Hall effect – Applications.

UNIT III **MAGNETIC MATERIALS AND SUPERCONDUCTORS** **9**

Origin of magnetic moment – Magnetic properties of Dia, Para, Ferro, anti-Ferro and ferrite materials – Domain theory – Hysteresis – Soft and Hard magnetic materials – Superconductivity: properties – Type I and Type II superconductors – BCS theory of superconductivity (Qualitative) – High temperature Superconductors – Applications of Superconductors: SQUID, Cryotron, Magnetic levitation.

UNIT IV **ACOUSTICS** **9**

Classification of Sound – Decibel – Weber – Fechner law – Sabine's formula –derivation using growth and decay method – Absorption Coefficient and its determination – Factors affecting acoustics of buildings and their remedies.

UNIT V **NEW ENGINEERING MATERIALS** **9**

Shape memory alloys (SMA): Characteristics, properties of NiTi alloy and application – Metallic glasses: properties, preparation and applications – Nanomaterial's: quantum structures: Q-dot, Q-wire, Q-well – Single electron phenomenon: Coulomb blockade effect – Single electron transistor – Carbon Nano tubes (CNT): properties and applications.

TOTAL: 45 PERIODS

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TEXT BOOKS:

1 Raghumani S, Ningthoujam, A K Tyagi, "Handbook of Materials Volume 1", Springer, 2024.
2 Malcom J Crocker, Jorge P Arenas, "Engineering Acoustics: Noise and Vibration Control", John Wiley & Sons, 2024.

REFERENCES:

1 Pallab Bhattacharya, "Semiconductor Optoelectronic Devices", Pearson Education, 2017.
2 Jerry H Ginsberg, "Acoustics – A Textbook for Engineers and Physicists Volume I: Fundamentals", ASA Press, Springer, 2018.

ONLINE RESOURCES:

1 https://onlinecourses.nptel.ac.in/noc24_ph05/preview
2 https://onlinecourses.nptel.ac.in/noc24_ph02/preview
3 https://onlinecourses.nptel.ac.in/noc21_ph14/preview

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the properties of conductors based on free electron theories.
CO2 Describe the concept of semiconductors Physics and its applications.
CO3 Summarize the classifications, properties and applications of magnetic and Superconducting materials.
CO4 Apply the acoustic phenomena related to the factors affecting the acoustics of buildings.
CO5 Explain the characteristics and applications of new engineering materials.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	-	-	-	-	-	-	-	-	-	-
CO2	2	2	-	-	-	-	-	-	-	-	-	1
CO3	2	2	-	-	-	-	-	-	-	-	-	-
CO4	3	2	1	1	-	1	1	-	-	-	-	1
CO5	2	2	-	-	-	1	1	-	-	-	-	1

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U23CY101	ENGINEERING CHEMISTRY (Common to all branches)	L	T	P	C
		3	0	0	3

Prerequisites: Fundamentals of Basic Chemistry

COURSE OBJECTIVES:

- To make the students conversant with water treatment techniques and the electrochemical reactions.
- To facilitate the understanding of fuel classification, preparation, combustion and environmental impact.
- To acquire a deep understanding of renewable energy sources and nano materials, their properties and applications.

UNIT I WATER AND ITS TREATMENT 9

Water: Sources and impurities, hardness, alkalinity. Boiler troubles: Scale and sludge. Treatment of boiler feed water: Internal treatment (sodium aluminate and calgon conditioning) and External treatment Ion exchange demineralization process, Municipal water treatment: primary treatment and disinfection (UV, Ozonation, break-point chlorination), Desalination of brackish water: Reverse Osmosis.

UNITII ELECTRO CHEMISTRY AND DEVICE CORROSION 9

Electrochemistry: Introduction, Electrochemical cells – electrolytic cell – reversible and irreversible cells. Electrode potential – Oxidation and reduction Potentials – emf, Nernst equation and applications. Reference electrodes – Calomel electrode – Electro chemical series – its applications.

Device Corrosion: Introduction- chemistry of IC and PCB – causes of corrosion on IC, PC-miniaturization and complex material utilization- forms of corrosion – anodic and cathodic corrosion-Prevention of corrosion.

UNITIII FUELS AND COMBUSTION 9

Fuels: Introduction: Classification of fuels; Coal and coke: Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method), Petroleum and Diesel: Manufacture of synthetic petrol (Bergius process), Knocking – octane number, diesel oil – cetane number; Power alcohol and biodiesel.

Combustion of Fuels: Introduction: Calorific value – higher and lower calorific values, Theoretical calculation of calorific value; Flue gas analysis – ORSAT Method. CO_2 emission and carbon foot print.

UNIT IV ENERGY SOURCES AND STORAGE DEVICES 9

Solar energy conversion: Principle, working and applications of solar cells; recent developments in solar cell materials. Wind energy; Geothermal energy. Hydrogen as fuel: Sources of hydrogen – Hydrogen production methods – electrolysis, limitations and applications.

Storage Devices: Batteries – Types of batteries, Primary battery – dry cell, Secondary battery – lead acid battery and lithium – ion battery; Electric vehicles working principles.

UNIT V NANO CHEMISTRY 9

Basics: Distinction between molecules, nanomaterials and bulk materials; Types of nanomaterials: Definition, properties and uses of nano particles and nanotube. Preparation

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of nano materials: laser ablation, chemical vapours deposition, electrochemical deposition and electro spinning. An application of nanomaterials in medicine, agriculture, energy, electronics and catalysis.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Jain P C, Monica Jain, "Engineering Chemistry", 17th Edition, Dhanpat Rai Publishing Company Pvt. Ltd., New Delhi, 2021.

2 Chatla Naga Babu, G Kanthimathi, "Text Book of Engineering Chemistry", 1st Edition, AG Publishing House, 2023.

REFERENCES:

1 Reza K Haghi, Fransico Torrens, "Engineering Technology and Industrial Chemistry with Applications", Apple Academic Press, 2021.

2 Anna Klinkova, "Nano Chemistry", 1st Edition, Springer. 2023.

3 Stroud N, "Fundamentals of Engineering Chemistry", American Academic Publishers, 2023.

ONLINE RESOURCES:

1 https://onlinecourses.nptel.ac.in/noc22_ch27/preview

2 https://nptel.ac.in/courses/105107207

3 https://onlinecourses.nptel.ac.in/noc19_mm21/preview

COURSEOUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Describe the type of factors present in boilers and the method used to treat hard water.

CO2 Apply the principles of electrochemistry to corrosion process and the applications of protective coatings to overcome the corrosion.

CO3 Summarize the various solid, liquid and gaseous fuels manufacturing methods and basic reactions involved in combustion reaction.

CO4 Describe the types of batteries their reactions and the significance of storage renewable energy resource.

CO5 Apply the basic concepts of nanomaterials and its application in various sectors.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	-	-	1	1	-	-	-	-	1
CO2	3	2	1	-	-	1	1	-	-	-	-	1
CO3	2	2	1	-	-	1	1	1	-	-	-	1
CO4	2	2	1	-	-	1	1	-	-	-	-	1
CO5	3	2	1	-	-	1	-	-	-	-	-	1

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U23PY201	PROBLEM SOLVING AND PYTHON PROGRAMMING (Common to all Branches)	L	T	P	C
		3	0	2	4

Prerequisites: Programming in C

COURSE OBJECTIVES:

- To understand the basics of algorithmic problem solving using Python conditionals and loops
- To define Python functions and use function calls to solve problems.
- To use Python data structures - lists, tuples, dictionaries to represent complex data and to input/output with files in Python.

UNIT I COMPUTATIONAL THINKING AND PROBLEM SOLVING **9**

Fundamentals of Computing – Identification of Computational Problems - Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion), Towers of Hanoi, insert a card in a list of sorted cards.

UNIT II DATA TYPES, EXPRESSIONS, STATEMENTS **9**

Python interpreter and interactive mode, debugging; values and types: int, float, Boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points,

UNIT III CONTROL FLOW, FUNCTIONS, STRINGS **9**

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, Strings: string slices, immutability, string functions and methods, Lists as arrays, linear search, binary search.

UNIT IV LISTS, TUPLES, DICTIONARIES **9**

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing; Illustrative programs: histogram, Retail bill preparation, sorting.

UNIT V FILES, MODULES, PACKAGES **9**

Files and exceptions: text files, reading and writing files, format operator; errors and exceptions, handling exceptions, modules, packages; Illustrative programs: GCD, setting offset in a file, wordcount, copyfile, voter's age, validation, marks range validation.

45 PERIODS

PRACTICAL EXERCISES:

1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same. (Electricity Billing, Retail shop billing)
2. Python programming using simple statements and expressions (exchange the values of two variables, compute Simple Interest).
3. Scientific problems using Conditionals and Iterative loops. (Prime factor of an Integer, Bin to Decimal, Octal and Hexa).
4. Implementing programs using Functions. (Factorial, largest number in alist).
5. Implementing programs using Strings. (Reverse, palindrome, character count, replacing characters).
6. Implementing operations of lists, tuples, and dictionaries.

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7a Implementing operations of file handling. (Copy from one file to another, word count).

7b Implementing real-time/technical applications using Exception handling. (Divide by zero error, voter's age validity, student mark range validation).

30 PERIODS

TOTAL: 75 PERIODS

TEXT BOOKS:

1 Allen B Downey, "Think Python: How to Think like a Computer Scientist", 2nd Edition, O'Reilly Publishers, 2016.

2 Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and Programming", 1st Edition, BCS Learning & Development Limited, 2017.

REFERENCES:

1 Paul Deitel, Harvey Deitel, "Python for Programmers", 1st Edition, Pearson Education, 2021.

2 G Venkatesh, Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021.

3 John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modelling and Understanding Data", 3rd Edition, MIT Press, 2021

4 Eric Matthes, "Python Crash Course, A Hands-on Project Based Introduction to Programming", 2nd Edition, No Starch Press, 2019.

5 Martin C Brown, "Python: The Complete Reference", 4th Edition, Tata McGraw Hill, 2018.

ONLINE RESOURCES

1 http://www.digimat.in/nptel/courses/video/106106212/L01.html

2 https://onlinecourses.swayam2.ac.in/cec24_cs03/preview

3 https://onlinecourses.swayam2.ac.in/cec24_cs01/preview

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Solve simple computational problems using notations.

CO2 Write python programs using statements and Expressions.

CO3 Apply control flow and functional concepts in a user define problems.

CO4 Apply python data structures - list, tuples and dictionaries for compound data.

CO5 Describe file handling and exceptional handling in python for solving problems.

CO – PO – PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	-	-	-	1	1	1	-	1
CO2	3	3	3	3	1	-	-	1	1	1	-	1
CO3	3	2	1	2	1	-	-	1	1	1	-	1
CO4	3	2	1	2	1	-	-	1	1	1	-	1
CO5	2	2	1	1	1	-	-	1	1	1	-	1

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U23ME201	ENGINEERING MECHANICS	L	T	P	C
Prerequisites:	**Engineering Physics**	3	0	0	3

COURSE OBJECTIVES:

- To learn the use of scalar and vector analytical techniques for analyzing forces in a statically determinate structure
- To introduce the equilibrium of rigid bodies, vector methods and free body diagram, friction and force
- To study and understand the distributed forces, surface, loading on beam and intensity, momentum, work and energy.

UNIT I **STATICS OF PARTICLES** **9**

Fundamental Concepts and Principles, Systems of Units, Method of Problem Solutions, Statics of Particles - Forces in a Plane, Resultant of Forces, Resolution of a Force into Components, Rectangular Components of a Force, Unit Vectors. Equilibrium of a Particle-Newton's First Law of Motion, Space and Free-Body Diagrams, Forces in Space, Equilibrium of a Particle in Space.

UNIT II **EQULIBRIUM OF RIGID BODIES** **9**

Principle of Transmissibility, Equivalent Forces, Vector Product of Two Vectors, Moment of a Force about a Point, Varignon's Theorem, Rectangular Components of the Moment of a Force, Scalar Product of Two Vectors, Mixed Triple Product of Three Vectors, Moment of a Force about an Axis, Couple - Moment of a Couple, Equivalent Couples, Addition of Couples, Resolution of a Given Force into a Force -Couple system, Further Reduction of a System of Forces, Equilibrium in Two and Three Dimensions - Reactions at Supports and Connections.

UNIT III **DISTRIBUTED FORCES** **9**

Centroids of lines and areas – symmetrical and unsymmetrical shapes, Determination of Centroids by Integration, Theorems of Pappus - Guldinus, Centre of Gravity of a Three-Dimensional Body, Centroid of a Volume, Composite Bodies, Moments of Inertia of Areas and Mass - Determination of the Moment of Inertia of an Area by Integration, Polar Moment of Inertia, Radius of Gyration of an Area, Parallel-Axis Theorem, Moments of Inertia of Composite Areas.

UNIT IV **FRICTION** **9**

The Laws of Dry Friction, Coefficients of Friction, Angles of Friction, Wedge friction, Wheel Friction, Rolling Resistance, Ladder friction.

UNIT V **DYNAMICS OF PARTICLES** **9**

Kinematics - Rectilinear Motion and Curvilinear Motion of Particles. Kinetics- Newton's Second Law of Motion-Equations of Motions, Dynamic Equilibrium, Energy and Momentum Methods - Work of a Force, Kinetic Energy of a Particle, Principle of Work and Energy, Principle of Impulse and Momentum, Impact of bodies.

TOTAL: 45 PERIODS

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TEXT BOOKS:

1 Beer Ferdinand P, Russel Johnston Jr., David F Mazurek, Philip J Cornwell, Sanjeev Sanghi, "Vector Mechanics for Engineers: Statics and Dynamics", Tata McGraw Hill, 12th Edition, 2019.

2 Vela Murali, "Engineering Mechanics-Statics and Dynamics", Oxford University Press, 2018.

REFERENCES:

1 Hibbeller, R C, "Engineering Mechanics: Statics, and Engineering Mechanics: Dynamics", 15th Edition, Prentice Hall of India, 2022.

2 Irving H. Shames, Krishna Mohana Rao G, "Engineering Mechanics – Statics and Dynamics", 4th New Edition, Pearson Education Asia Pvt. Ltd., 2016.

3 Meriam J L, Kraige L G, "Engineering Mechanics: Statics", John Wiley & Sons, 2017.

ONLINE RESOURCES:

1 https://archive.nptel.ac.in/courses/112/106/112106286/

2 https://www.youtube.com/watch?v=6nguX-cEsvw

3 https://www.youtube.com/watch?v=Z4WN2Z9okfs

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Summarize the scalar and vector analytical techniques for analyzing forces in statistically determinate structures.

CO2 Apply the concept of free body diagrams with scalar and vector approach to determine the equilibrium of rigid bodies.

CO3 Apply the concept of centroid, centre of gravity and moment of inertia to study the distributed forces on various beam structures.

CO4 Apply the principle of friction and apply the concept to various Engineering systems to determine the frictional forces.

CO5 Analyse the basic dynamic concepts to determine force, momentum, work and energy.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	-	-	-	-	-	-	2	1
CO2	3	2	1	2	-	-	-	-	-	-	-	-	2	1
CO3	3	2	1	2	-	-	-	-	-	-	-	-	2	1
CO4	3	2	1	2	-	-	-	-	-	-	-	-	2	1
CO5	3	3	2	2	-	-	-	-	-	-	-	-	2	1

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U23TA201	தமிழரும் தொழில்நுட்பமும்	L	T	P	C
	(Common to all Branches)	1	0	0	1

நோக்கம்:

- அறிவியல் மற்றும் பொறியியல் சார்ந்த அறிவுத்திறனைப் பெருக்குவதன் மூலம் உலக அளவில் அவர்களின் தரத்தை உயர்த்துவதன் நோக்கமாகும்.
- தமிழர் தொழில்நுட்பம் ஏனைய நாகரிகங்களுக்கு இணையான வளர்ச்சியைக் கொண்டதே இதன் நோக்கமாகும்.
- வேளாண்மை, கட்டிடக்கலை, இசைக்கருவிகள், கப்பற்கலை, போர்க்கலை என பல துறைகளில் தமிழர் தொழில்நுட்பத்தை சிறந்து விளங்குவதே நோக்கமாகும்.

அலகு – 1 **நெசவு மற்றும் பானைத் தொழில்நுட்பம்** 3

சங்க காலத்தில் நெசவுத் தொழில் - பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் - பாண்டங்களில் கீறில் குறியீடுகள்.

அலகு – 2 **வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்** 3

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு - சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் - சிலப்பதிகாரத்தில் மேடை வடிவமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும், கோவில்களும் - சோழர்காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் - நாயக்கர் காலக் கோவில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் - செட்டிநாட்டு வீடுகள் - பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ-சாரோசெனிக் கட்டிடக் கலை.

அலகு – 3 **உற்பத்தித் தொழில்நுட்பம்** 3

கப்பல் கட்டும் கலை - உலோகவியல் - இரும்புத் தொழிற்சாலை - இரும்பை உருக்குதல், எ.கு - வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் - நாணயங்கள் அச்சடித்தல் - மணி உருவாக்கும் தொழிற்சாலைகள் - கல்மணிகள், கண்ணாடி மணிகள் - சுடுமண் மணிகள் - சங்கு மணிகள் - எலும்புத்துண்டுகள் - தொல்லியல் சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

அலகு – 4 **வேளாண்மை மற்றும் நீர்பாசனத் தொழில்நுட்பம்** 3

அணை, - ஏரி, குளங்கள், மதகு - சோழர்காலக் குமிழித் தூம்பின் முக்கியத்துவம் - கால்நடை பராமரிப்பு - கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் - வேளாண்மை மற்றும் வேளாண்மை சார்ந்த செயல்பாடுகள் - கடல்சார் அறிவு - மீன்வளம் - முத்து மற்றும் முத்துக்குளித்தல் - பொருங்கடல் குறித்த பண்டைய அறிவு - அறிவு சார் சமூகம்.

அலகு – 5 **அறிவியல் தமிழ் மற்றும் கணித்தமிழ்** 3

அறிவியல் தமிழின் வளர்ச்சி - கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் - தமிழ் மென்பொருட்கள் உருவாக்கம் - தமிழ் இணையக் கல்விக்கழகம் - தமிழ் மின் நூலகம் - இணையத்தில் தமிழ் அகராதிகள் - சொற்குவைத் திட்டம்.

TOTAL: 15 PERIODS

TEXT BOOKS:

1. முனைவர் ஆ. பூபாலன் "தமிழரும் தொழில்நுட்பமும்" வி.ஆர்.பி. வெளியீடு புதிய பாடத்திட்டம் 2023 - 2024 அண்ணா பல்கலைக்கழகம்.
2. முனைவர் ஆ. ஹேமமாலினி "தமிழரும் தொழில்நுட்பமும்" வி.ஆர்.பி. வெளியீடு புதிய பாடத்திட்டம் 2023 - 2024 அண்ணா பல்கலைக்கழகம்.

REFERENCES:

1. முனைவர் கே. கே. பிள்ளை "தமிழக வரலாறு, மக்களும், பண்பாடும்," வெளியீடு:

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தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம், 1972.

2 முனைவர் இல. சுந்தரம், "பொருநை, ஆற்றங்கரை நாகரிகம்," வெளியீடு: தொல்லியல் துறை மற்றும் தமிழ்நாடு அரசுத் துறை, 2022.

3 Dr. S. V. சுப்பிரமணியன், ஐச.மு.ஐ. திருநாவுக்கரசு "தமிழர்களின் வரலாற்று பாரம்பரியம்", சர்வதேச தமிழ் ஆய்வு நிறுவனம், 2022.

ONLINE RESOURCES:

1 https://youtu.be/7qTXrUs02fs?si=SBBluhJu1i14o6yw

2 https://youtu.be/A0mxzo4f-s4?si=1C92FLv93BliZ2pn

3 https://youtu.be/Qia72HEV_uE?si=dp06r09Gi1SsKEyQ

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 தமிழின் தொன்மையான வரலாறு மற்றும் தொழில் நுட்பத்தை தொகுக்க இயலும்.
Summarize the ancient history and technology of Tamil.

CO2 சங்க கால வாழ்க்கை முறை மற்றும் கட்டிடக்கலை நுட்பங்களைப் பற்றி விளக்க இயலும்.
Explain the lifestyle and architectural techniques of the sangam period.

CO3 பண்டைய தமிழ் மக்களின் வணிக நடை முறைகள் மற்றும் நாணய பரிமாற்றம் பற்றி விளக்க இயலும்.
Explain the business practices and currency exchange of ancient Tamil people.

CO4 சங்க காலத்தில் வேளாண்மை மற்றும் நீர்பாசனத் தொழில்நுட்ப முறைகளைப் பற்றி தொகுக்க இயலும்.
Summarize the Agriculturen and Irrigation Technology in sangam period.

CO5 கணினி பயன்பாடுகளில், தமிழின் தொழில்நுட்ப வளர்ச்சியினைப் பற்றி விளக்க இயலும்.
Explain the computer applications in Tamil technological development.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	-	-	-	-	-	-	-	-	-	-
CO2	1	-	-	-	-	-	-	-	-	-	-	-
CO3	1	-	-	-	-	-	-	-	-	-	-	-
CO4	1	-	-	-	-	-	-	-	-	-	-	-
CO5	1	-	-	-	-	-	-	-	-	-	-	-

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U23PC101	PHYSICS AND CHEMISTRY LABORATORY	L	T	P	C
	(Common to all branches)	0	0	3	1.5

Prerequisites: Principles of Physics and Chemistry

COURSE OBJECTIVES:

- To provide an experimental foundation for the theoretical concepts introduced in the lectures.
- To teach how to make careful experimental observations and how to think about and draw conclusions from such data.
- To help students understand the role of direct observation in physics and chemistry to distinguish between inferences based on theory and the outcomes of experiments.

PHYSICS LABORATORY

LIST OF EXPERIMENTS (Any FIVE Experiments)

1. Determination of Young's modulus by Non uniform bending method.
2. Determination of Rigidity modulus of wire and moment of inertia using torsional pendulum.
3. Determination of Young's modulus by Simple harmonic oscillations of cantilever.
4. Determination of Wavelength of the Laser using grating.
5. Determination of Numerical aperture and acceptance angle in an optical fiber.
6. Determination of velocity of sound and compressibility of liquid –Ultrasonic Interferometer.
7. Determination of thickness of a thin sheet of wire–Air wedge.

CHEMISTRY LABORATORY

LIST OF EXPERIMENTS (Any FIVE Experiments)

1. Determination of total, temporary and permanent hardness of water by EDTA method.
2. Determination of chloride content of water sample by Argentometric method.
3. Determination of alkalinity in water sample.
4. Preparation of nanoparticles (TiO_2/ZnO/CuO) by Sol-Gel method.
5. Determination of strength of given hydrochloric acid using pH meter.
6. Conductometric titration of strong acid Vs strong base.
7. Conductometric titration of barium chloride Vs sodium sulphate.
8. Estimation of iron content of the given solution by using potentiometer.

TOTAL: 45 PERIODS

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COURSE OUTCOMES:

CO1 Calculate the Young's modulus by non-uniform bending, simple harmonic oscillations by Torsion Pendulum.

CO2 Calculate the thickness of a thin wire by air wedge and velocity of sound, compressibility of liquid using ultra sonic interferometer.

CO3 Calculate the wavelength, acceptance angle and numerical aperture using laser.

CO4 Estimate the amount of Hardness, chloride, alkalinity in water samples.

CO5 Estimate the amount of acid, iron content present in a given solution by using pH, conductivity and potentiometric titration.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	-	-	-	1	1	2	-	1
CO2	3	2	1	1	-	-	-	1	1	2	-	1
CO3	3	2	1	1	-	-	-	1	1	2	-	1
CO4	3	3	1	3	-	-	-	1	1	2	-	1
CO5	3	3	1	3	-	-	-	1	1	2	-	1

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U23ME202	COMPUTER AIDED MACHINE DRAWING LABORATORY	L	T	P	C
Prerequisites:	**Engineering Practices Laboratory**	0	0	3	1.5

COURSE OBJECTIVES:

- To acquaint the skills and practical experience in handling 2D drafting and 3D modelling software systems, standard drawing practices using fits and tolerances.
- To prepare assembly drawings both manually and using standard CAD packages.
- To Preparing standard drawing layout for modeled parts, assemblies with BoM.

PART I **DRAWING STANDARDS & FITS AND TOLERANCES** **15**

BIS specifications – Welding symbols, riveted joints, keys, fasteners – Reference tohand book for the selection of standard components like bolts, nuts, screws, keys etc. - Limits, Fits – Tolerancing of individual dimensions IS919- Specification of Fits– Preparation of production drawings and reading of part and assembly drawings, basic principles of Geometric Dimensioning & Tolerancing.

PART II **2D DRAFTING** **30**

LIST OF EXPERIMENTS

1. Drawing, Editing, Dimensioning, Layering, Hatching, Block, Array,Detailing, Detailed Drawing.
2. Bearings – Bush Bearing.
3. Valves – Safety and Non-return Valves.
4. Couplings – Flange, Oldham's, Muff, Gear couplings.
5. Joints – Universal, Knuckle, Gib& Cotter, Strap, Sleeve &Cotter joints.
6. Engine parts–Piston, Connecting Rod, Cross head (vertical and vertical).

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the standard drawing layout for modelled assemblies with BoM.
CO2 Explain the limits, fits, and tolerance and basics of machine components.
CO3 Create the bearings and valve parts and assemble the components.
CO4 Create the coupling and joints parts and assemble the components.
CO5 Create the engine parts and assemble the components.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	2	1	1	1	1	1	1	-	1	-	-	2	1
CO2	2	2	1	1	1	1	1	1	-	1	-	-	2	1
CO3	3	3	3	3	1	1	1	1	-	1	-	-	2	1
CO4	3	3	3	3	1	1	1	1	-	1	-	-	2	1
CO5	3	3	3	3	1	1	1	1	-	1	-	-	2	1

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U23MA301 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS **L T P C**
Pre requisites: Engineering Mathematics **3 1 0 4**

COURSE OBJECTIVES:

- To know the importance of partial differential equations in modelling various engineering problems.
- To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.
- To introduce the techniques of Fourier transform and Z – Transform to analyze continuous and discrete signals.

UNIT I **PARTIAL DIFFERENTIAL EQUATIONS** **12**

Formation of partial differential equations – Singular integrals – Solutions of standard types of first order partial differential equations – Lagrange's linear equation – Linear partial differential equations of second and higher order with constant coefficients of homogeneous type.

UNIT II **FOURIER SERIES** **12**

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Parseval's identity – Harmonic analysis.

UNIT III **APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS** **12**

Classification of PDE – Method of separation of variables – Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two-dimensional equation of heat conduction (excluding insulated edges).

UNIT IV **FOURIER TRANSFORMS** **12**

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT V **Z – TRANSFORMS AND DIFFERENCE EQUATIONS** **12**

Z– Transforms – Elementary properties – Inverse Z – transform (using partial fraction and residues) – Convolution theorem– Solution of difference equations using Z – transform.

TOTAL: 60 PERIODS

TEXT BOOKS:

1 Richard Haberman., "Applied Partial Differential Equations with Fourier Series and Boundary Value Problems", 5th Edition, Pearson Education, 2019.
2 B S Grewal, "Higher Engineering Mathematics", 45th Edition, Khanna Publishers, 2020.

REFERENCES:

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1 Macieg Borodzik, Pawel Goldstein., "Problems on Partial Differential Equations" Springer Cham, 2019.
2 J O Bird, "Higher Engineering Mathematics", 9th Edition, Routledge, Taylor & Francis Group, 2021.

ONLINE RESOURCES:

1 https://nptel.ac.in/courses/111/103/111103021/
2 https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/lecture-notes/
3 https://archive.nptel.ac.in/courses/111/101/111101153/

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Solve the various types of partial differential equations.
CO2 Solve differential equations using Fourier series.
CO3 Apply Fourier series techniques to solve one and two-dimensional heat flow and wave phenomena.
CO4 Solve the mathematical principles of Fourier transforms.
CO5 Apply Z-transform techniques in partial differential equations.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	1	-	-	-	1	-	1
CO2	3	2	1	1	-	-	-	1	-	-	-	1	1	-
CO3	3	2	1	1	-	-	-	1	-	-	-	1	1	1
CO4	3	2	1	1	-	-	-	1	-	-	-	1	1	-
CO5	3	2	1	1	-	-	-	1	-	-	-	1	1	1

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U23ME302 **ENGINEERING THERMODYNAMICS**

Pre-Requisites: Engineering Physics

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To learn the basics of thermodynamic systems, laws of thermodynamics and applications of the laws.
- To study the properties of pure substance, formation of steam and heat transfer in various processes.
- To understand the properties of gases, gas mixtures and various thermodynamic relations.

UNIT I **BASICS, ZEROTH AND FIRST LAW** **9**

Review of Basics – Thermodynamic systems, Properties and processes Thermodynamic Equilibrium - Displacement work - P-V diagram. Thermal equilibrium - Zeroth law – Concept of temperature and Temperature Scales. First law – application to closed and open systems – steady and unsteady flow processes

UNIT II **SECOND LAW AND ENTROPY** **9**

Heat Engine – Refrigerator - Heat pump. Statements of second law and their equivalence & corollaries. Carnot cycle - Reversed Carnot cycle - Performance - Clausius inequality. Concept of entropy - T-s diagram - Tds Equations - Entropy change for a pure substance.

UNIT III **AVAILABILITY AND APPLICATIONS OF SECOND LAW** **9**

Ideal gases undergoing different processes - principle of increase in entropy. Applications of second law. High and low-grade energy. Availability and Irreversibility for open and closed system processes - First and Second law Efficiency

UNIT IV **PROPERTIES OF PURE SUBSTANCES** **9**

Steam - formation and its thermodynamic properties - p-v, p-T, T-v, T-s, h-s diagrams. PVT surface. Determination of dryness fraction. Calculation of work done and heat transfer in nonflow and flow processes using Steam Table and Mollier Chart.

UNIT V **GAS MIXTURES AND THERMODYNAMIC RELATIONS** **9**

Properties of Ideal gas, real gas - comparison. Equations of state for ideal and real gases. vander Waal's relation - Reduced properties - Compressibility factor - Principle of Corresponding states - Generalized Compressibility Chart. Maxwell relations - TdS Equations - heat capacities relations - Energy equation, Joule Thomson experiment - Clausius-Clapeyron equation.

TOTAL: 45 PERIODS

TEXTBOOKS:

1 P K Nag "Engineering Thermodynamics", 6th Edition, Tata McGraw Hill, 2017.

2 Michael Boles, Yunus Cengel, Mehmet Kanoglu, "Thermodynamics an Engineering Approach", 9th Edition, Tata McGraw Hill, 2019.

REFERENCES:

1 V Babu, "Engineering Thermodynamics", 1st Edition, CRC Press, 2019.
2 R K Rajput," Engineering Thermodynamics", 5th Edition, Lakshmi Publications, 2016.
3 S K Gupta, "Engineering Thermodynamics", Revised Edition, S. Chand & Company, 2020.

ONLINE RESOURCES:

1 https://archive.nptel.ac.in/courses/112/106/112106310/
2 https://nptel.ac.in/courses/112105123
3 https://archive.nptel.ac.in/courses/101/104/101104063/

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Summarize the basics and applications of zeroth and first law of thermodynamics.
CO2 Apply the second law of thermodynamics to solve problems in various thermal system.
CO3 Apply the concept of availability and irreversibility for open and closed systems.
CO4 Describe the formation of steam and properties of pure substance.
CO5 Analyze the properties of gas mixtures and various thermodynamic relations.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	-	-	1	-	-	-	2	1
CO2	3	2	1	2	-	-	-	-	1	-	-	-	2	1
CO3	3	2	1	2	-	-	-	-	1	-	-	-	2	1
CO4	2	2	1	1	-	-	-	-	1	-	-	-	2	1
CO5	3	3	2	2	-	-	-	-	1	-	-	-	2	1

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U23ME303	FLUID MECHANICS AND MACHINERY	L	T	P	C
Prerequisites:	Engineering Mechanics	3	0	2	4

COURSE OBJECTIVES:

- To study the properties of fluids, measurement of pressure, types of flow and basic equations of motion.
- To understand the importance of dimensional analysis.
- To understand the importance of various types of flow in pumps and turbines.

UNIT I **INTRODUCTION** **9**

Units & Dimensions. Properties of fluids – Specific gravity, specific weight, viscosity, compressibility, vapour pressure and gas laws – capillarity and surface tension. Flow characteristics: concepts of system and control volume. Application of control volume to continuity equation, energy equation, momentum equation.

UNIT II **FLOW THROUGH CIRCULAR CONDUITS** **9**

Laminar flow through circular conduits and circular annuli, Boundary layer concepts, Boundary layer thickness. Hydraulic and energy gradient, Darcy – Weisbach equation, Friction factor and Moody diagram, Minor losses, Flow through pipes in series and in parallel.

UNIT III **DIMENSIONAL ANALYSIS** **9**

Dimension and units: Buckingham's π theorem, Discussion on dimensionless parameters, Models and similitude, Applications of dimensionless parameters.

UNIT IV **PUMPS** **9**

Classification of pumps – Centrifugal pumps – Working principle – Heads and efficiencies- Velocity triangles – Work done by the impeller – Performance curves – Reciprocating pump working principle – Indicator diagram and its variations – Work saved by fitting air vessels – Rotary pumps.

UNIT V **TURBINES** **9**

Impact of jets – Velocity triangles – Theory of roto dynamic machines – Classification of turbines – Working principles – Pelton wheel – Modern Francis turbine – Kaplan turbine – Work done – Efficiencies – Draft tube – Specific speed – Performance curves for turbines – Governing of turbines.

45 PERIODS

PRACTICAL EXCERCISES

1. Calibration of Flow Measuring instruments – venturimeter, orifice meter, rotameter.
2. Estimate the friction factor in flow through pipes.
3. Conduct experiments and draw the characteristic curves of centrifugal pump/submersible pump
4. Conduct experiments and draw the characteristic curves of reciprocating pumps.
5. Conduct experiments and draw the characteristic curves of Kaplan Turbine.

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6 Conduct experiments and draw the characteristic curves of the Pelton wheel.

7 Conduct experiments and draw the characteristics curves of Francis turbine.

30 PERIODS
TOTAL: 75 PERIODS

TEXT BOOKS:

1 R K Bansal, "Fluid Mechanics and Hydraulic Machines", 11th Edition, Laxmi Publication Pvt. Ltd., 2024.

2 K Subramanya, "Fluid mechanics and Hydraulic Machines Problems and Solutions", 2nd Edition, Tata McGraw Hill, 2018.

REFERENCES:

1 P N Modi, S M Seth, "Hydraulics and Fluid Mechanics including Hydraulic Machines", 23rd Edition, Rajsons Publications, 2022.

2 D S Kumar, "Fluid Mechanics and Fluid Power Engineering", S K Kataria & Sons, 2024.

3 R K Rajput, "A text book of Fluid Mechanics", S. Chand & Company Ltd., 2019.

ONLINE RESOURCES:

1 https://youtu.be/47bEFVyczLk

2 https://archive.nptel.ac.in/courses/112/105/112105269

3 https://archive.nptel.ac.in/courses/112/105/112105206

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Apply the fluid properties to measure flow characteristics.

CO2 Apply the concept of friction losses to determine the losses in pipes.

CO3 Analyse the importance of dimensional and model analysis.

CO4 Analyse the characteristics of different types of pumps.

CO5 Analyse the characteristics of different types of turbines.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	1	-	-	1	1	-	-	-	2	1
CO2	3	2	1	2	1	-	-	1	1	-	-	-	2	1
CO3	3	3	2	2	1	-	-	1	1	-	-	-	2	1
CO4	3	3	2	2	1	-	-	1	1	-	-	-	2	1
CO5	3	3	2	2	1	-	-	1	1	-	-	-	2	1

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U23ME304 ENGINEERING MATERIALS AND METALLURGY **L T P C**

Prerequisites: Engineering Chemistry **3 0 0 3**

COURSE OBJECTIVES:

- To impart knowledge on the structure, properties, treatment, testing of metals and non-metallic materials
- To acquire sound knowledge on the production, processing, characterization, structural properties and application of different engineering materials.
- To study the physical and chemical behaviour of metallic elements, inter metallic compounds and their alloys

UNIT I ALLOYS AND PHASE DIAGRAMS **9**

Constitution of alloys – Solid solutions, substitutional and interstitial – phase diagrams, Isomorphous, eutectic, eutectoid, peritectic, and peritectoid reactions, Iron – carbon equilibrium diagram. Classification of steel and cast-Iron, microstructure, properties and application.

UNIT II HEAT TREATMENT **9**

Definition – Full annealing, stress relief, recrystallisation and spheroidising – normalising, hardening and tempering of steel. Isothermal transformation diagrams – cooling curves superimposed on I.T. diagram CCR – Hardenability, Jominy end quench test – Aus tempering, martempering – case hardening, carburizing, Nitriding, cyaniding, carbonitriding – Flame and Induction hardening

UNIT III FERROUS AND NON-FERROUS METALS **9**

Effect of alloying additions on steel- α and β stabilisers– stainless and tool steels – HSLA, Maraging steels – Cast Iron – Grey, white, malleable, spheroidal – alloy cast irons, Copper and copper alloys – Brass, Bronze and Cupronickel – Aluminium and Al-Cu – Bearing alloys, Mg-alloys

UNIT IV NON-METALLIC MATERIALS **9**

Polymers – types of polymers – Properties and applications of various thermosetting and thermoplastic polymers (PP, PS, PVC, PMMA, PET, PC, PA, ABS, PI, PAI, PPO, PPS, Polymers – Urea and Phenol formaldehydes)- Engineering Ceramics – Properties and applications of Al_2O_3, SiC, Si_3N_4, PSZ and SIALON –Composites Classifications- Metal Matrix and FRP – Applications of Composites

UNIT V MECHANICAL PROPERTIES AND DEFORMATION MECHANISMS **9**

Mechanisms of plastic deformation, slip and twinning – Types of fracture – Testing of materials under tension, compression and shear loads – Hardness tests (Brinell, Vickers and Rockwell), Impact test, Izod and charpy tests, fatigue and creep failure mechanisms

TOTAL: 45 PERIODS

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TEXT BOOKS:

1 Avner S H, "Introduction to Physical Metallurgy", 2nd Edition, Tata McGraw Hill, 2017.
2 Williams D Callister, "Material Science and Engineering", Revised Indian Edition, John Wiley & Sons, 2020.

REFERENCES:

1 Gregory N. Haidemenopoulos, "Physical Metallurgy Principles and Design", CRC Press, 2018.
2 Ray H S, Ghosh A, "Principles of Extractive Metallurgy", New Age International Publishers, 2024.
3 William D Callister Jr., David G Rethwisch, "Callister's Materials Science and Engineering ", 10th Edition, John Wiley & Sons, 2020.

ONLINE RESOURCES:

1 https://archive.nptel.ac.in/courses/113/102/113102080/
2 https://archive.nptel.ac.in/courses/113/105/113105024/
3 https://archive.nptel.ac.in/courses/113/107/113107078/

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the alloys and phase diagram, Iron-Iron carbon diagram and steel classification.
CO2 Explain the isothermal transformation, continuous cooling diagrams and different heat treatment processes.
CO3 Summarize the effect of alloying elements on ferrous and non-ferrous metals.
CO4 Summarize the properties and applications of non-metallic materials.
CO5 Explain the mechanical properties and testing of materials

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	1	-	-	-	-	-	-	1	1
CO2	2	2	1	1	-	1	-	-	-	-	-	-	1	1
CO3	2	2	1	1	-	1	-	-	-	-	-	-	1	1
CO4	2	2	1	1	-	1	-	-	-	-	-	-	1	1
CO5	2	2	1	1	-	1	-	-	-	-	-	-	1	1

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U23ME305	MANUFACTURING TECHNOLOGY – I	L	T	P	C
Prerequisites: Nil		3	0	0	3

COURSE OBJECTIVES:

- To illustrate the working principles of various metal casting processes.
- To learn and apply the working principles of various metal joining processes.
- To analyze the working principles of bulk deformation of metals.

UNIT I **METAL CASTING PROCESSES** **9**

Sand Casting – Sand Mould – Type of patterns - Pattern Materials – Pattern allowances – moulding sand Properties and testing – Cores –Types and applications – moulding machines – Types and applications–Melting furnaces – Principle of special casting processes- Shell, investment – Ceramic mould – Pressure die casting – low pressure, gravity- Tilt pouring, high pressure die casting- Centrifugal Casting – CO_2 casting –-Defects in Sand casting process-remedies.

UNIT II **METAL JOINING PROCESSES** **9**

Fusion welding processes – Oxy fuel welding– Filler and Flux materials--Arc welding, Electrodes, Coating and specifications–Gas Tungsten arc welding–Gas metal arc welding-Submerged arc welding–Plasma arc welding––Resistance welding Processes-Electron beam welding–Laser beam Welding Friction welding – Friction stir welding – Diffusion welding – Thermit Welding, Weld defects –inspection & remedies–Brazing-soldering–Adhesive bonding.

UNIT III **BULK DEFORMATION PROCESSES** **9**

Hot working and cold working of metals–Forging processes–Open, impression and closed die forging–cold forging- Characteristics of the processes – Typical forging operations – rolling of metals – Types of Rolling–Flat strip rolling–shape rolling operations–Defects in rolled parts–Principle of rod and wire drawing–Tube drawing–Principles of Extrusion–Types–Hot and Cold extrusion. Introduction to shaping operations.

UNIT IV **SHEET METAL PROCESSES** **9**

Sheet metal characteristics–Typical shearing, bending and drawing operations–Stretch forming operations Formability of sheet metal–Test methods–special forming processes-Working principle and applications Hydroforming–Rubber pad forming–Metal spinning–Introduction of Explosive forming, magnetic pulse forming, peen forming, Super plastic forming–Micro forming–Incremental forming.

UNIT V **MANUFACTURE OF PLASTIC COMPONENTS** **9**

Types and characteristics of plastics – Moulding of thermoplastics & Thermosetting polymers– working principles and typical applications – injection moulding – Plunger and screw machines – Compression moulding, Transfer moulding–Typical industrial applications–introduction to blow moulding–Rotational moulding–Film blowing–Extrusion–Thermoforming–Bonding of Thermoplastics-duff moulding.

TOTAL: 45 PERIODS

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TEXT BOOKS:

1 Kalpakjian S, "Manufacturing Engineering and Technology", 7th Edition, Pearson Education, 2018.
2 P N Rao, "Manufacturing Technology Volume 1", 5th Edition, Tata McGraw Hill, 2018.

REFERENCES:

1 Rajender Singh, "Introduction to Basic Manufacturing Process & Workshop Technology", 3rd Edition, New Age International Publishers, 2023.
2 Rajput R K, "A Textbook of Manufacturing Technology: Manufacturing Processes", 3rd Edition, Laxmi Publications Pvt. Ltd., 2023.
3 Sharma P C, "A Textbook of Production Technology", S. Chand & Company Ltd., 2022.

ONLINE RESOURCES:

1. https://archive.nptel.ac.in/courses/112/107/112107083/
2. https://archive.nptel.ac.in/courses/112/107/112107213/
3. https://archive.nptel.ac.in/courses/112/107/112107145/

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the principle of different metal casting processes.

CO2 Describe the various metal joining processes.

CO3 Explain the different bulk deformation processes.

CO4 Apply the various sheet metal forming processes.

CO5 Explain suitable moulding techniques for manufacturing of plastics components.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	-	1	-	-	-	-	2	1
CO2	2	2	1	1	-	-	-	1	-	-	-	-	2	1
CO3	2	2	1	1	-	-	-	1	-	-	-	-	2	1
CO4	3	2	1	2	-	-	-	1	-	-	-	-	2	1
CO5	2	2	1	1	-	-	-	1	-	-	-	-	2	1

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U23MX01 **PERSONAL VALUES**

L	T	P	C
2	0	0	0

Prerequisites: Nil

COURSE OBJECTIVES:

- To understand the values through practical activities.
- To understand about physical and mental well-being.
- To know about meditation methods.

UNIT I **SELF CONCEPT** **6**

Understanding self-Concept – Identify Yourself – Who am I – an individual, Engineer, citizen – Attitude – Measuring Behaviour – Change of Behaviour – Personality – Characteristics in personal, professional life.

UNIT II **INDIVIDUAL VALUES** **6**

Personal Values – Attributes –Courage – Creativity, Honesty, Perfection, Simplicity, and Responsibility – Measuring personal values.

UNIT III **MORAL VALUES** **6**

Understanding self-Concept – Identify Yourself – Who am I – an individual, engineer, and citizen – Attitude – Measuring Behaviour – Change of Behaviour – Personality – Characteristics in personal, professional life. Personal Values – Attributes –Courage – Creativity, Honesty, Perfection, Simplicity, Responsibility – Measuring personal values
Moral – Understanding right and wrong – Positive thoughts – Respect to others – Doing good to society.

UNIT IV **PHYSICAL AND MENTAL WELL-BEING** **6**

Health – Physical fitness –Mental vigour – Diet management – Yoga – Meditation – Peaceful life – Happiness in life Goal Setting – Decision making skill – Overcome of Barriers – Success – Mental strength and weakness.

UNIT V **DECISION MAKING** **6**

Goal Setting – Decision making skill – Overcome of Barriers – Success – Mental strength and weakness.

TOTAL: 30 PERIODS

REFERENCES:

1 Barun K. Mitra, "Personality Development and Soft Skills", Oxford University Press, 2016.
2 B. N. Ghosh, "Managing Soft Skills for Personality Development", Tata McGraw Hill, 2012.

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Become an individual in knowing the self.

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CO2 Acquire and express Personal Values, Spiritual values and fitness.

CO3 Practice simple physical exercise and breathing techniques.

CO4 Practice Yoga asana which will enhance the quality of life.

CO5 Practice Meditation and get benefitted.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	1	-	-	-	1
CO2	-	-	-	-	-	-	-	1	-	-	-	1
CO3	-	-	-	-	-	-	-	1	-	-	-	1
CO4	-	-	-	-	-	-	-	1	-	-	-	1
CO5	-	-	-	-	-	-	-	1	-	-	-	1

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U23ME306 **MANUFACTURING TECHNOLOGY LABORATORY** **L T P C**

Prerequisites: Engineering Practices Laboratory **0 0 3 1.5**

COURSE OBJECTIVES:

- Selecting appropriate tools, equipment and machines to complete a given job.
- To Perform various welding processes using GMAW and fabricating gears using gear making machines.
- To Perform various machining processes such as rolling, drawing, turning, shaping, drilling, milling and analyzing the defects after machining

LIST OF EXPERIMENTS

1. Fabricating simple structural shapes using Gas Metal Arc Welding machines.
2. Preparing green sand moulds with cast patterns.
3. Taper Turning and Eccentric Turning on circular parts using a lathe machine.
4. Knurling, external and internal thread cutting on circular parts using a lathe machine.
5. Shaping–Square and Hexagonal Heads on circular parts using a shaper machine.
6. Drilling and Reaming using a vertical drilling machine.
7. Milling contours on plates using a vertical milling machine.
8. Cutting spur and helical gear using a milling machine.
9. Generating gears using a gear hobbing machine.
10. Grinding components using cylindrical and centreless grinding machines.
11. Grinding components using a surface grinding machine.
12. Cutting force calculation using dynamometer in lathe machine.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Apply the fabricating methods by welding and green sand moulding

CO2 Apply the machining processes on the work piece in rolling, drawing, turning, shaping, drilling and milling.

CO3 Apply the gear making methods in milling and hobbing machines

CO4 Apply the Grinding process using various grinding machines

CO5 Analyze the cutting forces using dynamometer in lathe and milling machine.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1	-	-	-	1	1	-	-	-	2	1
CO2	3	3	2	1	-	-	-	1	1	-	-	-	2	1
CO3	3	3	2	1	-	-	-	1	1	-	-	-	2	1
CO4	3	3	2	1	-	-	-	1	1	-	-	-	2	1
CO5	3	3	2	2	-	-	-	1	1	-	-	-	2	1

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U23EEC301	EMPLOYABILITY SKILLS – I	L	T	P	C
Prerequisites: Nil		0	0	2	1

COURSE OBJECTIVES:

- To educate and enrich the students on quantitative aptitude, logical reasoning and written communication.

UNIT I **QUANTITATIVE APTITUDE – PART 1** **6**

Numbers: Number system – Squaring of Numbers – Square Roots – Cube Roots – Divisibility – HCF, LCM – Decimals – Clocks.

UNIT II **QUANTITATIVE APTITUDE – PART 2** **6**

Averages – problem on Ages – Ratio & Proportion – Mixture and Allegations.

UNIT III **LOGICAL REASONING – PART – 1** **6**

Alphabet Test Series – Number Test Series– Analogies – Odd Words – Statement & Conclusions – Blood Relations – Odd man out.

UNIT IV **EFFECTIVE ENGLISH – SPOKEN ENGLISH** **6**

Basic Rules of Grammar – Parts of Speech – Tenses – Verbs – Sentences construction – Vocabulary – idioms & phrases – Synonyms – Antonyms – Dialogues and conversation – Exercise (Speaking).

UNIT V **WRITTEN COMMUNICATION – PART 1** **6**

Usage of noun, pronoun, adjective (Comparative Forms), Verb, Adjectives, Adverb, Tenses, Articles and Preposition – Change of Voice – Change of Speech.

TOTAL: 30 PERIODS

TEXT BOOKS:

1 R S Aggarwal, "Quantitative Aptitude", Revised Edition, S Chand & Co Ltd., 2017.

2 R S Aggarwal, "A Modern Approach to Verbal and Non-verbal Reasoning", S Chand & Co Ltd., 2018.

REFERENCES:

1 Abhijit Guha, "Quantitative Aptitude", 3rd Edition, Tata McGraw Hill, 2009.

2 Raj N Bakshmi, "English Grammar Practice," 1st Edition, Orient Black Swan, 2009.

3 M Ashra Rizvi, "Effective Technical Communication," 2nd Edition, Tata McGraw Hill, 2017.

4 Norman Lewis, "Word Power Made Easy", W.R. Goyal Publishers, 2020.

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U23ME401	THEORY OF MACHINES	L	T	P	C
Prerequisites:	**Engineering Mechanics**	3	0	0	3

COURSE OBJECTIVES:

- Impart knowledge on various types of links, mechanisms, velocity and acceleration of those mechanisms.
- Study about Friction drives, clutches, brakes, gears, gear trains, gyroscopes and their effects on vehicles.
- To understand the principles of static and dynamic balancing, frequency of free, forced and torsional vibrations.

UNIT I **KINEMATICS OF MECHANISMS** **9**

Mechanisms – Terminology and definitions – kinematics inversions of 4 bar and slider crank chain – kinematics analysis in simple mechanisms – velocity and acceleration polygons – graphical approach – cams – classifications – displacement diagrams - layout of cam profiles.

UNITII **GEARS AND GEAR TRAINS** **9**

Spur gear – law of toothed gearing – involute gearing – Interchangeable gears – Gear tooth action interference and undercutting – gear trains – parallel axis gears trains – epicyclical gear trains

UNITIII **GYROSCOPES AND GOVERNORS** **9**

Gyroscopes, effect of precession motion on the stability of moving vehicles such as, aero planes and motor car. Governors - Introduction, Watt Governor, Porter Governor and Proell Governor.

UNIT IV **FRICTION AND FRICTION DRIVES** **9**

Introduction to friction, Laws of friction, Coefficient of friction, Inclined plane, Pivot and Collars, Friction clutches-centrifugal clutch. Brakes: Types of brakes Block and Shoe brakes, Internal expanding shoe brake.

UNITV **BALANCING AND VIBRATIONS** **9**

Static and Dynamic balancing – Balancing of revolving and reciprocating masses – Balancing machines – free vibrations – Equations of motion – natural Frequency – Damped Vibration – Critical speed of simple shaft – Torsional vibration – Forced Vibration – Vibration isolation.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Rattan S S, "Theory of Machines", 4th Edition, Tata McGrawHill, 2019.

2 Bansal R K, Brar J S, "A text book of Theory of Machines", 5th Edition, Laxmi Publications, 2023.

REFERENCES:

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1 Rao J S, "The Theory of Machines Through Solved Problems", 2nd Edition, New Age International Publishers, 2023.
2 Khurmi R S, "Theory of Machines", S Chand Publications, 2020.
3 Mehta, J.S., Kailey, A.S. "Mechanical Vibrations", 2nd Edition, S. Chand & Company Ltd., 2018.

ONLINE RESOURCES:

1 https://nptel.ac.in/courses/112104114/
2 https://archive.nptel.ac.in/courses/112/104/112104121/
3 https://archive.nptel.ac.in/courses/112/106/112106270/

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the basic concepts of kinematics and working principle of simple mechanisms
CO2 Analyse the mechanisms of toothed gearing and the velocity ratio in different gear trains.
CO3 Apply the fluctuation effects in governors and the effects of gyroscopic couple in automobile, aeroplane and ship applications.
CO4 Apply the concept of friction in different friction drives like bearings, brakes and clutches.
CO5 Apply and solve the impact of balancing and vibrations in the design of mechanical systems.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	-	1	-	1	-	-	2	1
CO2	3	3	2	2	-	-	-	1	-	1	-	-	2	1
CO3	3	2	1	2	-	-	-	1	-	1	-	-	2	1
CO4	3	2	1	2	-	-	-	1	-	1	-	-	2	1
CO5	3	2	1	2	-	-	-	1	-	1	-	-	2	1

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U23ME402	THERMAL ENGINEERING – I	L	T	P	C
Prerequisites:	**Engineering Thermodynamics**	3	0	0	3

COURSE OBJECTIVES:

- To understand the basic principles and types of steam nozzles and steam turbines
- To acquire the concept of utilising residual heat in thermal systems using cogeneration principle
- To study the thermodynamic concepts for Boilers, Refrigeration & Air conditioning Systems

UNIT I **STEAM NOZZLES** **9**

Types and Shapes of nozzles, Flow of steam through nozzles, Critical pressure ratio, Variation of mass flow rate with pressure ratio. Effect of friction. Metastable flow.

UNIT II **STEAM TURBINES** **9**

Types, Impulse and reaction principles, Velocity diagrams, Work done and efficiency – optimal operating conditions. Multi-staging, compounding and governing.

UNIT III **COGENERATION AND RESIDUAL HEAT RECOVERY** **9**

Cogeneration Principles, Cycle Analysis, Applications, Source and utilisation of residual heat. Heat pipes, Heat pumps, Recuperative and Regenerative heat exchangers. Economic Aspects.

UNIT IV **BOILERS** **9**

Types and comparison. Mountings and Accessories. Fuels - Solid, Liquid and Gas. Performance calculations, Boiler trial.

UNIT V **REFRIGERATION AND AIR – CONDITIONING** **9**

Vapour compression refrigeration cycle, Effect of Superheat and Sub-cooling, Performance calculations, Working principle of air cycle, vapour absorption system, and Thermoelectric refrigeration. Air conditioning systems, concept of RSHF, GSHF and ESHF, Cooling load calculations. Cooling towers – concept and types.

TOTAL: 45 PERIODS

TEXTBOOKS:

1. Rajput R K, "Thermal Engineering", 11th Edition Laxmi Publications, 2020.
2. Sadhu Singh, Sukumar Pati "Thermal Engineering", 1st Edition, Pearson Education, 2018.

REFERENCES:

1. J Selwin Rajadurai, "Thermodynamics and Thermal Engineering ", 1st Edition, New Age International Pvt. Ltd, 2018.
2. V K Jain, "Refrigeration & Air-conditioning", 1st Edition, Laxmi Publications, 2023.
3. David Borge-Diez, Enrique Rosales-Asensio, "Heat Energy Recovery for Industrial Processes and Wastes", 1st Edition, Springer International, 2023.

ONLINE RESOURCES:

1 https://youtu.be/AXcb3TBLETY?si=0AOeDlSHaeDaHBJk

2 https://youtu.be/-cr5vfV4YAI?si=41MO89JXZnEAZRLf

3 https://archive.nptel.ac.in/courses/112/107/112107208/

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the concept of steam nozzles, their types, effect of friction and critical pressure ratio.

CO2 Apply the velocity diagrams for steam turbines to determine the work done and their efficiency.

CO3 Apply the concept of residual heat recovery principle for Cogeneration and regenerative heat exchangers.

CO4 Explain the functioning and features of different types of Boilers and their accessories and to calculate the performance parameters.

CO5 Apply the vapour compression and absorption principles to refrigeration and air conditioning.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	-	-	-	1	-	-	-	-	2	1
CO2	3	2	1	2	-	-	-	1	-	-	-	-	2	1
CO3	3	2	1	2	-	-	-	1	-	-	-	-	2	1
CO4	2	1	1	1	-	-	-	1	-	-	-	-	2	1
CO5	3	2	1	2	-	-	-	1	-	-	-	-	2	1

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U23ME403	HYDRAULICS AND PNEUMATICS	L	T	P	C
Prerequisites:	Fluid Mechanics and Machinery	3	0	0	3

COURSE OBJECTIVES:

- To provide students with knowledge on the application of fluid power in process, construction and manufacturing Industries.
- To provide students with an understanding of the fluids and components utilized in modern industrial fluid power systems.
- To develop a measurable degree of competence in the design, construction and operation of fluid power circuits.

UNIT I FLUID POWER PRINCIPLES AND HYDRAULIC PUMPS 9

Introduction to Fluid power – Advantages and Applications – Fluid power systems – Types of fluids – Properties of fluids and selection – Basics of Hydraulics — Pascals Law – Principles of flow – Friction loss – Work, Power and Torque Problems, Sources of Hydraulic power: Pumping Theory – Pump Classification – Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criteria of Linear and Rotary – Fixed and Variable displacement pumps – Problems.

UNITII HYDRAULIC ACTUATORS AND CONTROL COMPONENTS 9

Hydraulic Actuators: Cylinders – Types and construction, Application, Hydraulic cushioning – Hydraulic motors – Control Components: Direction Control, Flow control and pressure control valves – Types, Construction and Operation – Servo and Proportional valves – Applications – Accessories: Reservoirs, Pressure Switches – Applications – Fluid Power ANSI Symbols – Problems.

UNIT III HYDRAULIC CIRCUITS AND SYSTEMS 9

Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double – Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Hydrostatic transmission, Electro hydraulic circuits, Mechanical hydraulic servo systems.

UNIT IV PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS 9

Properties of air – Perfect Gas Laws – Compressor – Filters, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit – Cascade method – Electro Pneumatic System – Elements – Ladder diagram – Problems, Introduction to fluidics and pneumatic logic circuits.

UNITV TROUBLESHOOTING AND APPLICATIONS 9

Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems, Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift applications. Design of Pneumatic circuits for Pick and Place applications and tool handling in CNC Machine tools – Low-cost Automation – Hydraulic and Pneumatic power packs.

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TOTAL: 45 PERIODS

TEXT BOOKS:

1 Patel Prakash R, "Oil Hydraulics and Pneumatics", Shashwat Publication, 2023.
2 Majumdar S R, "Oil Hydraulics Systems – Principles and Maintenance", Tata McGraw Hill, 2017.

REFERENCES:

1 Jagadeesha T, "Pneumatics Concepts, Design and Applications ", Universities Press, 2020.
2 Srinivasan R, "Hydraulic and Pneumatic Controls", 3rd Edition, Vijay Nicole Imprints, 2019.
3 Ilango Sivaraman, "Introduction to Hydraulics and Pneumatics", 3rd Edition, Prentice Hall India, 2017.

ONLINE RESOURCES:

1 https://nptel.ac.in/courses/112106300
2 https://youtu.be/zLdfD5j3I1g
3 https://archive.nptel.ac.in/courses/112/105/112105047/

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the Fluid power and operation of different types of pumps.
CO2 Summarize the features and functions of Hydraulic motors, actuators and Flow control valves.
CO3 Explain the different types of Hydraulic circuits and systems.
CO4 Explain the working of different pneumatic circuits and systems.
CO5 Analyze the methods of various troubleshooting systems.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	-	1	-	-	-	-	2	1
CO2	2	2	1	1	-	-	-	1	-	-	-	-	2	1
CO3	2	2	1	1	-	-	-	1	-	-	-	-	2	1
CO4	2	2	1	1	-	-	-	1	-	-	-	-	2	1
CO5	3	3	2	1	-	-	-	1	-	-	-	-	2	1

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U23ME404	MANUFACTURING TECHNOLOGY – II	L	T	P	C
Prerequisites:	**Manufacturing Technology – I**	3	0	0	3

COURSE OBJECTIVES:

- To study the concepts and basic mechanics of metal cuts and the factors affecting machinability.
- To learn the working principle of special machines and abrasive finishing processes
- To gain the knowledge in recent trends in manufacturing

UNIT I **MECHANICS OF METAL CUTTING** **9**

Mechanics of chip formation, forces in machining, Types of chip, cutting tools – single point cutting tool nomenclature, orthogonal and oblique metal cutting, thermal aspects, cutting tool materials, tool wear, tool life, surface finish, cutting fluids and Machinability.

UNIT II **TURNING MACHINES** **9**

Centre lathe, constructional features, specification, operations – taper turning methods, thread cutting methods, special attachments, surface roughness in turning, machining time and power estimation. Special lathes –Capstan and turret lathes-tool layout–automatic lathes: semi-automatic–single spindle: Swiss type, automatic screw type–multi spindle.

UNIT III **SHAPER, MILLING AND GEAR CUTTING MACHINES** **9**

Shaper - Types of operations. Drilling, reaming, boring, Tapping. Milling operations – types of milling cutter. Gear cutting – forming and generation principle and construction of gear milling, hobbing and gear shaping processes – finishing of gears.

UNIT IV **ABRASIVE PROCESS AND BROACHING** **9**

Abrasive processes: grinding wheel – specifications and selection, types of grinding process–cylindrical grinding, surface grinding, centre-less grinding and internal grinding-Typical applications – concepts of surface integrity, broaching machines: broach construction – push, pull, surface and continuous broaching machines.

UNIT V **RECENT TRENDS IN MANUFACTURING** **9**

Overview – Need – Development of Additive Manufacturing Technology -Principle – AM Process Chain- Classification -Rapid Prototyping- Rapid Tooling – Rapid Manufacturing – Applications- Benefits -Case studies.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Kalpakjian S, "Manufacturing Engineering and Technology", 7th edition, Pearson Education, 2018.

2 Rao P N, "Manufacturing Technology, Volume – I" 5th Edition, Tata McGraw Hill, 2020.

REFERENCES:

1 P C Sharma, "Manufacturing Technology – II", S. Chand & Company Ltd., 2022.
2 A B Chattopadhyay, "Machining and Machine Tools", 2nd Edition, John Wiley & Sons, 2017.
3 Sridhar S, Natesh C P, "Introduction to Additive Manufacturing", 1st Edition, InSc International Publisher, 2020.

ONLINE RESOURCES:

1 https://nptel.ac.in/courses/112105126
2 https://nptel.ac.in/courses/112105306
3 https://archive.nptel.ac.in/courses/112/104/112104265/

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the mechanism of metal removal process and to identify the factors involved in improving machinability.
CO2 Describe the constructional and operational features of centre lathe and other special purpose lathes.
CO3 Describe the constructional and operational features of reciprocating machine tools.
CO4 Describe the conceptual elements and basic concepts of broaching and abrasive procedures.
CO5 Describe the technical and building aspects of additive manufacturing.

CO PO – MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	1	-	1	-	-	-	-	1	1
CO2	2	2	1	1	-	1	-	1	-	-	-	-	1	1
CO3	2	2	1	1	-	1	-	1	-	-	-	-	1	1
CO4	2	2	1	1	-	1	-	1	-	-	-	-	1	1
CO5	2	2	1	1	-	1	-	1	-	-	-	-	1	1

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U23ME405	STRENGTH OF MATERIALS	L	T	P	C
Pre requisites:	**Engineering Mechanics**	3	0	0	3

COURSE OBJECTIVES:

- To understand the nature of stress developed in bars, beams, cylinders and spheres for various types of loads.
- To Estimate the load carrying capacity of columns, stresses, due to bending and failure of material.
- Calculate the component dimensions and shape on stresses, Torsion and deformations in various types of loading.

UNIT I **STRESS, STRAIN AND DEFORMATION OF SOLIDS** **9**

Deformation in solids-Hooke's law, Stress and strain-tension, compression and shear stresses-Elastic constants and their relations- Volumetric, linear, shear strains- Principal stresses and planes-Mohr's circle.

UNIT II **BEAM LOAD AND STRESS** **9**

Types of beams: Supports and Loads – Shear force and Bending Moment in beams Cantilever, Simply supported and Overhanging beams – Stresses in beams. Stress variation along the length and in the beam section -Effect of shape of beam On stress induced – Shear stresses in beams – Shear flow.

UNIT III **BEAM DEFLECTION** **9**

Double Integration method – Macaulay's method – Area moment method for computation of slopes and deflections in beams - Conjugate beam and strain energy – Maxwell's reciprocal theorems- Theory of simple bending.

UNIT IV **TORSION** **9**

Torsion, stress, deformation in circular and hollow shaft, stepped shafts, deflection of shafts fixed at ends, stresses and deflection of helical springs and leaf spring.

UNIT V **THIN CYLINDERS, SPHERES AND THICK CYLINDERS** **9**

Stresses in thin cylindrical shells due to internal pressure circumferential and longitudinal stresses and deformation in thin and thick cylinders – spherical shells subjected to internal pressure – Deformation in spherical shells – Lame's theorem.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Jindal U C, "Strength of Materials", 1st Edition, Personal Education, 2020.
2 Bansal R K, "Strength of Materials", 7th Edition, Laxmi Publications Pvt. Ltd., 2022.

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REFERENCES:

1 Dr K Singh, "Strength of Materials", 4th Edition, Springer International Publishing, 2020.
2 R K Rajput, "Strength of Materials" 7th Edition, S. Chand & Company Ltd., 2018.
3 Hibbeler R C., "Mechanics of Materials", 11th Edition, Pearson Education, 2023.

ONLINE RESOURCES:

1 https://archive.nptel.ac.in/courses/105/105/105105108/
2 https://youtu.be/xMCReTC--Dg
3 https://archive.nptel.ac.in/courses/112/107/112107146/

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Apply the rigid bodies and deformable solids response when subjected to different stress.
CO2 Apply the different types of beam response when subjected to different types of loads.
CO3 Analyse of beam deflection and slope using different mathematical methods.
CO4 Apply the different types of shafts and spring response when subjected to forces
CO5 Explain Stresses in a thin cylindrical shell due to internal pressure.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	-	-	-	1	-	-	-	-	2	1
CO2	3	2	1	2	-	-	-	-	-	-	-	-	2	1
CO3	3	2	2	2	-	-	-	1	-	-	-	-	2	1
CO4	3	2	1	2	-	-	-	-	-	-	-	-	2	1
CO5	2	2	1	1	-	-	-	1	-	-	-	-	2	1

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U23ME406 **METROLOGY AND MEASUREMENTS** L T P C

Prerequisites: Engineering Physics 3 0 2 4

COURSE OBJECTIVES:

- Inspection of engineering parts with various precision instruments.
- Principles of measuring tools and gauges and their applications, design for fits and tolerances
- Evaluation and inspection of surface roughness and Inspection of spur gear.

UNIT I **BASICS OF METROLOGY** 9

Measurement – Need, Process, Role in quality control; Factors affecting measurement – SWIPE; Errors in Measurements Types – Control – Measurement uncertainty – Types, Estimation, Problems on Estimation of Uncertainty, Statistical analysis of measurement data, Measurement system analysis, Calibration of measuring instruments, Principle of air gauging-ISO standards.

UNITII **MEASUREMENT OF LINEAR, ANGULAR DIMENSIONS** 9

Linear Measuring Instruments – Vernier caliper, Micrometer, Vernier height gauge, Depth Micrometer, Bore gauge, Telescoping gauge; Gauge blocks – Use and precautions, Comparators – Working and advantages; Opto-mechanical measurements using measuring microscope and Profile projector – Angular measuring instruments – Bevel protractor, Angle gauges, Sine bar, Autocollimator, Angle dekkor. Measurement of Screw threads – Single element measurements – Pitch Diameter, Lead, Pitch. Measurement of Gears – purpose – Analytical measurement – Runout, Pitch variation, Tooth profile, Tooth thickness, Lead – Functional checking – Rolling gear test.

UNITIII **TOLERANCE ANALYSIS** 9

Tolerancing– Interchangeability, Selective assembly, Tolerance representation, Terminology, Limits and Fits, Problems (using tables IS919); Design of Limit gauges, Problems. Tolerance analysis in manufacturing, Process capability, tolerance stackup, tolerance charting.

UNIT IV **METROLOGY OF SURFACES** 9

Fundamentals of GD & T-Conventional vs Geometric tolerance, Datums, Inspection of geometric deviations like straightness, flatness, roundness deviations; Simple problems – Measurement of Surface finish – Functionality of surfaces, Parameters, Comparative, Stylus based and Optical Measurement techniques, Filters, Introduction to 3D surface metrology-Parameters.

UNITV **ADVANCES IN METROLOGY** 9

Lasers in metrology – Advantages of lasers – Laser scan micrometers; Laser interferometers – Applications – Straightness, Alignment; Ball bar tests, Computer Aided Metrology – Basic concept of CMM – Types of CMM – Constructional features – Probes – Accessories – Software – Applications – Multisensor CMMs. Machine Vision –Basic concepts of machine vision system – Elements – Applications.

45 PERIODS

PRACTICAL EXCERCISES:

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1. Calibration of Vernier / Micrometer / Dial Gauge.
2. Measurements of Gear Tooth Dimensions.
3. Measurement of Taper Angle using sine bar / tool makers microscope.
4. Checking the limits of dimensional tolerances using comparators
5. Measurement of Displacement (Strain Gauge / LVDT / Wheatstone Bridge).
6. Measurement of Temperature using Thermocouple / Pyrometer.
7. Measurement of Force and Torque

30 PERIODS
TOTAL: 75 PERIODS

TEXT BOOKS:

1 Samir Mekid, "Metrology and Instrumentation Practical Applications for Engineering and Manufacturing", 1st Edition, John Wiley & Sons, 2021.
2 Alokesh Pramanik, Chander Prakash, "Advances in Metrology and Measurement of Engineering Surfaces", Springer Nature, 2020.

REFERENCES:

1 A K Bewoor and V A Kulkarni, "Metrology and Measurement", Tata McGraw Hill, 2017.
2 Dotson Connie, "Dimensional Metrology", 6th Edition, Cengage Learning, 2016.
3 Beckwith, Marangoni, Lienhard, "Mechanical Measurements", 6th Edition, Pearson Education, 2020.

ONLINE RESOURCES:

1 https://archive.nptel.ac.in/courses/112/104/112104250
2 https://nptel.ac.in/courses/112106179
3. https://home.iitk.ac.in/~nsinha/Metrology.pdf

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the principle in measurements, metrology and measuring devices.
CO2 Apply the principle of linear and angular measuring instruments.
CO3 Analyze the limits and fits in various design and the tolerances in manufacturing.
CO4 Analyze the roughness of surfaces and deviations like straightness, flatness and roundness.
CO5 Explain the various advancements in metrology like CMM, Laser scan micrometer, machine vision etc.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	-	1	1	-	-	-	2	1
CO2	3	2	2	1	-	-	-	1	1	-	-	-	2	1
CO3	3	3	2	2	-	-	-	1	1	-	-	-	2	1
CO4	3	3	2	2	-	-	-	1	1	-	-	-	2	1
CO5	2	2	1	1	-	-	-	1	1	-	-	-	2	1

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U23ME407 **STRENGTH OF MATERIAL LABORATORY**

L	T	P	C
0	0	3	1.5

Prerequisites: Nil

COURSE OBJECTIVES:

- To study the mechanical properties of metals, wood and spring by testing in the laboratory.
- The student has a clear understanding of the design for strength and stiffness.
- To study the deflection test on beams and hardening of specimens.

LIST OF EXPERIMENTS

1. Tension Test on Mild Steel Rod.
2. Compression Test on Mild Steel Rod.
3. Single Shear test on Metals.
4. Double Shear test on Metals.
5. Torsion Test on Mild Steel Rod.
6. Impact Test on Metal Specimens - IZOD
7. Impact Test on Metal Specimens - CHARPY
8. Brinell Hardness Test on Metals.
9. Rockwell Hardness Test on Metals
10. Compression Test on Helical Spring.
11. Deflection Test on Carriage Spring.
12. Bending Test on Steel Beam

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Analyse the Mechanical Properties of materials.

CO2 Apply the deflection test on beams and compression test on helical springs.

CO3 Analyse the effects of hardening on metal specimens.

CO4 Analyse the effects of tempering on metal specimens.

CO5 Analyse the effect of torsion on metal rods and ability to perform various hardness tests.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	-	-	-	-	1	-	-	2	1
CO2	3	2	1	2	-	-	-	-	-	1	-	-	2	1
CO3	3	3	2	2	-	-	-	-	-	1	-	-	2	1
CO4	3	3	2	2	-	-	-	-	-	1	-	-	2	1
CO5	3	3	2	2	-	-	-	-	-	1	-	-	2	1

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U23ME408 **DYNAMICS LABORATORY** **L T P C**

Prerequisites: Physics and Chemistry Laboratory **0 0 3 1.5**

COURSE OBJECTIVES:

- Learn the principle in kinematics and dynamics of machinery.
- To gain knowledge in natural frequency, damping coefficient and critical speed of shafts.
- Learn a basic understanding of various measuring devices used for dynamic testing.

LIST OF EXPERIMENTS:

1. Determination of Mass moment of inertia of Fly wheel and Axle system.
2. Determination of Mass Moment of Inertia of axisymmetric bodies using Turn Table apparatus.
3. Determination of Mass Moment of Inertia using bifilar suspension
4. Determination of Mass Moment of Inertia using compound pendulum
5. Motorized gyroscope – Study of gyroscopic effect and couple.
6. Determination of range sensitivity, effort for Watts Governor
7. Determination of range sensitivity, effort for Porter Governor
8. Determination of range sensitivity, effort for Proell Governor
9. Determination of range sensitivity, effort for Hartnell Governor
10. Cams – Cam profile drawing, Motion curves and study of jump phenomenon Single degree of freedom Spring Mass System – Determination of natural Frequency and verification of Laws of springs – Damping coefficient determination
11. Determination of torsional natural frequency of single and Double Rotor systems.
12. Whirling of shafts – Determination of critical speeds of shafts with concentrated loads.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Apply the concepts in dynamic balancing.

CO2 Analyse the mass moment of inertia of various mechanical devices.

CO3 Analyse the measurement of the sensitivity in various governors.

CO4 Apply the natural frequency in shafts under torsion.

CO5 Analyse the motion curves in cam follower system.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	-	-	-	-	1	-	-	-	2	1
CO2	3	3	2	2	-	-	-	-	1	-	-	-	2	1
CO3	3	3	2	2	-	-	-	-	1	-	-	-	2	1
CO4	3	2	1	2	-	-	-	-	1	-	-	-	2	1
CO5	3	3	2	2	-	-	-	-	1	-	-	-	2	1

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U23EEC401	EMPLOYABILITY SKILLS – II	L	T	P	C
Prerequisites: Nil		0	0	2	1

COURSE OBJECTIVES:

- To educate and enrich the students on quantitative aptitude, logical reasoning and written communication.

UNIT I **QUANTITATIVE APTITUDE PART – 3** **6**

Percentages – Profit and Loss – Simple Interest & Compound Interest – logarithms.

UNIT II **QUANTITATIVE APTITUDE PART – 4** **6**

Algebra – Linear Equation – Quadratic equation – Polynomials – Time and Distance – Problems on train – Time and Work.

UNIT III **LOGICAL REASONING PART – 2** **6**

Coding and Decoding – Data Sufficiency – Seating Arrangement – syllogism.

UNIT IV **WRITTEN COMMUNICATION PART – 2** **6**

Sentences Formation – Sentence Completion - Sentence Correction – Jumbled Sentences – Letter Drafting – Reading Comprehension – Contextual Usage.

UNIT V **WRITTEN COMMUNICATION PART – 3** **6**

Practices: Sentence Completion – Sentence Correction – Jumbled Sentences – Synonyms and Antonyms – Using the same word as different parts of speech – Interpretation of Pictorial Representations – Editing.

TOTAL: 30 PERIODS

TEXT BOOKS:

1 R S Aggarwal, "Quantitative Aptitude", Revised Edition, S Chand & Co Ltd., 2017.

2 R S Aggarwal, "A Modern Approach to Verbal and Non-verbal Reasoning", S Chand & Co Ltd., 2018.

REFERENCES:

1 Abhijit Guha, "Quantitative Aptitude", 3rd Edition, Tata McGraw Hill, 2009.

2 Raj N Bakshmi, "English Grammar Practice," 1st Edition, Orient Black Swan, 2009.

3 M Ashra Rizvi, "Effective Technical Communication," 2nd Edition, Tata McGraw Hill, 2017.

4 Norman Lewis, "Word Power Made Easy", W.R. Goyal Publishers, 2020.

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U23CB501 **CYBER SECURITY** L T P C
3 0 2 4

COURSE OBJECTIVES:

- To understand the basics of cyber security, cyber crimes and cyber law.
- To learn about social media issues relevant to cyber security.
- To know about digital devices security, tools and technologies for cyber security.

UNIT I **INTRODUCTION TO CYBER SECURITY** 9

Defining Cyberspace and Overview of Computer and Web-technology, Architecture of cyberspace, Communication and web technology, Internet, World wide web, Concept of cyber security, Issues and challenges of cyber security.

UNIT II **CYBERCRIME AND CYBER LAW** 9

Classification of cyber crimes, Common cyber crimes- cyber crime targeting computers and mobiles, financial frauds, malware and ransomware attacks, zero day and zero click attacks, Reporting of cyber crimes, Remedial and mitigation measures, Legal perspective of cyber crime, IT Act 2000 and its amendments, Cyber crime and offences, Organisations dealing with Cyber security in India.

UNIT III **SOCIAL MEDIA OVERVIEW AND SECURITY** 9

Introduction to Social networks. Types of Social media, Social media platforms, Social media monitoring, Social media privacy, Security issues related to social media, Flagging and reporting of inappropriate content, Laws regarding posting of inappropriate content, Best practices for the use of Social media, Case studies.

UNIT IV **E - COMMERCE AND DIGITAL PAYMENTS** 9

E- Commerce, Elements of E-Commerce security, E-Commerce threats, E-Commerce security best practices, Introduction to digital payments, Components of digital payment, Modes of digital payments – Banking Cards, Unified Payment Interface (UPI), e-Wallets, Unstructured Supplementary Service Data (USSD), Digital payments related common frauds and preventive measures. RBI guidelines on digital payments and customer protection in unauthorised banking transactions.

UNIT V **DIGITAL DEVICES SECURITY, TOOLS AND TECHNOLOGIES FOR CYBER SECURITY** 9

Mobile phone security, Password policy, Security patch management, Data backup, Downloading and management of third party software, Device security policy, Significance of host firewall and Ant-virus, Management of host firewall and Anti-virus, Wi-Fi security.

45 PERIODS

PRACTICAL EXERCISES:

1 Checklist for reporting cyber crime at cyber crime Police Station and reporting cyber crime online.
2 Configuring security settings in Mobile Wallets and UPIs and Checklist for secure net banking.
3 Setting and configuring two factor authentication in the Mobile phone and Security patch management and updates in Computer and Mobiles.
4 Managing Application permissions in Mobile phone.
5 Wi-Fi security management in computer and mobile.

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30 PERIODS

TOTAL: 75 PERIODS

REFERENCES:

1 Ramesh Chandra Mishra, "Cyber Crime Impact in the New Millennium", Authors Press, 2010.
2 Sumit Belapure, Nina Godbole, "Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", 1st Edition, Wiley India Pvt. Ltd., 2011.
3 Kumar K, "Cyber Laws: Intellectual Property & E-Commerce Security", Dominant Publishers, 2011.
4 Eric Cole, Ronald Krutz, James W Conley, "Network Security Bible", 2nd Edition, Wiley India Pvt. Ltd., 2011.
5 E Maiwald, "Fundamentals of Network Security", Tata McGraw Hill, 2017.

ONLINE RESOURCES

1 http://www.digimat.in/nptel/courses/video/106106212/L01.html
2 https://onlinecourses.swayam2.ac.in/cec24_cs03/preview
3 https://onlinecourses.swayam2.ac.in/cec24_cs01/preview

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the concept of Cyber security and issues and challenges associated with it.
CO2 Explain cyber crimes, their nature, legal remedies and as to how report the crimes through available platforms and procedures.
CO3 Apply various privacy and security concerns on online Social media.
CO4 Apply concepts related cyber security aspects to E-Commerce and digital payments.
CO5 Apply Wi-Fi security management concepts in computer and mobile.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	1	-	2	1	1	-	1
CO2	2	2	1	1	-	1	-	2	1	1	-	1
CO3	3	2	1	2	1	1	-	2	1	1	-	1
CO4	3	2	1	2	1	1	-	2	1	1	-	1
CO5	3	2	1	2	1	1	-	2	1	1	-	1

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CHENNAI-6

U23ME501	DESIGN OF MACHINE ELEMENTS	L	T	P	C
		3	0	0	3

Prerequisites: Engineering Mechanics

Course Objectives:

- To learn the various steps involved in the Design Process, shafts design and couplings for various applications.
- To learn the design of temporary and permanent Joints and designing helical, leaf springs, flywheels, connecting rods and crank shafts for various applications.
- To Learn designing and select sliding and rolling contact bearings, seals and gaskets.

(Use of PSG Design Data book is permitted)

UNIT I FUNDAMENTAL CONCEPTS IN DESIGN 9

Introduction to the design process - factors influencing machine design - Preferred numbers- Direct, Bending and torsional loading- Modes of failure - Factor of safety – Combined loads – Eccentric loading – curved beams – crane hook and 'C' frame. Theories of failure – Design based on strength and stiffness – Fluctuating stresses – Endurance limit.

UNIT II DESIGN OF SHAFTS AND COUPLINGS 9

Shafts and Axles - Design of solid and hollow shafts based on strength, rigidity and critical speed – Keys and splines – Rigid and flexible couplings.

UNIT III DESIGN OF TEMPORARY AND PERMANENT JOINTS 9

Threaded fasteners - Bolted joints including eccentric loading, Knuckle joints, Cotter joints – Welded joints- Butt, Fillet and parallel transverse fillet welds – welded joints subjected to bending, torsional and eccentric loads, riveted joints for structures.

UNIT IV DESIGN OF ENERGY STORING ELEMENTS 9

Types of springs, design of helical and concentric springs–surge in springs, Design of laminated springs - Flywheels considering stresses in rims and arms for engines and punching machines- Solid and Rimmed flywheels.

UNIT V DESIGN OF BEARINGS AND MISCELLANEOUS ELEMENTS 9

Sliding contact and rolling contact bearings - Hydrodynamic journal bearings, Sommer fled Number, Raimondi& Boyd graphs, - Selection of Rolling Contact bearings –Design of Seals and Gaskets.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Bhandari V B, "Design of Machine Elements", 4th Edition, Tata McGraw Hill, 2016.
2. Joseph Shigley, Richard G Budynas and J Keith Nisbett "Mechanical Engineering Design", 10th Edition, Tata McGraw Hill , 2015.

REFERENCES:

1. Ansel C Ugural, "Mechanical Design of Machine Components", 2nd Edition, CRC Press, 2018.
2. Merhyle Franklin Spotts, Terry E Shoup, and Lee Emrey Hornberger, "Design

of Machine Elements", 8th Edition, Prentice Hall of India, 2018.

3 Robert C Juvinall, Kurt M Marshek, "Fundamentals of Machine Component Design", 6th Edition, John Wiley & Sons, 2017.

ONLINE RESOURCES:

1 http://kcl.digimat.in/nptel/courses/video/112105124/L01.html

2 https://archive.nptel.ac.in/courses/112/105/112105125

3 https://osme.co.in/wp-content/uploads/2023/01/2

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the design machine members subjected to static and variable loads.

CO2 Apply the concepts of design to shafts, key and couplings.

CO3 Apply the concepts of design to bolted, Knuckle, Cotter, riveted and welded joints.

CO4 Apply the concept of design to helical, leaf springs, flywheels, connecting rods and crank shafts.

CO5 Apply the concepts of design and select sliding and rolling contact bearings, seals and gaskets.

CO – PO - PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	-	1	1	-	-	1	2	1
CO2	3	2	1	2	-	-	-	1	1	-	-	1	2	1
CO3	3	2	1	2	-	-	-	1	1	-	-	1	2	1
CO4	3	2	1	2	-	-	-	1	1	-	-	1	2	1
CO5	3	2	1	2	-	-	-	1	1	-	-	1	2	1

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U23ME502	THERMAL ENGINEERING – II	L	T	P	C
		3	0	2	4

Prerequisites: Thermal Engineering - I

Course Objectives:

- To familiarize the concepts, laws and different gas power cycles, knowledge on the working principles of IC engines.
- To impart the engine components and working principles of SI and CI engines and the performance characterization of diesel and petrol engines.
- To study the performance of Air Compressor and Gas turbines

UNIT I THERMODYNAMIC CYCLES 9

Air Standard Cycles – Carnot, Otto, Diesel, Dual, Brayton – Cycle Analysis, Performance and Comparison, Basic Rankine Cycle, modified, reheat and regenerative cycles.

UNIT II INTERNAL COMBUSTION ENGINES 9

IC engine – Classification, working, components and their functions. Ideal and actual: Valve and port timing diagrams, p-v diagrams- two stroke & four stroke, and SI & CI engines – comparison. Geometric, operating, and performance comparison of SI and CI engines. Desirable properties and qualities of fuels. Air-fuel ratio calculation – lean and rich mixtures. Combustion in SI & CI Engines – Knocking – phenomena and control

UNIT III RECIPROCATING AIR COMPRESSOR 9

Classification and comparison, working principle, work of compression - with and without clearance, Volumetric efficiency, Isothermal efficiency and Isentropic efficiency. Multistage air compressor with Intercooling.

UNIT IV HEAT BALANCE AND TURBOCHARGING OF IC ENGINES 9

Performance parameters and calculations. Morse and Heat Balance tests. Multipoint Fuel Injection system and Common Rail Direct injection systems. Ignition systems – Magneto, Battery and Electronic. Lubrication and Cooling systems. Concepts of Supercharging and Turbocharging – Emission Norms.

UNIT V GAS TURBINES 9

Gas turbine cycle analysis — opens and closed cycle. Performance and its improvement Regenerative, Intercooled, Reheated cycles and their combinations. Materials for Turbines.

45 PERIODS

TEXT BOOKS:

1 Rajput R K, "Thermal Engineering", 3rd Edition, S Chand Publishers, 2017.

2 Kothandaraman R, Domkundwar S S, Domkundwar A V , "Thermal Engineering", 5th Edition," Dhanpat Rai & Sons, 2016.

REFERENCES:

1 Sadhu Singh, SukumarPati, "Thermal Engineering", 1st Edition, Pearson Education, 2018.

2 Patel Prakash Bhai, Ratu Bhai, "Thermal Engineering - II", 1st Edition, Shashwat

Publication, 2021.

3 Ganesan V, "Internal Combustion Engines", 3rd Edition, Tata McGraw Hill, 2022.

PRACTICAL EXERCISES:

1 Valve Timing and Port Timing diagrams.

2 Actual p-v diagrams of IC engines.

3 Performance Test on 4 – stroke Diesel engine.

4 Heat Balance Test on 4 – stroke Diesel Engine.

5 Morse Test on Multi-cylinder Petrol Engine

6 Retardation Test on a Diesel Engine.

7 Determination of Flash Point and Fire Point of various fuels / lubricants.

30 PERIODS
TOTAL: 75 PERIODS

ONLINE RESOURCES:

1 https://ocw.mit.edu/courses/2-61-internal-combustion-engines-spring-2017

2 https://onlinecourses.nptel.ac.in/noc23_me31/preview

3 https://www.sciencedirect.com/topics/chemistry/thermodynamic-cycle

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Apply thermodynamic concepts to different air standard cycles.

CO2 Explain the functioning and features of IC engines, components.

CO3 Analyse the performance of air compressors with help of compression processes.

CO4 Evaluate the performance parameters on IC Engines.

CO5 Explain the flow process in Gas turbines.

CO – PO - PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	-	-	2	1	1	-	-	1	2	1
CO2	2	2	1	1	-	-	2	-	1	-	-	1	2	1
CO3	3	3	2	2	-	-	2	1	1	-	-	1	2	1
CO4	3	3	2	2	-	-	2	-	1	-	-	1	2	1
CO5	2	2	1	1	-	-	2	1	1	-	-	1	2	1

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U23MG501 **PROFESSIONAL ETHICS AND IPR** **L T P C**

Prerequisites: Nil **2 0 0 2**

COURSE OBJECTIVES:

- To enable the students to create an awareness on engineering ethics and human values.
- To know how to apply safety, responsibility and rights in workplaces.
- To install moral and social values and loyalty and to appreciate the rights of others.

UNIT I **HUMAN VALUES** **6**

Morals, Values and Ethics – Integrity – Work Ethics – Service Learning – Civic Virtue – Respect for Others – Living Peacefully – Caring - Sharing – Honesty – Courage – Valuing Time – Cooperation – Commitment – Empathy – Self-Confidence - Character – Spirituality.

UNIT II **ENGINEERING ETHICS** **6**

Senses of 'Engineering Ethics' – variety of moral issued - types of inquiry – moral dilemmas – moral autonomy – Kohlberg's theory - Gilligan's theory – consensus and controversy – Models of Professional Roles – theories about right action - Self-interest – customs and religion – uses of ethical theories.

UNIT III **ENGINEERING AS SOCIAL EXPERIMENTATION** **6**

Engineering as experimentation – engineers as responsible experimenters – codes of ethics – a balanced outlook on law – Case study: The challenger disaster.

UNIT IV **SAFETY, RESPONSIBILITIES AND IPR** **6**

Safety and risk – assessment of safety and risk – risk benefit analysis and reducing risk – Collegiality and loyalty – respect for authority - collective bargaining – confidentiality – conflicts of interest – occupational crime – professional rights – employee rights – Intellectual Property Rights (IPR) – discrimination. Case studies: The Three mile island and Chernobyl disaster

UNIT V **GLOBAL ISSUES** **6**

Multinational corporations - Environmental ethics – computer ethics – weapons development – engineers as managers – consulting engineers - engineers as expert witnesses and advisors - Code of Conduct – Corporate Social Responsibility

TOTAL: 30 PERIODS

TEXT BOOKS:

1 Mike W Martin and Roland Schinzinger, "Ethics in Engineering", 4th Edition, McGraw Hill, New York 2017.

2 Govindarajan M, Natarajan S and Senthil Kumar V S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2013.

REFERENCES:

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1 John R Boatright, "Ethics and the Conduct of Business", 4th Edition, Pearson Education, New Delhi, 2017.
2 Charles D and Fleddermann, "Engineering Ethics", Pearson Education, New Jersey, 2012.
3 Charles E Harris, Michael S Protchard and Michael J Rabins, "Engineering Ethics Concepts and Cases", 4th Edition, Wadsworth Thompson Learning, United States, 2005.

Upon the completion of the course, the students will be able to

CO1 Comprehend the core human values that shape the ethical behaviour of an Engineer.

CO2 Apply ethics in the profession.

CO3 Summarize the structure and function of state government and local bodies.

CO4 Apply safety, responsibility and rights in workplaces.

CO5 Summarize the global issues with regard to ethics.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	3	-	3	2	-	2	3
CO2	-	-	-	-	-	3	-	3	2	-	2	3
CO3	-	-	-	-	-	3	-	3	2	-	2	3
CO4	-	-	-	-	-	3	-	3	2	-	2	3
CO5	-	-	-	-	-	3	-	3	2	-	2	3

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U23MX02	ENVIRONMENTAL SCIENCES AND SUSTAINABILITY	L	T	P	C
Prerequisites:	**Engineering Chemistry**	2	0	0	0

COURSE OBJECTIVES:

- To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation.
- To impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters.
- To familiarize the concept of sustainable development goals and appreciate the interdependence of economic and social aspects of sustainability, recognize and analyze climate changes, concept of carbon credit and the challenges of environmental management.

UNIT I **ENVIRONMENT AND BIODIVERSITY** **6**

Definition, scope and importance of environment – need for public awareness, Eco-system and Energy flow – ecological succession, Types of biodiversity: genetic, species and ecosystem diversity – values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ.

UNIT II **ENVIRONMENTAL POLLUTION** **6**

Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollutions, Solid, Hazardous and E-Waste management. Case studies on Occupational Health and Safety Management system (OHASMS), Environmental protection, Environmental protection acts.

UNIT III **RENEWABLE SOURCES OF ENERGY** **6**

Energy management and conservation, New Energy Sources: Need of new sources. Different types of new energy sources, Applications of Hydrogen energy, Ocean energy resources, Tidal energy conversion, Concept, origin and power plants of geothermal energy.

UNIT IV **USTAINABILITY AND MANAGEMENT** **6**

Development, GDP, Sustainability – concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium development goals, and protocols Sustainable Development Goals – targets, indicators and intervention Areas Climate change – Global, Regional and local environmental issues and possible solutions-case studies, Concept of Carbon Credit, Carbon Footprint. Environmental management in industry – A case study.

UNIT V **SUSTAINABILITY PRACTICES** **6**

Zero waste and R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy efficiency, Sustainable transports. Sustainable energy: Non-conventional Sources, Energy Cycles, carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socio-economical and technological change.

TOTAL: 30 PERIODS

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REFERENCES:

1 Anubha Kaushik and C. P. Kaushik's, "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers, 2018.

2 Benny Joseph, "Environmental Science and Engineering", Tata McGraw Hill, 2016.

3 Gilbert M Masters, "Introduction to Environmental Engineering and Science", 2nd Edition, Pearson Education, 2004.

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the functions of environment, ecosystems and biodiversity and their conservation.

CO2 Explain the causes, effects of environmental pollution and natural disasters and contribute to the preventive measures in the society.

CO3 Comprehend renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations.

CO4 Summarize the different goals of sustainable development and apply them for suitable technological advancement and societal development.

CO5 Explain the sustainability practices and identify green materials, energy cycles and the role of sustainable urbanization.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	-	-	-	1	3	1	-	-	-	1
CO2	1	-	-	-	-	1	3	1	-	-	-	1
CO3	1	-	-	-	-	1	3	1	-	-	-	1
CO4	1	-	-	-	-	1	3	1	-	-	-	1
CO5	1	-	-	-	-	1	3	1	-	-	-	1

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U23EEC501	EMPLOYABILITY SKILLS – III	L	T	P	C
		0	0	2	1

Prerequisites: Nil

COURSE OBJECTIVES:

- To educate and enrich the students on quantitative aptitude, data interpretation and analysis and written communication.

UNIT I **QUANTITATIVE APTITUDE PART – 5** 6

Probability –Permutation and Combination - Calendars – Logarithm.

UNIT II **QUANTITATIVE APTITUDE PART – 6** 6

Geometry – Straight Line – Triangles – Quadrilaterals – Circle – Co-ordinate Geometry – Cube – Cone – Sphere.

UNIT III **DATA INTERPRETATION AND ANALYSIS- 1** 6

Data Interpretation based on Text – Data Interpretation based on Graphs and Tables. Graphs Column Graphs.

UNIT IV **DATA INTERPRETATION AND ANALYSIS -2** 6

Bar Graphs - Line Charts - Pie Chart - Graphs representing Area - Venn Diagram & Flow Charts.

UNIT V **LOGICAL REASONING PART – 3** 6

Syllogism – Assertion and Reasons – Statements and Assumptions – Identifying Valid Inferences – Identifying strong arguments and weak arguments – Statements and Conclusions – Cause and Effect – Deriving conclusions from passages.

TOTAL: 30 PERIODS

TEXT BOOKS:

1 R S Aggarwal, "Quantitative Aptitude", Revised Edition, S Chand & Co Ltd., 2017.

2 R S Aggarwal, "A Modern Approach to Verbal and Non-verbal Reasoning", S Chand & Co Ltd., 2018.

REFERENCES:

1 Abhijit Guha, "Quantitative Aptitude", 3rd Edition, Tata McGraw Hill, 2009.

2 Raj N Bakshmi, "English Grammar Practice," 1st Edition, Orient Black Swan, 2009.

3 M Ashra Rizvi, "Effective Technical Communication," 2nd Edition, Tata McGraw Hill, 2017.

4 Norman Lewis, "Word Power Made Easy", W.R. Goyal Publishers, 2020.

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CHENNAI - ...

U23ME601	HEAT AND MASS TRANSFER	L	T	P	C
		3	0	2	4

Prerequisites: Thermal Engineering – II

Course Objectives:

- To Understand the concept and application of conduction, convection.
- To Learn the concept and application of radiation and the principle of heat transfer and heat exchangers.
- To Understand the principle of mass transfer.

(Use of HMT Data Book permitted)

UNIT I **CONDUCTION** **9**

General Differential equation – Cartesian, Cylindrical and Spherical Coordinates – One Dimensional Steady State Heat Conduction – plane and Composite Systems – Conduction with Internal Heat Generation – Extended Surfaces – Unsteady Heat Conduction – Lumped Analysis – Semi Infinite and Infinite Solids – Use of Heisler's charts – Methods of enhanced thermal conduction

UNIT II **CONVECTION** **9**

Conservation Equations, Boundary Layer Concept – Forced Convection: External Flow – Flow over Plates, Cylinders Spheres and Bank of tubes. Internal Flow – Entrance effects. Free Convection – Flow over Vertical Plate, Horizontal Plate, Inclined Plate, Cylinders and Spheres. Mixed Convection.

UNIT III **PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS** **9**

Nusselt's theory of condensation- Regimes of Pool boiling and Flow boiling - Correlations in boiling and condensation. Heat Exchanger Types – TEMA Standards - Overall Heat Transfer Coefficient – Fouling Factors. LMTD and NTU methods. Fundamentals of Heat Pipes and its applications.

UNIT IV **RADIATION** **9**

Introduction to Thermal Radiation - Radiation laws and Radiative properties - Black Body and Graybody Radiation - Radiosity - View Factor Relations. Electrical Analogy. Radiation Shields.

UNIT V **MASS TRANSFER** **9**

Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state and Transient Diffusion - Stefan flow –Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations.

45 PERIODS

TEXT BOOKS:

1. Sachdeva R C, "Fundamentals of Engineering Heat & Mass Transfer", 5th Edition, New Age International Publishers, 2017.
2. Yunus Cengel, Afshin Ghajar, "Heat and Mass Transfer: Fundamentals & Applications", 6th Edition, Tata McGraw Hill, 2020.

REFERENCES:

1. Theodore L. Bergmen, "Fundamentals of Heat and Mass Transfer", 8th Edition, John Wiley & Sons, 2020.

2 Holman J P, Souvik Bhattacharyya, "Heat Transfer", 10th Edition, Tata McGraw Hill Education, 2017.

3 Nag P K, "Heat and Mass Transfer", 3rd Edition, Tata McGraw Hill Education, 2021.

ONLINE RESOURCES:

1 https://nptel.ac.in/courses/112101097

2 https://youtu.be/qFJg7bwr2PA?si=S0PWA-BU_J7Fougq

3 https://archive.nptel.ac.in/courses/112/108/112108149

PRACTICAL EXERCISES:

1 Thermal conductivity measurement using guarded plate apparatus.

2 Thermal conductivity measurement of pipe insulation using lagged pipe apparatus.

3 Determination of heat transfer coefficient under natural convection from a vertical cylinder.

4 Determination of Thermal conductivity of composite wall.

5 Determination of Stefan – Boltzmann constant.

6 Determination of emissivity of a grey surface.

7 Effectiveness of parallel and counter flow heat exchanger.

30 PERIODS
TOTAL: 75 PERIODS

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Apply heat conduction equations to different surface configurations under steady state and transient conditions.

CO2 Apply free & forced convective heat transfer correlations to internal & external flow through/over various surface configurations.

CO3 Apply LMTD and NTU methods of thermal analysis to different types of heat exchanger configurations.

CO4 Apply the principles to radiative heat transfer between different types of surfaces to solve problems.

CO5 Apply diffusive and convective mass transfer equations and correlations to with different applications.

CO – PO - PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	-	-	-	-	1	-	-	1	2	1
CO2	3	2	1	2	-	-	-	-	1	-	-	1	2	1
CO3	3	2	1	2	-	-	-	-	1	-	-	1	2	1
CO4	3	2	1	2	-	-	-	-	1	-	-	1	2	1
CO5	3	2	1	2	-	-	-	-	1	-	-	1	2	1

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U23ME602	DESIGN OF TRANSMISSION SYSTEM	L	T	P	C
		3	0	0	3

Prerequisites: Design of Machine Elements

Course Objectives:

- To gain knowledge on the principles and procedure for the design of Mechanical power Transmission components.
- To understand the standard procedure available for Design of Transmission of Mechanical elements spur gears and parallel axis helical gears.
- To learn the design bevel, worm and cross helical gears of the Transmission system, variable speed gearbox and design to cams, brakes and clutches.

(Use of PSG Design Data book is permitted)

UNIT I **DESIGN OF FLEXIBLE ELEMENTS** **9**

Design of Flat belts and pulleys - Selection of V belts and pulleys – Selection of hoisting wire ropes and pulleys – Design of Transmission chains and Sprockets.

UNIT II **SPUR GEARS AND PARALLEL AXIS HELICAL GEARS** **9**

Speed ratios and number of teeth-Force analysis -Tooth stresses - Dynamic effects – Fatigue strength - Factor of safety - Gear materials – Design of straight tooth spur & helical gears based on strength and wear considerations – Pressure angle in the normal and transverse plane-Equivalent number of teeth-forces for helical gears.

UNIT III **BEVEL, WORM AND CROSS HELICAL GEARS** **9**

Straight bevel gear: Tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of a pair of straight bevel gears. Worm Gear: Merits and demerits terminology. Thermal capacity, materials-forces and stresses, efficiency, estimating the size of the worm gear pair. Cross helical: Terminology-helix angles-Estimating the size of the pair of cross helical gears

UNIT IV **GEAR BOXES** **9**

Geometric progression - Standard step ratio - Ray diagram, kinematics layout -Design of sliding mesh gear box - Design of multi speed gear box for machine tool applications - Constant mesh gear box - Speed reducer unit. – Variable speed gearbox, Fluid Couplings, Torque Converters for automotive applications

UNIT V **CAMS, CLUTCHES AND BRAKES** **9**

Cam Design: Types-pressure angle and undercutting base circle determination-forces and surface stresses. Design of plate clutches –axial clutches-cone clutches-internal expanding rim clutches-Electromagnetic clutches. Band and Block brakes - external shoe brakes – Internal expanding shoe brakes.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Bhandari V B, "Design of Machine Elements", 4th Edition, Tata McGraw Hill, 2016.
2. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "Mechanical Engineering Design", 8th Edition, Tata McGraw Hill, 2018.

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REFERENCES:

1 Merhyle F Spotts, Terry E Shoup, Lee E Hornberger, "Design of Machine Elements" 8th Edition, Prentice Hall of India, 2019.

2 Orthwein W, "Machine Component Design", 2nd Edition, Jaico Publishing, 2022.

3 Robert C Juvinall, Kurt M Marshek, "Fundamentals of Machine Design", 4th Edition, Wiley, 2015.

ONLINE RESOURCES:

1 https://onlinecourses.nptel.ac.in/noc24_me71/preview

2 https://sites.google.com/site/designoftransmissionsystems

3 https://www.youtube.com/watch?v=4yW5bAqMU

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Compute the design parameters of flexible transmission elements like belts, chains and wire ropes for given condition.

CO2 Compute the spur and helical gear terminology considering strength and wear.

CO3 Compute the required parameters in designing worm, bevel and double helical gear power transmission.

CO4 Calculate the speed ratio and gear box parameters for the given application.

CO5 Compute the parameters require to design cam, clutches and brakes for varied applications.

CO – PO - PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	-	2	1	-	-	-	-	1	2	1
CO2	3	2	1	2	-	2	1	-	-	-	-	1	2	1
CO3	3	2	1	2	-	2	1	-	-	-	-	1	2	1
CO4	3	2	1	2	-	2	1	-	-	-	-	1	2	1
CO5	3	2	1	2	-	2	1	-	-	-	-	1	2	1

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U23ME603	COMPUTER AIDED DESIGN AND MANUFACTURING	L	T	P	C
		3	0	0	3

Prerequisites: Manufacturing Technology - I

Course Objectives:

- To provide an overview of how computers are being used in mechanical component design
- To understand the application of computers in various aspects of Manufacturing viz., Design, Proper planning, Manufacturing cost, Layout & Material Handling system.
- To study the constructional details and working of CNC machines and develop the part program for various CAD figures this helps in manufacturing of parts by turning and milling operations.

UNIT I **INTRODUCTION** **9**

Product cycle- Design process- sequential and concurrent engineering- Computer aided design – CAD system architecture- Computer graphics – coordinate systems- 2D and 3D transformations- homogeneous coordinates - Line drawing -Clipping- viewing transformation-Brief introduction to CAD and CAM – Manufacturing Planning, Manufacturing control- Introduction to CAD/CAM –CAD/CAM concepts ––Types of production - Manufacturing models and Metrics – Mathematical models of Production Performance.

UNIT II **GEOMETRIC MODELING** **9**

Representation of curves- Hermite curve- Bezier curve- B-spline curves-rational curves- Techniques for surface modeling – surface patch- Coons and bicubic patches- Bezier and B-spline surfaces. Solid modeling techniques- CSG and B-rep..

UNIT III **CAD STANDARDS** **9**

Standards for computer graphics- Graphical Kernel System (GKS) - standards for exchange images- Open Graphics Library (OpenGL) - Data exchange standards - IGES, STEP, CALS etc. - Communication standards.

UNIT IV **FUNDAMENTAL OF CNC AND PART PROGRAMING** **9**

Introduction to NC systems and CNC - Machine axis and Coordinate system- CNC machine tools- Principle of operation CNC- Construction features including structure- Drives and CNC controllers- 2D and 3D machining on CNC- Introduction of Part Programming, types - Detailed Manual part programming on Lathe & Milling machines using G codes and M codes- Cutting Cycles, Loops, Sub program and Macros- Introduction of CAM package.

UNIT V **CELLULAR MANUFACTURING AND FLEXIBLE MANUFACTURING SYSTEM** **9**

Group Technology(GT), Part Families–Parts Classification and coding–Simple Problems in Opitz Part Coding system–Production flow Analysis–Cellular Manufacturing–Composite part concept–Types of Flexibility - FMS – FMS Components – FMS Application & Benefits – FMS Planning and Control– Quantitative analysis in FMS

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Ibrahim Zeid, "Mastering CAD CAM", 2nd Edition, Tata McGraw Hill, 2019.
2. Mikell P Groover, "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India, 2018.

REFERENCES:

1. Radhakrishnan P, Subramanyan S, Raju V, "CAD/CAM/CIM", 2nd Edition, New Age International, New Delhi, 2019.
2. Donald Hearn, M Pauline Baker "Computer Graphics", Prentice Hall of India, 2018.
3. Foley, Wan Dam, Feiner, Hughes "Computer Graphics Principles & Practice" Pearson Education, 2019.

ONLINE RESOURCES:

1. https://archive.nptel.ac.in/courses/112/102/112102101
2. https://onlinecourses.swayam2.ac.in/nou22_me08/preview
3. https://www.youtube.com/watch?v=PFj6lNxSJ4w

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the 2D and 3D transformations, clipping algorithm, Manufacturing models and Metrics.

CO2 Explain the fundamentals of parametric curves, surfaces and Solids.

CO3 Summarize the different types of Standard systems used in CAD.

CO4 Apply NC & CNC programming concepts to develop part programmes for Lathe & Milling Machines.

CO5 Summarize the different types of techniques used in Cellular Manufacturing and FMS.

CO – PO - PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	-	1	-	-	-	-	2	1
CO2	2	2	1	1	-	-	-	1	-	-	-	-	2	1
CO3	2	2	1	1	-	-	-	1	-	-	-	-	2	1
CO4	3	2	1	2	-	-	-	1	-	-	-	-	2	1
CO5	2	2	1	1	-	-	-	1	-	-	-	-	2	1

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U23ME604	CAD/CAM LABORATORY	L	T	P	C
		0	0	3	1.5

Course Objectives:

- To gain practical experience in handling 2D drafting and 3D modelling software systems.
- To Designing 3 Dimensional geometric models of parts, sub-assemblies, assemblies and exporting it to drawing.
- To Programming G&M Code programming and simulate the CNC program and Generating part programming data through CAM software.

PART I **3D GEOMETRIC MODELLING** **5**

CAD Introduction:

Sketch:Solid modeling: Extrude, Revolve, Sweep, Variational sweep and Loft. Surface modeling: Extrude Sweep, Trim, Mesh of curves and Free form. Feature manipulation: Copy, Edit, Pattern, Suppress, History operations. Assembly: Constraints, Exploded Views, Interference check Drafting: Lay outs, Standard & Sectional Views, Detailing & Plotting.

PART II **CREATION OF 3D ASSEMBLY MODEL OF FOLLOWING MACHINE ELEMENTS USING 3D MODELLING SOFTWARE:** **25**

1	Flange Coupling
2	Plummer Block
3	Screw Jack
4	Lathe Tailstock
5	Universal Joint
6	Machine Vice
7	Stuffing box
8	Crosshead
9	Safety Valves
10	Non-return valves
11	Connecting rod
12	Piston
13	Crankshaft

*Students may also be trained in manual drawing of some of the above components (specify the number–progressive arrangement of 3D).

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PART III **MANUAL PART PROGRAMMING** **15**

1	CNC Machining Centre i) Linear Cutting. ii) Circular cutting. iii) Cutter Radius Compensation. iv) Canned Cycle Operations.	
2	CNC Turning Centre v) Straight, Taper and Radial Turning. vi) Thread Cutting. vii) Rough and Finish Turning Cycle.	
3	Drilling and Tapping Cycle.	

TOTAL : 45PERIODS

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the basic concept of solid modelling and drafting.

CO2 Design the components in 3D modelling using the software systems.

CO3 Explain the concept of CNC machine programming.

CO4 Describe the manual part programming and simulate the CNC program.

CO5 Explain the generation of part programming using G code and M code through CAM software.

CO – PO - PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	2	1	-	1	-	-	-	-	2	1
CO2	3	3	3	3	2	1	-	1	-	-	-	-	2	1
CO3	2	2	1	1	2	1	-	1	-	-	-	-	2	1
CO4	2	2	1	1	2	1	-	1	-	-	-	-	2	1
CO5	2	2	1	1	2	1	-	1	-	-	-	-	2	1

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U23EEC601	EMPLOYABILITY SKILLS – IV	L	T	P	C
Prerequisites: Nil		0	0	2	1

COURSE OBJECTIVES:

- To educate and enrich the students on quantitative aptitude, logical reasoning and verbal communication.

UNIT I **ADVANCED QUANTITATIVE APTITUDE – 1** **6**

Averages – problem on Ages – Ratio & Proportion – Mixture and Allegations.

UNIT II **ADVANCED QUANTITATIVE APTITUDE – 2** **6**

Percentages – Profit and Loss – Simple Interest & Compound Interest – logarithms.

UNIT III **ADVANCED QUANTITATIVE APTITUDE – 3** **6**

Algebra – Linear Equation – Quadratic equation – Polynomials – Time and Distance – Problems on train – Time and Work.

UNIT IV **ADVANCED LOGICAL REASONING** **6**

Coding and decoding – Blood relations – Direction Series – Syllogism – puzzles.

UNIT V **ADVANCED VERBAL COMMUNICATION** **6**

Error Spotting – Jumbled Sentences – Comprehension – Idioms and Phrases – Synonyms and Antonyms.

TOTAL: 30 PERIODS

TEXT BOOKS:

1. R S Aggarwal, "Quantitative Aptitude", Revised Edition, S Chand & Co Ltd., 2017.
2. R S Aggarwal, "A Modern Approach to Verbal and Non-verbal Reasoning", S Chand & Co Ltd., 2018.

REFERENCES:

1. Abhijit Guha, "Quantitative Aptitude", 3rd Edition, Tata McGraw Hill, 2009.
2. Raj N Bakshmi, "English Grammar Practice," 1st Edition, Orient Black Swan, 2009.
3. M Ashra Rizvi, "Effective Technical Communication," 2nd Edition, Tata McGraw Hill, 2017.
4. Norman Lewis, "Word Power Made Easy", W.R. Goyal Publishers, 2020.

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U23ME701	POWER PLANT ENGINEERING	L	T	P	C
		3	0	0	3

Prerequisites: Heat and Mass Transfer

Course Objectives:

- To understand the principle, construction and working of the traditional power generation methods.
- To improvise the knowledge on working of the non-traditional and renewable power generation methodologies
- To be familiar with the applications of power plants and estimate the costs of electrical energy production

UNIT I THERMAL POWER PLANTS 9

Layout of Thermal Power Plant – Selection Criteria –Boilers- Fluidized Bed Boilers – Boiler Trial and Testing - Fuel and Ash Handling Systems -Pulverizer - Stokers – Dust Collectors - Cooling Towers – Feed Water Treatment – Distributed Control System.

UNIT II GAS TURBINE AND DIESEL POWER PLANTS 9

Gas Turbine Cycles - Thermodynamic Analysis of Cycles - Reheating - Regeneration and Intercooling - Layout of Gas Turbine Power Plant- Selection Criteria - Binary and Combined Cycle - IGCC. Diesel Power Plant: Layout –Types - Selection Criteria– Selection of Engine

UNIT III NUCLEAR AND HYDEL POWER PLANTS 9

Nuclear Power Plant: Layout - Selection Criteria – Types of Reactors - Radioactivity – Fission Process – Reaction Rates – Diffusion Theory -Elastic Scattering and Slowing Down – Global Standards in Waste Disposal and Nuclear Safety. Hydel Power Plant: Layout - Selection Criteria - Selection of Turbines -Micro Hydel Developments.

UNIT IV OTHER TYPES OF POWER GENERATION 9

MHD Power Generation –Solar Thermal and PV System- WECS - Types – Biomass -Geo thermal –OTEC- Micro Fuel Cells and Portable Power - Comparative Analysis of Combined Heat and Power Cycles.

UNIT V POWER PLANT ECONOMICS 9

Cost of Electric Energy – Load Duration Curves-Fixed and Operating Costs – Energy Rates – Types of Tariffs – Economics of Load Sharing - Comparison -Selection and Economics of Various Power Plants – Energy Auditing – Types - Energy Auditing for Thermal Power Plant – Waste Heat Recovery Boilers in Cement, Sugar and Steel Plants

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Nag P K, "Power Plant Engineering", 3rd Edition, Tata McGraw Hill Publishing Company, 2018.
2. Rajput R K, "A Text Book of Power Plant Engineering", 5th Edition, Laxmi Publications, 2019.

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REFERENCES:

1 El-Wakil M M, "Power Plant Technology", Tata McGraw Hill, 2019.

2 Godfrey Boyle, "Renewable Energy", Oxford University Press, 2018.

3 Bansal N K, "Non-Conventional Energy Resources", Vikas Publishing House, 2019.

ONLINE RESOURCES:

1 https://nptel.ac.in/courses/112107291

2 https://onlinecourses.nptel.ac.in/noc22_me73/preview

3 https://archive.nptel.ac.in/courses/121/106/121106014

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the construction and working of the components inside a thermal power plant.

CO2 Summarize the construction and working of the Diesel, Gas and Combined cycle power plants.

CO3 Describe the construction and working of the nuclear and hydel power plants.

CO4 Apply the layout, construction and working of the Renewable energy power plants.

CO5 Summarize the applications of power plants and power plant economics

CO – PO - PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	1	1	-	-	-	-	-	2	1
CO2	2	2	1	1	-	1	1	-	-	-	-	-	2	1
CO3	2	2	1	1	-	1	1	-	-	-	-	-	2	1
CO4	3	2	1	2	-	1	1	-	-	-	-	-	2	1
CO5	2	2	1	1	-	1	1	-	-	-	-	-	2	1

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U23ME702	AUTOMOBILE ENGINEERING	L	T	P	C
		3	0	0	3

Prerequisites: Design of Transmission System

Course Objectives:

- To impart an insight in construction and working principle of various parts of an automobile
- To describe the assembling and dismantling process of engine parts and transmission system
- To study about different alternate fuels, emission forms and standards for IC Engine for the betterment of society

UNIT I VEHICLE STRUCTURE AND ENGINES 9

Types of automobiles, vehicle construction and different layouts, chassis, frame and body, Vehicle aerodynamics (various resistances and moments involved), IC Engine components – functions, materials and its applications

UNIT II ENGINE AUXILIARY SYSTEMS 9

Electronically controlled gasoline injection system for SI engines (SPI, MPFI, GDI), electronically controlled diesel injection system, electronic ignition system, Supercharger and Turbo chargers (WGT, VGT), Engine emission control by three-way catalytic converter system.

UNIT III TRANSMISSION SYSTEMS 9

Clutch-types and construction, gear boxes-manual and automatic, gear shift mechanisms, overdrive, transfer box, fluid flywheel, torque converter, propeller shaft, slip joints, universal joints Differential and rear axle.

UNIT IV STEERING, BRAKES AND SUSPENSION SYSTEMS 9

Steering geometry and types of steering gear box - Power Steering, Types of Front Axle, Types of Suspension Systems, Pneumatic and Hydraulic Braking Systems, Anti- Lock Braking System (ABS), electronic brake force distribution (EBD) and Traction Control

UNIT V ALTERNATIVE ENERGY SOURCES 9

Hybrid Vehicles - Fuel Cell – Electric Battery, Electric vehicle – feasibility study of Electric, Hybrid and fuel cell vehicle, Alternate fuels - Emission norms (Euro and BS) and Driving cycle.

TOTAL : 45 PERIODS

TEXT BOOKS:

1 Jain K K, Asthana R B, "Automobile Engineering", Tata McGraw Hill, 2017.

2 Kirpal Singh, "Automobile Engineering", 7th Edition, Standard Publishers, 2018.

REFERENCES:

1 Ganesan V, "Internal Combustion Engines", 3rd Edition, Tata McGraw Hill, 2017.

2 Heinz Heisler, "Advanced Engine Technology", SAE International Publications, 2018.

3 Joseph Heitner, "Automotive Mechanics", 2nd Edition, East West Press, 2017.

ONLINE RESOURCES:

1 https://nptel.ac.in/courses/107/106/107106088

2 https://nptel.ac.in/courses/108106170

3 https://archive.nptel.ac.in/courses/112/103/112103262

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1	Summarize the automobiles, their construction and describe various components.
CO2	Explain the auxiliary systems like ignition, injection and emission control systems of an engine.
CO3	Apply the various transmission systems like clutches, gear boxes and axle systems.
CO4	Describe the steering, braking and suspension systems in automobile engineering.
CO5	Apply the concept of alternative energy sources in Hybrid and Electric vehicles.

CO – PO - PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	-	-	-	-	-	-	2	1
CO2	2	2	1	1	-	-	-	-	-	-	-	-	2	1
CO3	3	2	1	2	-	-	-	-	-	-	-	-	2	1
CO4	2	2	1	1	-	-	-	-	-	-	-	-	2	1
CO5	3	2	1	2	-	-	2	2	-	-	-	-	2	1

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U23ME703	MECHATRONICS	L	T	P	C
		3	0	2	4

Prerequisites: Hydraulic and Pneumatics

Course Objectives:

- To Understand key elements of Mechatronics system, impart knowledge on various types of sensors, microprocessor and microcontroller programming
- To Understand the concept of programmable peripheral interface and PLC system and its ladder programming, and Significance of PLC systems in industrial application.
- To understand the design process in mechatronics system and study various case studies.

UNIT I INTRODUCTION TO MECHATRONICS AND SENSORS 9

Introduction to Mechatronics – Systems – Concepts of Mechatronics approach – Need for Mechatronics – Emerging areas of Mechatronics – Classification of Mechatronics. Sensors and Transducers: Static and dynamic Characteristics of Sensor, Potentiometers – LVDT – Capacitance sensors – Strain gauges – Eddy current sensor – Hall effect sensor – Temperature sensors.

UNIT II MICROPROCESSOR AND MICROCONTROLLER 9

Introduction – Architecture of 8085 – Pin Configuration – Addressing Modes –Instruction set, Timing diagram of 8085 – Concepts of 8051 microcontroller – Block diagram,.

UNIT III PROGRAMMABLE PERIPHERAL INTERFACE 9

Introduction – Architecture of 8255, Keyboard interfacing, LED display –interfacing, ADC and DAC interface, Temperature Control – Stepper Motor Control – Traffic Control interface.

UNIT IV PROGRAMMABLE LOGIC CONTROLLERS 9

Introduction- Basic structure- Input and output processing- Programming- Mnemonics- Timers, counters and internal relays- Data handling-Selection of PLC.

UNIT V MECHATRONICS SYSTEM DESIGN AND CASE STUDIES 9

Design process-stages of design process-Traditional and Mechatronics design concepts- Case studies of Mechatronics systems- Pick and place Robot - Engine Management system- Automatic car park barrier.

45 PERIODS

PRACTICAL EXERCISES:

1. Design a hydraulic circuit to actuate the cylinders in sequence A+B+A-B-.
2. Write a program to run the stepper motor in clockwise direction by 8085 Microcontroller kit.
3. Write a program to Add two numbers by 8051 Microcontroller kit.
4. Design a Electro Pneumatic circuit to actuate Single acting cylinder.
5. Design a Electro Pneumatic circuit to actuate Double acting cylinder.
6. Design a Pneumatic circuit to actuate Single acting cylinder by PLC.
7. Design a Pneumatic circuit to actuate Double acting cylinder by PLC.

30 PERIODS

TOTAL : 75 PERIODS

TEXT BOOKS:

1. William Bolton, "Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering", 7th Edition, Pearson Education, 2023.

2 Godfrey C. Onwubolu, " Mechatronics: Principles and Applications ", 2nd Edition, Elsevier's Science & Technology, 2023.

REFERENCES:

1 David G. Alciatore, Michael B. Histand, "Introduction to Mechatronics and Measurement Systems ", 6th Edition, Tata McGraw Hill, 2023.

2 Biswanath samanta, "Introduction to Mechatronics: An Integrated Approach", 1st Edition, Springer, 2024.

3 Ajay kumaretal, "Mechatronics: Concepts, Tools, Applications, and New Trends", 1st Edition, CRC Press, 2025.

ONLINE RESOURCES:

1 https://onlinecourses.nptel.ac.in/noc22_me128/preview

2 https://www.classcentral.com/subject/mechatronics

3 https://cursa.app/en/free-course/mechtronics-chjh

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Describe the key elements of the mechatronics system and various types of sensors.

CO2 Explain about the Architecture of 8085 Microprocessor and 8051 Microcontroller.

CO3 Explain about the architecture of 8255 programmable peripheral interface and its applications.

CO4 Describe the architecture of PLC with ladder programming.

CO5 Comprehend the various stages of mechatronics system and different types of case studies.

CO – PO - PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	1	-	-	1	-	-	-	-	1	1
CO2	2	2	1	1	1	-	-	1	-	-	-	-	1	1
CO3	2	2	1	1	1	-	-	1	-	-	-	-	1	1
CO4	2	2	1	1	1	-	-	1	-	-	-	-	1	1
CO5	2	2	1	1	1	-	-	1	-	-	-	-	1	1

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U23MG701	PROJECT MANAGEMENT AND FINANCE	L	T	P	C
Prerequisites:	**Basic management and finance concepts**	2	0	0	2

COURSE OBJECTIVES:

- To know about basic concepts of operational and project management
- To impart the knowledge of the project structure and process of project appraisal.
- To know about formulation of a team, implementation, monitoring and controlling a project.

UNIT I **BASIC CONCEPT** **6**

Concept and categories of project - Project development cycle - Concept, tools and techniques of project management - Logistics and supply chain management - Forms of project organizations.

UNIT II **THE VERTICAL STRUCTURE PLANE** **6**

Project identification, formulation and preparation. Market and demand estimation – Market survey techniques - Demand forecasting. Materials management - Analysis of materials input, technology, production, plant capacity, location and site, civil works, charts, layouts and work schedule. Cost of project - Means of financing, estimates of cost – Financial projections.

UNIT III **PROCESS OF PROJECT APPRAISAL** **6**

Technical, Economic, Financial, Legal and Social appraisal of the Industrial Projects Problems due to rate of discount, wage-rate, exchange rates, treatment of taxes, social cost – benefits -treatment of risk and uncertainty - sensitivity analysis and probability approach - Single as well as multiple projects - Big data analytics - PLM and SLM.

UNIT IV **PROJECT TEAM FORMULATION AND MAXIMIZING PARTICIPATION** **6**

Project Team frame works – Project Team cultures - Barriers and challenges – Selecting Team Members – Key skills of effective project leaders - Giving / receiving feedback from different members of the project.

UNIT V **IMPLEMENTATION, MONITORING AND CONTROL OF PROJECTS** **6**

Project scheduling, network techniques for resource, cost budgeting and scheduling – project management teams and coordination – Monitoring and post implementation, evaluation of the project – ERP – Project financing.

TOTAL: 30 PERIODS

TEXT BOOKS:

1 Gobalakrishnan P and Ramamoorthy V E, "Textbook of Project Management", Trinity Press, 7th Edition, 2014.

2 Harvey Maylor, "Project Management", 3rd Edition, Pearson Education, 2010.

REFERENCES:

1 James P Clements, Jack Gido, "Effective project management", 3rd Edition, Cengage Learning, 2008.

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2 Clifford F Gray, Erik W Larson, "Project Management: The Managerial Process", 3rd Edition, TMH, 2010.
3 Sadhan Choudhury, "Project Management", Tata Mc-Graw Hill Publishing Co., 1st Edition, 2007.

Upon the completion of the course, the students will be able to

CO1 Explain the concept of operational and project management.

CO2 Define the scope of a project and develop the project plan.

CO3 Evaluate the technical, business and social environment related to the project.

CO4 Explain team formulation and successful team management.

CO5 Design projects using tools and techniques.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	3	-	3	2	-	3	3
CO2	-	-	-	-	-	3	-	3	2	-	3	3
CO3	-	-	-	-	-	3	-	3	2	-	3	3
CO4	-	-	-	-	-	3	-	3	2	-	3	3
CO5	-	-	-	-	-	3	-	3	2	-	3	3

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U23ME705	SIMULATION AND ANALYSIS LABORATORY	L	T	P	C
		0	0	3	1.5

Course Objectives:

- To give exposure to software tools needed to analyze engineering problems.
- To expose the students to different applications of simulation and analysis tools.

LIST OF EXPERIMENTS

A	**SIMULATION**
1	MATLAB basics, Dealing with matrices, Graphing-Functions of one variable and two variables
2	Use of Matlab to solve simple problems in vibration
B	**ANALYSIS**
1	Force and Stress analysis using link elements in Trusses, cables etc.
2	Stress and deflection analysis in beams with different support conditions
3	Stress analysis of flat plates and simple shells.
4	Stress analysis of axis – symmetric components.
5	Thermal stress and heat transfer analysis of plates.
6	Thermal stress analysis of cylindrical shells.
7	Vibration analysis of spring-mass systems.
8	Model analysis of Beams.

TOTAL: 45 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.NO	NAME OF THE EQUIPMENT	QTY
1	Computer Workstation	15
2	Colour Desk Jet Printer	01
3	Multibody Dynamic Software Suitable for Mechanism simulation & analysis	15 Licenses
4	C / MATLAB	5 Licenses

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1	Analyze the working principle of air conditioning system, hydraulic and pneumatic cam follower mechanisms using MATLAB.
CO2	Analyze the stresses and strains induced in plates, brackets and beams and heat transfer problems.
CO3	Evaluate the natural frequency and mode shape analysis of 2D components and beams.
CO4	Explain the Knowledge regarding the mechanism of heat transfer in mechanical components.
CO5	Evaluate the vibration effects on mechanical components.

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CO – PO - PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1	-	-	1	1	-	-	2	2	1
CO2	3	3	2	2	1	-	-	1	1	-	-	2	2	1
CO3	3	3	2	2	1	-	-	1	1	-	-	2	2	1
CO4	2	2	1	1	1	-	-	1	1	-	-	2	2	1
CO5	3	3	2	2	1	-	-	1	1	-	-	2	2	1

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U23PEME01	GAS DYNAMICS AND JET PROPULSION	L	T	P	C
		3	0	0	3

Prerequisites: Fluid Mechanics

Course Objectives:

- To understand the basic difference between incompressible& compressible Flow.
- To understand the phenomenon of shock waves and its effect on flow.
- To gain some basic Knowledge about jet propulsion and Rocket Propulsion.

(Use of Gas Tables book is permitted)

UNIT I 9

Energy and momentum equations of compressible fluid flows – Stagnation states, Mach waves and Mach cone – Effect of Mach number on compressibility – Isentropic flow through variable ducts – Nozzle and Diffusers, Design of inlets nozzles and Diffusers.

UNIT II FLOW THROUGH DUCTS 9

Flows through constant area ducts with heat transfer (Rayleigh flow), Slope of Rayleigh line, and Friction (Fanno flow) Slope of Fanno line– Flows through constant area ducts in an isothermal flow-variation of flow properties.

UNIT III NORMAL AND OBLIQUE SHOCKS 9

Governing equations –Variation of flow parameters across the normal and oblique shocks –Prandtl –Meyer relations, Rankine-Hugoniot equations, Strength of the shock– Applications.

UNIT IV JET PROPULSION 9

Theory of jet propulsion –Thrust equation –Thrust power and propulsive efficiency – Operating principle, cycle analysis and performance characteristics of ram jet, turbojet, turbofan and turbo prop engines, Aircraft matching.

UNIT V SPACE PROPULSION 9

Types of rocket engines – Propellants feeding systems – Theory of rocket propulsion – Performance study – Terminal and characteristic velocity – Applications – space flights- Rocket equations – Escape and Orbital velocity.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Anderson, J D, "Modern Compressible flow", 3rd Edition, Tata McGraw Hill, 2018.

2 Yahya S M, "Fundamentals of Compressible Flow", New Age International Pvt. Ltd, 2019.

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REFERENCES:

1 Ganesan V "Internal Combustion Engines", 3rd Edition, Tata McGraw Hill, 2019.

2 Heinz Heisler, "Advanced Engine Technology, "SAE International Publications, 2018.

3 Yahiya S M "Gas Tables", 9th Edition, New Age International Publishers, 2022.

ONLINE RESOURCES:

1 https://nptel.ac.in/courses/112103021/101106044/112106166

2 https://www.sciencedirect.com/topics/engineering/jet-propulsion

3 https://theory-of-aerospace-propulsion/sforza/978-1-85617-912-6

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Apply heat conduction equations to different surface configurations under steady state and transient conditions.

CO2 Apply free & forced convective heat transfer correlations to internal & external flow through/over various surface configurations.

CO3 Apply LMTD and NTU methods of thermal analysis to different types of heat exchanger configurations.

CO4 Apply the principles to radiative heat transfer between different types of surfaces to solve problems.

CO5 Apply diffusive and convective mass transfer equations and correlations to with different applications.

CO–PO–PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	-	-	-	1	-	-	-	-	3	-
CO2	3	2	1	2	-	-	-	1	-	-	-	-	3	-
CO3	3	2	1	2	-	-	-	1	-	-	-	-	3	-
CO4	3	2	1	2	-	-	-	1	-	-	-	-	3	-
CO5	3	2	1	2	-	-	-	1	-	-	-	-	3	-

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U23PEME02	REFRIGERATION AND AIR CONDITIONING	L	T	P	C
		3	0	0	3

Prerequisites: Thermal Engineering

Course Objectives:

- To understand the underlying principles of operations in different Refrigeration systems.
- To give an overall knowledge on psychometric properties and processes
- To provide knowledge on design aspects and load estimation of Refrigeration & Air conditioning system

(Use of Refrigerant Tables and Charts are permitted)

UNIT I INTRODUCTION 9

First and Second Laws of Thermodynamics - Heat Engines-Heat Pumps- Refrigeration Systems - Unit of Refrigeration and C.O.P.– Refrigerants, Desirable properties – Classification – Nomenclatures. Ton of Refrigeration. Refrigeration Cycles: Reverse Carnot Cycle -Bell Coleman Cycle

UNIT II VAPOUR COMPRESSION REFRIGERATION SYSTEM 9

Vapour compression cycle: p-h and T-s diagrams - deviations from theoretical cycle – sub cooling and super heating- effects of condenser and evaporator pressure on COP- multi pressure system - low temperature refrigeration - Cascade systems – problems. Equipment's: Type of Compressors, Condensers, Expansion devices, Evaporators.

UNIT III OTHER REFRIGERATION SYSTEMS 9

Working principles of Vapour absorption systems and adsorption cooling systems – Steam jet refrigeration- Ejector refrigeration systems- Thermoelectric refrigeration- Air refrigeration - Magnetic Vortex and Pulse tube refrigeration systems

UNIT IV PSYCHROMETRIC PROPERTIES AND PROCESSES 9

Properties of moist Air-Gibbs Dalton law, Specific humidity, Dew point temperature, Degree of saturation, Relative humidity, Enthalpy, Humid specific heat, Wet bulb temperature Thermodynamic wet bulb temperature, Psychometric chart; Psychometric of air-conditioning processes, mixing of air streams.

UNIT V AIR CONDITIONING SYSTEMS AND LOAD ESTIMATION 9

Air conditioning loads: Outside and inside design conditions; Heat transfer through structure, human comfort & IAQ principles, effective temperature & chart, calculation of summer & winter air conditioning load; Classifications, Layout of plants; Air distribution system; Filters; Air Conditioning Systems with Controls: Temperature, Pressure and Humidity sensors, Actuators & Safety controls.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Arora, C P, "Refrigeration and Air Conditioning", 3rdEdition, Tata McGraw Hill, 2010.
2. Yahya S M, "Fundamentals of Compressible Flow", New Age International Pvt. Ltd., 2019.

REFERENCES:

1 Roy J Dossat, "Principles of Refrigeration", 4th Edition, Pearson Education , 2009.

2 Arora, C P, "Refrigeration and Air Conditioning", 3rd Edition, Tata McGraw Hill, 2010.

3 Ananta Narayanan P N, "Basic Refrigeration and Air Conditioning", 4th Edition, Tata McGraw Hill, 2013.

ONLINE RESOURCES:

1 https://nptel.ac.in/courses/112105129/

2 https://archive.nptel.ac.in/courses/112/107/112107208/

3 https://link.springer.com/article/10.1134/S0010508212040053

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the basic concepts of Refrigeration.

CO2 Solve analytical problems in Vapour Compression Refrigeration systems.

CO3 Explain the vapour absorption systems, adsorption cooling systems and other refrigeration systems.

CO4 Explain the psychometric chart for solving various air conditioning and psychometric processes.

CO5 Calculate the load in various air conditioning systems.

CO–PO–PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	-	1	-	-	-	-	2	-
CO2	3	2	1	2	-	-	-	1	-	-	-	-	3	-
CO3	2	2	1	1	-	-	-	1	-	-	-	-	3	-
CO4	2	2	1	1	-	-	-	1	-	-	-	-	2	-
CO5	3	2	1	2	-	-	-	1	-	-	-	-	3	-

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U23PEME03	COMPUTATIONAL FLUID DYNAMICS	L	T	P	C
		2	0	2	3

Prerequisites: Fluid Mechanics

Course Objectives:

- To expose the students to the basics of CFD and the procedures
- To acquire knowledge of finite difference and finite volume methods
- To acquire the ability to solve the problems using finite volume method

UNIT I INTRODUCTION AND GOVERNING EQUATIONS 6

Introduction - Impact and applications of CFD in diverse fields - Governing equations of fluid dynamics – Continuity - Momentum and energy - Generic integral form for governing equations - Initial and Boundary conditions - Governing equations for boundary layers - Classification of partial differential equations – Hyperbolic - Parabolic - Elliptic and Mixed types - Applications and relevance.

UNIT II FINITE DIFFERENCE METHOD 6

Derivation of finite difference equations – Simple Methods – General Methods for first and second order accuracy – solution methods for finite difference equations – Elliptic equations – Iterative solution Methods – Parabolic equations – Explicit and Implicit schemes

UNIT III FINITE VOLUME METHOD FOR CONDUCTION 6

Finite volume formulation for steady state one and two -dimensional diffusion problems. One dimensional unsteady heat conduction through Explicit, Crank – Nicolson and fully implicit schemes.

UNIT IV FINITE VOLUME METHOD FOR CONVECTION 6

Steady one-dimensional convection– Central, upwind differencing schemes-properties of discretization schemes – Conservativeness, Roundedness, Transportiveness, Hybrid, Power- law, QUICK Schemes.

UNIT V PROBLEM SOLVING USING CFD 6

Turbulence Modelling, different turbulent modelling scheme. Incompressible Viscous Flows: Applications to internal flows and boundary layer flows. Eddy viscosity and non-eddy viscosity models; Vehicle Aerodynamic Simulation Wind tunnel and on-road simulation of vehicles; simulation in climatic and acoustic wind tunnels; velocity vector and pressure contour simulation.

30 PERIODS

TEXT BOOKS:

1 Hoffman, "Computational Fluid Dynamics for Engineering", 3rd Edition, Engineering Education System, 2019.

2 Chung T J, "Computational Fluid Dynamics", Cambridge University Press, 2020.

REFERENCES:

1. Anil W, "Introduction to Computational Fluid Dynamics", Cambridge University Press, 2019.
2. Muralidhar K, Sundararajan T, "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, 2020.
3. Patankar, S V "Numerical Heat Transfer and Fluid Flow", Hemisphere Publishing Corporation, 2021.

ONLINE RESOURCES:

1. https://www.mie.utoronto.ca/
2. https://nptel.ac.in/courses/112/107/112107079/
3. https://www.udemy.com/topic/computational-fluid-dynamics/srsltid

PRACTICAL EXERCISES:

1. In-compressible flow Analysis to Measure uniformity of flow rates
2. Simulation of various flow problems
3. CFD simulation of flow analysis over a Cylinder Surface 3D.
4. CFD simulation of Intermixing of Fluids in a Bent-Pipe 3D.
5. CFD simulation of flow and heat transfer analysis of Double Pipe Counter Flow Heat Exchanger.

30 PERIODS
TOTAL: 60 PERIODS

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

- **CO1** Explain the mathematical representation of the governing equations of fluid flow and heat transfer.
- **CO2** Apply the explicit, implicit and semi-implicit methods of finite differencing based on applications
- **CO3** Analyse the governing equations to formulate numerical solutions for conduction problems using finite volume method
- **CO4** Summarize different schemes used for convection problems using finite volume methods
- **CO5** Apply the knowledge of CFD techniques, basic aspects of discretization and grid generation.

CO–PO–PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	-	1	-	-	-	-	3	-
CO2	3	2	1	2	-	-	-	1	-	-	-	-	3	-
CO3	3	3	2	2	-	-	-	1	-	-	-	-	3	-
CO4	2	2	1	1	-	-	-	1	-	-	-	-	3	-
CO5	3	2	1	2	-	-	-	1	-	-	-	-	3	-

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U23PEME04	ADVANCED IC ENGINES	L	T	P	C
		3	0	0	3

Prerequisites: Thermal Engineering

Course Objectives:

- Study the working of Gasoline fuel injection systems and SI combustion and the working of Diesel fuel injection systems and CI combustion.
- Identifying the source and measure it; explain the mechanism of emission formation andcontrol methods.
- Illustrate the Selecting alternative fuel resources and its utilization techniques in IC engines and future power train systems

UNIT I SPARK IGNITION ENGINES 9

Mixture requirements – Fuel injection systems – Mono-point, Multipoint & Direct injection - Stages of combustion – Normal and Abnormal combustion, Spark Knock, Factors affecting knock, Combustion chambers

UNIT II COMPRESSION IGNITION ENGINES 9

Diesel Fuel Injection Systems – Mechanical and Common Rail Direct Injection Systems Stages of combustion – Knocking – Factors affecting knock –Direct and Indirect injection systems – Fuel Spray behaviour – Spray structure and spray penetration – Air motion - Combustion chambers – Turbo charging – Waste Gate, Variable Geometry turbochargers.

UNIT III EMISSION FORMATION AND CONTROL 9

Sources – Formation of Carbon Monoxide, Unburnt hydrocarbon, Oxides of Nitrogen, Smoke and Particulate matter – Methods of controlling emissions – In-cylinder treatments – After treatment systems – Three Way Catalytic converter, Selective Catalytic Reduction, De-NOx Catalyst, Diesel Oxidation Catalyst and Particulate Traps – Methods of emission measurement – Emission norms and Driving cycles.

UNIT IV ALTERNATIVE FUEL 9

Alcohol Fuels, Hydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel - Properties, Suitability, Merits and Demerits – Utilisation Methods - Engine Modifications.

UNIT V ALTERNATE COMBUSTION AND POWER TRAIN SYSTEM 9

Low Temperature Combustion - Homogeneous charge compression ignition (HCCI) – Reactivity Controlled Compression Ignition (RCCI) – Gasoline Compression Ignition – Spark Assisted HCCI - Hybrid Electric and Electric Vehicles –- Fuel Cells.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Ganesan V, "Internal Combustion Engines", 5th Edition, Tata McGraw Hill, 2019.

2 John B Heywood, "Internal Combustion Engines Fundamentals", Tata McGraw Hill, 2021.

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REFERENCES:

1 Pundir B P, "IC Engines Combustion & Emission", Narosa Publishing House, 2018.

2 Ashok B P, "IC Engines ",Narosa Publishing House, 2018.

3 Duffy Smith, "Auto Fuel Systems", The Good Heart Wilcox Company, 2020.

ONLINE RESOURCES:

1 https://ocw.mit.edu/courses/2-61-internal-combustion-engines-spring-2017

2 https://fmcet.in/MECH/ME2041_uw.pdfhttps://easyengineering.net/me6016-advanced-i-c-engines/

3 https://easyengineering.net/me6016-advanced-i-c-engines

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the working of Gasoline fuel injection systems and SI combustion

CO2 Explain the working of Diesel fuel injection systems and CI combustion.

CO3 Explain the mechanism of emission formation and control methods.

CO4 Explain the alternative fuel resources and its utilization techniques in IC engines.

CO5 Explain advanced combustion modes and future power train systems.

CO–PO–PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	-	-	3	-	-	3	1	2
CO2	2	2	1	1	-	-	-	-	3	-	-	3	1	2
CO3	2	2	1	1	-	-	-	-	3	-	-	3	3	2
CO4	2	2	1	1	-	-	-	-	-	-	-	1	1	2
CO5	2	2	1	1	-	-	-	-	-	-	-	-	2	2

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U23PEME05	TURBO MACHINES	L	T	P	C
		3	0	0	3

Prerequisites: Fluid Mechanics and Machinery

Course Objectives:

- To study the energy transfer in rotor and stator parts of the turbo machines
- To study the function of various elements of centrifugal fans and blowers
- To evaluating the working and performance of centrifugal compressor

UNIT I **WORKING PRINCIPLES** **9**

Classification of Turbo machines. Energy transfer between fluid and rotor - Euler equation and its interpretation. Velocity triangles. Efficiencies in Compressor and Turbine stages. Degree of reaction. Dimensionless parameters for Turbo machines.

UNIT II **CENTRIFUGAL FANS AND BLOWERS** **9**

Types – components – working. Flow analysis in impeller blades-volute and diffusers. Velocity triangles - h-s diagram. Stage parameters in fans and blowers. Performance characteristic curves – various losses. Fan – bearings, drives and noise.

UNIT III **CENTRIFUGAL COMPRESSOR** **9**

Components - blade types. Velocity triangles - h-s diagram, stage work. Slip factor and Degree of Reaction. Performance characteristics and various losses. Geometry and performance calculation.

UNIT IV **AXIAL FLOW COMPRESSOR** **9**

Construction details. Work done factor. Velocity triangles - h-s diagram, stage work. Work done factor. Performance characteristics, efficiency and stage losses – Stalling and Surging. Free and Forced vortex flow.

UNIT V **AXIAL AND RADIAL FLOW TURBINES** **9**

Axial flow turbines - Types – Elements - Stage velocity diagrams - h-s diagram, stage work impulse and reaction stages. Compounding of turbines. Performance coefficients and losses. Radial flow turbines: Types – Elements - Stage velocity diagrams - h-s diagram, stage work Performance coefficients and losses.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Ganesan V, "Gas Turbines", 3rd Edition, Tata McGraw Hill, 2019.

2 Yahiya S M, "Turbines, Compressor and Fans", 4th Edition, Tata McGraw Hill, 2020.

REFERENCES:

1 Gopalakrishnan G , Prithvi Raj D," A Treatise on Turbo machines", 2nd Edition, SciTech Publications Pvt Ltd, 2018.

2 Venkanna, B K, "Fundamentals of Turbo machinery", Prentice Hall of India, 2019

3 Saravanamutto, Rogers, Cohen, Straznicky, "Gas Turbine Theory", 6th Edition, Pearson Education, 2020.

ONLINE RESOURCES:

1 https://www. NPTEL_4X4E0mYqJ1jre

2 https:// www. G/n-XcgJ-gSdmRtzl7

3 https://www.worldscientific.com/worldscibooks/10.1142/7582

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the energy transfer in rotor and stator parts of the turbo machines

CO2 Explain the function of various elements of centrifugal fans and blowers.

CO3 Evaluate the working and performance of centrifugal compressor.

CO4 Analyse flow behaviour and flow losses in axial flow compressor.

CO5 Explain the types and working of axial and radial flow turbines.

CO–PO–PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	-	-	1	-	-	1	2	-
CO2	2	2	1	1	-	-	-	-	1	-	-	1	2	-
CO3	3	3	2	2	-	-	-	-	1	-	-	1	2	-
CO4	3	3	2	2	-	-	-	-	1	-	-	1	2	-
CO5	2	2	1	1	-	-	-	-	1	-	-	1	2	-

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U23PEME06	COMBUSTION ENGINEERING	L	T	P	C
		3	0	0	3

Prerequisites: Thermal Engineering

Course Objectives:

- Discuss about the chemical reactions for the fuels and gaseous and vaporized Fuels.
- Analyse the combustion of liquid and solid fuels in turbines and boilers.
- Discuss the working principles of fluidized bed combustion and pressurized bed combustion.

UNIT I **CHEMICAL REACTIONS** **9**

Fuels and combustion, Theoretical and actual combustion processes, Enthalpy of formation and enthalpy of combustion, First law analysis of Reacting systems, Adiabatic flame temperature, Entropy change of reacting systems, Second law analysis of reacting systems, problems

UNIT II **COMBUSTION OF GASEOUS AND VAPORIZED FUELS** **9**

Review of types of fuels, Types of flames, Energy balance and furnace efficiency, Burner type, Emissions from gas-fired furnaces, Emissions control, Chamber design, Detonation.

UNIT III **COMBUSTION OF LIQUID FUELS** **9**

Spray combustion in furnace, spray formation and droplet behaviour, Gas turbine operating parameters, combustor design, ignition delay, and detonation of liquid fuel sprays.

UNIT IV **COMBUSTION OF SOLID FUELS** **9**

Drying of solid fuels, volatilization of solid fuels, stoker-fired boilers, Refuse and biomass fired boilers, Pulverized coal-burning systems, Pulverized coal combustion, Emission from pulverized coal, Problems

UNIT V **FLUIDIZED BED COMBUSTION** **9**

Fluidization fundamentals, combustion in bubbling bed, atmospheric fluidized bed combustion systems, circulating fluidized beds, pressurized fluidized bed combustion, problems.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Kenneth L, "Combustion Engineering in Mechanical", Tata McGraw Hill, 2017.

2 Ballaney P, "Thermal Engineering", 4th Edition, Khanna Publishers, 2018.

REFERENCES:

1 Gary L Borma, "Combustion Engineering", Tata McGraw Hill, 2019.

2 Kenneth Brayden, Kenneth W Ragland, Song-Charng Kong, "Combustion Engineering", 3rd Edition, Taylor & Francis, 2022.

3 Nag P K, "Basic and Applied Thermodynamics", 2nd Edition, Tata McGraw Hill, 2018.

ONLINE RESOURCES:

1 https://goodreads.com/book/show/3785353-combustion-engineering
2 https://engineering.purdue.edu/online/courses/combustion
3 https://www.classcentral.com/course/ fundamentals-of-combustion

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Evaluate the chemical reactions in fuels and first law, second law in chemical reactions.

CO2 Apply basic concepts in the design of combustion systems

CO3 Evaluate the performance of combustion in liquid in turbines.

CO4 Apply the working principles of combustion in solid fluids in boilers.

CO5 Analyse the performance of fluidized bed combustion and pressurized bed combustion.

CO–PO–PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	-	-	-	1	-	1	2	1	1
CO2	3	2	1	2	-	-	-	-	1	-	1	2	1	1
CO3	3	3	2	2	-	-	-	-	1	-	1	2	1	1
CO4	3	2	1	2	-	-	-	-	1	-	1	2	1	1
CO5	3	3	2	2	-	-	-	-	1	-	1	2	1	1

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U23PEME07	SUSTAINABLE ENERGY SOURCES	L	T	P	C
		3	0	0	3

Prerequisites: Basic Mechanical Engineering

Course Objectives:

- To get exposure to solar radiation and its environmental impact to power
- To know about the various applications in solar & Wind energy
- To know about Biomass & geothermal energy with other energy sources

UNIT I **ENERGY SCENARIO** **9**

Indian energy scenario in various sectors – domestic, industrial, commercial, agriculture, transportation and others – Present conventional energy status – Present renewable energy status-Potential of various renewable energy sources-Global energy status-Per capita energy consumption - Future energy plans.

UNIT II **SOLAR ENERGY** **9**

Solar radiation – Measurements of solar radiation and sunshine – Solar spectrum - Solar thermal collectors – Flat plate and concentrating collectors – Solar thermal applications – Solar thermal energy storage – Fundamentals of solar photovoltaic conversion – Solar cells – Solar PV Systems – Solar PV applications.

UNIT III **WIND ENERGY** **9**

Wind data and energy estimation – Betz limit - Site selection for wind farms – characteristics - Wind resource assessment - Horizontal axis wind turbine – components - Vertical axis wind turbine – Wind turbine generators and its performance – Hybrid systems – Environmental issues – Applications.

UNIT IV **BIO-ENERGY** **9**

Bio resources – Biomass direct combustion – thermochemical conversion - biochemical conversion-mechanical conversion - Biomass gasifier - Types of biomass gasifiers - Cogeneration –- Carbonisation – Pyrolysis - Biogas plants – Digesters – Biodiesel production – Ethanol production - Applications.

UNIT V **OCEAN AND THERMAL ENERGY** **9**

Small hydro - Tidal energy – Wave energy – Open and closed OTEC Cycles – Limitations – Geothermal energy – Geothermal energy sources - Types of geothermal power plants – Applications - Environmental impact.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Mehmet Kanoglu," Fundamentals and Applications of Renewable Energy", 1st Edition, Tata McGraw Hill, 2020.
2. Kothari, Renewable Energy Sources and Emerging Technologies, 2nd Edition, Prentice Hall of India, 2021.

REFERENCES:

1 Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, 2022.

2 Rai G D , "Non-Conventional Energy Sources", Khanna Publishers, 2019.

3 YorKrozer, "Economics of Renewable Energy", Tata McGraw Hill, 2019.

ONLINE RESOURCES:

1 https://onlinecourses.nptel.ac.in/noc25_ch40/preview
2 https://www.scimagojr.com/journalsearch.phpq
3 https://sciencedirect/aHjGcKP_7qE

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the Global and Indian energy Scenario

CO2 Explain the various energy Technologies and application

CO3 Explain the various wind energy technologies.

CO4 Explain the various Bio energy technologies

CO5 Explain the ocean and thermal energy technologies.

CO–PO–PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	-	1	-	-	-	-	2	-
CO2	2	2	1	1	-	-	-	1	-	-	-	-	2	-
CO3	2	2	1	1	-	-	-	1	-	-	-	-	2	-
CO4	2	2	1	1	-	-	-	1	-	-	-	-	2	-
CO5	2	2	1	1	-	-	-	1	-	-	-	-	2	-

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U23PEME08	ENERGY CONSERVATION IN INDUSTRIES	L	T	P	C
		2	0	2	3

Prerequisites: Fluid Mechanics

Course Objectives:

- Learn Quantifying the energy demand and energy supply scenario of nation.
- Analysing factors behind energy billing and applying the concept of demand
- Diagnosing the causes for under performance of various electrical utilities

UNIT I **INTRODUCTION** **6**

Energy scenario of World, India and TN - Environmental aspects of Energy Generation – Material and Energy balancing - Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers. Basic instruments for Energy Auditing.

UNIT II **ELECTRICAL SUPPLY SYSTEMS** **6**

Electricity Tariff structures – Typical Billing - Demand Side Management - HT and LT supply - Power Factor – Energy conservation in Transformers – Harmonics

UNIT III **ENERGY CONSERVATION IN MAJOR THERMAL UTILITIES** **6**

Stoichiometry - Combustion principles. Energy conservation in: Boilers - Steam Distribution Systems - Furnaces - Thermic Fluid Heaters – Cooling Towers – D.G. sets. Insulation and Refractories - Waste Heat Recovery Devices

UNIT IV **ENERGY CONSERVATION IN MAJOR ELECTRICAL UTILITIES** **6**

Energy conservation in: Motors - Pumps – Fans – Blowers - Compressed Air Systems - Refrigeration and Air Conditioning Systems - Illumination systems

UNIT V **ENERGY MONITORING, TARGETING, LABELLING AND ECONOMICS** **6**

Elements of Monitoring & Targeting System – CUSUM - Energy / Cost index diagram – Energy Labelling - Energy Economics – Cost of production and Life Cycle Costing - Economic evaluation techniques – Discounting and Non-Discounting - ESCO concept – PAT scheme

TOTAL: 30 PERIODS

TEXT BOOKS:

1. Prabodh Khampariya,"Energy Conservation and Management", 1st Edition, BR Publisher, 2016.
2. Nagabhushan Raju K, "Industrial Energy Conservation Techniques", Atlantic Publishers, 2017.

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REFERENCES:

1 Abbi Y P, Shashank Jai , "Handbook on Energy Audit and Environment Management", TERI Press, 2017.

2 Albert Thumann, Paul Mehta D, "Handbook of Energy Engineering", 7th Edition, The Fairmont Press, 2018.

3 Paul O' Callaghan, "Design and management for energy conservation", Pergamon Press, 2021.

ONLINE RESOURCES:

1 https://www.uppclonline.com/en_GB TipsforEnergyConservationforInd

2 https://kanchi.ac.in/coursematerials/BMEF187E10

3 https://kerone -role-of-the-energy-conservation-in-industries/

PRACTICAL EXERCISES:

1 Determination of calorific value of a gaseous fuel using Bomb Calorimeter.

2 Determination of calorific value of a solid and liquid fuel using Boy's Gas Calorimeter.

3 Computation of area of irregular shapes by using plan meter.

4 Performance test on 4-Stroke VCR (Variable Compression Ratio) Petrol Engine test rig.

5 Valve Timing diagram of an I.C. Engine

30 PERIODS
TOTAL: 60 PERIODS

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the energy demand and energy supply scenario of nation

CO2 Explain the factors behind energy billing and apply the concept of demand side

CO3 Explain the stoichiometric air requirement for any given fuel and quantify the energy

CO4 Analyse the causes for under performance of various electrical utilities

CO5 Apply CUSUM and other financial evaluation techniques to estimate the energy

CO–PO–PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	1	-	3	-	1	-	-	1	2	2
CO2	2	2	1	1	1	-	3	-	1	-	-	1	2	2
CO3	2	2	1	1	1	-	3	-	1	-	-	1	2	2
CO4	3	3	2	2	1	-	3	-	1	-	-	1	2	2
CO5	3	2	1	2	1	-	3	-	1	-	-	1	2	2

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U23PEME09	ENERGY STORAGE DEVICES	L	T	P	C
		3	0	0	3

Prerequisites: Basic Mechanical Engineering

Course Objectives:

- Study the various types of energy storage devices and technologies
- Learn the basics of batteries and hybrid systems for EVs and other mobile application
- Evaluate an insight into other energy storage devices, hydrogen, and fuel cells

UNIT I INTRODUCTION TO ENERGY STORAGE 9

Need for Energy Storage – Types of Energy Storage – Various forms of Energy Storage – Mechanical– Thermal - Chemical– Electrochemical – Electrical - Other alternative energy storage technologies – Efficiency and Comparison

UNIT II ENERGY STORAGE SYSTEMS 9

Pumped Air Energy Storage – Compressed Air Energy Storage – Flywheel – Sensible and Latent Heat Storage – Storage Materials – Performance Evaluation - Thermochemical systems – Batteries –Charging and Discharging – Battery testing and performance

UNIT III MOBILE AND HYBRID ENERGY STORAGE SYSTEMS 9

Batteries for electric vehicles - Battery specifications for cars, heart pacemakers, computer standby supplies – V2G and G2V technologies – HESS.

UNIT IV RENEWABLE ENERGY STORAGE AND ENERGY MANAGEMENT 9

Storage of Renewable Energy Systems –Solar Energy – Wind Energy – Energy Storage in Micro grid– Smart Grid – Energy Conversion Efficiency - Battery Management Systems – EVBMS – Energy Audit and Management

UNIT V OTHER ENERGY DEVICES 9

Superconducting Magnetic Energy Storage (SMES), Super capacitors – MHD Power generation – Hydrogen Storage - Fuel Cells – Basic principle and classifications – PEMFC, AMFC, DMFC, SOFC,MCFC and Biofuel Cells – Biogas Storage.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Rober Huggins, "Energy Storage: Fundamentals, Materials and Applications", 2nd Edition, Springer, 2015.
2. Dell, Ronald M Rand, David A J, "Understanding Batteries", Royal Society of Chemistry, 2017.

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REFERENCES:

1 Ibrahim A Rosen, "Thermal Energy Storage Systems and Applications", John Wiley & Sons, 2018.

2 Lindon David, "Handbook of Batteries", Tata McGraw Hill, 2021.

3 Aulice Scibioh M Viswanathan B, "Fuel Cells – Principles and Applications', University Press, 2022.

ONLINE RESOURCES:

1 https://energystorageforum.com/energy-storage-technologies

2 https://www.sciencedirect.com/journal/journal-of-energy-storage

3 http://eie.nits.ac.in/renewable-energy-and-energy-storage-systems

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the need and identify the suitable energy storage devices for applications

CO2 Explain the working of various energy storage devices and their importance

CO3 Explain the basic characteristics of batteries for mobile and hybrid systems

CO4 Analyse the storage of renewable energies and management systems

CO5 Explain the need for other energy devices and their scope for applications

CO–PO–PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	1	-	2	-	-	-	–	1	2	3
CO2	2	2	1	1	1	-	2	-	-	-	-	1	2	3
CO3	2	2	1	1	1	-	2	-	-	-	-	1	2	3
CO4	3	3	2	2	1	-	2	-	-	-	–	1	2	3
CO5	2	2	1	1	1	-	2	-	-	-	--	1	2	3

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U23PEME10	EQUIPMENT FOR POLLUTION CONTROL	L	T	P	C
		3	0	0	3

Prerequisites: Environmental Science

Course Objectives:

- To study the pollution control regulation and standards, water and wastewater
- To study the equipment for various water pollution
- To study the pollution monitoring equipment

UNIT I POLLUTION CONTROL REGULATIONS AND STANDARDS 9

Pollutants in water and wastewater – sources and impacts- Characteristics and impacts of solid and hazardous wastes - Indian Constitution and Environmental Protection Legislations - Environmental Standards under different Environmental legislations.

UNIT II EQUIPMENT FOR WATER POLLUTION CONTROL 9

Operational principles and Design criteria of Flash mixers, Flocculators, Clarifiers, Sand Filters, Adsorption Columns, Aerators, Air blowers, Distillation units, Centrifugal and Reciprocating Pumps, Chemical dosing systems, Motors, Pipes, valves and Fittings.- Filed visit to a wastewater treatment plant

UNIT III EQUIPMENT FOR AIR POLLUTION CONTROL 9

Operational principles and Design criteria of Cyclone separators, gravity settlers, Wet Scrubbers, Air strippers, Bag Filters, Electrostatic precipitators, Bio filters - Field visit to an industry with air pollution control systems

UNIT IV EQUIPMENT FOR SOLID WASTE PROCESSING 9

Operational principles and Design criteria of Cyclone separators, gravity settlers, Wet Scrubbers, Air strippers, Bag Filters, Electrostatic precipitators, Bio filters - Field visit to an industry with air pollution control systems

UNIT V POLLUTION MONITORING EQUIPMENT 9

Equipment's for sampling of water, solids and air- Sample preservation Equipment – incubators – Cold Storage systems- equipment for analysis of water and air samples- Ambient air and flue gas sampling and monitoring equipment

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Verlag Berlin, "Air Pollution Control Equipment - Selection, Design, Operation", Atlantic Publisher, 2018.

2 Kenneth C, "Air Pollution Control Equipment", CRC Press, 2019.

REFERENCES:

1 Metcalf Eddy, INC, "Wastewater Engineering – Treatment and Reuse", 4th Edition, Tata McGraw Hill, 2018.

2 Noel de Nevers, "Air Pollution Control Engg", Tata McGraw Hill, 2019.

3 Shyam Diwan & Armin Rosencranz, "Environmental Law and Policy in India", Oxford University Press, 2021.

ONLINE RESOURCES:

1 https://onlinecourses.nptel.ac.in/noc23_ce14/preview
2 https://sciendirect/video.php?id1938&c11
3 https://ch506npc.wordpress.com/2019/10/11/air-pollution-control

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the different types of pollution, their sources and effects
CO2 Analyse the pollution control regulations and standards
CO3 Explain the various equipment for pollution control
CO4 Explain the operational principles of solid waste processing
CO5 Explain the Conduct performance assessment of pollution control equipment

CO–PO–PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	3	-	1	-	-	-	2	-
CO2	3	3	2	2	-	-	3	-	1	-	-	-	2	-
CO3	2	2	1	1	-	-	3	-	1	-	-	-	2	-
CO4	2	2	1	1	-	-	3	-	1	-	-	-	2	-
CO5	2	2	1	1	-	-	3	-	1	-	-	-	2	-

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U23PEME11	BIOENERGY CONVERSION TECHNOLOGIES	L	T	P	C
		3	0	0	3

Prerequisites: Engineering Chemistry

Course Objectives:

- Elucidate on biomass, types, availability, and characteristics and study the bio-methanation process.
- Impart knowledge on combustion of biofuels and describe the significance of equivalence ratio on thermochemical conversion of biomass.
- Provide insight to the possibilities of producing liquid fuels from biomass

UNIT I **INTRODUCTION** **9**

Biomass: types – advantages and drawbacks – typical characteristics – proximate & ultimate analysis – comparison with coal - Indian scenario - carbon neutrality – biomass assessment studies – typical conversion mechanisms - densification technologies

UNIT II **BIOMETHANATION** **9**

Bio methanation process – influencing parameters – typical feed stocks – Biogas plants: types and design, Biogas appliances – burner, luminaries and power generation systems – Industrial effluent-based biogas plants

UNIT III **COMBUSTION** **9**

Perfect, complete and incomplete combustion – stoichiometric air requirement for biofuels - equivalence ratio – fixed Bed and fluid Bed combustion

UNIT IV **GASIFICATION, PYROLYSIS AND CARBONISATION** **9**

Chemistry of gasification - types – comparison – typical application – performance evaluation – economics. Pyrolysis - Classification - process governing parameters – Typical yield rates. Carbonization – merits of carbonized fuels – techniques adopted for carbonisation

UNIT V **LIQUIFIED BIOFUELS** **9**

Straight Vegetable Oil (SVO) as fuel - Biodiesel production from oil seeds, waste oils and algae Process and chemistry - Biodiesel Vs. Diesel – comparison on emission and performance fronts. Production of alcoholic fuels from biomass – engine modifications

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Nidhi Adlakha, Rakesh Bhatnagar , Syed Shams Yazdani, "Biomass for Bioenergy and Biomaterials", 1st Edition, CRC Press, 2021.
2. Augustine O Ayeni, Bioenergy and Biochemical Processing Technologies, Springer, 2022.

REFERENCES:

1 David Boyles, "Bio Energy Technology Thermodynamics and costs", Ellis Hoknood Chichester, 2020.

2 Mahaeswari R C, "Bio Energy for Rural Energisation", Concepts Publication, 2021.

3 Partita Bajpai,"Biomass to Energy Conversion Technologies", 1st Edition, Prakash India Private Limited, 2021.

ONLINE RESOURCES:

1 https://onlinecourses.nptel.ac.in/noc23_ch76/preview
2 https://www.sciencedirect.com/science/article/abs/pii/082
3 https://eleviser/mh51mAUexK4/featureshared/67

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the surplus biomass availability of any given area
CO2 Design a biogas plant for a variety of biofuels.
CO3 Evaluate the cost of steam generation coal and petroleum fuels
CO4 Analyse the influence of process governing parameters in thermochemical
CO5 Explain the Synthesize liquid biofuels for power generation from biomass

CO–PO–PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	1	-	-	-	-	-	2	-
CO2	3	3	3	3	-	-	1	-	-	-	-	-	2	-
CO3	3	3	2	2	-	-	1	-	-	-	-	-	2	-
CO4	3	3	2	2	-	-	1	-	-	-	-	-	2	-
CO5	2	2	1	1	-	-	1	-	-	-	-	-	2	-

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U23PEME12	SOLAR THERMAL TECHNOLOGY	L	T	P	C
		3	0	0	3

Prerequisites:

Course Objectives:

- To get exposure to solar radiation and its environmental impact to power
- To Understand the principles of thermal technology in solar thermal systems.
- To Understand the solar applications of various systems such as Hot water generation, space heating, distillation related to solar energy

UNIT I **SOLAR COLLECTORS** **9**

Introduction to Solar energy - Flat plate - Evacuated tube – Concentrated - Pool and Air collectors Construction – Function - Suitability – Comparison - Storage Tank - Solar Fluids – Collector Heat Exchanger Factor.

UNIT II **SOLAR WATER HEATING SYSTEMS** **9**

Natural, Forced circulation systems, Integral Collector Storage System - Thermo syphon System - Open Loop, Drain Down, Drain Back, Antifreeze Systems - Refrigerant Solar Water Heaters - Solar Heated Pools.

UNIT III **SOLAR SPACE CONDITIONING SYSTEMS** **9**

Liquid Type Solar Heating System With / Without Storage - Heat Storage Configurations – Heat Delivery Methods - Air-Type Solar Heating Systems - Solar Refrigeration and Air Conditioning.

UNIT IV **OTHER SOLAR APPLICATIONS** **9**

Solar Cooking – Distillation - Desalination - Solar Ponds – Solar Passive Architecture – Solar Drying – Solar Chimney – Swimming Pool Heating – Retrofit Water Heaters – Low Flow Pumped systems – Solar vehicles

UNIT V **SOLAR ECONOMICS** **9**

Application of economic methods to analyse the feasibility of solar systems to decide project / policy alternatives - Net energy analysis - cost requirements for active and passive heating and cooling - for electric power generation - and for industrial process-heating

TOTAL: 45 PERIODS

TEXT BOOKS:

1 J A Duffie, "Solar Engineering of Thermal Processes", John Wiley & Sons, 2019.

2 H P Garg, Bhargava, D Reidal, "Solar Thermal Energy Storage", Springer, 2020.

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REFERENCES:

1 Bob Ramlow, Benjamin Nusz, "Solar Water Heating, New Society Publishing", 2019.

2 John Canivan, "Solar Thermal Energy", Sunny Future Press, 2020.

3 Charles Christopher Newton, "Concentrated Solar Thermal Energy", Taylor & Francis Ltd., 2021.

ONLINE RESOURCES:

1 https://archive.nptel.ac.in/courses/115/103/115103123
2 https://www.sciencedirect.com/topics/engineering/solar-thermal
3 https://springer/mpHZWYpKDJgsi/fJejoX8oi_6AmQjs

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Describe the types of solar collectors, storage tank and collector heat heater
CO2 Explain the working principle of various solar water heating systems
CO3 Describe the solar space conditioning systems, heat storage configurations
CO4 Summarize the other solar applications such as solar cooking, chimney
CO5 Explain the importance of cost and estimation of solar systems

CO–PO–PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	-	1	-	-	-	-	2	-
CO2	2	2	1	1	-	-	-	1	-	-	-	-	2	-
CO3	2	2	1	1	-	-	-	1	-	-	-	-	2	-
CO4	2	2	1	1	-	-	-	1	-	-	-	-	2	-
CO5	2	2	1	1	-	-	-	1	-	-	-	-	2	-

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U23PEME13	DESIGN FOR MANUFACTURING	L	T	P	C
		2	0	2	3

Prerequisites: Strength of Materials

Course Objectives:

- To learn the design consideration principles in the design of cast products
- To learn design consideration principles of forming in the design
- To learn design consideration principles of machining in turned, drilled products

UNIT I **INTRODUCTION AND CASTING** **6**

Introduction - Economics of process selection - General design principles for manufacturability; Design considerations for: Sand cast – Die cast – Permanent mold cast parts

UNIT II **FORMING** **6**

Design considerations for: Metal extruded parts – Impact/Cold extruded parts – Stamped parts –Forged parts.

UNIT III **MACHINING** **6**

Design considerations for: Turned parts – Drilled parts – Milled, planed, shaped and slotted parts– Ground parts

UNIT IV **WELDING** **6**

Arc welding – Design considerations for: Cost reduction – Minimizing distortion – Weld strength – Weldment & heat treatment. Resistance welding – Design considerations for: Spot – Seam – Projection – Flash & Upset weldment

UNIT V **ASSEMBLY** **6**

Design for assembly – General assembly recommendations – Minimizing the no. of parts – Design considerations for: Rivets – Screw fasteners – Gasket & Seals – Press fits – Snap fits – Automatic assembly.

30 PERIODS

TEXT BOOKS:

1. Corradopoli "Design of Manufacturing", 2nd Edition, Tata McGraw Hill, 2017.
2. Tilley, Warma, "Design of Manufacturing and Assembly", Wheels Publishing, 2018.

REFERENCES:

1. Geoffrey Boothroyd, "Product Design for Manufacture and Assembly ", 5th Edition, Graw Hitchin, 2019.
2. Molly O, "Design for Manufacturing", 3rd Edition, Springer, 2020.
3. Pravin Kumar, "Fundamental of Design Manufacturing", 3rd Edition, S.K. Kataria & Sons, 2021.

PRACTICAL EXERCISES:

1. Preparation of green sand moulds various engineering components
2. Forging Engineering components

3	3. I. II. III.	Machining the following Taper turning Eccentric turning Drilling operation
4	Different types of joining of plates using arc welding machines	
5	Simple assembly of machine components	

30 PERIODS
TOTAL: 60 PERIODS

ONLINE RESOURCES:

1 https://archive.nptel.ac.in/courses/107/103/107103012
2 https://www.sciencedirect.com/book/97807506/design-for-manufacturing
3 https://link.springer.com/book/10.1007/978-3-662-68463-4

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Summarize the different methods of Manufacturing process
CO2 Design consideration principles of machining in turned, drilled products
CO3 Design consideration principles of forming in extruded, stamped, and forged products
CO4 Analyse the Economics of process selection
CO5 Design for assembly recommendations for Screw fasteners

CO–PO–PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	-	1	1	-	-	2	3	2
CO2	3	3	3	3	-	-	-	1	1	-	-	2	3	2
CO3	3	3	3	3	-	-	-	1	1	-	-	2	3	2
CO4	3	3	2	2	-	-	-	1	1	-	-	2	3	2
CO5	3	3	3	3	-	-	-	1	1	-	-	2	3	2

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U23PEME14	DESIGN OF JIGS AND FIXTURES	L	T	P	C
		3	0	0	3

Prerequisites: Design of Machine Elements

Course Objectives:

- To understand the functions &principles of Jigs, fixtures and press tools
- To gain proficiency in the development of required views of the final design
- To understand the press working terminologies and elements of cutting dies

Use of P S G Design Data Book is permitted in the University examination

UNIT I **LOCATING AND CLAMPING PRINCIPLES** **9**

Design and development of jigs and fixtures for given component- Types of Jigs – Post, Turnover, Channel, latch, box, pot, angular post jigs – Indexing jigs – General principles of milling, Lathe, boring, broaching and grinding fixtures – Assembly, Inspection and Welding fixtures – Modular fixturing systems- Quick change fixtures

UNIT II **JIGS AND FIXTURES** **9**

Design and development of jigs and fixtures for given component- Types of Jigs – Post, Turnover, Channel, latch, box, pot, angular post jigs – Indexing jigs – General principles of milling, Lathe, boring, broaching and grinding fixtures – Assembly, Inspection and Welding fixtures – Modular fixturing systems- Quick change fixtures.

UNIT III **PRESS WORKING TERMINOLOGIES AND ELEMENTS OF CUTTING DIES** **9**

Press Working Terminologies - operations – Types of presses – press accessories – Computation of press capacity – Strip layout – Material Utilization – Shearing action – Clearances – Press Work Materials – Centre of pressure- Design of various elements of dies – Die Block.

UNIT IV **BENDING AND DRAWING DIES** **9**

Difference between bending and drawing – Blank development for above operations – Types of Bending dies – Press capacity – Spring back – knockouts – direct and indirect – pressure pads – Ejectors – Variables affecting Metal flow in drawing operations.

UNIT V **FORMING TECHNIQUES AND EVALUATION** **9**

Bulging, Swaging, Embossing, coining, curling, hole flanging, shaving and sizing, assembly, fine Blanking dies – recent trends in tool design- computer Aids for sheet metal forming Analysis-Single minute exchange of dies – Poke yoke

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Joshi PH, "Jigs and Fixtures", 2nd Edition, Tata McGraw Hill, 2019.

2 Joshi PH, "Press tools - Design and Construction", Wheels Publishing, 2020.

REFERENCES:

1 Venkatraman K, "Design of Jig and Fixtures ", John Wiley & Sons, 2019.

2 Hoffman, "Jigs and Fixture Design", Thomson Delmar Learning, 2020.

3 Kempster, "Jigs and Fixture Design", 3rdEdition, Hoddes and Stoughton, 2021.

ONLINE RESOURCES:

1 https://archive.nptel.ac.in/courses/107/103/107103012
2 https:// www.sciencedirect.com/book/9780750673419
3 https:// link.springer.com/book/10.1007/978-3-662-68463

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Summarize the different methods of Locating Jigs and Fixtures and Clamping
CO2 Design the jigs and fixtures for given component
CO3 Explain the press working terminologies and elements of cutting dies
CO4 Describe the Bending and Drawing dies
CO5 Summarize the different types of forming techniques

CO–PO–PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	-	1	1	-	-	2	3	2
CO2	3	3	3	3	-	-	-	1	1	-	-	2	3	2
CO3	2	2	1	1	-	-	-	1	1	-	-	2	3	2
CO4	2	2	1	1	-	-	-	1	1	-	-	2	3	2
CO5	2	2	1	1	-	-	-	1	1	-	-	2	3	2

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U23PEME15	DESIGN FOR X	L	T	P	C
		3	0	0	3

Prerequisites: Manufacturing Technology

Course Objectives:

- To develop and design products for various engineering applications.
- To learn the design consideration principles of forming in the design of product
- To learn design consideration principles of machining in the design of Milling

UNIT I **INTRODUCTION** 9

General design principles for manufacturability - strength and mechanical factors, mechanisms selection, evaluation method, Process capability - Feature tolerances Geometric Tolerances - Assembly limits -Datum features - Tolerance stacks. Design to minimize material usage – Design for disassembly – Design for recyclability – Design for manufacture – Design for energy efficiency – Design to regulations and standards.

UNIT II **FACTORS INFLUENCING FORM DESIGN** 9

Working principle, Material, Manufacture, Design- Possible solutions - Materials choice – Influence of materials on form design - form design of welded members, forgings and castings.

UNIT III **COMPONENT DESIGN - MACHINING CONSIDERATION** 9

Design features to facilitate machining - drills - milling cutters - keyways - Doweling procedures, countersunk screws - Reduction of machined area- simplification by separation- simplification by amalgamation - Design for machinability

UNIT IV **COMPONENT DESIGN – CASTING CONSIDERATION** 9

Redesign of castings based on parting line considerations - Minimizing core requirements, machined holes, redesign of cast members to obviate cores. Identification of uneconomical design - Modifying the design - group technology - Computer Applications for DFMA

UNIT V **DESIGN FOR ADDITIVE MANUFACTURING** 9

Introduction to AM, DFMA concepts and objectives, AM unique capabilities, exploring design freedoms, Design tools for AM, Part Orientation, Removal of Supports, Hollowing out parts, Inclusion of Undercuts and Other Manufacturing Constraining Features

TOTAL: 45 PERIODS

TEXT BOOKS:

1 James G Braila, "Design for X", Tata McGraw Hill, 2018.

2 Molloy, Warman S, "Design for X-Concepts, Architectures and Implementation", Springer, 2019.

REFERENCES:

1 Huang G O," Design for X", Concurrent Engineering, Elsevier, 2018.

2 Kai Yang, "Design for Six Sigma: A Roadmap for Product Development", Tata McGraw Hill, 2019.

3 Graedel T Allen B, "Design for the Environment Angle Wood Cliff", Prentice Hall of India, 2020.

ONLINE RESOURCES:

1 https:// /resources/blog/design-for-x
2 https:// https://nptel.ac.in/courses/112107217
3 https://www.sciencedirect.com/topics/engineering/design-for-

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the design principles for x
CO2 Analyse the factors influencing form design
CO3 Analyse the component design features of various machines
CO4 Analyse the design consideration principles of welding in the design
CO5 Apply the design consideration principles of x

CO–PO–PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	-	1	1	-	-	2	3	2
CO2	3	3	2	2	-	-	-	1	1	-	-	2	3	2
CO3	3	3	2	2	-	-	-	1	1	-	-	2	3	2
CO4	3	3	2	2	-	-	-	1	1	-	-	2	3	2
CO5	3	2	1	2	-	-	-	1	1	-	-	2	3	2

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U23PEME16	DESIGN OF PRESSURE VESSELS	L	T	P	C
		3	0	0	3

Prerequisites: Design of Machine Elements

Course Objectives:

- To introduce the Mathematical knowledge to pressure vessels and piping
- To study the design of vessels and theory of reinforcement
- To learn piping layout and flow diagrams

UNIT I **INTRODUCTION** **9**

Methods for determining stresses – Terminology and Ligament Efficiency – Applications

UNIT II **STRESSES IN PRESSURE VESSELS** **9**

Introduction – Stresses in a circular ring, cylinder –Dilation of pressure vessels, Membrane stress Analysis of Vessel – Cylindrical, spherical and, conical heads – Thermal Stresses – Discontinuity stresses in pressure vessels.

UNIT III **DESIGN OF VESSELS** **9**

Design of Tall cylindrical self-supporting process columns – Supports for short vertical vessels –Stress concentration at a variable Thickness transition section in a cylindrical vessel, about a circular whole, elliptical opening. Theory of Reinforcement – Pressure Vessel Design

UNIT IV **BUCKLING AND FRACTURE ANALYSIS IN VESSELS** **9**

Buckling phenomenon – Elastic Buckling of circular ring and cylinders under external pressure –collapse of thick walled cylinders or tubes under external pressure – Effect of supports on Elastic Buckling of Cylinders – Buckling under combined External pressure and axial loading.

UNIT V **PIPING** **9**

Introduction – Flow diagram – piping layout and piping stress Analysis

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Dennis Mossis R, "Pressure Vessels Design ", 4th Edition, Butterworth-Heinemann, 2016.
2. John R Mackay, "Power Boiler and Pressure Vessels", 3rd Edition, ASME Publisher, 2018.

REFERENCES:

1. John F Harvey, "Theory and Design of Pressure Vessels", 3rd Edition, CBS Publishers and Distributors, 2019.
2. Harvey J F " Theory and Design of Pressure Vessels", TRS Publishers, 2019.
3. Sam Kannapan, "Introduction to Pipe Stress Analysis", 2nd Edition, John Wiley & Sons, 2020.

ONLINE RESOURCES:

1 https:// Pressure-Vessel-Design-Manual-Dennis/dp/0123870003
2 https:// www.udemy.com/course/design-of-pressure-vessel
3 https://onlinecourses.nptel.ac.in/noc22_ch63/preview

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain Methods for determining stresses Terminology and Ligament
CO2 Analyze the stress in pressure vessels for the given problem
CO3 Design a pressure vessel using safety standards
CO4 Evaluate buckling and cracks in vessels under load conditions
CO5 Develop a piping layout for a specific case.

CO–PO–PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	-	-	1	-	-	1	1	1
CO2	3	3	2	2	-	-	-	-	1	-	-	1	1	1
CO3	3	3	3	3	-	-	-	-	1	-	-	1	1	1
CO4	3	3	2	2	-	-	-	-	1	-	-	1	1	1
CO5	3	3	3	3	-	-	-	-	1	-		1	1	1

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U23PEME17	ERGONOMICS IN AUTOMOTIVE DESIGN	L	T	P	C
		3	0	0	3

Prerequisites: Fundamental Concept of Ergonomics

Course Objectives:

- To understand the fundamental principles of ergonomics
- To describe the ergonomics in seating and visibility and also their importance
- To study about the importance of ergonomics in frames, body in Automobile

UNIT I **FUNDAMENTALS OF ERGONOMICS** **9**

Introduction- principles – applications- Dimension Determination, Anthropometry – Need, Data collection methodology, Different postural considerations -Recent developments in ergonomics and styling

UNIT II **ERGONOMICS FOR SEATING** **9**

Seating dimensions- interior ergonomics- seat comfort- suspension seats- split frame seating-back pain reducers- driver & pillion seating arrangement dash board instruments-electronic displays commercial vehicle cabin ergonomics-mechanical package layout- goods vehicle layout.

UNIT III **ERGONOMICS FOR VISIBILITY** **9**

Regulations- driver's visibility- tests for visibility- methods of improving visibility and space- Dash board equipment and arrangement, mirror and cockpit design

UNIT IV **ERGONOMICS FOR FRAMES AND BODY** **9**

Types of frame, construction, loads, design consideration, materials, , ergonomics & comfort, Positioning of operational controls, Types of three wheeler bodies, layout, RTO regulations, aerodynamic, aesthetic & ergonomics considerations for body work.

UNIT V **VEHICLE ERGONOMICS** **9**

Passenger Compartment, Floor Pan, Vehicle interior ergonomics, ergonomics system design Technical requirements, Force Analysis, Seating and position – ECE Regulations, Human Factors, Navigation systems, pedal positioning Crash tests, forces in rollover, head on impact

45 PERIODS

TEXT BOOKS:

1 Vivek D Bhise "Ergonomics in the Automotive Design Process", CRC Press, 2017.

2 Gkika N "Automotive Ergonomics: Driver-Vehicle Interaction", CRC Press, 2018.

REFERENCES:

1 Johnson W and Mamalis A G , "Crashworthiness of Vehicles", MEP, 2019.

2 Edward A, "Lamps and Lighting", Hodder & Stoughton, 2020.

3 Arora Willen, "Ergonomics and Human Factors", SAE Publication, 2021.

ONLINE RESOURCES:

1 https://nptel.ac.in/courses/112104222
2 https://eleviser/courses/107103004
3 https:// noc/courses/noc19/SEM2/noc19-de01

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Summarize the various general ergonomic techniques
CO2 Design a new styling in a given vehicle model
CO3 Describe the importance of ergonomics in reducing driver fatigue
CO4 Explain the role of ergonomics in the look and safe operation
CO5 Apply the Knowledge in mirror design and logical formation cockpit

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	2	-	-	-	-	-	2	-
CO2	3	3	3	3	-	-	2	-	-	-	-	-	2	-
CO3	2	2	1	1	-	-	2	-	-	-	-	-	2	-
CO4	2	2	1	1	-	-	2	-	-	-	-	-	2	-
CO5	3	2	1	2	-	-	2	-	-	-	-	-	2	-

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U23PEME18	DESIGN CONCEPTS IN ENGINEERING	L	T	P	C
		3	0	0	3

Prerequisites: Design of Machine Elements

Course Objectives:

- To study the various design requirements and get acquainted with the processes involved in product development.
- To study the design processes to develop a successful product
- Designing solutions through the human needs and providing a solution

UNIT I **DESIGN TERMINOLOGY** **9**

Definition-various methods and forms of design-importance of product design-static and dynamic products-various design projects-morphology of design-requirements of a good design-concurrent engineering-computer aided engineering-codes and standards-product and process cycles-benchmarking

UNIT II **INTRODUCTION TO DESIGN PROCESSES** **9**

Basic modules in design process-scientific method and design method-Need identification, importance of problem definition-structured problem, real life problem-information gathering -customer requirementsQuality Function Deployment (QFD)-product design specifications-generation of alternative solutions Analysis.

UNIT III **CREATIVITY IN DESIGN** **9**

Creativity and problem solving-vertical and lateral thinking-invention-psychological view, mental blocksCreativity methods-brainstorming, synaptic, force fitting methods, mind map, concept map-Theory of innovative problem solving (TRIZ) - conceptual decomposition creating design concepts

UNIT IV **HUMAN AND SOCIETAL ASPECTS IN PRODUCT DEVELOPMENT** **9**

Human factors in design, ergonomics, user friendly design-Aesthetics and visual aspects environmental aspects-marketing aspects-team aspects-legal aspects-presentation aspects

UNIT V **MATERIAL AND PROCESSES IN DESIGN** **9**

Material selection for performance characteristics of materials-selection for new design substitution for existing design-economics of materials-selection methods-recycling and material selection-types of manufacturing process

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Dieter G N , Linda C Schmidt, "Engineering Design", Tata McGraw Hill, 2018.

2 Horenstein, M N, "Design Concepts for Engineers", Prentice Hall of India, 2019.

REFERENCES:

1 James Garratt, "Design and Technology", Cambridge University Press, 2018.

2 Joseph E Shigley, "Mechanical Engineering Design", Tata McGraw Hill , 2019.

3 Sumesh Krishnan, "Concepts in Engineering Design", Notion Press, 2020.

ONLINE RESOURCES:

1 https://nptel.ac.in/courses/12156393
2 https://eleviser/noc21_ee19/preview
3 https://springler/noc22_cs18/preview

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Analyse the various design requirements and get acquainted with the processes involved in the process

CO2 Apply the design processes to create a functional product

CO3 Apply scientific approaches to provide design solutions

CO4 Design solutions through the human needs

CO5 Apply the principles of material selection, costing and manufacturing in design

CO–PO–PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	-	-	-	1	-	-	1	2	-
CO2	3	2	1	2	-	-	-	-	1	-	-	1	2	-
CO3	3	2	1	2		-	-	-	1	-	-	1	2	-
CO4	3	3	3	3	-	-	-	-	1	-	-	1	2	-
CO5	3	2	1	2	-	-	-	-	1	-	-	1	2	-

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V4

U23PEME19	DIGITAL MANUFACTURING AND IOT	L	T	P	C
		2	0	2	3

Prerequisites: Concept of IoT

Course Objectives:

- To study the various aspects of digital manufacturing
- To formulate smart manufacturing systems in the digital work environment
- To interpret IoT to support digital manufacturing

UNIT I **INTRODUCTION** **6**

Introduction – Need – Overview of Digital Manufacturing and the Past – Aspects of Digital Manufacturing: Product life cycle, Smart factory, and value chain management – Practical Benefits of Digital Manufacturing – The Future of Digital Manufacturing

UNIT II **DIGITAL LIFE CYCLE & SUPPLY CHAIN MANAGEMENT** **6**

Collaborative Product Development, Mapping Requirements to specifications – Part Numbering, Engineering Vaulting, and Product reuse – Engineering Change Management, Bill of Material and Process Consistency – Digital Mock up and Prototype development – Virtual testing and collateral. Overview of Digital Supply Chain - Scope& Challenges in Digital SC - Effective Digital Transformation - Future Practices in SCM

UNIT III **SMART FACTORY** **6**

Smart Factory – Levels of Smart Factories – Benefits – Technologies used in Smart Factory – Smart Factory in IoT- Key Principles of a Smart Factory – Creating a Smart Factory – Smart Factories and Cyber security integration

UNIT IV **INDUSTRY 4.0** **6**

Introduction – Industry 4.0 –Internet of Things – Industrial Internet of Things – Framework: Connectivity devices and services – Intelligent networks of manufacturing – Cloud computing – Data analytics –Cyber physical systems –Machine to Machine communication – Case Studies

UNIT V **STUDY OF DIGITAL TWIN** **6**

Basic Concepts – Features and Implementation – Digital Twin: Digital Thread and Digital Shadow- Building Blocks – Types – Characteristics of a Good Digital Twin Platform – Benefits, Impact & Challenges – Future of Digital Twins.

TOTAL:30 PERIODS

TEXT BOOKS:

1. Zude Zhou, Shane, "Fundamentals of Digital Manufacturing Science", Springer, 2022.
2. Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", CRC press, 2021.

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REFERENCES:

1 Lihui Wang, "Collaborative Design and Planning for Digital Manufacturing", Springer, 2018.

2 Andrew Yeh, "Digital Twin Driven Smart Magnificence", 2019.

3 Andrew Chin, "IoT and edges computing for artificial intelligence", Perry Publication, 2021.

ONLINE RESOURCES:

1 https://onlinecourses.nptel.ac.in/noc20_cs69/preview
2 https://itmpravartak.org.in/digital_mfg_practice
3 https://www.sciencedirect.com/science/article/pii/S2665917422002951

PRACTICAL EXERCISES:

1 Measure the Distance Using Ultrasonic Sensor and Make Led Blink Using Arduino
2 Detect the Vibration of an Object Using Arduino
3 Sense a Finger When it is placed on Board Using Arduino
4 Temperature Notification Using Arduino
5 (a) Switch Light On and Off Based on the Input of User Using Raspberry Pi.
(b) Connect with the Available Wi-Fi Using Arduino

30 PERIODS
TOTAL:60 PERIODS

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the various elements in the digital manufacturing
CO2 Differentiate the concepts involved in digital product development life cycle
CO3 Apply the proper procedure of validating practical work through digital validation
CO4 Discuss the concepts of IoT and its role in digital manufacturing
CO5 Analyse and optimize practical manufacturing processes through digital twins

CO–PO–PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	2	-	-	-	1	-	-	1	1	-
CO2	2	2	1	1	2	-	-	-	1	-	-	1	1	-
CO3	3	2	1	2	2	-	-	-	1	-	-	1	1	-
CO4	3	3	2	2	2	-	-	-	1	-	-	1	1	-
CO5	3	3	2	2	2	-	-	-	1	-	-	1	1	-

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GOWRIVAKKAM, CHENNAI -

U23PEME20	NEW PRODUCT DEVELOPMENT	L	T	P	C
		3	0	0	3

Prerequisites: Engineering Design

Course Objectives:

- To introduce the fundamental concepts and development of Product
- To study the New product qualification and Market Survey on similar products
- To learn Reverse Engineering. Cloud points generation, converting cloud data to 3Dmodel

UNIT I **FUNDAMENTALS OF NPD** 9

Introduction – Reading of Drawing – Grid reading, Revisions, ECN (Engg. Change Note), Component material grade, Specifications, customer specific requirements – Basics of monitoring of NPD applying Gantt chart, Critical path analysis – Fundamentals of BOM (Bill of Materials), Engg. BOM & Manufacturing BOM. Basics of MIS software and their application in industries like SAP, MS Dynamics, and Oracle ERP Cloud– QFD

UNIT II **MATERIAL SPECIFICATIONS, ANALYSIS & PROCESS** 9

Material specification standards – ISO, DIN, JIS, ASTM, EN, etc. – Awareness on various manufacturing process like Metal castings & Forming, Machining (Conventional, 3 Axis, 4 Axis, 5 Axis,), Fabrications, Welding process.

UNIT III **ESSENTIALS OF NPD** 9

RFQ (Request of Quotation) Processing – Feasibility Studies & reporting – CFT (Cross Functional Team) discussion on new product and reporting – Concept design, Machine selection for tool making, Machining – Manufacturing Process selection, Machining Planning, cutting tool selection.

UNIT IV **CRITERIONS OF NPD** 9

New product qualification for Dimensions, Mechanical & Physical Properties, Internal Soundness proving through X-Ray, Radiography, Ultrasonic Testing, MPT, etc. Agreement with customer for testing frequencies.

UNIT V **REPORTING & FORWARD-THINKING OF NPD** 9

Detailed study on PPAP with 18 elements reporting, APQP and its 5 Sections, APQP vs PPAP, Importance of SOP (Standard Operating Procedure) – Purpose & documents, deployment in shop floor. Prototyping & RPT - Concepts, Application and its advantages, 3D Printing – resin models, Sand cores for foundries.

45 PERIODS

TEXT BOOKS:

1. Marc Anechoic "New Product Development: from Initial Idea to Product Management", 3rd Edition, L. B. Associates Pvt. Ltd., 2017.
2. Karl T Ulrich, Maria, "Product Design and development", 4th Edition, Tata McGraw Hill, 2018.

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REFERENCES:

1 Steven C, "Wheelwright Revolutionizing Product Development", CBR publisher, 2017.

2 James Morgan, "Toyota Product Development System", Elsevier, 2018.

3 Robert Brands, "Winning at New Products", 6th Edition, Butterworth-Heinemann, 2019.

ONLINE RESOURCES:

1 https://onlinecourses.swayam2.ac.in/imb19_mg01/preview
2 https://online sprinkler/imb23_mg01/preview
3 https://archive.nptel.ac.in/courses/112/107/112107217

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain fundamental concepts and requirements of the New Product development
CO2 Explain the Material specification standards, analysis and manufacturing process
CO3 Explain the Feasibility Studies & reporting of New Product development
CO4 Analyze the New product qualification and Market Survey on similar products.
CO5 Apply Reverse Engineering, converting cloud data to 3D models

CO–PO–PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	-	-	-	-	-	-	1	-
CO2	2	2	1	1	-	-	-	-	-	-	-	-	1	-
CO3	2	2	1	1	-	-	-	-	-	-	-	-	1	-
CO4	3	3	2	2	-	-	-	-	-	-	-	-	1	-
CO5	3	2	1	2	-	-	-	-	-	-	-	-	1	-

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U23PEME21	UNCONVENTIONAL MACHINING PROCESSES	L	T	P	C
		3	0	0	3

Prerequisites: Manufacturing Technology

Course Objectives:

- To learn about mechanical, thermal, and electrical machining processes.
- To learn about chemical and electro chemical machining processes
- To learn about recent and advanced machining processes, the various process

UNIT I MECHANICAL ENERGY BASED PROCESSES 9

Unconventional machining Process – Need – classification – merits, demerits and applications. Abrasive Jet Machining – Water Jet Machining – Abrasive Water Jet Machining - Ultrasonic Machining. (AJM, WJM, AWJM and USM). Working Principles – equipment used – Process parameters – MRR- Applications

UNIT II THERMAL AND ELECTRICAL ENERGY BASED PROCESSES 9

Electric Discharge Machining (EDM) – Wire cut EDM – Working Principle-equipment's-Process Parameters-Surface Finish and MRR- electrode / Tool – Power and control Circuits-Tool Wear – Dielectric – Flushing –– Applications. Laser Beam machining and drilling, (LBM), plasma, Arc machining (PAM) and Electron Beam Machining (EBM). Principles – Equipment –Types - Beam control techniques – Applications

UNIT III CHEMICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES 9

Chemical machining and Electro-Chemical machining (CHM and ECM) - Etchants – Maskant - techniques of applying maskants - Process Parameters – Surface finish and MRR-Applications. Principles of ECM- equipment's-Surface Roughness and MRR Electrical circuit-Process Parameters- ECG and ECH – Applications

UNIT IV ADVANCED NANO FINISHING PROCESSES 9

Abrasive flow machining, chemo-mechanical polishing, magnetic abrasive finishing, magneto rheological finishing, magneto rheological abrasive flow finishing their working principles, equipment's, effect of process parameters, applications, advantages and limitations

UNIT V RECENT TRENDS IN NON-TRADITIONAL MACHINING PROCESSES 9

Recent developments in non-traditional machining processes, their working principles, equipment's, effect of process parameters, applications, advantages and limitations. Comparison of non-traditional machining processes

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Vijay K Jain "Advanced Machining Processes", Allied Publishers Pvt. Ltd., 2017.

2 Pandey P C & Shan H S. "Modern Machining Processes", 3rd Edition, Tata McGraw Hill, 2019.

REFERENCES:

1 Benedict G F, "Non-traditional Manufacturing Processes", Marcel Dekker, 2018.

2 M Geough, "Advanced Methods of Machining", Chapman and Hall, 2019.

3 Paul De Garmo, "Material and Processes in Manufacturing", Allied Publishers, 2021.

ONLINE RESOURCES:

1 https://archive.nptel.ac.in/courses/112/105/112105212
2 https://eleviser/courses/112103202
3 https://sprinkler/watchv4Js4wfdqtYk

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the need for unconventional machining processes and its classification
CO2 Analyse the Various Effect of Thermal and Electrical Process in Machining.
CO3 Describe the Various Effect of Chemical and Electrical Chemical in Machining
CO4 Explain the various Nano abrasives based on unconventional machining processes
CO5 Analyse the various recent trends based on unconventional machining processes

CO–PO–PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	1	1	1	1	-	-	-	-	2	1
CO2	3	3	2	2	1	1	1	1	-	-	-	-	2	1
CO3	2	2	1	1	1	1	1	1	-	-	-	-	2	1
CO4	2	2	1	1	1	1	1	1	-	-	-	-	2	1
CO5	3	3	2	2	1	1	1	1	-	-	-	-	2	1

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U23PEME22	LEAN MANUFACTURING	L	T	P	C
		3	0	0	3

Prerequisites: Manufacturing Technology

Course Objectives:

- To introduce the basics of 6 SIGMA
- To study the lean concepts and its elements
- To learn implementation and challenges of lean manufacturing

UNIT I **BASICS OF 6 SIGMA** **9**

Introduction to 6 Sigma, basic tools of six sigma like problem solving approach, standard deviation, normal distribution, various sigma levels with some examples, value for the enterprise, Variation, and sources of variation, Mean and moving the mean, Various quality costs, cost of poor quality

UNIT II **INTRODUCTION TO LEAN MANUFACTURING TOOLS** **9**

Process Capability Indices, Cause and Effect diagram, Control Charts, Introduction to FMEA, APQP, PPAP. 3 foundational 6 Sigma methodologies: DMAIC, DMEDI, and Process Management DMEDI for process creation, DMAIC for process improvement and PDCA for sustaining improvements

UNIT III **DEEPER UNDERSTANDING METHODOLOGIES** **9**

What is a process, Why Process management, Keys to process management, Difference between process management and 6 Sigma, Introduction to Deming cycle, PDCA, DMAIC and continuous improvement, DMEDI for creation process, DMAIC Vs DMEDI with examples, Introduction to Toyota Production System, Six Sigma and Production System integration

UNIT IV **LEAN ELEMENTS** **9**

Introduction to Lean Concepts like In-Built Quality, Concept of Right Part at the Right Time, Lead Time reduction, Optimum utilization of Capital, Optimum utilization of People. Understanding the Zero-defect concept and Metrics, Focus on Human Resources, Quality, Delivery, and Cost. Building Zero defect capabilities, Cultural and Organizational aspects

UNIT V **IMPLEMENTATION AND CHALLENGES** **9**

Implementing Checks and Balances in the process, Robust Information Systems, Dashboard, follow up and robust corrective and preventive mechanism. Concept of Audits, and continuous improvement from gap analysis, risk assessments etc.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 JM Juran, FM Gryna, "Quality Planning and Analysis", Tata McGraw Hill, 2017.

2 Akhilesh N Singh, Bibliophile South Asia, "Lean Manufacturing: Principles to Practice", 2019.

REFERENCES:

1 Erick C Jones, "Quality Management for Organizations Using Lean Six Sigma Techniques", 2019.

2 William M Feld, "Lean Manufacturing Techniques", CRC Press, 1st Edition, 2020.

3 Pascal Denis "Lean Manufacturing Principle to Practice", 5th Edition, 2019.

ONLINE RESOURCES:

1 https://nptel.ac.in/courses/112104188
2 https://www.sciencedirect.com/science/article/abs/pii/S22147
3 https://onlinecourses.swayam.ac.in/noc20_mg19/preview

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the basics of 6 SIGMA
CO2 Explain the lean manufacturing tools
CO3 Explain about the deeper understanding methodologies of Lean manufacturing
CO4 Explain lean concepts and its elements
CO5 Explain the implementation and challenges of lean manufacturing

CO–PO–PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	-	-	1	-	-	-	1	2
CO2	2	2	1	1	-	-	-	-	1	-	-	-	1	2
CO3	2	2	1	1	-	-	-	-	1	-	-	-	1	2
CO4	2	2	1	1	-	-	-	-	1	-	-	-	1	2
CO5	2	2	1	1	-	-	-	-	1	-	-	-	1	2

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U23PEME23	WELDING TECHNOLOGY	L	T	P	C
		3	0	0	3

Prerequisites: Manufacturing Technology

Course Objectives:

- To understand the basics of welding &the various types of welding processes
- To familiarize with fundamentals of Welding Technology
- Understand the principles of welding inspection and testing processes

UNIT I **GAS AND ARC WELDING PROCESSES** **9**

Fundamental principles – Air Acetylene welding, Oxyacetylene welding, Carbon arc welding, Shielded metal arc welding, Submerged arc welding, TIG & MIG welding, Plasma arc welding and Electro slag welding processes - advantages, limitations and applications

UNIT II **RESISTANCE WELDING PROCESSES** **9**

Spot welding, Seam welding, Projection welding, Resistance Butt welding, Flash Butt welding, Percussion welding and High frequency resistance welding processes - advantages, limitations and applications

UNIT III **SOLID STATE WELDING PROCESSES** **9**

Cold welding, Diffusion bonding, Explosive welding, Ultrasonic welding, Friction welding, Forge welding, Roll welding and Hot pressure welding processes - advantages, limitations and applications

UNIT IV **OTHERWELDINGPROCESSES** **9**

Thermite welding, Atomic hydrogen welding, Electron beam welding, Laser Beam welding, Friction stir welding, Underwater welding, Welding automation in aerospace, nuclear and surface transport vehicles

UNIT V **DESIGN OF WELD JOINTS, WELDABILITY AND TESTING OF WELDMENTS** **9**

Various weld joint designs – Welding defects – causes and remedies - Weld ability of Aluminium, Copper, and Stainless steels. Destructive and non-destructive testing of elements. Current trends in Welding technology: Hybrid welding, automation in welding

TOTAL:45 PERIODS

TEXT BOOKS:

1 Little R L, "Welding and welding Technology", Tata McGraw Hill, 2018.

2 Parmer S, "Welding Engineering and Technology", 1st Edition, Khanna Publishers, New Delhi, 2019.

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REFERENCES:

1 Davis A C, "The Science and Practice of Welding", Cambridge University Press, 2018.

2 Nadkarni S V, "Modern Arc Welding Technology", Oxford Publishers, 2019.

3 Christopher Davis, "Laser Welding-Practical Guide", Jaico Publishing House, 2020.

ONLINE RESOURCES:

1 https://nptel.ac.in/courses/112104199
2 https://www.sciencedirect.com/science/article/abs/pii/S2214785322018284
3 https://onlinecourses.swayam.ac.in/noc20_mg19/preview

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the importance of UAVs, classification and their applications
CO2 Analyse the Welding processes for varied engineering applications
CO3 Explain the different processes work out and its parameters
CO4 Design a welding procedure specification for welding
CO5 Apply knowledge, techniques, skills, and modern tools of the Welding Processes

CO–PO–PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	1	-	-	-	-	-	-	1	2
CO2	3	3	2	2	-	1	-	-	-	-	-	-	1	2
CO3	2	2	1	1	-	1	-	-	-	-	-	-	3	2
CO4	3	3	3	3	-	1	-	-	-	-	-	-	1	2
CO5	3	2	1	1	-	1	-	-	-	-	-	-	2	2

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U23PEME24	CASTING PROCESS	L	T	P	C
		3	0	0	3

Prerequisites: Manufacturing Technology

Course Objectives:

- To understand the principle, procedure, and applications of various foundry processes.
- To understand the basic phenomena involved in metal casting process, gating and risering system
- To impart about the sand casting process and its importance

UNIT I **CASTING PROCESS** **9**

Introduction to casting – pattern – materials allowances – coding – types – moulds – mould making, sand – properties, types and testing of sands – core making – type of cores – single box, two box and 3 box moulding processes.

UNIT II **CASTING METALLURGY** **9**

Solidification of pure metal and alloys – shrinkage in cast metals – progressive and directional solidification –Degasification of the melt-casting defects – Cast ability of steel , Cast Iron, Al alloys , Babbit alloy and Cu alloy

UNIT III **DESIGN OF GATING SYSTEMS** **9**

Gating systems and their characteristics; the effects of gates on aspiration; turbulence and dross trap; recent trends. Chvorinov's Rule - Riser design - NRL method of riser design; feeding distance.

UNIT IV **RECENT TRENDS IN CASTING AND FOUNDRY LAYOUT** **9**

Shell moulding, precision investment casting, CO2 moulding, centrifugal casting, Die casting, and Continuous casting, Counter gravity low pressure casting, Squeeze casting and semi-solid processes. Layout of mechanized foundry – sand reclamation – material handling in foundry pollution control in foundry –- Computer aided design of casting

UNIT V **TESTING OF CASTINGS** **9**

Causes and remedies for casting defects –Destructive testing – NDT – Dye penetrant – magnetic particle – X-ray, ultrasonic- case studies in testing of joints & castings. Methods of elimination and control of dissolved gases in castings. use of statistical quality control in foundry

TOTAL:45 PERIODS

TEXT BOOKS:

1 Jain P L, "Principles of Foundry Technology", Tata McGraw Hill, 2018.

2 Davinderjit Kaur Sherrill, "Casting Procedures", AkiNik Publications, 2019.

REFERENCES:

1 Johncampell, "Metal Casting Process", Butterworth-Heinemann Ltd., 2019.

2 Travis Haiyer, "Casting Process", Clanrye International Publisher, 2020.

3 Srinivasan, "Foundry Engineering", Khanna Publications, 2021.

ONLINE RESOURCES:

1 https://archive.nptel.ac.in/courses/112/107/112107083/
2 https://swayam/tVikA8nLe0c?si=egUtLPvm-kYmb7eQ
3 https://elesiver/2Kat1F-I4lI?si=Cd-Hj0S62gncABJc

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the various steps in Casting Process
CO2 Analyse the Casting Solidification and Cast ability of metals
CO3 Design casting systems using various foundry practices
CO4 Apply recent trends in casting methods
CO5 Summarize testing of materials defect in the casting

CO–PO–PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	-	-	1	-	1	2	1	1
CO2	3	3	2	2	-	-	-	-	1	-	1	2	1	1
CO3	3	3	3	3	-	-	-	-	1	-	1	2	1	1
CO4	3	2	1	2	-	-	-	-	1	-	1	2	1	1
CO5	2	2	1	1	-	-	-	-	1	-	1	2	1	1

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U23PEME25	INDUSTRIAL ROBOTICS	L	T	P	C
		3	0	0	3

Prerequisites: Kinematics of Machinery

Course Objectives:

- To introduce robotics and definition, history of robotics and robot anatomy.
- To learn the simulation of robot kinematics and manipulation.
- To study mobile robots and applications of industrial, service, and domestic robots.

UNIT I **INTRODUCTION** **9**

Robot: Definition, History of Robotics, Robot Anatomy, Co-ordinate systems, types and classification, Configuration space and degrees of freedom of rigid bodies and robots, Configuration space topology and representation; configuration and velocity constraints; task space and workspace, Rigid-body motions, rotation matrices, angular velocities, and exponential coordinates of rotation, Homogeneous transformation matrices.

UNIT II **SIMULATION OF ROBOT KINEMATICS** **9**

Robot kinematics, Forward and inverse kinematics (two three four degrees of freedom), Forward and inverse kinematics of velocity, Homogeneous transformation matrices, translation and rotation matrices Dennavit and Hartenberg (D-H) transformation, Dynamics of Open Chains, Trajectory Generation, motion planning, robot control: First- and second-order linear error dynamics, stability of a feedback control system.

UNIT III **GRASPING AND MANIPULATION OF ROBOTS** **9**

Kinematics of contact, contact types (rolling, sliding, and breaking), graphical methods for representing kinematic constraints in the plane, and form-closure grasping, Coulomb friction, friction cones, graphical methods for representing forces and torques in the plane, End effectors, grippers, types of grippers, gripper force analysis, and examples of manipulation and grasping.

UNIT IV **MOBILE ROBOTS** **9**

Mobile robot, Wheeled Mobile Robots: Kinematic models of omnidirectional and nonholonomic wheeled mobile robots, Controllability, motion planning, feedback control of nonholonomic wheeled mobile robots; odometry for wheeled mobile robots; and mobile manipulation. Reference Trajectory generation, feed forward control.

UNIT V **APPLICATIONS OF ROBOTS** **9**

Application of robotics: industrial robots, Service robots, domestic and household robots, medical robots, military robots, agricultural robots, space robots, Aerial robotics Role of robots in inspection, assembly, material handling, underwater, space and healthcare

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Kevin M Lynch, Frank C Park, "Modern Robotics: Mechanics, Planning and Control", 2nd Edition, Cambridge University Press, 2017.

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2 Julian Evans, "Modern Robotics: Mechanics, Systems and Control", Larsen and Keller Education, 2019.

REFERENCES:

1 Jared Kroff, "Modern Robotics: Designs, Systems and Control", Willford Press, 2019.

2 Chenguang Yang, Hongbin Ma, Mengyin Fu, "Advanced Technologies in Modern Robotic Applications", Springer, 2018.

3 S B Niku, "Introduction to Robotics – Analysis, Control, Applications", John Wiley & Sons, 2020.

ONLINE RESOURCES:

1 https://onlinecourses.nptel.ac.in/noc23_me143/preview

2 https://link.springer.com/book/10.1007/978-3-319-32552-1

3 https://hades.mech.northwestern.edu/images/2/2e/MR-largefont-v2.pdf

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Describe the history of robotics and robot anatomy.

CO2 Create the simulation of robot kinematics.

CO3 Describe the grasping and manipulation of robots.

CO4 Explain about mobile robots and manipulation.

CO5 Describe the applications of industrial, service and domestic robots.

CO–PO–PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	1	-	-	-	1	-	-	-	1	1
CO2	3	3	3	3	1	-	-	-	1	-	-	-	1	1
CO3	2	2	1	1	1	-	-	-	1	-	-	-	1	1
CO4	2	2	1	1	1	-	-	-	1	-	-	-	1	1
CO5	2	2	1	1	1	-	-	-	1	-	-	-	1	1

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U23PEME26	DRONE TECHNOLOGY & IT'S APPLICATIONS	L	T	P	C
		3	0	0	3

Prerequisites: Engineering Mechanics

Course Objectives:

- To use in design of a small drones and its applications.
- To study about Post Processing Software in Drone Surveying.
- To study the analysis of propelling and flight mechanism.

UNIT I **INTRODUCTION TO DRONES** **7**

Definition and history of drones, Types of drones and their applications, Drone components and terminology, Regulations and Guidelines for drone usage.

UNIT II **DRONE DESIGN AND ASSEMBLY** **8**

Design considerations for drone airframe and propulsion systems, Selecting and assembling drone components such as motors, batteries, flight controllers, and cameras, Basic wiring and soldering techniques.

UNIT III **DRONE MOTORS AND ESC** **10**

Working types: Brush and Brushless Motors, motor sizing and identification, mounting patterns and thread size, Thrust to Weight ratio, KV ratings, advanced motor selection, Electronic Speed Controller (ESC).

UNIT IV **FLIGHT MECHANICS AND DYNAMICS** **10**

Basic principles of flight mechanics, flight controller board, Selection of drone controller with example, Factors affecting drone flight performance and efficiency.

UNIT V **APPLICATIONS OF DRONE** **10**

Overview of commercial and industrial drone applications, Case studies and examples of successful drone deployments, GPS based navigation system, Drone Camera Systems, Agro application, Drone Delivery, Future trends and developments in the drone industry.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. S K Kopparthy, "Drone Technology: Theory and Practice", 2nd Edition, Springer, 2020.
2. K Sundar, R V Rajakumar, "Multicopters: Principles and Applications", Springer, 2021.

REFERENCES:

1. D Saxby, "Drone Aerial Photography and Video: Techniques and Stories from the Field", Cengage Learning, 2018.
2. D McLeod, "Getting Started with Drone: How to Build, Flyand Program Your Own Drone", A Press Publishers, 2019.
3. M A Banks, "Building and Flying Electric Model Aircraft", O'Reilly Media Inc, 2018.

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ONLINE RESOURCES:

1 https://onlinecourses.nptel.ac.in/noc22_ae03/preview

2 https://link.springer.com/book/10.1007/978-981-15-5616-2

3 https://www.sciencedirect.com/science/article/pii/S2352146522000847

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the importance of UAVs, classification and their applications.

CO2 Evaluate the suitable drone component based on design requirements.

CO3 Describe the integration of drone components.

CO4 Summarize the uses of transmitter, receiver and telemetry system and its configuration.

CO5 Explain basic control of drone and perform ground test and troubleshooting.

CO–PO–PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	1	-	1	-	-	-	-	1	1	1
CO2	3	3	2	2	1	-	1	-	-	-	-	1	1	1
CO3	2	2	1	1	1	-	1	-	-	-	-	1	1	1
CO4	2	2	1	1	1	-	1	-	-	-	-	1	1	1
CO5	2	2	1	1	1	-	1	-	-	-	-	1	1	1

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U23PEME27	INDUSTRIAL LAYOUT DESIGN AND SAFETY	L	T	P	C
		2	0	2	3

Prerequisites: Fundamental concepts of Safety

Course Objectives:

- To introduce the industrial facility layout design principles, process and material flow analysis and product and equipment analysis.
- To learn the facilities layout design algorithms and selecting appropriate software.
- To study the facilities layout problem modelling tools and algorithms for production.

UNIT I **INTRODUCTION** **6**

Industrial Facility Layout: Definition, Types of Layout Problems, Engineering Design Problem Approach – Product Analysis, Equipment Selection, Personnel Requirement Analysis, Space Requirement and Availability – Process and Material Flow Analysis, Data Requirement for Layout Decisions, Tools for Presenting Layout Designs.

UNIT II **FACILITIES LAYOUT DESIGN & ALGORITHMS** **6**

Traditional Approaches to Facility Layout, Systematic Layout Planning, Special Considerations in Office Layout, Engineering Design Problem Approach, Code Compliance, OSHA, ADA Regulations, and Other Considerations in Facility Design – Algorithms for the Layout Problem, Construction Algorithms, Improvement Algorithms, Hybrid Algorithms, Layout Software.

UNIT III **FACILITIES LAYOUT PROBLEM MODELS & ALGORITHMS** **6**

Models for the Layout Problem, Generic Modeling Tools, Models for the Single-Row Layout Problem, Models for the Multi row Layout Problem with Departments of Equal and Unequal Area – Material Handling, Principles, Types, Models for Material- Handling System Design – Storage and Warehousing.

UNIT IV **SAFETY PLANNING & MANAGEMENT** **6**

Introduction: Elements of Safety Programming, Safety Management. Upgrading Safety. Developmental Programs: Safety Procedures, Arrangements and Performance Measures, Education, Training and Development in Safety. Safety Performance.

UNIT V **APPROACHES IN SAFETY MANAGEMENT** **6**

Safeguarding against Common Potential Hazards: Trips, Slips and Falls, Preventing Electrocution, Static Electricity, Hazardous Energy Control. Specific Hazard Control Measures: Forklift Hazard Control, Tractor Hazard Control. Safe Handling and Storage: Material Handling, Compressed Gas Cylinders, Corrosive Substances.

TOTAL: 30 PERIODS

TEXT BOOKS:

1. Sunderesh S Heragu, "Facilities Design", CRC Press Taylor & Francis Group, 2018.
2. L M Deshmukh, "Industrial Safety Management: Hazard Identification and Risk Control", 2nd Edition, Tata McGraw Hill, 2018.

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REFERENCES:

1 Eric Teicholz, "Facility Design and Management Handbook", Tata McGraw Hill, 2021.

2 James A Tompkins, John A White, Yavuz A Bozer, J M A Tanchoco, "Facilities Planning", John Wiley & Sons, 2019.

3 Matthew P Stevens, Fred E Meyers, "Manufacturing Facilities Design and Material Handling", Purdue University Press, 2020.

ONLINE RESOURCES:

1 https://onlinecourses.nptel.ac.in/noc20_mg43/

2 https://www.sciencedirect.com/science/article/pii/S1877050924003016

3 https://link.springer.com/article/10.1007/s12008-024-01920-0

PRACTICAL EXERCISES:

1 Simulation of Manufacturing Shop

2 Simulation of Batch Production System

3 Simulation of Multi Machine Assignment System

4 Simulation of Manufacturing and Material Handling Systems

5 Simulation of a Shop Floor

6 Simulation of Material Handling Systems

30 PERIODS
TOTAL: 60 PERIODS

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Describe the basic concepts of industrial facility layout, types and flow analysis

CO2 Apply layout design methods and algorithms while considering safety and regulatory requirements.

CO3 Analyze layout problems using models for different facility arrangements.

CO4 Evaluate safety management programs, including procedures, training components and performance measures.

CO5 Apply control measures for common industrial hazards and safe material handling practices.

CO–PO–PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	-	-	-	-	-	1	2	1
CO2	3	2	1	2	-	-	-	-	-	-	-	1	2	1
CO3	3	3	2	2	-	-	-	-	-	-	-	1	2	1
CO4	3	3	2	2	-	-	-	-	-	-	-	1	2	1
CO5	3	2	1	2	-	-	-	-	-	-	-	1	2	1

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U23PEME28	PRODUCT LIFE CYCLE MANAGEMENT	L	T	P	C
		3	0	0	3

Prerequisites: Principles of Management

Course Objectives:

- To study about the history, concepts and terminology in PLM.
- To develop different modules offered in commercial PLM/PDM tools.
- To demonstrate PLM/PDM approaches & use ERP systems.

UNIT I HISTORY, CONCEPTS AND TERMINOLOGY OF PLM 9

Introduction to PLM, Need for PLM, opportunities of PLM, Different views of PLM - Engineering Data Management (EDM), Product Data Management (PDM), Collaborative Product Definition Management (cPDm), Collaborative Product Commerce (CPC), Product Lifecycle Management (PLM). PLM/PDM Infrastructure – Network and Communications, Data Management, Heterogeneous data sources and applications.

UNIT II PLM/PDM FUNCTIONS AND FEATURES 9

User Functions – Data Vault and Document Management, Workflow and Process Management, Product Structure Management, Product Classification and Programme Management. Utility Functions –Communication and Notification, data transport, data translation, image services, system administration and application integration.

UNIT III DETAILS OF MODULES IN A PDM/PLM SOFTWARE 9

Case studies based on top few commercial PLM/PDM tools – Team center, Wind chill, ENOVIA, Aras PLM, SAP PLM, Arena, Oracle Agile PLM and Autodesk Vault. - Architecture of PLM software- selection criterion of software for particular application - Brand name to be removed.

UNIT IV ROLE OF PLM IN INDUSTRIES 9

Case studies on PLM selection and implementation (like auto, aero, electronic) - other possible sectors, PLM visioning, PLM strategy, PLM feasibility study, change management for PLM, financial justification of PLM, barriers to PLM implementation, ten step approach to PLM, benefits of PLM for–business, organization, users, product or service, process performance- process compliance and process automation.

UNIT V BASICS ON CUSTOMISATION/INTEGRATION OF PDM/PLM SOFTWARE 9

PLM Customization, use of EAI technology (Middleware), Integration with legacy database, CAD, SLM and ERP.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Product Lifecycle Management for a Global Market", Springer 2019.

2 Product Life Cycles and Product Management", 2nd Edition, Praeger Publishers Inc. 2018.

REFERENCES:

1 Antti Saaksvuori, Anselmi Immonen, "Product Lifecycle Management", Springer 2018.

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2 Ivica Crnkovic, Ulf Asklund, Annita Persson Dahlqvist, "Implementing and Integrating Product Data Management and Software Configuration Management", Artech House Publishers, 2018.

3 John Stark, "Product Lifecycle Management: 21st Century Paradigm for Product Realisation", Springer, 2018.

ONLINE RESOURCES:

1. https://archive.nptel.ac.in/courses/110/107/110107161/
2. https://www.sciencedirect.com/science/article/pii/S2212827123004225
3. https://link.springer.com/book/10.1007/978-3-540-78172-1

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Summarize the history, concepts and terminology of PLM.

CO2 Explain the functions and features of PLM/PDM.

CO3 Describe the different modules offered in commercial PLM/PDM tools.

CO4 Summarize the implement PLM/PDM approaches for industrial applications.

CO5 Explain PLM/PDM with legacy databases, CAx & ERP systems.

CO–PO–PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	-	1	-	-	-	-	1	-
CO2	2	2	1	1	-	-	-	1	-	-	-	-	1	-
CO3	2	2	1	1	-	-	-	1	-	-	-	-	1	-
CO4	2	2	1	1	-	-	-	1	-	-	-	-	1	-
CO5	2	2	1	1	-	-	-	1	-	-	-	-	1	-

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U23PEME29	AUTOMATION IN MANUFACTURING	L	T	P	C
		3	0	0	3

Prerequisites: Manufacturing Technology

Course Objectives:

- Give a brief exposure to automation principles and control technologies and introduce the concept of fixed automation using transfer lines
- Train the students in the programmable automation such as CNC and Industrial robotics
- Provide knowledge on the use of automated material handling, storage and data capture.

UNIT I **MANUFACTURING OPERATION** **9**

Automation in production systems, principles and strategies, Product/production relationships, Production concepts and mathematical models, manufacturing economics

UNIT II **CONTROL TECHNOLOGIES** **9**

Automated systems – elements, functions, levels, Continuous Vs discrete control, Computer process control, Sensors, Actuators, ADC, DAC, Programmable logic controllers – ladder logic diagrams.

UNIT III **TRANSFER LINES** **9**

Automated production lines – applications, Analysis – with and without buffers, automated assembly systems, line unbalancing concept.

UNIT IV **NUMERICAL CONTROL AND ROBOTICS** **9**

NC - CNC – Part programming – DNC – Adaptive control – Robot anatomy – Specifications –End effectors – Industrial applications.

UNIT V **AUTOMATED HANDLING AND STORAGE** **9**

Automated guided vehicle systems, AS/RS, Carousel storage, Automatic data capture - Barcode technology.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Mikell P Groover, "Automation, Production Systems and Computer Integrated Manufacturing", Pearson Education, 2018.

2 Frank Lamb, "Industrial Automation", 4th Edition, Tata McGraw Hill, 2019.

REFERENCES:

1 Mikell P Groover, Emory W Zimmers Jr, "CAD/CAM: Computer-Aided Design and Manufacturing", Pearson Education, 2019.

2 Tien-Chien Chang, Richard A Wysk, Hsu-Pin Wang, "Computer Aided Manufacturing", Pearson Education, 2019.

3 Peter G Martin, Gregory Hale, "Automation Made Easy", International Society of Automation Publishers, 2019.

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc21_me120/preview
2. https://link.springer.com/chapter/10.1007/978-3-642-52323-6_2
3. https://www.sciencedirect.com/science/article/pii/S1474667015330925

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the requirements of automation in manufacturing systems.

CO2 Describe the techniques of machinery automation, shop floor automation.

CO3 Analyze the material handling systems for automated industries.

CO4 Explain the numerical controls used in the industrial applications

CO5 Describe the working principle of automated guided vehicles.

CO–PO–PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	-	1	-	-	-	-	1	-
CO2	2	2	1	1	-	-	-	1	-	-	-	-	1	-
CO3	3	2	1	2	-	-	-	1	-	-	-	-	1	-
CO4	2	2	1	1	-	-	-	1	-	-	-	-	1	-
CO5	2	2	1	1	-	-	-	1	-	-	-	-	1	-

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U23PEME30	DIGITAL TWIN AND INDUSTRY 5.0	L	T	P	C
		3	0	0	3

Prerequisites: Basics of CAD

Course Objectives:

- To understand the basics concepts in digital twin and to introduce the concepts in digital twin in a discrete Industry.
- To introduce the concepts in digital twin in a process Industry.
- To obtain the knowledge in industry 5.0 and to know about the advantages in industry 5.0.

UNIT I **INTRODUCTION** **9**

Digital twin – Definition, types of Industry and its key requirements, Importance, Application of Digital Twin in process, product, service industries, History of Digital Twin, DTT role in industry innovation, Technologies/tools enabling Digital Twin – Virtual CAD Models – control Parameters- Real time systems – control Parameters – Handshaking Through Internet – cyber physical systems.

UNIT II **DIGITAL TWIN IN A DISCRETE INDUSTRY** **9**

Basics of Discrete Industry, Trends in the discrete industry, control system requirements in a discrete industry, Digital Twin of a Product, Digital Thread in Discrete Industry, Data collection & analysis for product & production improvements, Automation simulation, Digital Enterprise.

UNIT III **DIGITAL TWIN IN A PROCESS INDUSTRY** **9**

Basics of Process Industry, Trends in the process industry, control system requirements in a process industry, Digital Twin of a plant, Digital Thread in process Industry, Data collection and analysis for process improvements, process safety, Automation simulation, Digital Enterprise.

UNIT IV **INDUSTRY 5.0** **9**

Industrial Revolutions, Industry 5.0 – Definition, principles, Application of Industry 5.0 in process & discrete industries, Benefits of Industry 5.0, challenges in Industry 5.0, Smart manufacturing, Internet of Things 5.0, Industrial Gateways, Basics of Communication requirements – cognitive systems 5.0.

UNIT V **ADVANTAGES OF DIGITAL TWIN** **9**

Improvement in product quality, production process, process Safety, identify bottlenecks and improve efficiency, achieve flexibility in production, continuous prediction and tuning of production process through Simulation, reducing the time to market.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Alp Ustundag, Emre Cevikcan, "Industry 4.0: Managing the Digital Transformation", 3rd Edition, Springer, 2018.

2 Andrew Yeh Chris Nee, Fei Tao, Meng Zhang, "Digital Twin Driven Smart Manufacturing", 4th Edition, Elsevier Science, 2019.

REFERENCES:

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1 Uthayan Elangovan, "Industry 5.0: The Future of the Industrial Economy", CRC Press, 2022.

2 Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", APress Publishers, 2015.

3 Christoph Jan Bartodziej, "The Concept Industry 4.0: An Empirical Analysis of Technologies and Applications in Production Logistics", Springer, 2018.

ONLINE RESOURCES:

1 https://link.springer.com/chapter/10.1007/978-3-031-38165-2_69

2 https://link.springer.com/chapter/10.1007/978-3-031-16841-3_7

3 https://www.sciencedirect.com/science/article/pii/S0166361521001652

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the fundamentals and technologies behind Digital Twin and its industrial relevance.

CO2 Apply Digital Twin concepts in discrete industries for automation and product improvement.

CO3 Apply Digital Twin in process industries to enhance control, safety, and efficiency.

CO4 Summarize the roles and challenges of Industry 5.0 in smart manufacturing.

CO5 Explain the advantages in industry 5.0 with various applications.

CO–PO–PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	-	-	-	-	-	-	2	1
CO2	3	2	1	2	-	-	-	-	-	-	-	--	2	1
CO3	3	2	1	2	-	-	-	-	-	-	-	-	2	1
CO4	2	2	1	1	-	-	-	-	-	-	-	-	2	1
CO5	2	2	1	1	-	-	-	-	-	-	-	-	2	1

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U23PEME31	FAILURE ANALYSIS AND NDT TECHNIQUES	L	T	P	C
		2	0	2	3

Prerequisites: Strength of Materials

Course Objectives:

- To introduce the need and scope of failure analysis and fundamental sources.
- To learn about non-destructive testing and basic principles of visual inspection.
- To study the acoustic testing principle and technique and instrumentation.

UNIT I **INTRODUCTION** **6**

Introduction and need and scope of failure analysis. Engineering Disasters and understanding failure analysis. Fundamental sources of failures. Deficient design. Improper Manufacturing & Assembly. Tree diagram and FMEA.

UNIT II **VISUAL INSPECTION** **6**

Introduction to Non-Destructive Testing: An Introduction, Visual examination, Basic Principle, The Eye, Optical aids used for visual inspection, Applications. Liquid Penetrant Testing: Physical principles, Procedure for penetrant testing, Penetrant testing materials, Penetrant testing methods, Sensitivity, Applications, Limitations.

UNIT III **MAGNETIC TESTING** **6**

Magnetic Particle Testing, Eddy Current Testing: Magnetism-basic definitions and principle of. magnetic particle testing, Magnetizing techniques, induced current flow, Procedure used for testing a component, Equipment Used for magnetic particle testing, Sensitivity, Limitations. Eddy Current Testing: Principles, Instrumentation for eddy current testing Techniques. Sensitivity Advanced Eddy Current Test Methods.

UNIT IV **RADIOGRAPHY TESTING** **6**

Radiography, Ultrasonic Testing: Basic principle, Electromagnetic radiation, Sources, Radiation attenuation in the specimen. Effect of radiation in film, Radiographic imaging, Inspection techniques, Applications of radiographic inspection, Limitations, Safety in Industrial Radiography, Standards, Neutron radiography. Ultrasonic Testing: Basic properties of sound beam, Ultrasonic transducers, Inspection methods, Techniques for Normal Beam Inspection, Angle Beam Inspection, Flaw characterization techniques.

UNIT V **ACOUSTIC TESTING** **6**

Acoustic Emission Testing: Principle of Acoustic Emission Testing, Technique, Instrumentation, Sensitivity, Applications, Standards. Thermograph: Basic Principles, Detectors and Equipment, Techniques, Applications, Codes and Standards. In Situ Metallographic Examination: Approach to the Selection of Site for Metallographic.

30 PERIODS

TEXT BOOKS:

1. Baldev Raj, T Jayakumar, M Thavasimuthu, "Practical Non-Destructive Testing", Narosa Publishing House, 2018.
2. Ravi Prakash, "Non-Destructive Testing Techniques", 1st Edition, New Age International Publishers, 2018.

REFERENCES:

1 Paul McIntire, ASM Metals Handbook, "Non-Destructive Evaluation and Quality Control", American Society of Metals, 2019.

2 Daniel C. Sonnenberg, Donald E. Bray, Don E. McIntire, "Acoustic Emission Testing", ASM International, 2018.

3 Charles J Hellier, "Handbook of Non-Destructive Evaluation", Tata McGraw Hill, 2019.

ONLINE RESOURCES:

1 https://archive.nptel.ac.in/courses/112/107/112107241/

2 https://www.sciencedirect.com/science/article/pii/S2212827115008021

3 https://link.springer.com/article/10.1007/s11668-021-01325-1

PRACTICAL EXERCISES:

1 Conduct experiment using liquid penetrant testing.

2 Conduct experiment using magnetic particle testing.

3 Conduct experiment using ultrasonic testing.

4 Conduct experiment using electromagnetic testing.

5 Conduct experiment using acoustic emission testing.

30 PERIODS
TOTAL: 60 PERIODS

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the causes and types of engineering failures using failure analysis tools

CO2 Apply visual inspection and liquid penetrant testing techniques for defect detection in components.

CO3 Apply magnetic particle and eddy current testing methods for identifying surface and subsurface defects.

CO4 Analyze internal flaws using radiographic and ultrasonic testing methods.

CO5 Evaluate the suitability of advanced testing techniques such as acoustic emission testing, thermography.

CO–PO–PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	1	-	-	1	-	-	-	-	2	2
CO2	3	2	1	2	1	-	-	1	-	-	-	-	2	2
CO3	3	2	1	2	1	-	-	1	-	-	-	-	2	2
CO4	3	3	2	2	1	-	-	1	-	-	-	-	2	2
CO5	3	3	2	2	1	-	-	1	-	-	-	-	2	2

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U23PEME32	COMPOSITE MATERIALS	L	T	P	C
		3	0	0	3

Prerequisites: Engineering Materials and Metallurgy

Course Objectives:

- To study the fundamentals of composite material strength and its mechanical behaviour.
- To study the fundamentals of composite material strength and its mechanical.
- To study the analysis of fibre reinforced Laminate design for different combinations of plies with different orientations of the fibre.

UNIT I **LAMINA CONSTITUTIVE EQUATIONS & MANUFACTURING** **9**

Definition –Need – General Characteristics, Applications. Fibers – Glass, Carbon, Ceramic and Aramid Fibers. Matrices – Polymer, Graphite, Ceramic and Metal Matrices – Characteristics of fibers and matrices. Lamina Constitutive Equations: Lamina Assumptions – Macroscopic Viewpoint. Generalized Hooke's Law. Reduction to Homogeneous Orthotropic Lamina – Isotropic limit case, Orthotropic Stiffness matrix (Qij), Typical Commercial material properties, Rule of Mixtures. Generally Orthotropic Lamina – Transformation Matrix, Transformed Stiffness. Manufacturing: Bag Moulding Compression Moulding – Pultrusion – Filament Winding – Other Manufacturing Processes.

UNIT II **FLAT PLATE LAMINATE CONSTITUTE EQUATIONS** **9**

Definition of stress and Moment Resultants. Strain Displacement relations. Basic Assumptions of Laminated anisotropic plates. Laminate Constitutive Equations – Coupling Interactions, Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates. Laminate Structural Moduli. Evaluation of Lamina Properties from Laminate Tests. Quasi-Isotropic Laminates. Determination of Lamina stresses within Laminates.

UNIT III **LAMINA STRENGTH ANALYSIS** **9**

Introduction - Maximum Stress and Strain Criteria. Von-Misses Yield criterion for Isotropic Materials. Generalized Hill's Criterion for Anisotropic materials. Tsai-Hill's Failure Criterion for Composites. Tensor Polynomial (Tsai-Wu) Failure criterion. Prediction of laminate Failure.

UNIT IV **THERMAL ANALYSIS** **9**

Assumption of Constant C.T. E's. Modification of Hooke's Law. Modification of Laminate Constitutive Equations. Orthotropic Lamina C.T.E's. C.T.Es for special Laminate Configurations –Unidirectional, Off- axis, Symmetric Balanced Laminates, Zero C.T.E laminates, Thermally Quasi-Isotropic Laminates.

UNIT V **ANALYSIS OF LAMINATED FLAT PLATES** **9**

Equilibrium Equations of Motion. Energy Formulations. Static Bending Analysis. Buckling Analysis. Free Vibrations – Natural Frequencies.

TOTAL: 45 PERIODS

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TEXT BOOKS:

1 Gibson R F, "Principles of Composite Material Mechanics", 2nd Edition, Tata McGraw Hill, 2019.

2 Hyer M W, "Stress Analysis of Fiber–Reinforced Composite Materials", 4th Edition, Tata McGraw Hill, 2019.

REFERENCES:

1 Agarwal B D, Broutman L J, "Analysis and Performance of Fiber Composites", John Wiley and Sons, 2018.

2 Issac M Daniel, Ori Ishai, "Engineering Mechanics of Composite Materials", Oxford University Press, 2019.

3 Mallick P K, "Fiber Reinforced Composites: Materials, Manufacturing and Design", 3rd Edition, CRC Press, 2018.

ONLINE RESOURCES:

1 https://www.iitgoa.ac.in

2 https://taylorfrancis.com

3 https://www.xometry.com/resources/3d-printing/composite/

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Summarize the various types of Fibers, and manufacturing methods for Composites.

CO2 Explain the Flat plate laminate constitutive equations considering various laminate types and coupling effects.

CO3 Analyze Lamina strength using different failure criteria including Tsai-Hill and Tsai-Wu theories.

CO4 Analyze the thermal behaviour of Composite laminates using modified constitutive equations.

CO5 Analyze Laminate flat plates under static, buckling, and vibration conditions using equilibrium equations and energy formulations.

CO–PO–PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	-	-	1	-	-	-	2	1
CO2	2	2	1	1	-	-	-	-	1	-	-	-	2	1
CO3	3	3	1	2	-	-	-	-	1	-	-	-	2	1
CO4	3	3	2	2	-	-	-	-	1	-	-	-	2	1
CO5	3	3	2	2	-	-	-	-	1	-	-	-	2	1

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U23PEME33	SMART MATERIALS	L	T	P	C
		3	0	0	3

Prerequisites: Engineering Materials and Metallurgy

Course Objectives:

- To learn about different types of smart materials.
- To understand the techniques to develop solutions for industrial problems using smart structures.
- To learn the engineering principles in smart sensor, actuator and transducer technologies.

UNIT I **INTELLIGENT MATERIALS** **9**

Primitive functions of intelligent materials, Intelligence inherent in materials, Materials intelligently harmonizing with humanity, Intelligent biological materials.

UNIT II **SMART MATERIALS** **9**

Actuator materials, Sensing technologies, Micro-sensors, Intelligent systems, Hybrid smart materials, Passive sensory smart structures, and Reactive actuator based smart structures, Active sensing and reactive smart structures, Smart skins.

UNIT III **ELECTRO-RHEOLOGICAL AND MAGNETO-RHEOLOGICAL FLUIDS** **9**

Suspensions and electro & magneto-rheological fluids, Electro & Magneto- rheological phenomena and working principle, Charge migration mechanism for the dispersed phase, Electro & Magneto-rheological fluid actuators.

UNIT IV **PIEZOELECTRIC MATERIALS** **9**

Background, Piezoelectricity, Industrial piezoelectric materials, Smart materials featuring piezoelectric elements, design solution, self-tuning absorber, performance function.

UNIT V **SHAPE MEMORY MATERIALS** **9**

Background and Applications, Continuum applications: Structures and machine systems, Discrete applications, Impediments to applications of shape-memory- alloys, Shape-memory-plastics.

45 PERIODS

TEXT BOOKS:

1 Vijayamohanan K Pillai, Meera Parthasarathy, "Smart Materials: A Chemist's Perspective", 5th Edition, Universities Press, 2019.

2 Mel Schwartz, "Smart Material", CRC Press, 2018.

REFERENCES:

1 Stephen Manne, "Biomimetic Materials Chemistry", John Wiley & Sons, 2019.

2 Smaili A, Mrad F, "Materials of Memory", 2nd Edition, Oxford University Press, 2019.

3 Mel Schwartz, "The Encyclopaedia of Smart Material", John Wiley & Sons, 2018.

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ONLINE RESOURCES:

1 https://nptel.ac.in/courses/112104173

2 https://www.elsevier.com/connect/the-smart-materials-revolution-is-here

3 https://link.springer.com/book/9783031924200

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Describe the primitive functions of the smart materials and their implantation.

CO2 Apply the principles of operation and methods of analysis in materials.

CO3 Explain the materials for their properties and different applications.

CO4 Analyse piezoelectric materials their properties and different applications.

CO5 Describe the shape memory materials their properties and different applications.

CO–PO–PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	-	1	-	-	-	-	2	1
CO2	3	2	1	2	-	-	-	1	-	-	-	-	2	1
CO3	2	2	1	1	-	-	-	1	-	-	-	-	2	1
CO4	3	3	2	2	-	-	-	1	-	-	-	-	2	1
CO5	2	2	1	1	-	-	-	1	-	-	-	-	2	1

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U23PEME34	MECHANICAL BEHAVIOUR OF MATERIALS	L	T	P	C
		3	0	0	3

Prerequisites: Strength of Materials

Course Objectives:

- To have an overview of elastic and plastic behaviour of materials and enlightened with the different strengthening mechanisms.
- To obtain an insight into the types of fracture and mechanics of fracture and the fatigue behaviour of materials.
- To interpret an insight on the high temperature behaviour of materials.

UNIT I **ELASTIC AND PLASTIC BEHAVIOUR** **9**

Elastic behaviour of materials - Hooke's law, plastic behaviour: dislocation theory, Types of dislocations, Burger's vectors and dislocation loops, dislocations in the FCC, HCP and BCC lattice, stress fields and energies of dislocations, forces on and between dislocations, dislocation climb, intersections of dislocations, Jogs, dislocation sources, multiplication of dislocations, dislocation pile-ups, Slip and twinning. Methods of observing dislocations.

UNIT II **STRENGTHENING MECHANISMS** **9**

Elementary discussion of cold working, grain boundary strengthening. Solid solution is strengthening, Martensitic strengthening, Precipitation strengthening, Particulate Strengthening, Dispersion strengthening, Fibre strengthening, Yield point phenomenon, strain aging and dynamic strain aging.

UNIT III **FRACTURE AND FRACTURE MECHANICS** **9**

Types of fracture, Basic mechanisms of ductile and brittle fracture, Griffith's theory of brittle fracture, Orowan's modification. Izod and Charpy Impacts tests, Ductile to Brittle Transition Temperature (DBTT), Factors affecting DBTT, Determination of DBTT. Fracture mechanics-Introduction, Modes of fracture, Stress intensity factor, Fracture toughness and Determination of KIC.

UNIT IV **FATIGUE BEHAVIOUR AND TESTING** **9**

Fatigue: Stress cycles, S-N curves, Effect of mean stress, Factors affecting Fatigue, Structural changes accompanying fatigue, Cumulative damage- Miner law, HCF / LCF, creep- fatigue interactions, micro mechanisms of fatigue crack initiation and growth, fatigue testing machines- Pari's Equation, Residual life prediction under Fatigue. Macro, Microstructural features of fatigue fracture

UNIT V **CREEP BEHAVIOUR AND TESTING** **9**

Creep curve, Stages in creep curve and explanation, Structural changes during creep, Creep mechanisms, Metallurgical factors affecting creep, High temperature alloys, Stress rupture testing, Creep testing machines, creep life prediction-Omega (Damage rate) method, Larson-Miller (parametric) method. Deformation Mechanism Maps according to Frost/Ashby, Super plasticity.

45 PERIODS

TEXT BOOKS:

1 Dieter G E, "Mechanical Metallurgy", 2nd Edition, Tata McGraw Hill, 2018.

2 Thomas H Courtney, "Mechanical Behaviour of Materials", Waveland Press, 2018.

REFERENCES:

1 Bhargava A K, Sharma C P, "Mechanical Behaviour and Testing of Materials", Pearson Learning, 2019.

2 Norman E Dowling, "Mechanical Behaviour of Materials", Pearson Education, 2018.

3 Prashant Kumar, "Elements of Fracture Mechanics", Tata McGraw Hill, 2019.

ONLINE RESOURCES:

1 https://archive.nptel.ac.in/courses/113/106/113106101/

2 https://link.springer.com/book/10.1007/978-94-007-2546-1

3 https://www.sciencedirect.com/science/article/pii/S1369702109700860

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the role of dislocations and the mechanisms of plastic deformation.

CO2 Explain the strengthening mechanisms of polycrystalline and composite materials.

CO3 Analyse the nature of fracture and its underlying mechanism.

CO4 Analyse the micro-mechanics, factors and life predictions of components under fatigue loading.

CO5 Describe the behaviour of materials under high temperature, metallurgical factors and life prediction of high temperature materials.

CO–PO–PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	-	1	-	-	-	-	2	1
CO2	2	2	1	1	-	-	-	1	-	-	-	-	2	1
CO3	3	3	2	2	-	-	-	1	-	-	-	-	2	1
CO4	3	3	2	2	-	-	-	1	-	-	-	-	2	1
CO5	2	2	1	1	-	-	-	1	-	-	-	-	2	1

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U23PEME35	METAL AND POWDER FORMING TECHNIQUES	L	T	P	C
		3	0	0	3

Prerequisites: Engineering Materials and Metallurgy

Course Objectives:

- To describe the types of deformations and classification of forming processes.
- To study the sheet metal forming processes and to distinguish the differences between conventional forming and special forming processes.
- To study the various stages involved in the powder forming processes.

UNIT I **INTRODUCTION** **9**

Mechanical behavior of materials- Elastic and plastic deformations - Classification of forming processes - Temperature in metal working: Cold, Warm and hot working - Introduction to the theory of plastic deformation.

UNIT II **BULK FORMING** **9**

Introduction - Plastic deformation in forging, rolling, extrusion, rod/wire, tube drawing and swaging processes and their applications - Effect of friction, calculation of forces, work done, process parameters, equipment's and defects - Design for manufacturing - Economics of bulk forming.

UNIT III **SHEET METAL FORMING** **9**

Introduction - Sheet metal characteristics - Conventional sheet metal forming processes like shearing, bending and miscellaneous forming processes - High energy rate forming processes - Super plastic forming processes - Deep drawing process - Principles, process parameters, advantages, limitations and applications of the above - Formability of sheet metals - Equipment's - Defects - Design for manufacturing - Economics of sheet metal forming.

UNIT IV **SPECIAL FORMING** **9**

Orbital forging - Isothermal forging - Hot and cold Isostatic pressing - High speed extrusion - High-speed forming machines - Rubber pad forming - Water hammer forming - Fine blanking - Incremental forming and comparing the above with conventional forming.

UNIT V **POWDER FORMING** **9**

Introduction - Powder production methods - Particle size characterization – Blending – Compacting - Sintering - Secondary and finishing operations - Advantages and applications of powder metallurgy - Design for manufacturing - Powder forging, rolling, extrusion, drawing - Economics of powder forging.

45 PERIODS

TEXT BOOKS:

1 Kalpakjian S, Schmid S R, "Manufacturing Engineering and Technology", 2nd Edition, Pearson Education 2018.

2 Sadhu Singh, "Theory of Plasticity and Metal Forming Processes", Khanna Publishers, 2019.

REFERENCES:

1 Heinz Tschätsch, "Metal Forming Practise: Processes-Machines-Tools", Springer Verlag, 2019.

2 Juneja B L, "Fundamentals of Metal Forming Processes", 3rd Edition, New Age International Publishers, 2018.

3 Kumar Surender, "Technology of Metal Forming Processes", Pearson Education, 2019.

ONLINE RESOURCES:

1 https://archive.nptel.ac.in/courses/112/106/112106153/

2 https://www.sciencedirect.com/science/article/pii/S2214785318313336

3 https://link.springer.com/referenceworkentry/10.1007/978-981-19-0740-1_1163-1

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the deformation types and classification of forming processes.

CO2 Describe the bulk forming processes and their applications.

CO3 Explain the different sheet metal forming processes and their applications.

CO4 Analyse the conventional and special forming processes.

CO5 Explain the powder forming processes and its applications.

CO–PO–PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	-	1	-	-	-	-	2	1
CO2	2	2	1	1	-	-	-	1	-	-	-	-	2	1
CO3	2	2	1	1	-	-	-	1	-	-	-	-	2	1
CO4	3	3	2	2	-	-	-	1	-	-	-	-	2	1
CO5	2	2	1	1	-	-	-	1	-	-	-	-	2	1

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U23PEME36	MATERIALS FOR GREEN ENGINEERING	L	T	P	C
		3	0	0	3

Prerequisites: Manufacturing Technology

Course Objectives:

- Acquiring knowledge on green energy technology.
- Getting knowledge on different sources of renewable energies.
- Obtaining knowledge on different green energy materials.

UNIT I **GREEN ENERGY AND SUSTAINABLE DEVELOPMENT** **9**

Global warming; greenhouse gas emissions, impacts, mitigation and adaptation; future energy Systems- clean/green energy technologies. Criteria for choosing appropriate green energy technologies, life cycle cost; the emerging trends – process/product innovation-, technological/ environmental aspects.

UNIT II **RENEWABLE ENERGY RESOURCES** **9**

Current energy requirements - Review of conventional energy resources. Solar Energy and its conversion methods, solar thermal collectors – photovoltaic; Wind energy – Ocean, Wave and Tidal energy. Smart batteries – Fuel Cells and Types – Materials. Other Sources: Hydropower, Nuclear fission and fusion-Geothermal energy.

UNIT III **GREEN NANOTECHNOLOGY** **9**

Nanoparticles preparation techniques, Greener Nanosynthesis: Greener Synthetic Methods for Functionalized Metal Nanoparticles, Greener Preparations of Semiconductor and Inorganic Oxide Nanoparticles, green synthesis of Metal nanoparticles, Nanomaterials for Alternative Energy.

UNIT IV **PROCESSING OF GREEN ENERGY MATERIALS** **9**

Silicon processing methods - Fabrication methods: physical and chemical vapour deposition techniques, photolithography, electroless and electrochemical deposition, etching, mask plating. Newer Energy Materials: Carbon nano-tubes (CNTs) and multiwall carbon nanotubes (MWCNTs) - methods of production, properties and its utility in energy devices.

UNIT V **GREEN MANAGEMENT** **9**

Concept of green management; evolution; nature, scope, importance and types; developing a theory; green management in India; relevance in twenty first century.

45 PERIODS

TEXT BOOKS:

1 Jazmin Seijas Nogarida, "Green Management and Green Technologies: Exploring the Causal Relationship" 2nd Edition, IGI Global, 2019.

2 M Graziani, P Fornasiero, "Renewable Resources and Renewable Energy – A Global Challenge", CRC Taylor and Francis, 2019.

REFERENCES:

1 Ed K Mulder, "Sustainable Development for Engineering", Greenleaf Publishing, 2018.

2 J Fiksel, "Design for Environment", Tata McGraw Hill, 2019.

3 M Charter, U Tischner, "Sustainable Solutions", Greenleaf Publishing, 2018.

ONLINE RESOURCES:

1 https://onlinecourses.nptel.ac.in/noc19_ce40/preview

2 https://www.azonano.com/nanotechnology-video-details.aspx?VidID=133

3 https://link.springer.com/collections/cahgfajabb

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the green energy technology and its application.

CO2 Explain the different sources of renewable energies.

CO3 Explain the green nanotechnology for alternative energies into useful forms.

CO4 Explain the energy sciences, its importance and utility.

CO5 Summarize the green management concept and its applications.

CO–PO–PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	1	1	-	-	-	-	1	-
CO2	2	2	1	1	-	-	1	1	-	-	-	-	1	-
CO3	2	2	1	1	-	-	1	1	-	-	-	-	1	-
CO4	2	2	1	1	-	-	1	1	-	-	-	-	1	-
CO5	2	2	1	1	-	-	1	1	-	-	-	-	1	-

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U23PEME37	FUNDAMENTALS OF NANOSCIENCE	L	T	P	C
		3	0	0	3

Prerequisites: Physics

Course Objectives:

- To introduce the basics of 6 SIGMA.
- To study the lean concepts and its elements.
- To learn implementation and challenges of lean manufacturing.

UNIT I **INTRODUCTION** **9**

General definition and size effects–important nano structured materials and nanoparticles- importance of nano materials- Size effect on thermal, electrical, electronic, mechanical, optical and magnetic properties of nano materials- surface area - band gap energy and applications. Photochemistry and Electrochemistry of nano materials –Ionic properties of nano materials- Nano catalysis.

UNIT II **SYNTHESIS OF NANOMATERIALS** **9**

Bottom up and Top-down approach for obtaining nano materials - Precipitation methods – sol gel technique – high energy ball milling, CVD and PVD methods, gas phase condensation, magnetron sputtering and laser deposition methods – laser ablation, sputtering.

UNIT III **NANO COMPOSITES** **9**

Definition- importance of nanocomposites- nano composite materials-classification of composites- metal/metal oxides, metal-polymer- thermoplastic based, thermoset based and elastomer based- influence of size, shape and role of interface in composites applications.

UNIT IV **NANO STRUCTURES AND CHARACTERIZATION TECHNIQUES** **9**

Classifications of nanomaterials - Zero dimensional, one-dimensional and two-dimensional nanostructures- Kinetics in nanostructured materials- multilayer thin films and superlattice- clusters of metals, semiconductors and nanocomposites. Spectroscopic techniques, Diffraction methods, thermal analysis method, BET analysis method.

UNIT V **APPLICATION OF NANO MATERIALS** **9**

Overview of nanomaterials properties and their applications, nano painting, nano coating, nanomaterials for renewable energy, Molecular Electronics and Nanoelectronics – Nanobots- Biological Applications. Emerging technologies for environmental applications- Practice of nanoparticles for environmental remediation and water treatment.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Mick Wilson, Kamali Kannangara, Geoff Smith, Michelle Simmom, Burkhard Raguse, "Nano Technology: Basic Science & Engineering Technology", 2nd Edition, Overseas Press, 2018.
2. William A Goddard, "Handbook of Nanoscience, Engineering and Technology", CRC Taylor and Francis Group, 2018.

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REFERENCES:

1 R H J Hannink, A J Hill, "Nanostructure Control", Wood Head Publishing, 2018.

2 C N R Rao, A Muller, A K Cheetham, "The Chemistry of Nanomaterials: Synthesis, Properties and Applications Vol. I & II", 2nd Edition, Wiley VCH Verlag GmbH & Co, 2019.

3 Ivor Brodie,Julius J Muray, "The Physics of Micro/Nano – Fabrication", Springer, 2018.

ONLINE RESOURCES:

1 https://web.pdx.edu/pmoeck/phy381/intro-nanotech.pdf

2 https://nnci.net/what-nano

3 https://onlinecourses.nptel.ac.in/noc21_mm38/preview

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the basic properties such as structural, physical, chemical properties of nanomaterials and their applications.

CO2 Summarize the various types of nano material synthesis.

CO3 Describe the shape, size, structure of composite nano materials and their interference.

CO4 Explain the different characterization techniques for nanomaterials.

CO5 Describe the application of nanomaterials in different fields.

CO–PO–PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	-	-	-	-	-	-	2	1
CO2	2	2	1	1	-	-	-	-	-	-	-	-	2	1
CO3	2	2	1	1	-	-	-	-	-	-	-	-	2	1
CO4	2	2	1	1	-	-	-	-	-	-	-	-	2	1
CO5	2	2	1	1	-	-	-	-	-	-	-	-	2	1

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U23PEME38	ADDITIVE MANUFACTURING	L	T	P	C
		2	0	2	3

Prerequisites: Manufacturing Technology

Course Objectives:

- To introduce the development of Additive Manufacturing (AM), various business opportunities and applications.
- To familiarize various software tools, processes and techniques to create physical object that satisfy product development / prototyping requirements, using AM.
- To gain knowledge on applications of binder jetting, material jetting and sheet lamination processes.

UNIT I **INTRODUCTION** **6**

Overview - Need - Development of Additive Manufacturing (AM) Technology: Rapid Prototyping- Rapid Tooling - Rapid Manufacturing - Additive Manufacturing. AM Process Chain- ASTM/ISO 52900 Classification - Benefits. Applications: Building Printing - Bioprinting - Food Printing- Electronics Printing. Business Opportunities.

UNIT II **DESIGN FOR ADDITIVE MANUFACTURING** **6**

Concepts and Objectives - AM Unique Capabilities - Part Consolidation – Topology Optimization - Generative design - Lattice Structures - Multi-Material Parts and Graded Materials - Data Processing: CAD Model Preparation - Support Structure - Slicing - Tool Path Generation – Design rules for Extrusion based AM.

UNIT III **VAT POLYMERIZATION AND DIRECTED ENERGY DEPOSITION** **6**

Photo polymerization: Stereolithography Apparatus (SLA) - Materials -Process – top down and bottom-up approach - Advantages - Limitations - Applications. Digital Light Processing- Process - Advantages - Applications. Continuous Liquid Interface Production Technology. Directed Energy Deposition: Laser Engineered Net Shaping.

UNIT IV **POWDER BED FUSION AND MATERIAL EXTRUSION** **6**

Powder Bed Fusion: Selective Laser Sintering: Process - Powder Fusion Mechanism - Materials and Application. Selective Laser Melting, Electron Beam Melting (EBM): Materials - Process - Advantages and Applications. Material Extrusion: Fused Deposition Modeling- Process-Materials -Applications and Limitations.

UNIT V **OTHER ADDITIVE MANUFACTURING PROCESSES** **6**

Binder Jetting: Three-Dimensional Printing - Materials - Process - Benefits- Limitations - Applications. Material Jetting: Multijet Modeling- Materials - Process - Benefits - Applications. Sheet Lamination: Laminated Object Manufacturing - Basic Principle- Mechanism: Gluing or Adhesive Bonding - Thermal Bonding- Materials.

30 PERIODS

TEXT BOOKS:

1 Ian Gibson, David Rosen, Brent Stucker, Mahyar Khorasani, "Additive Manufacturing Technologies", 2nd Edition, Springer, 2021.

2 Andreas Gebhardt, Jan-Steffen Hötter, "Additive Manufacturing: 3D Printing for Prototyping and Manufacturing", Hanser Publications, 2020.

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REFERENCES:

1 Andreas Gebhardt, "Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing", Hanser Gardner Publications, 2018.

2 Amit Bandyopadhyay, Susmita Bose, "Additive Manufacturing", CRC Press, 2019.

3 Liou L W, Liou F W, "Rapid Prototyping ad Engineering Applications: A Toolbox for Prototype Development", CRC Press, 2018.

ONLINE RESOURCES:

1 https://link.springer.com/journal/40964

2 https://www.sciencedirect.com/journal/additive-manufacturing

3 https://onlinecourses.nptel.ac.in/noc21_me115/preview

PRACTICAL EXERCISES:

1 Modelling and converting CAD models into STL files

2 Manipulation and error fixing of STL file

3 Design and fabrication of parts by varying part orientation and support structures

4 Fabrication of parts with material extrusion AM process

5 Fabrication of parts with vat polymerization AM process

30 PERIODS
TOTAL: 60 PERIODS

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the process chain and applications of additive manufacturing across various domains.

CO2 Apply the principles for additive manufacturing including topology optimization, lattice structures and toolpath generation.

CO3 Explain the vat polymerization and direct energy deposition processes and its applications.

CO4 Evaluate the suitability of powder bed fusion and material extrusion processes.

CO5 Describe the advantages, limitations, applications of binder jetting, material jetting and sheet lamination processes.

CO–PO–PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	1	-	-	1	-	-	-	-	2	1
CO2	3	2	1	2	1	-	-	1	-	-	-	-	2	1
CO3	2	2	1	1	1	-	-	1	-	-	-	-	2	1
CO4	3	3	2	2	1	-	-	1	-	-	-	-	2	1
CO5	2	2	1	1	1	-	-	1	-	-	-	-	2	1

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U23PEME39	INDUSTRIAL TRIBOLOGY	L	T	P	C
		3	0	0	3

Prerequisites: Theory of Machines

Course Objectives:

- To study the fundamentals of surface features, different types of friction and wear mechanism associated with metals and non-metals.
- To study the different types of lubrication, lubricants and lubrication theory.
- To study the various types of bearings and bearing materials.

UNIT I SURFACE INTERACTION AND FRICTION 9

Topography of Surfaces – Surface features - Properties and measurement – Surface interaction – Adhesive Theory of Sliding Friction – Rolling Friction - Friction properties of metallic and non-metallic materials – friction in extreme conditions – Thermal considerations in sliding contact.

UNIT II WEAR AND SURFACE TREATMENT 9

Types of wear – Mechanism of various types of wear – Laws of wear –Theoretical wear models - Wear of Metals and Non-metals – Surface treatments – Surface modifications – surface coatings methods - Surface Topography measurements –Laser methods – instrumentation – International standards in friction and wear measurements.

UNIT III LUBRICANTS AND TYPES OF LUBRICATION 9

Lubricants and their physical properties - Viscosity and other properties of oils – Additives and selection of Lubricants - Lubricants standards – Lubrication Regimes – Solid Lubrication - Dry and marginally lubricated contacts - Boundary Lubrication - Hydrodynamic lubrication, Hydro static lubrication and gas lubrication.

UNIT IV FILM LUBRICATION THEORY 9

Fluid film in simple shear - Viscous flow between very close parallel plates - Shear stress variation Reynolds equation for film lubrication - High speed unloaded journal bearings - Loaded journal bearings –The Somerfield diagram.

UNIT V SURFACE ENGINEERING AND MATERIALS FOR BEARINGS 9

Surface modifications - Transformation hardening - Surface fusion – Thermo-chemical processes – Surface coatings - Plating and anodizing - Materials for rolling element bearings - Materials for fluid film bearings - Materials for marginally lubricated and dry bearings.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Williams J A, "Engineering Tribology", Cambridge University Press, 2018.
2. G W Stachowiak, A W Batchelor, "Engineering Tribology", Butterworth-Heinemann, 2019.

REFERENCES:

1. Cameron A, "Basic Lubrication Theory", Ellis Herward Ltd, 2018.
2. Halling J (Editor), "Principles of Tribology", Macmillan Publishers, 2019.

3 Rabinowicz E, "Friction and Wear of Materials", John Wiley & Sons, 2019.

ONLINE RESOURCES:

1 https://archive.nptel.ac.in/courses/112/102/112102015/

2 https://www.sciencedirect.com/journal/tribology-international

3 https://link.springer.com/chapter/10.1007/978-3-031-57409-2_1

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain about topography of surfaces, surface interactions and friction.

CO2 Summarize various types of wear and surface treatment process.

CO3 Explain the hydrodynamic lubrication, Boundary Lubrication, Solid Lubrication and Hydrostatic Lubrication.

CO4 Explain the film lubrication theory.

CO5 Analyse the Materials for fluid film bearings and Materials for marginally lubricated and dry bearings.

CO–PO–PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	-	1	-	-	-	-	2	1
CO2	2	2	1	1	-	-	-	1	-	-	-	-	2	1
CO3	2	2	1	1	-	-	-	1	-	-	-	-	2	1
CO4	3	2	1	2	-	-	-	1	-	-	-	-	2	1
CO5	3	3	2	2	-	-	-	1	-	-	-	-	2	1

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U23PEME40	SURFACE ENGINEERING	L	T	P	C
		3	0	0	3

Prerequisites: Theory of Machines

Course Objectives:

- To enable the Engineering students about the value of surface engineering.
- To make the engineering students to understand the importance of surface & its interactions with its environment.
- To equip the students to understand the various & Advanced surface modification techniques.

UNIT I **BASICS OF SURFACE PROPERTIES** **9**

Introduction – Tribology – surface degradation – wear – types of wear – adhesive – abrasive – oxidative –corrosive – erosive and fretting wear – roles of friction and lubrication – corrosion – types – passivity – mechanism of growth and break down of passive film – corrosion control.

UNIT II **SURFACE CLEANING** **9**

Solar radiation – Measurements of solar radiation and sunshine – Solar spectrum - Solar thermal collectors – Flat plate and concentrating collectors – Solar thermal applications – Solar thermal energy storage – Fundamentals of solar photovoltaic conversion – Solar cells – Solar PV Systems – Solar PV applications.

UNIT III **SURFACE COATING TECHNIQUES** **9**

Introduction – principle – parameters of electrodeposition –Faraday's laws of electrodeposition-electrodeposition of copper, nickel, chromium and gold for industrial practices – organic coatings paints-requirements of good paints-constituents of paints-function-formulation of durable paint enamel coatings-special paints-heat resistant and fire-retardant paints-electroless coatings conversion coatings.

UNIT IV **ADVANCED SURFACE MODIFICATION PROCESS** **9**

Introduction –physical vapor deposition-chemical vapor deposition- ion beam process – ion beam assisted vapour deposition – ion implantation – reactive ion sputtering coating – electron beam process – electron beam assisted vapour deposition – laser assisted surface modification – laser alloying – laser melting – laser ablation – laser sprayed deposit – direct metal deposition by lase.

UNIT V **STANDARDS FOR SURFACE ENGINEERING MEASUREMENTS** **9**

Introduction – Terminology – laboratory accreditation – sampling – surface finish evaluation – bare and coated materials – product quality standards for specific coating process – conversion coatings – galvanized coatings – electrodeposited coatings – vapor deposited coatings –standards & ASTM Standards for measurement of surface treated materials – depth – thickness –hardness and friction coefficient.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Ramnarayan Chattopadhyay, "Advanced Thermally Assisted Surface Engineering Processes", 2nd Edition, Kluwer Academic Publishers, 2020.

2 Sudarshan T S, "Surface Modification Technologies – An Engineer's Guide", Marcel Dekker, 2019.

REFERENCES:

1 Varghese C D, "Electroplating and Other Surface Treatments – A Practical Guide", 2nd Edition, Tata McGraw Hill, 2019.

2 Adamson A W, Gast A P, "Physical Chemistry of Surfaces", 6th Edition, John Wiley & Sons, 2018.

3 Stanley J Dapkunas, "Surface Engineering Measurement Standards for Inorganic Materials", National Institute of Standards & Technology, 2020.

ONLINE RESOURCES:

1 https://www.routledge.com/Tribology-in-Sustainable-Manufacturing/Katiyar-Rao-Rani-Sulaiman-Davim/p/book/9781032426310

2 https://www.routledge.com/Surface-Engineering-Methods-and-Applications/Walia-Murtaza-Pandey-Tyagi/p/book/9781032055015

3 https://archive.nptel.ac.in/courses/112/107/112107248/

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Describe the concept and basis of surface engineering.

CO2 Explain the various methods of surface modification techniques.

CO3 Explain the various modification phenomena.

CO4 Apply the advanced surface modification process using electron beam and laser beam.

CO5 Summarize the ASTM standards for surface engineering measurements.

CO–PO–PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	-	-	-	1	-	-	2	1
CO2	2	2	1	1	-	-	-	-	-	1	-	-	2	1
CO3	2	2	1	1	-	-	-	-	-	1	-	-	2	1
CO4	3	2	1	2	-	-	-	-	-	1	-	-	2	1
CO5	2	2	1	1	-	-	-	-	-	1	-	-	2	1

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U23PEME41	HYBRID AND ELECTRIC VEHICLE TECHNOLOGY	L	T	P	C
		3	0	0	3

Prerequisites: Engineering Materials and Metallurgy

Course Objectives:

- To introduce the concept of hybrid and electric drive trains.
- To elaborate on the types and utilisation of hybrid and electric drive trains.
- To expose on different types of AC and DC drives for electric vehicles.

UNIT I **INTRODUCTION** **9**

Basics of vehicle performance, vehicle power source characterization, transmission characteristics, History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

UNIT II **HYBRID ELECTRIC DRIVE TRAINS** **9**

Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis. Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.

UNIT III **CONTROL OF AC & DC DRIVES** **9**

Introduction to electric components used in hybrid and electric vehicles, Configuration, and control -DC Motor drives, Induction Motor drives, Permanent Magnet Motor drive, and Switch Reluctance Motor drives, drive system efficiency.

UNIT IV **ENERGY STORAGE** **9**

Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Energy storage and its analysis–Battery based, Fuel Cell based, and Super Capacitor based, Hybridization of different Energy storage vices.

UNIT V **DRIVESIZING AND ENERGY MANAGEMENT STRATEGIES** **9**

Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selection of appropriate energy storage technology, Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification, and comparison of energy management strategies, Implementation issues.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Iqbal Hussain, "Electric and Hybrid Vehicles: Design Fundamentals", 2nd Edition, CRC Press, 2021.

2 James Larminie, John Lowry, "Electric Vehicle Technology Explained", John Wiley & Sons, 2019.

REFERENCES:

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1 Mehrdad Ehsani, Yimi Gao, Sebastian E Gay, Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", CRC Press 2018.
2 Rand D A J, Woods R, Dell R M, "Batteries for Electric Vehicles", John Wiley & Sons, 2019.
3 Jack Erjavec, "Hybrid, Electric and Fuel-Cell Vehicles", 3rd Edition, Cengage Learning, 2019.

ONLINE RESOURCES:

1 https://nptel.ac.in/courses/108102121
2 https://link.springer.com/chapter/10.1007/978-981-99-6749-0_29
3 https://www.sciencedirect.com/science/article/pii/B9780128030219000045

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Describe the Characterise and configure hybrid drive trains requirement for a vehicle.
CO2 Design the appropriate hybrid and electric drive trains in a vehicle.
CO3 Design and install suitable AC and DC drives for electric vehicles.
CO4 Apply the suitable energy storage system for a hybrid/electric vehicle.
CO5 Explain energy management strategies for better economy and efficiency.

CO–PO–PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	1	-	1	-	-	-	-	2	1
CO2	3	3	3	3	-	1	-	1	-	-	-	-	2	1
CO3	3	3	3	3	-	1	-	1	-	-	-	-	2	1
CO4	3	2	1	2	-	1	-	1	-	-	-	-	2	1
CO5	3	2	1	2	-	1	-	1	-	-	-	-	2	1

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U23PEME42	IOT FOR MANUFACTURING INDUSTRY	L	T	P	C
		3	0	0	3

Prerequisites: Fundamental concept of IOT

Course Objectives:

- To enable the interconnection and integration of the physical world and the cyber space.
- To introduce some background and related technologies of IoT.
- To introduce Digital Manufacturing & Digital twin concepts and their applications in industry.

UNIT I INTRODUCTION TO DIGITAL MANUFACTURING 9

Introduction- Digital Manufacturing and Design Operation Mode and Architecture of Digital Manufacturing System, Digital Thread-Components. and Implementation, Advanced Manufacturing Process Analysis, Intelligent Machining, Advanced Manufacturing Enterprise, Cyber Security in Manufacturing, Model Based Systems Engineering.

UNIT II INTERNET OF THINGS (IOT) 9

Introduction to IoT, Sensing, Actuation, Basics of Networking, Communication Protocols, Sensor Networks, Machine-to-Machine Communications. Interoperability in IoT, Introduction to Arduino Programming, Integration of Sensors and Actuators with Arduino. Applications, IoT data management requirements, Architecture of IoT, Technological challenges, Industrial Gateways, Basics of Communication requirements, RFID and the Electronic Product Code (EPC) network, The web of things, Issues in implementing IoT.

UNIT III PROGRAMMING FOR IOT 9

Introduction to Python programming, Raspberry Pi. Implementation of IoT with Raspberry Pi, Introduction to SDN for IoT, Data Handling and Analytics, Cloud Computing.

UNIT IV CLOUD AND FOG COMPUTING 9

Cloud Computing, Sensor-Cloud. Fog Computing, Smart Cities and Smart Homes. Connected Vehicles, Smart Grid, Industrial IoT- Case Studies.

UNIT V DIGITAL TWIN ANDINDUSTRY 4.0 9

Digital twin - Definition, types of Industry & its key requirements, Importance, Application of Digital Twin in process, product, service industries, History of Digital Twin, DTT role in industry innovation, Technologies/tools enabling Digital Twin, Industrial Revolutions, Industry 4.0 – Definition, principles, Application of Industry 4.0 in process & discrete industries, Benefits of Industry 4.0.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", 2nd Edition, Apress, 2018.
2. Christoph Jan Bartodziej, "The Concept Industry 4.0: An Empirical Analysis of Technologies and Applications in Production Logistics", Springer Gambler, 2018.

REFERENCES:

1 Ibrahim Garbie, "Sustainability in Manufacturing Enterprises: Concepts, Analyses and Assessments for Industry 4.0", Springer, 2019.

2 Ronald R Yager, Jordán Pascual Espada, "New Advances in the Internet of Things", Springer,2018.

3 Ulrich Sendler, "The Internet of Things: Industries 4.0 Unleashed", Springer, 2019.

ONLINE RESOURCES:

1 https://www.internetsociety.org/iot

2 https://event.asme.org/digitaltwin/About/Digital-Twin-Resources

3 https://www.coursera.org/specializations/digital-manufacturingdesign-technolo

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the Digital Manufacturing and its components.

CO2 Describe IoT concepts such as sensors, communication protocols, Arduino integration, and data management.

CO3 Summarize the various programming techniques for IoT.

CO4 Explain the Cloud and Fog Computing for manufacturing industries.

CO5 Summarize the advantages of Industry 4.0 and Digital Twin.

CO–PO–PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	-	-	-	-	-	2	2	1
CO2	2	2	1	1	-	-	-	-	-	-	-	2	2	1
CO3	2	2	1	1	-	-	-	-	-	-	-	-2	2	1
CO4	2	2	1	1	-	-	-	-	-	-	-	2	2	1
CO5	2	2	1	3	-	-	-	-	-	-	-	-2	2	1

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U23PEME43	ELECTRICAL DRIVES AND CONTROLS	L	T	P	C
		2	0	2	3

Prerequisites: Basics of Electrical and Electronics Engineering

Course Objectives:

- To understand the basic concepts of different types of electrical machines and their performance
- To study the different methods of starting D.C motors and induction motors
- To study the conventional and solid-state drives

UNIT I **INTRODUCTION** **6**

Basic Elements — Types of Electric Drives — factors influencing the choice of electrical drives — heating and cooling curves — Loading conditions and classes of duty — Selection of power rating for drive motors with regard to thermal overloading and Load variation factors.

UNIT II **DRIVE MOTOR CHARACTERISTICS** **6**

Mechanical characteristics — Speed-Torque characteristics of various types of load and drive motors — Braking of Electrical motors — DC motors: Shunt, series and compound — single phase and three phase induction motors.

UNIT III **STARTING METHODS** **6**

Types of D.C Motor starters — Typical control circuits for shunt and series motors — Three phase squirrel cage and slip ring induction motors.

UNIT IV **CONVENTIONAL AND SOLID-STATE SPEED CONTROL OF D.C. DRIVES** **6**

Speed control of DC series and shunt motors — Armature and field control, Ward-Leonard control system — Using controlled rectifiers and DC choppers –applications.

UNIT V **CONVENTIONAL AND SOLID-STATE SPEED CONTROL OF A.C. DRIVES** **6**

Speed control of three phase induction motor — Voltage control, voltage / frequency control, slip power recovery scheme — Using inverters and AC voltage regulators — applications.

30 PERIODS

TEXT BOOKS:

1. Nagrath I J, Kothari D P, "Electrical Machines", 2nd Edition, Tata McGraw Hill, 2018.
2. Vedam Subrahmaniam, "Electric Drives (Concepts and Applications)", Tata McGraw Hill, 2019.

REFERENCES:

1. Partab H, "Art and Science and Utilisation of Electrical Energy", Dhanpat Rai and Sons, 2018.
2. Pillai S K, "A First Course on Electric Drives", Wiley Eastern Limited, 2012.
3. Singh M D, Khanchandani K B, "Power Electronics", Tata McGraw Hill, 2018.

ONLINE RESOURCES:

1 https://archive.nptel.ac.in/courses/108/104/108104140/

2 http://wagnerrp.com/files/9780750667401.pdf

3 http://nitttrc.edu.in/nptel/courses/video/108104140/L06.html

PRACTICAL EXERCISES:

1 Load test on DC Shunt & DC Series motor

2 Speed control of DC shunt motor (Armature, Field control)

3 Load test on single phase transformer

4 Regulation of an alternator by EMF & MMF methods

5 V curves and inverted V curves of synchronous Motor

6 Load test on three phase squirrel cage Induction motor

7 Speed control of three phase slip ring Induction Motor

30 PERIODS
TOTAL :60 PERIODS

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the basic elements of electric drives and factors affecting the selection of drive motors, including thermal effects and load duty.

CO2 Analyze the speed-torque characteristics and braking methods of various motors including DC and AC types.

CO3 Describe different starting methods for DC and AC motors with control circuit diagrams.

CO4 Apply conventional and solid-state speed control methods for DC drives using field, armature and converter-based control techniques.

CO5 Evaluate different speed control techniques of AC motors including inverter-based and slip power recovery systems.

CO–PO–PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	1	-	-	1	-	-	-	-	1	-
CO2	3	3	2	2	1	-	-	1	-	-	-	-	1	-
CO3	2	2	1	1	1	-	-	1	-	-	-	-	1	-
CO4	3	2	1	2	1	-	-	1	-	-	-	-	1	-
CO5	3	3	2	2	1	-	-	1	-	-	-	-	1	-

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U23PEME44	INDUSTRIAL HEALTH MEASUREMENTS	L	T	P	C
		3	0	0	3

Prerequisites: Environmental Safety and Disaster Management

Course Objectives:

- To introduce the development of Additive Manufacturing (AM), various business opportunities and applications.
- To familiarize various software tools, processes and techniques to create physicalobject that satisfy product development/prototypingrequirements using AM.
- To gain knowledge on applications of binder jetting, material jetting and sheet lamination processes.

UNIT I **INTRODUCTION** 9

Need for developing Environment, Health and Safety systems in work places - Accident Case Studies - Status and relationship of Acts - Regulations and Codes of Practice - Role of trade union safety representatives. International initiatives - Ergonomics and work place.

UNIT II **OCCUPATIONAL HEALTH AND HYGIENE** 9

Definition of the term occupational health and hygiene - Categories of health hazards - Exposure pathways and human responses to hazardous and toxic substances - Advantages and limitations of environmental monitoring and occupational exposure limits - Hierarchy of control measures for occupational health risks - Role of personal protective equipment and the selection criteria - Effects on humans - control methods and reduction strategies for noise, radiation and excessive stress.

UNIT III **WORKPLACE SAFETY AND SAFETY SYSTEMS** 9

Features of Satisfactory and Safe design of work premises – good housekeeping - lighting and colour, Ventilation and Heat Control – Electrical Safety – Fire Safety – Safe Systems of work for manual handling operations – Machine guarding – Working at different levels – Process and System Safety.

UNIT IV **HAZARDS AND RISK MANAGEMENT** 9

Safety appraisal - analysis and control techniques – plant safety inspection – Accident investigation - Analysis and Reporting – Hazard and Risk Management Techniques – major accident hazard control – Onsite and Offsite emergency plans

UNIT V **ENVIRONMENTAL HEALTH AND SAFETY MANAGEMENT** 9

Concept of Environmental Health and Safety Management – Elements of Environmental Health and Safety Management Policy and methods of its effective implementation and review – Elements of Management Principles – Education and Training – Employee Participation.

TOTAL:45 PERIODS

TEXT BOOKS:

1 Mistry K U, "Fundamentals of Industrial Safety and Health", 2nd Edition, Siddharth Prakashan Publisher, 2018.

2 Charles D Reese, "Occupational Health and Safety Management: A Practical Approach", CRC Press,2018.

ONLINE RESOURCES:

1 https://onlinecourses.nptel.ac.in/noc22_ae03/preview

2 https://link.springer.com/book/10.1007/978-981-15-5616-2

3 https://www.sciencedirect.com/science/article/pii/S2352146522000847

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the importance of UAVs, classification and their applications.

CO2 Evaluate the suitable drone component based on design requirements.

CO3 Describe the integration of drone components.

CO4 Summarize the uses of transmitter, receiver and telemetry system and its configuration.

CO5 Explain basic control of drone and perform ground test and troubleshooting.

CO–PO–PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	1	-	1	-	-	-	-	1	1	1
CO2	3	3	2	2	1	-	1	-	-	-	-	1	1	1
CO3	2	2	1	1	1	-	1	-	-	-	-	1	1	1
CO4	2	2	1	1	1	-	1	-	-	-	-	1	1	1
CO5	2	2	1	1	1	-	1	-	-	-	-	1	1	1

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U23PEME45	PRODUCTION PLANNING AND CONTROL	L	T	P	C
		3	0	0	3

Prerequisites: Manufacturing Technology

Course Objectives:

- To understand the concept of production planning and control and work study.
- To apply the concept of product planning and to analyse the production scheduling.
- To apply the Inventory Control concepts and to prepare the manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

UNIT I INTRODUCTION 9

Objectives and benefits of planning and control-Functions of production control-Types of production job-batch and continuous-Product development and design-Marketing aspect - Functional Aspects-Operational Aspect-Durability and dependability aspect aesthetic aspect. Profit consideration-Standardization, Simplification & specialization-Break even analysis- Economics of a new design.

UNIT II WORK STUDY 9

Method study, basic procedure-Selection-Recording of process - Critical analysis, Development - Implementation - Micro motion and memo motion study – work measurement - Techniques of work measurement - Time study - Production study - Work sampling - Synthesis from standard data - Predetermined motion time standards.

UNIT III PRODUCT PLANNING AND PROCESS PLANNING 9

Product planning-Extending the original product information-Problems in lack of product planning-Process planning and routing- Prerequisite information needed for process planning- Steps in process planning-Quantity determination in batch production-Machine capacity, balancing- Analysis of process capabilities in a multi-product.

UNIT IV PRODUCTION SCHEDULING 9

Production Control Systems-Loading and scheduling-Master Scheduling-Scheduling rules-Gantt Charts-Perpetual Loading-Basic scheduling problems - Line of balance – Flow production scheduling- Batch production scheduling-Product sequencing – Production Control systems- Periodic batch control- Material requirement planning kanban – Dispatching-Progress reporting and expediting- Manufacturing lead time-Techniques for aligning completion times and due dates.

UNIT V INVENTORY CONTROL AND RECENT TRENDS IN PPC 9

Inventory control - Purpose of holding stock-Effect of demand on inventories - Ordering procedures. Two bin system - Ordering cycle system - Determination of Economic order quantity and economic lot size - ABC analysis - Recorder procedure - Introduction to computer integrated production planning systems – elements of JUST IN TIME SYSTEMS - Fundamentals of MRP II and ERP.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 James B Dilworth, "Operations Management – Design, Planning and Control for Manufacturing and Services", 3rd Edition, Tata McGraw Hill, 2018.

2 Martand Telsang, "Industrial Engineering and Production Management", S Chand and Company, 2019.

REFERENCES:

1 Elwood Elwood S Buffa, Rakesh K Sarin, "Modern Production/Operations Management", John Wiley and Sons 2019.

2 Jain K C, Aggarwal L N, "Production Planning Control and Industrial Management", Khanna Publishers 2019.

3 Samson Eilon, "Elements of Production Planning and Control", Universal Book Corp, 2019.

ONLINE RESOURCES:

1 https://nptel.ac.in/courses/112107143.

2 https://www.educate.elsevier.com/book/details/9780128183649

3 https://link.springer.com/chapter/10.1007/978-3-031-77106-4_11

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain production planning, control schedule and work-study chart.

CO2 Explain the method study, motion study and work measurement techniques.

CO3 Explain the concept product planning and process planning.

CO4 Describe the production scheduling using Gnatt chart, material requirement planning and dispatching techniques.

CO5 Summarize the manufacturing requirement for inventory control and Enterprise Resource Planning.

CO–PO–PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	-	1	-	-	-	-	1	2
CO2	2	2	1	1	-	-	-	1	-	-	-	-	1	2
CO3	2	2	1	1	-	-	-	1	-	-	-	-	1	2
CO4	2	2	1	2	-	-	-	1	-	-	-	-	1	2
CO5	2	2	1	1	-	-	-	1	-	-	-	-	1	2

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U23PEME46	MAINTENANCE ENGINEERING	L	T	P	C
		3	0	0	3

Prerequisites: Fundamental concepts of Machines

Course Objectives:

- To enable the student to understand the principles, functions and practices adapted in industry for the successful management of maintenance activities.
- To explain the different maintenance categories like Preventive maintenance, condition monitoring and repair of machine elements.
- To illustrate some of the simple instruments used for condition monitoring in industry.

UNIT I PRINCIPLES AND PRACTICES OF MAINTENANCE PLANNING 9

Basic Principles of maintenance planning – Objectives and principles of planned maintenance activity – Importance and benefits of sound Maintenance systems – Reliability and machine availability – MTBF, MTTR and MWT – Factors of availability – Maintenance organization – Maintenance economics.

UNIT II MAINTENANCE POLICIES – PREVENTIVE MAINTENANCE 9

Maintenance categories – Comparative merits of each category – Preventive maintenance, maintenance schedules, repair cycle - Principles and methods of lubrication – TPM.

UNIT III CONDITION MONITORING 9

Condition Monitoring – Cost comparison with and without CM – On-load testing and offload testing – Methods and instruments for CM – Temperature sensitive tapes – Pistol thermometers – wear-debris analysis.

UNIT IV REPAIR METHODS FOR BASIC MACHINE ELEMENTS 9

Repair methods for beds, slide ways, spindles, gears, lead screws and bearings – Failure analysis – Failures and their development – Logical fault location methods – Sequential fault location.

UNIT V REPAIR METHODS FOR MATERIAL HANDLING EQUIPMENT 9

Repair methods for Material handling equipment - Equipment records –Job order systems -Use of computers in maintenance.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Srivastava S K, "Industrial Maintenance Management", S Chand and Co, 2019.
2. Venkataraman K, "Maintenance Engineering and Management", Prentice Hall of India, 2017.

REFERENCES:

1. Bhattacharya S N, "Installation, Servicing and Maintenance", 2nd Edition, S Chand and Co, 2018.
2. White E N, "Maintenance Planning", I Documentation, Gower Press, 2019.
3. Garg H P, "Industrial Maintenance", S Chand and Co, 2019.

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ONLINE RESOURCES:

1 https://nptel.ac.in/courses/112105048.

2 https://www.sciencedirect.com/science/article/pii/S2212827124007674

3 https://link.springer.com/book/10.1007/978-1-84882-472-0

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain principles and practices of maintenance engineering.

CO2 Describe the maintenance policies and categories related to preventive maintenance.

CO3 Apply the concept of condition monitoring in maintenance engineering.

CO4 Explain the repair methods for various basic machine elements.

CO5 Explain the repair method for material handling equipment.

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	-	1	-	-	-	-	2	1
CO2	2	2	1	1	-	-	-	1	-	-	-	-	2	1
CO3	3	2	1	2	-	-	-	1	-	-	-	-	2	1
CO4	2	2	1	1	-	-	-	1	-	-	-	-	2	1
CO5	2	2	1	1	-	-	-	1	-	-	-	-	2	1

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U23PEME47	ARTIFICIAL INTELLIGENCE	L	T	P	C
		3	0	0	3

Prerequisites: Mechatronics

Course Objectives:

- To study the concepts of Artificial Intelligence.
- To study the methods of solving problems using Artificial Intelligence.
- To Learn the knowledge representation techniques, reasoning techniques and planning.

UNIT I **INTRODUCTION AND AGENTS** **9**

Introduction– History of AI-Intelligent agent –Structure of Agents– Problem solving agents – Uninformed search strategies-Searching with partial information.

UNIT II **INFORMED SEARCH METHODS AND GAME PLAYING** **9**

Informed search Strategies – A* Heuristic function – Hill Climbing search – Constraint Satisfaction problem- Optimal decisions in games – Pruning –Alpha-Beta pruning.

UNIT III **KNOWLEDGE AND LOGIC** **9**

Knowledge based agent – The Wumpus world environment –Propositional Logic- First-order logic –Syntax and Semantics of FOL-Knowledge engineering process – Inference in FOL – Forward and backward chaining algorithm.

UNIT IV **PLANNING** **9**

Planning Problem-Language of planning problems-Planning with state space search-Partial order planning. Planning graphs-Planning with propositional logic-Analysis of planning approaches.

UNIT V **Forms of Learning** **9**

Inductive learning-Learning Decision trees-Ensemble Learning-Logical formulation of learning-Explanation based learning-Learning using relevance information.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Stuart R, Peter N, "Artificial Intelligence: A Modern Approach", 2nd Edition, Prentice Hall of India, 2019.
2. Elaine R, Kevin K, "Artificial Intelligence", Tata McGraw Hill, 2018.

REFERENCES:

1. Tim Jones M, "Artificial Intelligence: A System Approach", Infinity Science Press, 2018.
2. Ben Coppin, "Artificial Intelligence Illuminated", Jones and Bartlett Learning, 2018.
3. Yoshua Bengio, "Deep Learning", MIT Press, 2019.

ONLINE RESOURCES:

1. https://link.springer.com/journal/10462
2. https://ebookcentral.proquest.com/lib/ship/detail.action?docID=958762

3 http://proship.klnpa.org/login?url=http://search.ebscohost.com

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the useful search techniques, knowledge representation techniques.

CO2 Explain the important concepts like Expert Systems, AI applications.

CO3 Explain the Forward and backward chaining algorithms.

CO4 Describe the planning with state search and its graphs.

CO5 Explain the ensemble learning with their advantages and disadvantages.

CO–PO–PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	-	-	1	-	-	1	2	1
CO2	2	2	1	1	-	-	-	-	1	-	-	1	2	1
CO3	2	2	1	1	-	-	-	-	1	-	-	1	2	1
CO4	2	2	1	1	-	-	-	-	1	-	-	1	2	1
CO5	2	2	1	1	-	-	-	-	1	-	-	1	2	1

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U23PEME48	METAL CUTTING AND CNC MACHINES	L	T	P	C
		3	0	0	3

Prerequisites: Manufacturing Technology

Course Objectives:

- To understand the theory of metal cutting
- To understand the concepts of gear manufacture
- To understand CNC machines constructional features, working and programming

UNIT I **MECHANICS OF METAL CUTTING** **10**

Tool nomenclature – single point and multi point cutting tools – orthogonal & oblique cutting – cutting forces, Merchant circle diagram – force & velocity relationship

UNIT II **TOOL MATERIAL, TOOL WEAR AND TOOL LIFE** **9**

Requisites of tool materials – types of tool materials – Tool wear – Types, mechanism – Tool life - Machinability - types of chips – cutting fluids.

UNIT III **GEAR MANUFACTURE** **8**

Different methods of gear manufacture – Gear hobbling and gear shaping machines specifications – gear generation – different methods – gear finishing and shaving – grinding and lapping of hobs and shaping cutters – gear honing – gear broaching.

UNIT IV **CNC MACHINES** **9**

NC, CNC & DNC – types of CNC – constructional features – drives and control systems – feedback devices – Interchangeable tooling system – preset & qualified tools – ISO specification – Machining center – Turning center – CNC wire cut EDM.

UNIT V **CNC PROGRAMMING** **9**

Manual part programming – steps involved – sample program in lathe & milling. - Computer aided part programming – APT - CAM package – canned cycles - Programming.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Nagpal G R, "Machine Tool Engineering", 2nd Edition, Khanna Publishers, 2018.

2 Groover M P, "Automation, Production Systems and Computer Integrated Manufacturing", 3rd Edition, Prentice Hall of India, 2019.

REFERENCES:

1 G E Thyer, "Computer Numerical Control of Machine Tools", BH Newners, 2019.

2 Hajra Choudhury C J, "Elements of Workshop Technology", Asia Publishing House, 2019.

3 Jonathan Lin S C, "Computer Numerical Control from Programming to Networking", Delmar Publishers, 2021.

ONLINE RESOURCES:

1 https://link.springer.com/book/10.1007/978-3-319-73561-0

2 https://www.sciencedirect.com/science/article/pii/S2667344423000014

3 https://onlinecourses.nptel.ac.in/noc20_me30/previewhttps://youtu.be/ljveGnQw2G0

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Apply the principles of metal cutting and mechanics in machining process.

CO2 Explain tool materials based on requirement of the operation.

CO3 Summarize the concepts of various gear manufacturing methods.

CO4 Explain the numerical controls and its types.

CO5 Summarize the steps involved in CNC Programming.

CO–PO–PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	-	-	-	1	-	-	-	-	2	1
CO2	2	2	1	1	-	-	-	1	-	-	-	-	2	1
CO3	2	2	1	1	-	-	-	1	-	-	-	-	2	1
CO4	2	2	1	1	-	-	-	1	-	-	-	-	2	1
CO5	2	2	1	1	-	-	-	1	-	-	-	-	2	1

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U23OE101	ALGEBRA AND NUMBER THEORY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To make the student acquire sound knowledge of groups, rings, fields and polynomials which will be then used to solve the real life problems.
- To make the students to understand the basic concepts in number theory.
- To give an integrated approach to number theory and abstract algebra, and provide a firm basis for further reading and studying in the subject

UNIT I **GROUPS AND RINGS** 9

Groups - Definition - Properties - Homomorphism - Isomorphism - Cyclic groups - Cosets - Lagrange's theorem. Rings: Definition - Sub rings - Integral domain - Field - Integer modulo n - Ring homomorphism.

UNIT II **FINITE FIELDS AND POLYNOMIALS** 9

Rings - Polynomial rings - Irreducible polynomials over finite fields - Factorization of polynomials over finite fields.

UNIT III **DIVISIBILITY THEORY AND CANONICAL DECOMPOSITIONS** 9

Division algorithm – Base - b representations – Number patterns – Prime and composite numbers – GCD – Euclidean algorithm – Fundamental theorem of arithmetic – LCM.

UNIT IV **DIOPHANTINE EQUATIONS AND CONGRUENCES** 9

Linear Diophantine equations – Congruence's – Linear Congruence's - Applications: Divisibility tests - Modular exponentiation-Chinese remainder theorem – 2 x 2 linear systems.

UNIT V **CLASSICAL THEOREMS AND MULTIPLICATIVE FUNCTIONS** 9

Wilson's theorem – Fermat's little theorem – Euler's theorem – Euler's Phi functions – Tau and Sigma functions.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Jordi Guardia, Nicusor Minculete, Diana Savin, Montserrat, "New Frontiers in Number Theory and Applications", 1st Edition, Birkhauser Verlag AG, 2024.
2. Richard Michael Hill, "Introduction to Number Theory", World Scientific Europe Ltd., 2018.

REFERENCES:

1. Steven Howard Weintraub, "An Introduction to Abstract Algebra", World Scientific Publishing Company, 1st Edition, 2022.
2. John Stillwell, "Algebraic Number Theory for Beginners: Following a Path from Euclid to Noether" Cambridge University Press, 2022.

3. Ian Stewart, David Tall, "Algebraic Number Theory and Fermat's Last Theorem", Taylor and Francis, 4th Edition, CRC Press, 2020.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/111106131
2. https://nptel.ac.in/courses/111101137
3. https://nptel.ac.in/courses/111103020

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Analyze the notations and properties of algebraic structures such as groups, rings and fields.
CO2 Analyze the polynomial rings and irreducible polynomials over finite fields.
CO3 Apply the division algorithm and fundamental theorems on prime numbers.
CO4 Apply the congruence relation in number theory to solve the real life problems.
CO5 Analyze the concepts of multiplicative functions and classical theorems.

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	-	-	-	-	-	-	-
CO2	3	3	2	2	-	-	-	-	-	-	-	-
CO3	3	2	1	2	-	-	-	-	-	-	-	-
CO4	3	2	1	2	-	-	-	-	-	-	-	-
CO5	3	3	2	2	-	-	-	1	-	-	-	1

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U23OE102 **PROBABILITY AND QUEUEING THEORY** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To understand the basic concepts of probability, one and two dimensional random variables, and to introduce some standard distributions applicable to engineering which can describe real life phenomenon.
- To understand the basic concepts of random processes which are widely used in IT fields.
- To understand the concepts and significance of advanced queueing models and apply in engineering.

UNIT I **PROBABILITY AND RANDOM VARIABLES** **9**

Probability – Axioms of probability – Conditional probability – Baye's theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

UNIT II **TWO DIMENSIONAL RANDOM VARIABLES** **9**

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables.

UNIT III **RANDOM PROCESSES** **9**

Classification – Stationary process – Markov process - Poisson process – Discrete parameter Markov chain – Chapman Kolmogorov equations – Limiting distributions.

UNIT IV **QUEUEING MODELS** **9**

Markovian queues – Birth and death processes – Single and multiple server queueing models – Little's formula - Queues with finite waiting rooms – Queues with impatient customers: Balking and reneging.

UNIT V **ADVANCED QUEUEING MODELS** **9**

Finite source models - M/G/1 queue – Pollaczek Khinchin formula - M/D/1 and M/EK/1 as special cases – Series queues – Open Jackson networks.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. S. Venkatarama Krishnan, "Probability and Random Processes", 1st Edition, John Wiley & Sons, 2022.
2. Padma Prithivirajan, "Probability and Queueing Theory", 1st Edition, LAP Lambert Academic Publishing, 2022.

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REFERENCES:

1. Athanasios Papoulis, S. Unnikrishna Pillai, "Probability, Random Variables and Stochastic Processes", 5th Edition, Tata McGraw Hill, 2021.
2. Geoffrey Grimmett, David Stirzaker, "Probability and Random Processes", 4th Edition, OUP Oxford, 2020.
3. H A Taha, "Operations Research", 10th Edition, Pearson Education, 2019.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/111103159
2. https://nptel.ac.in/courses/111106150
3. https://nptel.ac.in/courses/111103022

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Apply the concepts of probability and some standard distributions in real life problems.
CO2 Analyze the concepts of two dimensional random variables.
CO3 Apply the concept of random processes in Engineering disciplines.
CO4 Analyze the various queue models.
CO5 Apply the concepts of series queues and open Jackson networks in real life problems.

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	-	-	-	-	-	-	-	-
CO2	3	3	2	2	-	-	-	-	-	-	-	-
CO3	3	2	1	2	-	-	-	-	-	-	-	-
CO4	3	3	2	2	-	-	-	1	-	-	-	1
CO5	3	2	1	2	-	-	-	-	-	-	-	-

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U23OE103	PROBABILITY AND RANDOM PROCESSES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To provide necessary basics in probability that are relevant in applications such as random signals and linear systems in communication engineering.
- To understand the concepts of random processes which are widely used in communication networks.
- To understand the concept of correlation, spectral densities and significance of linear systems with random inputs.

UNIT I PROBABILITY AND RANDOM VARIABLES 9

Probability–Discrete and continuous random variables–Moments – Moment generating functions–Joint Distribution–Covariance and Correlation – Transformation of a random variable.

UNIT II RANDOM PROCESSES 9

Classification–Characterization – Cross correlation and Cross covariance functions – Stationary Random Processes – Markov process - Markov chain.

UNIT III SPECIAL RANDOM PROCESSES 9

Bernoulli Process – Gaussian Process – Poisson process – Random telegraph process.

UNIT IV CORRELATION AND SPECTRAL DENSITIES 9

Auto correlation functions – Cross correlation functions – Properties – Power spectral density – Cross spectral density – Properties.

UNIT V LINEAR SYSTEMS WITH RANDOM INPUTS 9

Linear time invariant system – System transfer function – Linear systems with random inputs – Auto correlation and cross correlation functions of input and output.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. S. Venkatarama Krishnan, "Probability and Random Processes", 1st Edition, John Wiley & Sons, 2022.
2. Athanasios Papoulis, S. Unnikrishna Pillai, "Probability, Random Variables and Stochastic Processes", 5th Edition, Tata Mc Graw Hill, 2021.

REFERENCES:

1. Geoffrey Grimmett, David Stirzaker, "Probability and Random Processes", 4th Edition, Oxford University Press, 2020.
2. Hossein Pishro-Nik, "Introduction to Probability, Statistics, and Random Processes", Online Edition, Kappa Research, 2023.
3. Sheldon M. Ross, "Introduction to Probability Models", 13th Edition, Academic Press, 2021.

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ONLINE RESOURCES:

1. https://archive.nptel.ac.in/courses/117/105/117105085/
2. https://ocw.mit.edu/courses/18-440-probability-and-random-variables-spring-2014/
3. https://ocw.mit.edu/courses/res-6-012-introduction-to-probability-spring-2018/pages/part-iii-random-processes/

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Apply one- and two-dimensional random variables in engineering applications.
CO2 Apply the concept random processes in engineering disciplines.
CO3 Apply special random process to model the occurrences of events and the time points.
CO4 Analyze the concept of autocorrelation, cross correlation, power spectral density and its importance in communication Engineering.
CO5 Analyze the response of random inputs to linear time invariant systems.

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	-	-	-	1	-	-	-	1
CO2	3	2	1	2	-	-	-	1	-	-	-	1
CO3	3	2	1	2	-	-	-	1	-	-	-	1
CO4	3	3	2	2	-	-	-	1	-	-	-	1
CO5	3	3	2	2	-	-	-	1	-	-	-	1

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U23OE104	LINEAR ALGEBRA	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To provide the basic notions of vector spaces which will then be used to solve related problems.
- To understand the concepts of linear transformation, inner product spaces and orthogonalization.
- To utilize numerical methods to determine the eigenvalues of a matrix and execute matrix decomposition.

UNIT I **VECTOR SPACES** **9**

Vector spaces over Real and Complex fields – Subspace – Linear space – Linear independence and dependence – Basis and dimension.

UNIT II **LINEAR TRANSFORMATION** **9**

Linear transformation – Rank space and null space – Rank and nullity – Dimension theorem.

UNIT III **MATRIX REPRESENTATION OF LINEAR TRANSFORMATION** **9**

Matrix representation of linear transformation – Eigenvalues and eigenvectors of linear transformation –Diagonalization.

UNIT IV **INNER PRODUCT SPACES** **9**

Inner product and norms – Properties – Orthogonal, Orthonormal vectors – Gram Schmidt orthonormalization process – Least square approximation.

UNIT V **EIGEN VALUE PROBLEMS AND MATRIX DECOMPOSITION** **9**

Eigen value Problems: Power method, Jacobi rotation method – Singular value decomposition – QR decomposition.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. David C Lay, Steven R Lay, Judi J McDonald, "Linear Algebra and Its Applications", 6th Edition, Pearson Education, 2021.
2. Kenneth Hoffman, Ray Kunze, "Linear Algebra", 2nd Edition Reprint, Pearson Education, 2023.

REFERENCES:

1. Gilbert Strang, "Linear Algebra and Its Applications", 5th Edition, Cengage Learning, 2020.
2. Stephen H Friedberg, Arnold J Insel, Lawrence E Spence, "Linear Algebra", 4th Edition, Pearson Education, 2020.
3. Serge Lang, "Introduction to Linear Algebra", Revised Edition 2nd, Springer, 2021.

ONLINE RESOURCES:

1. https://www.coursera.org/learn/introduction-to-linear-algebra
2. https://ocw.mit.edu/courses/18-06-linear-algebra-spring-2010/
3. https://onlinecourses.nptel.ac.in/noc22_ma45/preview

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Solve system of linear equations and test the consistency.
CO2 Analyze the basis and dimension of vector space.
CO3 Solve linear transformation and its matrix representation.
CO4 Solve orthonormal basis of inner product space and find least square approximation.
CO5 Evaluate the eigenvalues of a matrix using numerical techniques and perform matrix decomposition.

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	-	-	-	1	-	-	-	1
CO2	3	3	2	2	-	-	-	-	-	-	-	1
CO3	3	2	1	1	-	-	-	1	-	-	-	1
CO4	3	2	1	1	-	-	-	-	-	-	-	1
CO5	3	3	2	3	-	-	-	1	-	-	-	1

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U23OE105	EVERYDAY PHYSICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To develop knowledge in the basic concepts of physics.
- To understand the application of Physics in everyday life.
- To know how the applications show impact in everyday life.

UNIT I **MECHANICS AND HEAT** **9**

Force – weight – work – energy – power – horsepower – centrifuge – washing machine – variation of boiling point with pressure – pressure cooker – cooling by expansion – refrigerator - air conditioner – Bernoulli principle – Bunsen burner, aero plane.

UNIT II **SOUND AND OPTICS** **9**

Sound waves – Doppler Effect - power of lens – long sight and short sight – microscope – telescope – binocular – camera.

UNIT III **ELECTRICAL AND ELECTRONIC APPLIANCES** **9**

Working of the tube light and fan – kilowatt hour – fuse and heating elements – microwave oven – electric heater – photoelectric effect – video camera.

UNIT IV **GEOPHYSICS AND MEDICAL PHYSICS** **9**

Earthquake – Richter scale – rainfall unit – lightning arrestors – cosmic showers – Coolidge tube – X – rays – ultrasound scan – CAT.

UNIT V **ENERGY SOURCES** **9**

Fission – energy release – principle of nuclear reactor – radiation dosimeter – hazards and protection – solar energy – photovoltaic cell.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. D Halliday, R Rensick, J Walker, "Principles of Physics", 12th Edition , John Wiley & Sons, 2023.
2. P S Hemne, C L Arora, "Physics for B.Sc. students - Optics", S. Chand Publishing, 2022.

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REFERENCES:

1. N Ravi, "The Hindu Speaks on Scientific Facts" (Vol-1)", The Hindu Group, 2024.
2. John Christopher Draper, "A Text-book of Medical Physics", Legare Street Press, 2022.
3. Jahan Singh, "Fundamentals of Nuclear Physics", Pragati Prakashan, 2021.

ONLINE RESOURCES:

1. http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html
2. http://onlinecourses.nptel.ac.in/
3. https://books.google.com/books/about/An_Introduction_to_Medical_Physics.html

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Describe the mechanical concepts in various appliances.
CO2 Apply the elementary mechanical concepts in sound and optics.
CO3 Explain the working of electrical and electronic appliances.
CO4 Summarize the basic concepts in Geo Physics and nuclear physics.
CO5 Apply the concepts of nuclear physics and space sciences in our daily life.

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	-	-	-	-	-	-	-
CO2	3	2	1	2	-	-	-	-	-	-	-	-
CO3	2	2	1	1	-	-	-	-	-	-	-	1
CO4	2	2	1	1	-	-	-	-	-	-	-	-
CO5	3	2	1	2	-	-	-	-	-	-	-	-

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U23OE106	CONSUMER AWARENESS ON APPLIANCES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To acquire knowledge of the multiple gadgets and devices.
- To understand difference between products from multiple brands.
- To learn the basics of marketing of gadgets used in daily life.

UNIT I **POWER GADGETS AT HOME AND WORK** 9

The electric power grid – single and three phase connection – UPS – Voltage stabilizers – lighting – energy saving devices and techniques (fluorescent, CFL, LED, solar panels – household equipment: power consumption of devices (electric fan, air conditioner, refrigerator, washing machine).

UNIT II **COMMUNICATION AND ENTERTAINMENT ELECTRONICS** 9

Telephone – Facsimile – Cell phone – Photocopier – Scanner – microphones – CD/DVD/Blu-ray players – portable media players – use of headphones.

UNIT III **PRODUCT INFORMATION** 9

Brand name and brand mark – selection of good brand – Corporate brand and product brand – product guarantee and warranty – standardization – product servicing – after sales services.

UNIT IV **ONLINE RESOURCES** 9

Apps, cloud based resources – e-commerce and productivity tools – access patterns – Comparing products online – choosing websites and online stores – awareness on terms and conditions.

UNIT V **NETWORKING SITES AND SAFETY** 9

Significance of social networking sites, browsers and cookies – email scams – knowledge on complaint procedure and disputes settlement – security issues on payment portals.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Pearson, "Principles of Marketing", 19th Edition, Dimensions, 2023.
2. Jobber and Elli, "Principles and Practices of Marketing", 9th Edition, Tata McGraw Hill, 2020.

REFERENCES:

1. Kleinert Eric, "Troubleshooting and Repairing Major Appliances", 3rd Edition, Atlantic Publishers, 2022.
2. K B Bhatia," Electrical appliances and devices", Khanna Publishers, 2024.
3. Charlie wing, "How Your House Works - A Visual Guide to understanding and Maintaining your Home", John Wiley & Sons, 2023.

ONLINE RESOURCES:

1. https://www.springer.com/series/13812
2. https://cloud.google.com/learn/training/networking-security
3. https://onlinecourses.nptel.ac.in/noc24_ph17/preview

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Describe the power gadgets and their maintenance.
CO2 Explain the devices used for communication and entertainment.
CO3 Explain the information about multiple brand products to make intelligent purchase decisions.
CO4 Summarize the online resources and awareness about their making policies.
CO5 Describe the significance of social networking sites, knowledge on complaint procedure and security issues.

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	-	-	-	-	-	-	-
CO2	2	2	1	1	-	-	-	-	-	-	-	-
CO3	2	2	1	1	-	-	-	-	-	-	-	1
CO4	2	2	1	1	-	-	-	-	-	-	-	-
CO5	2	2	1	1	-	-	-	-	-	-	-	-

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U23OE107	BIOPHYSICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To apply the knowledge about the physical forces in analysing the human body.
- To identify the necessity of diagnosis and therapy for various devices.
- To appreciate the effects of acoustics and ultrasonic in human body.

UNIT I **PHYSICAL FORCES EXEMPILIFIED IN MAN** 9

Introduction – mechanical forces – osmotic force – electric forces – bioelectric potentials – colloids – inter molecular forces – electromagnetic forces – generalized force.

UNIT II **HEAT ENERGY AND BIO - ENERGETICS** 9

Heat transfer – heat loss by the human body to the ambient air – radioactive heat transfer from the human body – Stefan – Boltzmann law – counter current heat exchange applications to vasculature of the human arm – concept of entropy in biological systems – fundamentals of energy cycle.

UNIT III **WAVES: SOUND AND ULTRASOUND** 9

Absorption – principle mechanism of absorption of matter waves – frictional resistance and elastic reactance of bulk tissue – Weber – Fechner law – physiological effects of intense matter waves and ultrasonic therapy - applications.

UNIT IV **FLUID FLOW** 9

Flow of frictionless fluids: Bernoulli's law – fluid flow in constricted tube – blood flow through a blood vessel with a partial blockage – angioplasty. Flow of viscous fluids: Analogy between fluid flow and electric current flow – fluid friction.

UNIT V **RADIATION** 9

Isotopes as tracers – labeling with isotopes – stable and radioactive isotopes – biological effects of radiation – internal radiation hazards – radiation units – Dosimetry.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. E J Casey, "Biophysics – concepts and mechanism", Alpha Edition, 2021.
2. William C Parke, "Biophysics - A Student Guide to the Physics of the Life Science and Medicine", Springer Nature Switzerland, 2021.

REFERENCES:

1. P Narayanan, " Essentials of Biophysics " 3rd Edition, New Age International Private Limited, 2023.
2. M A Subramanian, "Biophysics Principles and Techniques", MJP Publishers, 2021.
3. Paul Davidovits, "Physics in Biology and Medicine", 5th Edition, Elsevier Science Publishing Co Inc., 2024.

ONLINE RESOURCES:

1. https://www.fuw.edu.pl/~jantosi/booksonbiophysics/Introduction_of_Biophysics.pdf
2. https://archive.org/details/volkenshtein-biophysics-mir
3. https://ia801307.us.archive.org/29/items/biophysicsconcep00case/biophysicsconcep00case.pdf

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Summarize the knowledge about the physical forces exemplified in the human body.
CO2 Explain the importance of heat transfer in human body.
CO3 Describe the principle mechanism of matter waves and applications of ultrasound.
CO4 Apply the various laws of fluid flow in the study of human body.
CO5 Summarize the concepts of acoustic and radiation therapy.

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	-	-	-	-	-	-	-
CO2	2	2	1	1	-	-	-	-	-	-	-	-
CO3	2	2	1	1	-	-	-	-	-	-	-	1
CO4	3	2	1	2	-	-	-	-	-	-	-	-
CO5	2	2	1	1	-	-	-	-	-	-	-	-

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U23OE108 **ASTROPHYSICS** L T P C
3 0 0 3

COURSE OBJECTIVES:

- To elucidate the nature of the myriad objects and the universe as a whole.
- To understand the structure and the formation of myriad objects.
- To inculcate the ideas of discouraging our galaxies and their formation theories.

UNIT I **OPTICAL ASTRONOMY** 9

Electromagnetic spectrum and astronomical sources - emission and absorption spectra Doppler Effect - units of distances - distance measurements in astronomy stellar distances - Apparent - Absolute, Bolometric magnitudes - Luminosity.

UNIT II **STARS** 9

Spectral classification of stars - H-R diagram: binary and multiple stars visual, astrometry and eclipsing binaries - galactic and globular clusters - Stellar evolution - birth and death of a star - Sun - typical star - Structure of photosphere - sunspots.

UNIT III **MOON** 9

The moon's orbit relative to the earth - moon's distance - moon's phases - sidereal and synodic month - character of moon's surface - lunar eclipse - lunar tides - origin of moon.

UNIT IV **BETWEEN THE PLANETS** 9

Asteroids - meteoroids - meteors - comets - orbits of comets - spectrum of comets - formation of comet's tail.

UNIT V **DISCOVERING OUR GALAXIES** 9

The Milky Way Structural Feature Galaxies - Galaxies and universe: shape of galaxies - distance of galaxies big bang and steady state theory - galactic rotation - cluster of galaxies - cosmology.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. K S Krishna Swamy, "Astrophysics", New Age International Private Limited, 2022.
2. Wolfgang Demtroder, "Astrophysics", Springer, 2023.

REFERENCES:

1. Minn Carleton College, "Astronomy", Legare Street Press, 2023.
2. Camille Flammarion, "Astronomy", Legare Street Press, 2023.
3. Maggie Aderin-Pocock , "The sky at night: The art of stargazing", BBC books, 2023.

Y6599yfrONLINE RESOURCES:

1. https://www.uu.edu/societies/inklings/books/scienceandfaith/Chapter4.pdf
2. https://www.britannica.com/science/stellar-classification
3. https://openstax.org/books/astronomy-2e/pages/5-6-the-doppler-effect

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Apply physics principles to the interpretation of a broad range of astrophysical Observations.

CO2 Explain stellar evolution, including red giants, supernovas, neutron stars, pulsars, white dwarfs and black holes, using evidence and presently accepted theories.

CO3 Summarize the basic properties of the Sun.

CO4 Describe the features of objects in the Solar System, giving details of similarities and differences between these objects.

CO5 Describe the main features of formation theories of various types of observed galaxies.

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	-	-	-	-	-	-	-	-
CO2	2	2	1	1	-	-	-	-	-	-	-	-
CO3	2	2	1	1	-	-	-	-	-	-	-	1
CO4	2	2	1	1	-	-	-	-	-	-	-	-
CO5	2	2	1	1	-	-	-	-	-	-	-	-

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U23OE109	INTRODUCTION TO NANOSCIENCE AND NANOTECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain about nanomaterials, their importance and their dimensions.
- To study about the synthetic methods of nanomaterials.
- To develop skills about the structure, function and application of nanomaterials.

UNIT I **INTRODUCTION** 9

Nanoscale Science and Technology- Introduction, Classifications of nanostructured materials - nano particles- quantum dots, nanowires ultra-thinfilms-multi layered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties.

UNIT II **GENERAL METHODS OF PREPARATION** 9

Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, Sputtering, Evaporation, Molecular Beam Epitaxy, Electrochemical deposition.

UNIT III **NANOMATERIALS** 9

Nanometal oxides-ZnO, TiO2, MgO, ZrO2, NiO, nano alumina, CaO, AgTiO2, Ferrites, Quantum wires, Quantum dots. Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- Synthesis, structure-property Relationships and applications, Nanocomposites – FRP synthesis, property and its application.

UNIT IV **CHARACTERIZATION TECHNIQUES** 9

Xray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques, AFM, SPM, STM, SNOM, ESCA, SIMS.

UNIT V **APPLICATIONS** 9

NanoInfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nanobiotechnology: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targeted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)-Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sun barrier products - In Photostat, printing, solar cell, battery.

TOTAL: 45 PERIODS

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TEXT BOOKS:

1. R L Snyder, R W Kelsall, D L Jones, "Nanotechnology: A Hands-On Approach", 2nd Edition , John Wiley & Sons, 2023.
2. M C Roco, W S Bainbridge, B E Tonn, G M Whitesides, "Nanotechnology Research Directions for Societal Needs in 2025", Springer, 2024.

REFERENCES:

1. C Binns, "Introduction to Nanoscience and Nanotechnology", 2nd Edition, Wiley- Blackwell, 2021.
2. T Pradeep, "Atomically Precise Metal Nanoclusters", Elsevier, 2022.
3. C Anandharamakrishnan, "3D Printing of Foods", John Wiley & Sons, 2024.

ONLINE RESOURCES:

1. https://www.classcentral.com/course/electronics-purdue-university-fundamentals-of-nan-40243
2. https://www.classcentral.com/course/swayam-chemistry-of-nanomaterials-269673.
3. https://www.classcentral.com/course/introduction-to-the-modern-nanotechnology-22238.

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the basic concepts of Nanoscience and Nanotechnology and their impact in various fields, types of nanomaterials, dimensions and their properties.

CO2 Summarize the various techniques involved in synthesizing nanomaterials for engineering and technology applications.

CO3 Describe the various forms of nanomaterials with their structure- property relationship and applications.

CO4 Explain the structure of nanomaterials using various characterization techniques.

CO5 Analyse the application of nano materials in medical, electronic and engineering fields.

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	-	1	-	-	-	-	1
CO2	2	2	1	1	-	-	1	-	-	-	-	1
CO3	2	2	1	1	-	-	1	-	-	-	-	1
CO4	2	2	1	1	-	-	1	-	-	-	-	1
CO5	3	3	2	2	-	-	1	-	-	-	-	1

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U23OE110	GREEN TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the concepts of green technology through understanding the basics of eco-system and Biodiversity.
- To learn different types of environmental acts and analyse the green tax incentives, rebates, business redesign and its models.
- To extend knowledge of the importance of life cycle assessment.

UNIT I **INTRODUCTION** 9

The concept of green technology – its origin and historical evolution – nature, scope, significance, and multi-disciplinary approaches – classification of green technologies (e.g., clean energy, sustainable materials, carbon capture) – developing theoretical frameworks to understand green innovation – green technology initiatives and policies in India.

UNIT II **SUSTAINABILITY AND ENVIRONMENT** 9

Organizational environment - internal and external environment - Indian corporate structure and environment - how to go green - spread the concept in organization - environmental and sustainability issues.

UNIT III **ECOSYSTEM ECONOMICS** 9

Approaches - ecological economics - indicators of sustainability - ecosystem services and their sustainable use; bio-diversity - Indian perspective - alternate theories - Steady-state economics – circular economy.

UNIT IV **LAWS OF GREEN TECHNOLOGY** 9

Laws - Environmental reporting standards and compliance mechanisms – ISO 14001 - green finance - financial initiative by United Nations Environment Programme (UNEP). Environmental Management Systems – principles, certification process, and organizational impact – ISO 14064.

UNIT V **GREEN ECONOMICS** 9

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. WIPO, "Green Technology Book: Solutions for Climate Change Mitigation", 2nd Edition, World Intellectual Property Organization, 2023.
2. S J Arceivala, "Green Technologies", 1st Edition, Tata McGraw Hill, 2023.

REFERENCES:

1. P Oksen, "Green Technology Book: Solutions for Climate Change Adaptation", 1st Edition, World Intellectual Property Organization, 2022.
2. A Kumar, S Singh, 'Renewable Energy and Green Technology: Principles and Practices", Routledge, 2023.
3. M N O Sadiku, "Emerging Green Technologies" CRC Press, 2022.

ONLINE RESOURCES:

1. https://archive.nptel.ac.in/courses/105/102/105102195/
2. https://onlinecourses.nptel.ac.in/noc20_ce57/preview
3. https://archive.nptel.ac.in/courses/105/107/105107176/

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Summarize the concepts of green technologies in a project.

CO2 Explain the importance of environment and sustainability and their classes and issues.

CO3 Apply Eco-system concepts for sustainable.

CO4 Explain the Environmental laws and regulations for green technology.

CO5 Apply the green tax incentives and rebates and Eco-commerce models for greener economics.

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	-	2	-	-	-	1	1
CO2	2	2	1	1	-	-	2	-	-	-	1	1
CO3	3	2	1	2	-	-	2	-	-	-	1	1
CO4	2	2	1	1	-	-	2	1	-	-	1	1
CO5	3	2	1	2	-	-	2	-	-	-	1	1

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U23OE111	THE ENVIRONMENT AND SOCIETY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the complexity of environmental and social impacts of industry.
- To analyze about personal responsibilities and roles in environmental and social problems.
- To acquire new ideas for better integrating industry, environment, and equity.

UNIT I ENVIRONMENT, ECOSYSTEM AND BIODIVERSITY 9

Introduction to Environment- Ecosystem and its types- Biodiversity- Types of biodiversity. Importance of biodiversity-Loss of Biodiversity- Conservation of Biodiversity.

UNIT II ENVIRONMENT AND THE HUMAN INTERACTION 9

Types of Anthropogenic Activities-Anthropogenic Activities and Their Impacts on the Environment-Ways to Mitigate the Negative Impacts of Anthropogenic Activities on the Environment-Mitigation Measures for Anthropogenic Impacts.

UNIT III ISSUES IN ENVIRONMENTALISM 9

Significant global environmental issues such as acid rain, climate change, and resource depletion; historical developments in cultural, social and economic issues related to land, forest, and water management in a global context; interface between environment and society.

UNIT IV THREATS TO ENVIRONMENT 9

Developmental issues and related impacts such as ecological degradation; environmental pollution; development-induced displacement, resettlement, and rehabilitation: problems, concerns, and compensative mechanisms; discussion on Project Affected People (PAPs).

UNIT V ENVIRONMENT AND SUSTAINABLE DEVELOPMENT 9

Causes and effects of Depletion of Natural Resources - Impact of environmental degradation-Need for Sustainable development, Strategies for Achieving Sustainability, Sustainable Development in India, Role of Individuals and Communities.

TOTAL: 45 PERIODS

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TEXT BOOKS:

1. A Sabban, "Advances in Green Electronics Technologies in 2023", 1st Edition, IntechOpen, 2023.
2. R Dogra, "Renewable Energy and Green Technology", 1st Edition; Brillion Publishing, 2023.

REFERENCES:

1. P Robbins, L Hintz, M Moore, "Environment and Society: A Critical Introduction", 3rd Edition, Wiley- Blackwell, 2022.
2. P Frankopan, "The Earth Transformed: An Untold History. Allen Lane", Bloomsbury publisher, 2023.
3. M A Ali, M Kamraju, "Natural Resources and Society: Understanding the Complex Relationship Between Humans and the Environment" Springer Cham, 2023.

ONLINE RESOURCES:

1. http://www.who.int/topics/environmental_pollution/en/
2. http://edugreen.teri.res.in/explore/explore.htm
3. https://onlinecourses.swayam2.ac.in/nou20_ag12/preview

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Describe the environment ecosystem, importance of biodiversity and its conservation.

CO2 Analyze the various anthropogenic activities, its impact on environment and mitigation measures.

CO3 Describe the various global environmental issues.

CO4 Analyse the ecological degradation, environmental pollution issues owing to developmental activities.

CO5 Apply the green tax incentives and rebates and Eco-commerce models for greener economics.

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	2	3	-	2	-	-	2
CO2	3	3	2	2	-	2	3	-	2	-	-	2
CO3	2	2	1	1	-	2	3	-	2	-	-	2
CO4	3	3	2	2	-	2	3	-	2	-	-	2
CO5	3	2	1	2	-	2	3	-	2	-	-	2

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U23OE112	INDUSTRIAL CORROSION AND PREVENTION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To impart Knowledge on fundamental concepts of corrosion.
- To know the various types of corrosion.
- To create corrosion prevention plans in various industries.

UNIT I INTRODUCTION TO CORROSION 9

Introduction and importance, Forms of corrosion - uniform corrosion, pitting, crevice corrosion, inter granular corrosion, stress corrosion cracking and prevention of corrosion.

UNIT II CORROSION CONTROL IN POWER INDUSTRIES 9

Introduction, Frequent forms of corrosion, environment, case studies and prevention methodology and corrosion resistance materials.

UNIT III CORROSION CONTROL IN PETROCHEMICAL INDUSTRIES 9

Introduction, regular forms of corrosion, environment, case studies, prevention strategies – inhibitors and surface engineering - corrosion resistance materials

UNIT IV CORROSION CONTROL IN MARINE INDUSTRIES 9

Introduction, Metallurgical properties influencing corrosion. Common forms of corrosion, environment, Passivity – design of corrosion resistant alloys, case studies, and corrosion resistance materials.

UNIT V CORROSION CONTROL IN FERTILIZER INDUSTRIES 9

Introduction, frequent forms of corrosion, environment, case studies and corrosion resistance materials.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Mars G Fontana, "Corrosion Engineering", 3rd Edition, Tata McGraw Hill, 2019.
2. D B David, M Bastidas David, "Corrosion and protection of Metals", Metals, 2020.

REFERENCES:

1. Savas Kaya, Ime Bassey Obot, Demet Özkir, Goncagül Serdaroglu, Ambrish Singh, "Corrosion Science: Theoretical and Practical Applications", Apple Academic Press, 2024.

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2. E J David, Talbot D R James, Talbot, "Corrosion Science and Technology", CRC Press, 2020.
3. E I Younes, Kacimi, Savas Kaya, Rachid Touir, "New Challenges and Industrial Applications for Corrosion Prevention and Control", IGI Global, 2020.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/113108051
2. https://www.corrosionclinic.com/corrosion_courses/corrosion_control_prevention_5-day.htm
3. https://www.ampp.org/technical-research/what-is-corrosion/corrosion-reference-library

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Describe the basic principles of corrosion and its types.

CO2 Explain about corrosion damage in the power, petroleum, marine, and fertilizer industries.

CO3 Analyze the corrosion prevention techniques in the industries.

CO4 Summarize theory behind the fabrication of a corrosion-resistant alloy.

CO5 Explain the causes and remedies for corrosion

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	-	-	-	-	-	-	1
CO2	2	2	1	1	-	-	1	-	-	-	-	1
CO3	3	3	2	2	-	-	1	-	-	-	-	1
CO4	2	2	1	1	-	-	1	-	-	-	-	1
CO5	2	2	1	1	-	-	1	-	-	-	-	1

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U23OE113 **ENGLISH THROUGH MEDIA** L T P C
3 0 0 3

COURSE OBJECTIVES:

- To enhance students' ability to read & write efficiently while developing information ethically.
- To cultivate students' proficiency in developing listening, thinking, advertising & persuasive writing.
- To equip their proficiency with phonetics, accents, group discussions in real life situations as well as visual and verbal media.

UNIT I **READING AND WRITING SKILLS** 9

Reading for information – Skimming & Scanning; Importance of Language: Subjective & Objective Language. Writing – Use of Language to manipulate information; writing feature stories – Presentation and Structure.

UNIT II **LISTENING AND INTERVIEWING SKILLS** 9

Listening to talks – conversational strategies. Interviewing Skills – Agreeing and Disagreeing – Asserting and Negotiating.

UNIT III **REPORTING SKILLS – ORAL AND WRITTEN** 9

Critical Thinking: Problem Solving Skills –conversation Etiquette – Politeness Strategies. Online Writing: Netiquette – Analytical report, Brevity in advertising, persuasive writing.

UNIT IV **PRESENTATION SKILLS** 9

Purpose and features of presentation – Narrating Consumer Oriented Marketing of products, Group Discussion on culture, tradition, values.

UNIT V **ANALYZING AND EVALUATING SKILLS** 9

Vocabulary – Collocations & Slangs – Referencing – welcoming, conducting Programmes. Reviewing & Commenting – Expressing through visual & verbal media – Authentic conversation based on real – life situations.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. "English for Engineers & Technologists", 2020 Edition, Orient Blackswan Private Ltd., 2020.
2. Veena Selvam, Sujatha Priyadarshini, Deepa Mary Francis, K N Shoba , Lourdes Joevani, "English for Science & Technology", Cambridge University Press, 2021.

REFERENCES:

1. James Curran, Joanna Redden, "Understanding Media: Communication, Power and Social Chang", Pelican Publishing, 2024.
2. Soma Mahesh Kumar, "Soft Skills: Enhanching Personal and Professional Success", 1st Edition, Tata McGraw Hill, 2023.
3. Rodney H Jones, Sylvia Jaworska, "Erhan Aslan; Language and Media- A Resource Book for Students", e-book, Routledge, 2020.

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ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc20hs32/preview
2. https://www.coursera.org/learn/working-with-the-media
3. https://www.udemy.com/course/political-candidate-media-and-public-speaking-training/

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Apply reading and writing skills by exploring the language used in media.
CO2 Apply listening skills to communicate effectively in their area of specialization.
CO3 Apply soft skills in both oral and written communication.
CO4 Apply speaking skills in a variety of mediums including live communication.
CO5 Analyze different types of texts in different media like online, print, and social media.

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	2	-	2	-	-
CO2	3	-	-	-	-	-	-	2	-	2	-	-
CO3	3	-	-	-	-	-	-	2	-	2	-	-
CO4	3	-	-	-	-	-	-	2	-	2	-	-
CO5	1	-	-	-	-	-	-	2	-	2	-	-

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U23OE114 **ENGLISH FOR EMPLOYABILITY SKILLS** L T P C
3 0 0 3

COURSE OBJECTIVES:

- To introduce the students to skills necessary for getting, keeping and being successful in a profession.
- To understand the importance of communication and enhance self-confidence.
- To develop and nurture the Employability skills of the students through individual and group activities.

UNIT I **COMMUNICATION SKILLS** 9

Communication: An Introduction; Formal and Informal English; Description, Narration and Demonstration; Methods of Communication, Verbal Communication, Non-verbal Communication; Importance of feedbacks, Basics of Effective Communication; Writing Skills - Parts of Speech and Sentences; Soft Skills for Employers and Employees.

UNIT II **RESUME WRITING** 9

Resume, Curriculum vitae, how to develop an impressive resume, Different formats of resume – Chronological, Functional, Hybrid, Job application or cover letter.

UNIT III **PRESENTATION SKILLS** 9

Presentation Techniques – Time Management Techniques – Body language – Managerial Skills –Making Effective Presentation, Professional presentation- planning, preparing and delivering presentation.

UNIT IV **GROUP DISCUSSION AND PUBLIC SPEAKING** 9

Introduction to Group Discussion – Understanding Group Dynamics – Group Discussion Strategies–Activities to Improve GD Skills – Public Speaking Techniques – Public Speaking Activities.

UNIT V **INTERVIEW SKILLS** 9

Listening to Interviews; Types of Interviews; Preparation for the Interview – Interview Techniques and Etiquettes – Mock Interview – Online Interview Techniques.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Prashant Sharma, "Soft Skills: Personality Development for Life Success", 1st Edition, BPB Publications, 2022.

2 Rajendran, Jayanthi, Jeya Santhi V, Nagalakshmi B, "The Art of English Communication: A Practical Approach", Notionpress.com, 2025.

REFERENCES:

1. Grant, Adam. "Think Again: The Power of Knowing What You Don't Know", Penguin Random House, 2021.
2. Harrison, Ryan. "How To Talk To Anybody: 14 Speaking Techniques To Instantly Connect with Anyone", LearnWell Books, 2022.
3. Gloria J Galanes, Katherine Adams, Carrisa S Hoelscher, Stephen A Spates, "Effective Group Discussion: Theory and Practice", Tata McGraw Hill, 2023.

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ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc20_hs15/preview
2. https://www.coursera.org/learn/verbal-communications-and-presentation-skills
3. The Complete Guide to Resume Formats: Chronological, Functional, and Hybrid | UseResume.ai

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

- **CO1** Apply Employment Skills In Their Environment
- **CO2** Write Resume Writing & Job Application.
- **CO3** Apply The Fundamental Inputs Of Communication Skills In Making Speech Delivery.
- **CO4** Apply Various Group Discussion Skills To Take Part In Effective Discussions In A Professional Context.
- **CO5** Analyze Various Interview Formats For Job Interviews.

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	3	3	3	-	1
CO2	3	-	-	-	-	-	-	3	3	3	-	1
CO3	3	-	-	-	-	-	-	3	3	3	-	1
CO4	3	-	-	-	-	-	-	3	3	3	-	1
CO5	3	-	-	-	-	-	-	3	3	3	-	1

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U23OE115 **INVENTIONS AND APPLICATIONS** L T P C
3 0 0 3

COURSE OBJECTIVES:

- To analyse the engineering principles underlying major scientific inventions and their technological evolution.
- To apply scientific inventions in solving real-world engineering problems.
- To design innovative, sustainable, and ethical engineering solutions inspired by emerging technologies.

UNIT I FOUNDATIONS OF INVENTION AND INNOVATION 9

Definition and scope of invention vs. discovery – Drivers of scientific progress – Case studies of transformative inventions (printing press, steam engine, electricity, semiconductor devices) – Innovation models: TRIZ, disruptive innovation, and design thinking – Intellectual property rights and patents.

UNIT II COMMUNICATION AND INFORMATION TECHNOLOGY 9

Evolution of telecommunication systems – From telegraph to 5G networks – Internet architecture, cloud computing, IoT, AI, machine learning, and quantum computing – Applications in governance, smart cities, and cyber-physical systems – Limitations and challenges in scalability and security.

UNIT III ENERGY AND TRANSPORTATION SYSTEMS 9

Engineering design of combustion engines, power plants, and aerodynamics of flight – Advancements in electric vehicles, high-speed rail, and autonomous transport – Renewable energy technologies: photovoltaic cells, wind turbines, hydrogen fuel cells, bioenergy – Integration into smart grids – Case studies on sustainable energy transitions.

UNIT IV INVENTIONS IN MEDICINE AND BIOTECHNOLOGY 9

Medical imaging innovations (X-ray, MRI, PET, CT) – Engineering of biomedical devices, artificial organs, prosthetics, and implants – Nanomaterials in drug delivery and diagnostics – Genetic engineering, CRISPR, and synthetic biology – Role of AI and big data in precision healthcare.

UNIT V FRONTIER TECHNOLOGIES AND ETHICAL DIMENSIONS 9

3D printing and additive manufacturing – Robotics and autonomous systems – Space exploration technologies (rocketry, satellites, reusable launch systems) – Environmental engineering innovations (carbon capture, water purification, climate engineering) – Ethical, social, and sustainability considerations of emerging technologies.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Vasant Gowariker, Science and Technology for Sustainable Development in India, 1st Edition, Sage Publications, 2020.
2. Rakesh Rathi, Nanotechnology and Smart Materials: Recent Advances and Applications, 1st Edition, CRC Press, 2021.

REFERENCES:

1. Cristiano Antonelli, Innovation and Technological Change: An Evolutionary Perspective, 2nd Edition, Routledge, 2020.
2. Pradeep Fulay and Mohammad Islam, Materials Science and Engineering: An Introduction to Concepts, 2nd Edition, CRC Press, 2021.
3. Debmalya Barh (Ed.), Genomic and Precision Medicine: Engineering and Applications, Academic Press, Elsevier, 2020.

ONLINE RESOURCES:

1. https://www.technologyreview.com
2. https://technology.nasa.gov
3. https://spectrum.ieee.org

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Analyse the principles and historical context of major inventions and innovations.

CO2 Evaluate the engineering design and technological basis of inventions across domains.

CO3 Apply scientific principles to assess the efficiency, scalability, and limitations of technologies.

CO4 Design innovative solutions by integrating interdisciplinary knowledge from engineering and science.

CO5 Critically assess ethical, environmental, and societal implications of emerging technologies.

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	2	-		1	-	2	-
CO2	3	3	2	3	2	2	-		2	-	2	-
CO3	3	2	1	2	2	2	2		2	-	2	-
CO4	3	3	3	3	2	2	2		3	-	2	-
CO5	3	3	2	3	2	2	2		2	-	2	-

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U23OE116	PUBLIC POLICY AND GOVERNANCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To impart Knowledge on public policy-making processes and governance structures.
- To know the role of government institutions, stakeholders, and societal actors in shaping public policies.
- To explore the cchallenges and opportunities for global policy cooperation.

UNIT I INTRODUCTION TO PUBLIC POLICY AND GOVERNANCE 9

Public Policy - Definition and scope, Theories of policy-making (e.g., rational choice, incrementalism, advocacy coalition framework), Models of governance (e.g., hierarchical, network, collaborative)

UNIT II POLICY ANALYSIS AND EVALUATION 9

Policy analysis - Methods and tools for policy analysis (e.g., cost-benefit analysis, policy modeling, stakeholder analysis) Criteria for evaluating policy effectiveness, efficiency, and equity Case studies of policy success and failure.

UNIT III ACTORS AND INSTITUTIONS IN PUBLIC POLICY 9

Role of government agencies, legislatures, and courts in policy-making Influence of interest groups, advocacy coalitions, and the media on policy agendas Comparative analysis of governance structures and processes in different political systems.

UNIT IV POLICY IMPLEMENTATION AND MANAGEMENT 9

Challenges and strategies in policy implementation - the role of public administration, bureaucracies, and public-private partnerships tools for monitoring, evaluation, and adaptive management of policies.

UNIT V POLICY ISSUES AND CONTEMPORARY CHALLENGES 9

Current debates and controversies in public policy (e.g., healthcare reform, climate change, immigration) Emerging policy issues (e.g., digital governance, artificial intelligence, global pandemics)

TOTAL: 45 PERIODS

TEXT BOOKS:

1. James A. Stimson, Michael B. Macken, and Robert S. Erikson, Dynamic Representation: Policy, Public Opinion, and Democracy, 2nd Edition, Cambridge University Press, 2022.
2. Thomas R. Dye., "Understanding Public Policy", 15th Edition, Pearson Publishing Co., 2021.

REFERENCES:

1. Christopher M. Weible and Paul A. Sabatier (Eds.), Theories of the Policy Process, 5th Edition, Routledge, 2022.
2. Michael E. Kraft and Scott R. Furlong., "Public Policy: Politics, Analysis, and Alternatives", 6th Edition, CQ Press, 2020.
3. B. Guy Peters, Advanced Introduction to Public Policy, 2nd Edition, Edward Elgar Publishing, 2021.

ONLINE RESOURCES:

1. https://www.brookings.edu
2. https://www.rand.org/topics/public-sector-governance.html
3. https://www.pewresearch.org/topic/politics-policy

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Understand the concepts and theories of public policy and governance.

CO2 Analyze the interplay between government, civil society, and the private sector in policymaking processes.

CO3 Evaluate the impact of public policies on different stakeholders and societal outcomes.

CO4 Develop skills in policy analysis, advocacy, and stakeholder engagement.

CO5 Apply theoretical frameworks to real-world policy issues and case studies. Understand the concepts and theories of public policy and governance.

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	2	-	2	2	-	2	-
CO2	3	3	2	2	-	2	-	2	2	-	2	-
CO3	3	3	2	3	-	2	-	2	2	-	2	-
CO4	3	3	3	3	-	2	-	2	2	-	2	-
CO5	3	2	1	2	-	2	-	2	2	-	2	-

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U23OE117	INTRODUCTION TO MOBILE COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand the basics of wireless transmission systems.
- Know about the fundamentals of GSM and 3G Services, its protocols and application.
- Understand about evolution of 4G Networks, its architecture and applications.

UNIT I INTRODUCTION TO WIRELESS TRANSMISSION 9

Introduction to mobile computing, Frequencies for radio transmission, Generations of Mobile Communication, Signals, Antennas ranges, Signal propagation, Multiplexing, Modulation, cellular systems.

UNIT II WIRELESS MOBILE NETWORKS 9

WLAN System and Protocol architecture, IEEE 802.11a, IEEE 802.11b, HIPERLAN1/2, Bluetooth, WPAN-802.15.4, Wireless USB, Zigbee, 6LoWPAN, LoRaWAN, WiMAX.

UNIT III MOBILE NETWORK AND TRANSPORT LAYER 9

Mobile IP, Registration, Tunnelling and encapsulation, IPv6, DHCP, Adhoc Routing Protocols, Multicast Routing, Traditional TCP, Classical TCP improvements, TCP over 2.5/3G wireless networks, VANET, IoT.

UNIT IV GSM AND 3G COMMUNICATIONS SYSTEMS 9

Introduction to GSM, Architecture, Protocols, Connection Establishment, Frequency Allocation, Routing, Mobility Management, Security, GPRS, UMTS Architecture, LMDS, MMDS.

UNIT V 4G AND BEYOND 9

4G Network- Introduction, vision, features, challenges and applications, 4G Technologies-Multicarrier Modulation, Smart antenna techniques, OFDM-MIMO Systems, Software Defined Radio, Cognitive Radio, LTE, advanced LTE, Introduction to 5G Networks.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Jochen Schiller, "Mobile Communications", Second Edition, Pearson Education, 2012.

2 Vijay Garg, "Wireless Communications and networking", 1st Edition, Elsevier, 2007.

REFERENCES:

1 Rappaport. T. S, "Wireless Communications", 2nd Edition, Pearson Education, 2010.

2 Simon Haykin, Michael Moher, David Koilpillai, "Modern Wireless Communications", 1st Edition Pearson Education, 2013.

3 Erik Dahlman, Stefan Parkvall, Johan Skold and Per Beming, "3G Evolution HSPA and LTE for Mobile Broadband", 2nd Edition, Academic Press, 2008.

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ONLINE RESOURCES:

1 https://onlinecourses.nptel.ac.in/noc24_ee72/preview

2 https://onlinecourses.nptel.ac.in/noc21_ee66/preview

3 https://www.coursera.org/learn/wireless-communications

Upon the completion of the course, the students will be able to

CO1 Explain wireless transmission techniques.

CO2 Describe various wireless mobile networking technologies.

CO3 Explain mobile network and transport layers techniques and protocols.

CO4 Describe fundamentals of GSM and 3G Services, its protocols and applications.

CO5 Explain the evolution of 4G Networks, its architecture and applications.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	1	3	-	-	-	-	-	1
CO2	3	2	2	1	1	3	-	-	-	-	-	1
CO3	3	2	2	1	1	3	-	-	-	-	-	1
CO4	3	2	2	1	1	3	-	-	-	-	-	1
CO5	3	2	2	1	1	3	-	-	-	-	-	1

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U23OE118	BASICS OF SIGNALS AND ITS PROCESSING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the concept of signals, types and its properties.
- To learn about the continuous time signals by using Fourier transform and Laplace transform.
- To understand the discrete time signals in the Discrete time Fourier and Z transform domain.

UNIT I INTRODUCTION TO SIGNALS 9

Introduction to Signals, Types of time signals, Continuous and discrete signal representation, Characteristics of Signals, Standard signals- Step, Ramp, Pulse, Impulse, Real and complex, Exponentials and Sinusoids, Energy of a Signal, Power of a signal, Problems, Different types of Signal Processing..

UNIT II CLASSIFICATION OF SIGNALS 9

Classification of signals – Continuous time (CT) and Discrete Time (DT) signals, Periodic & A periodic signals, Deterministic & Random signals, Causal and Non causal Signals, Problems.

UNIT III PROPERTIES OF SIGNALS 9

Properties of Continuous and discrete time signals: Reflection, Shifting, Scaling, Reversal, Periodic composite signals, Signal and noise, Frequency spectrum and Bandwidth, Problems.

UNIT IV FREQUENCY DOMAIN REPRESENTATION OF CT SIGNALS 9

Fourier Series for periodic signals, Fourier Transform, Properties of CTFT, Gibbs Phenomena, Dirichlet Conditions, Laplace Transforms, Properties of Laplace Transforms.

UNIT V FREQUENCY DOMAIN REPRESENTATION OF DT SIGNALS 9

Baseband signal Sampling, Discrete Time Fourier Series, Discrete Time Fourier Transform, Properties of DTFT, Z Transform, and Properties of Z Transform.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Hwei P. Hsu, "Schaum's Outlines of Signals and Systems", 3rd Edition, Tata Mc Graw Hill, 2002.
2 Alan V Oppenheim, Wilsky S, Nawab S H, "Signals and Systems", Pearson Education, 2015.

REFERENCES:

1 B P Lathi, "Principles of Linear Systems and Signals", 2nd Edition, Oxford University Press, 2009.
2 R E Zeimer, W H Tranter, R D Fannin, "Signals & Systems - Continuous and Discrete", Pearson Education, 2007.
3 John Alan Stuller, "An Introduction to Signals and Systems", Cengage Learning, 2007.

ONLINE RESOURCES:

1 https://onlinecourses.nptel.ac.in/noc21_ee20/preview

2 https://nptel.ac.in/courses/117102060

3 https://www.coursera.org/learn/dsp1

Upon the completion of the course, the students will be able to

CO1 Understand the fundamental concept of signals.

CO2 Understand the different classification of signals.

CO3 Explain the various properties of signals.

CO4 Describe the various properties of continuous time signals and its frequency domain representation.

CO5 Explain the various properties of Discrete time signals and its frequency domain representation.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	2	-	-	-	-	-	-	1
CO2	2	2	1	1	2	-	-	-	-	-	-	1
CO3	2	2	1	1	2	-	-	-	-	-	-	1
CO4	2	2	1	1	2	-	-	-	-	-	-	1
CO5	2	2	1	1	2	-	-	-	-	-	-	1

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U23OE119 **INTRODUCTION TO COMMUNICATION SYSTEMS** L T P C
3 0 0 3

COURSE OBJECTIVES:

- To introduce concept of basic analog and digital communication systems.
- To understand the various modulation techniques for analog and digital communication systems.
- To study the wired channel on communication systems.

UNIT I **ANALOG COMMUNICATION** 9

Amplitude modulation – DSBFC, square law modulator, envelope detection, Hilbert transform, SSB – frequency and phase shift methods of SSB generation – coherent detection.

UNIT II **ANGLE MODULATION** 9

Frequency Modulation, narrowband and wideband signals, Bessel functions, Carson's rule – bandwidth, Direct and indirect FM generation, demodulation using Phase-locked loop.

UNIT III **DIGITAL COMMUNICATION** 9

Nyquist sampling theorem – Pulse amplitude modulation, Pulse code modulation – Quantization – quantization noise, delta modulation, DPCM, Multiplexing and Multiple Access Techniques – FDM and FDMA, TDM and TDMA, CDMA.

UNIT IV **DIGITAL MODULATION TECHNIQUES** 9

Binary Phase Shift Keying – Binary Frequency Shift Keying, On-Off Keying, Optimum receiver structures for digital communication – matched filtering, correlation detection, probability of error.

UNIT V **MOBILE CELLULAR COMMUNICATION** 9

Evolution to cellular networks – Cellular systems generations and standards: 1G, 2G, 3G, 4G – Cellular network components – Components of a mobile phone – setting up a call process – Making a call process – Receiving a call process – Spectrum allocation: Policies and strategies, Role of TRAI.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Theodore S Rappaport, "Wireless Communications: Principles and Practice", 2nd Edition, Pearson Education, 2010.

2 Haykin S, "Communication Systems", 5th Edition, John Wiley & Sons, 2009.

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REFERENCES:

1 Sklar B, "Digital Communications Fundamentals and Applications", 2nd Edition, Pearson Education, 2016.

2 B P Lathi, "Modern Digital and Analog Communication Systems", 4th Edition, Oxford University Press, 2011.
3 Hwei P Hsu, "Schaum Outline Series - Analog and Digital Communications", Tata McGraw Hill, 2006.

ONLINE RESOURCES:

1 https://onlinecourses.nptel.ac.in/noc20_ee16/preview
2 https://www.mooc-list.com/tags/communication-systems
3 https://www.coursera.org/learn/communication

Upon the completion of the course, the students will be able to

CO1 Explain the basic concepts of analog communication systems.

CO2 Apply the modulation techniques for analog communication.

CO3 Apply the modulation techniques for digital communication.

CO4 Explain the concepts of sampling and quantization techniques.

CO5 Analyse the performance of wireless channels.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	3	-	3	-	-	-	-	-	1
CO2	3	2	2	3	-	3	-	-	-	-	-	1
CO3	3	2	2	3	-	3	-	-	-	-	-	1
CO4	3	2	2	3	-	3	-	-	-	-	-	1
CO5	3	2	2	3	-	3	-	-	-	-	-	1

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U23OE120	DRONE TECHNOLOGIES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basics of drone concepts.
- To learn and understand the fundaments of design, fabrication and programming drone.
- To know about the various applications of drone.

UNIT I **INTRODUCTION TO DRONE TECHNOLOGY** **9**

Drone Concept – Vocabulary Terminology- History of drone – Types of current generation of drones based on their method of propulsion- Drone technology impact on the businesses – Drone business through entrepreneurship – Opportunities applications for entrepreneurship and employability.

UNIT II **DRONE DESIGN, FABRICATION AND PROGRAMMING** **9**

Classifications of the UAV – Overview of the main drone parts – Technical characteristics of the parts – Function of the component parts – Assembling a drone – The energy sources – Level of autonomy – Drones configurations – The methods of programming drone – Download program Install program on computer – Running Programs – Multi rotor stabilization – Flight modes – Wi-Fi connection.

UNIT III **DRONE FLYING AND OPERATION** **9**

Concept of operation for drone – Flight modes – Operate a small drone in a controlled Environment – Drone controls Flight operations – management tool – Sensors – On-board storage capacity – Removable storage devices – Linked mobile devices and applications.

UNIT IV **DRONE COMMERCIAL APPLICATIONS** **9**

Choosing a drone based on the application – Drones in the insurance sector – Drones in delivering mail, parcels and other cargo – Drones in agriculture – Drones in inspection of transmission lines and power distribution – Drones in filming and panoramic picturing.

UNIT V **FUTURE DRONES AND SAFETY** **9**

The safety risks – Guidelines to fly safely – Specific aviation regulation and standardization – Drone license – Miniaturization of drones – Increasing autonomy of drones – The use of drones in swarms.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Daniel Tal, John Altschuld, "Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation", John Wiley & Sons, 2021.

2 Terry Kilby, Belinda Kilby, "Make: Getting Started with Drones ", Maker Media, Inc., 2016.

REFERENCES:

1 John Baichtal, "Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs", Que Publishing, 2016.
2 Zavrsnik, "Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance", Springer, 2018.
3 Sachi Nandan Mohanty, J V R Ravindra, Ġ Surya Narayana, "Drone Technology: Future Trends and Practical Applications", John Wiley & Sons, 2023.

ONLINE RESOURCES:

1 https://www.classcentral.com/subject/drones
2 https://onlinecourses.nptel.ac.in/noc22_ce05/preview
3 https://www.coursera.org/learn/drones-for-environmental-science

Upon the completion of the course, the students will be able to

CO1 Explain about various types of drone technology, drone fabrication and programming.
CO2 Analyse the suitable operating procedures for functioning a drone.
CO3 Analyse the appropriate sensors and actuators for Drones.
CO4 Design a drone mechanism for specific applications.
CO5 Write the programs for various drones.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	1	3	-	-	-	-	-	1
CO2	3	2	2	1	2	3	-	-	-	-	-	1
CO3	3	2	2	1	2	3	-	-	-	-	-	1
CO4	3	2	2	1	2	3	-	-	-	-	-	1
CO5	3	2	2	1	2	3	-	-	-	-	-	1

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U23OE121 **GEOGRAPHICAL INFORMATION SYSTEM** L T P C
3 0 0 3

COURSE OBJECTIVES:

- To introduce the fundamentals and components of Geographic Information System.
- To understand the types and models of Geographic Information System.
- To provide details of spatial data structures and input, management and output processes.

UNIT I **FUNDAMENTALS OF GIS** 9

Introduction to GIS – Basic spatial concepts – Coordinate Systems - GIS and Information Systems – Definitions – History of GIS – Components of a GIS – Hardware, Software, Data, People, Methods – Proprietary and open source Software – Types of data – Spatial, Attribute data – types of attributes – scales/ levels of measurements.

UNIT II **SPATIAL DATA MODELS** 9

Database Structures – Relational, Object Oriented – Entities – ER diagram - data models – Conceptual, logical and physical models - spatial data models – Raster Data Structures – Raster Data Compression – Vector Data Structures – Raster vs Vector Models – TIN and GRID data models.

UNIT III **DATA INPUT AND TOPOLOGY** 9

Concept of operation for drone – Flight modes – Operate a small drone in a controlled Environment – Drone controls Flight operations – management tool – Sensors – On-board storage capacity – Removable storage devices – Linked mobile devices and applications.

UNIT IV **DATA QUALITY AND STANDARDS** 9

Data quality – Basic aspects – completeness, logical consistency, positional accuracy, temporal accuracy, thematic accuracy and lineage – Metadata – GIS Standards – Interoperability – OGC – Spatial Data Infrastructure

UNIT V **DATA MANAGEMENT AND OUTPUT** 9

Import/Export – Data Management functions – Raster to Vector and Vector to Raster Conversion – Data Output – Map Compilation – Chart/Graphs – Multimedia – Enterprise Vs. Desktop GIS – distributed GIS.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Kang - Tsung Chang, "Introduction to Geographic Information Systems", 2nd Edition, Tata McGraw Hill, 2011.

2 Ian Heywood, Sarah Cornelius, Steve Carver, Srinivasa Raju, "An Introduction Geographical Information Systems", 2nd Edition, Pearson Education, 2007.

REFERENCES:

1 Lo C P, Albert K W Yeung, "Concepts and Techniques of Geographic Information Systems", Prentice Hall of India, 2006.

2 Jonathan Campbell, Michael Shin, "Essentials of Geographic Information Systems", Saylor Foundation, 2011.

3 Michael N DeMers, "Fundamentals of Geographic Information Systems", 4th Edition, John Wiley & Sons, 2009.

ONLINE RESOURCES:

1 https://nptel.ac.in/courses/105/102/105102015/

2 https://bhuvan.nrsc.gov.in/bhuvan_links.php

3 https://nptel.ac.in/courses/105/107/105107155/

Upon the completion of the course, the students will be able to

CO1 Explain the basics about the fundamentals of GIS.

CO2 Describe the types of data models.

CO3 Explain about data input and topology.

CO4 Apply various spatial analysis tools for deriving GIS based outcome.

CO5 Explain data management functions and data output

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	2	3	-	-	-	-	-	1
CO2	3	1	1	1	-	3	-	-	-	-	-	1
CO3	3	1	2	2	2	3	-	-	-	-	-	1
CO4	3	1	2	2	2	3	-	-	-	-	-	1
CO5	3	3	2	2	2	3	-	-	-	-	-	1

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U23OE122 FUNDAMENTALS OF ELECTRIC AND HYBRID VEHICLE

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand a comprehensive overview of Electric and Hybrid Electric Vehicles.
- To understand about different aspects of drive train topologies and components in HV & EV.
- To understand and advance in battery management and case studies.

UNIT I INTRODUCTION TO HYBRID ELECTRIC VEHICLES 9

History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, the impact of modern drive-trains on energy supplies, types of HV and EV, advantages over conventional vehicles, limitations of EV and HV, impact on the environment of EV and HV technology, disposal of battery cell and hazardous material and their impact on the environment.

UNIT II BASIC CONCEPT OF HYBRID TRACTION 9

Introduction to various hybrid drive-train topologies, Power flow control in hybrid drive-train topologies, Fuel efficiency analysis, braking fundamentals and regenerative braking in EVs.

UNIT III ELECTRIC COMPONENTS USED IN HYBRID AND ELECTRIC VEHICLES 9

Configuration and control of DC Motor drives, Configuration and control of Introduction Motor drives, configuration and control of Permanent Magnet Motor Drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

UNIT IV POWER MANAGEMENT AND ENERGY SOURCES OF EV & HV 9

Power and Energy management strategies and its general architecture of EV and HV, various battery sources, energy storage, battery based energy storage and simplified models of battery, Battery Management Systems (BMS), fuel cells, their characteristics and simplified models, Super capacitor based energy storage, its analysis and simplified models, flywheels and their modelling for energy storage in HV/BEV, hybridization of various energy storage devices, Selection of the energy storage technology.

UNIT V APPLICATIONS OF EV & HV 9

Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV), Electric Vehicle Adoption in Urban Mobility, Electric Vehicle Integration with Renewable Energy

TOTAL: 45 PERIODS

REFERENCES:

1. Iqbal Hussain, "Electric and Hybrid Vehicles Design Fundamentals", 2nd Edition, CRC Press, 2011.
2. Chris Mi, M Abul Masrur, David Wenzhong Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", 1st Edition, John Wiley &Sons, 2011.

3. Lino Guzzella, Antonio Sciarretta, Modern Electric, "Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", 2nd Edition, CRC Press, 2009.

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 Explain about the social and environmental significance, and impact of modern hybrid and electric vehicle

CO2 Describe Enhanced EV performance through diverse drives, efficiency analysis, and regenerative braking.

CO3 Explain the Improved efficiency and control in various motor drive configurations enhance performance.

CO4 Summarize on Efficient power management, battery technology understanding, and storage selection optimization

CO5 Explain about the Efficient vehicle designs, urban mobility, and renewable energy integration optimization.

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	-	1	-	-	-	-	1
CO2	2	2	1	1	-	-	1	-	-	-	-	1
CO3	2	2	1	1	-	-	1	-	-	-	-	1
CO4	2	2	1	1	-	-	1	-	-	-	-	1
CO5	2	2	1	1	-	-	1	-	-	-	-	1

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U23OE123	INTRODUCTION TO PLC PROGRAMMING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand basic PLC terminologies, digital principles, PLC architecture.
- Familiarize different programming languages of PLC.
- Develop PLC logic for simple applications using ladder logic

UNIT I **INTRODUCTION TO PLC** **9**

Introduction to PLC: Microprocessor, I/O Ports, Isolation, Filters, Drivers, Microcontrollers/DSP, PLC/DDC - PLC Construction: What is a PLC, PLC Memories, PLC I/O, , PLC Special I/O, PLC Types.

UNIT II **PLC INSTRUCTIONS** **9**

PLC Basic Instructions: PLC Ladder Language- Function block Programming- Ladder/Function Block functions- PLC Basic Instructions, Basic Examples (Start Stop Rung, Entry/Reset Rung)- Configuration of Sensors, Switches, Solid State Relays- Interlock examples- Timers, Counters, Examples.

UNIT III **PLC PROGRAMMING** **9**

Introduction to the Concept of IoT Devices – IoT Devices Versus Computers – IoT Configurations – Basic Components – Introduction to Arduino – Types of Arduino – Arduino Toolchain – Arduino Programming Structure – Sketches – Pins – Input/Output From Pins Using Sketches – Introduction to Arduino Shields – Integration of Sensors and Actuators with Arduino.

UNIT IV **COMMUNICATION OF PLC AND SCADA** **9**

Communication Protocol – Modbus, HART, Profibus- Communication facilities SCADA: - Hardware and software, Remote terminal units, Master Station and Communication architectures.

UNIT V **APPLICATIONS OF PLC** **9**

Stepper Motor Control- Elevator Control - CNC Machine Control- conveyor control- Interlocking Problems.

TOTAL:45 PERIODS

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REFERENCES:

1 Madhuchhanda Mitra , Samerjit Sengupta, "Programmable Logic Controllers Industrial Automation", 1st Edition, Penram International Publishing, 2019.

2 J R Hackworth , F D Hackworth, "Programmable Logic Controllers Principles and Applications", 2nd Edition, Pearson Education, 2020.

3 Ojula, "PLC Programming & Implementation" 1st Edition, Publish Drive Publications, 2022.

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 Explain basics of PLC and PLC types.

CO2 Analyse PLC basic instructions and timers.

CO3 Analyse PLC module addressing, different types of functions.

CO4 Explain communication protocol and architecture.

CO5 Analyze PLC programming in different motors.

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	-	-	-	-	-	-	1
CO2	3	3	1	2	-	-	-	-	-	-	-	1
CO3	3	3	1	2	-	-	-	-	-	-	-	1
CO4	2	2	1	1	-	-	-	-	-	-	-	1
CO5	3	3	1	2	-	-	-	-	-	-	-	1

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U23OE124	ENERGY MANAGEMENT AND AUDITING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To enable the students to understand the concept of Energy Management
- To know the electrical load management techniques and power trading marketing
- To understand the basics of Energy audit and its economic analysis

UNIT I ENERGY SCENARIO AND BASICS OF ENERGY 9

Types of Energy Sources – Life of Energy Sources - Energy Scenario in India – Energy vs Economic Growth - Linkage between Energy Use and Environment - Need for Energy Conservation Work, Energy and Power – Electricity Basics – Energy Units.

UNIT II LIGHTING SYSTEMS 9

Energy management in lighting systems – Task and the working space - Light sources – Ballasts – Lighting controls – Optimizing lighting energy – Power factor and effect of harmonics, lighting and energy standards

UNIT III METERING FOR ENERGY MANAGEMENT 9

Metering for energy management – Units of measure - Utility meters – Demand meters – Paralleling of current transformers – Instrument transformer burdens – Multi tasking solid state meters, metering location vs requirements, metering techniques.

UNIT IV SHORT-TERM POWER TRADE MARKET 9

Electricity Act 2003- Yearly Trends in Short-term Transactions of Electricity- Time of the Day Variation in Volume and Price of Electricity Transacted through Traders and Power Exchanges-Trading Margin Charged by Trading Licensees-Open Access Consumers on Power Exchanges-Effect of Congestion on the Volume of Electricity Transacted through Power Exchanges.

UNIT V ENERGY AUDIT 9

Energy Audit Definition – Need for Energy Audit – Types of Energy Audit and Approaches – Understanding Energy Costs - Energy Performance

TOTAL: 45 PERIODS

REFERENCES

1. Arry C White, Philip S Schmidt, David R Brown, "Industrial Energy Management Systems", 10th Edition, Hemisphere Publishing, 2023.
2. Albert Thumann, "Fundamentals of Energy Engineering", 3rd Edition, Prentice Hall of India, 2022.
3. A S Pabla, "Electrical Power distribution", 5th Edition, Tata McGraw Hill, 2018.

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COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1	Summarize the Energy Scenario and Basics of Electrical Energy
CO2	Explain the working and optimizing of Lightning System
CO3	Describe different meters and its necessity in Energy Management
CO4	Summarize the Short-Term Power Trade Market
CO5	Summarize the types of Energy Audit Approaches

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	-	1	-	-	-	-	1
CO2	2	2	1	1	-	-	-	-	-	-	-	1
CO3	2	2	1	1	-	-	-	-	-	-	-	1
CO4	2	2	1	1	-	-	-	-	-	-	-	1
CO5	2	2	1	1	-	-	-	-	-	-	-	1

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U23OE125	FUNDAMENTALS OF ROBOTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand and gain the knowledge of robotics.
- To understand and gain the knowledge of working principles of sensors and drives.
- To understand the social economical aspects and applications

UNIT I **INTRODUCTION** 9

Introduction to Principles & Strategies of Automation, Types & Levels of Automation, Need of Automation, Brief History, Basic Concepts of Robotics such as Definition, Three Laws, Elements of Robotic Systems i.e. Robot Anatomy, DoF, Misunderstood Devices etc., Classification of Robotic Systems on the Basis of Various Parameters such as Work Volume, etc., Associated Parameters i.e. Resolution, Accuracy, Repeatability, Dexterity, Compliance, RCC Device etc.

UNIT II **GRIPPERS AND TRANSMISSION SYSTEMS** 9

Grippers for Robotics - Types of Grippers, Guidelines for Design for Robotic Gripper, Force Analysis for Various Basic Gripper System, Degrees of Freedom - Determination of Degrees of Freedom for Four & Five Bar Mechanism, Slider Crank Mechanism, Stanford Robot and SCARA ROBOT using Grubler - Kutzbach Equation.

UNIT III **SENSORS AND DRIVES** 9

Sensors: - Classification and Applications of Sensors, Characteristics of Sensing Devices, Selections of Sensors. Need for Sensors and Vision Systems in the Working and Control of a Robot. Desirable Features and Working of Tactile, Proximity and Range Sensors, Position Sensors, Velocity Sensors, Acceleration Sensors. Drives: Type of Drive, Actuators- Pneumatic, Hydraulic, Electrical and its Selection while Designing a Robot System.

UNIT IV **ROBOT PROGRAMMING AND LANGUAGES** 9

Programming, WAIT, SIGNAL and DELAY Commands, Subroutines, Programming Languages: Generations of Robotic Languages, Introduction to Various Types such as VAL, RAIL, AML, python, ROS etc..

UNIT V **SOCIO-ECONOMIC ASPECTS AND APPLICATIONS** 9

Socio-Economic Aspect of Robotization. Economical Aspects for Robot Design, Safety for Robot and Standards, Introduction to Artificial Intelligence, AI Techniques, Need and Application of AI. Industrial Applications of Robot in Material Transfer, Manufacturing, Inspection and Assembly

TOTAL: 45 PERIODS

REFERENCES

1. Ashitava Ghosal, "Robotics: Fundamental Concepts and Analysis", 2nd Edition, Oxford Publishers, 2008.

2. Guruprasad K R, "Robotics: Mechanics And Control", 1st Edition, Prentice Hall of India, 2019.
3. K S Fu, Ralph Gonzalez, C S G Lee, "Robotics: Control, Sensing, Vision and Intelligence", 1st Edition, Tata McGraw Hill, 2017.

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 Explain the robot anatomy and terminologies related to Robotics technology

CO2 Describe the gripper force and transmission systems used in robotics.

CO3 Explain the various types, selection and need of sensors

CO4 Explain robot programming techniques and common programming commands

CO5 Describe socio-economic aspects, AI techniques and robot applications in the area of robotics.

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	-	-	1	-	-	-	1
CO2	2	2	1	1	-	-	-	-	-	-	-	1
CO3	2	2	1	1	-	-	-	-	-	-	-	1
CO4	2	2	1	1	-	-	-	-	-	-	-	1
CO5	2	2	1	1	-	-	-	-	-	-	-	1

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U23OE126	MEDICAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand basic concepts of bio signals and bio potential electrodes
- To understand various electrode configurations.
- To understand concepts and types of bio amplifiers.

UNIT I **BIO POTENTIAL ELECTRODES** **9**

Origin of Bio potential and its propagation. Electrode-Electrolyte interface, electrode skin interface, half-cell potential, impedance, polarization effects of electrode-non polarizable electrodes. Types of electrodes-surface, needle and micro electrodes and their equivalent circuits. Recording problems-measurement with two electrodes.

UNIT II **ELECTRODE CONFIGURATIONS** **9**

Bio signal characteristics- frequency and amplitude ranges ECG – Einthoven's triangle, standard 12 lead system, EEG-10-20 electrode system, unipolar, bipolar and average mode. EMG, ERG and EOG –unipolar and bipolar mode.

UNIT III **BIO AMPLIFIER** **9**

Need for bio-amplifier- single ended bio amplifier, differential bio amplifier-right leg driven ECG amplifier. Band pass filtering, isolation amplifiers-transformer and optical isolation-isolated DC amplifier and AC carrier amplifier. Chopper amplifier-Power line interference.

UNIT IV **MEASUREMENT OF NON ELECTRICAL PARAMETER** **9**

Temperature, respiration rate and pulse rate measurements. Blood Pressure and indirect-methods-Auscultatory-method-Oscillometric-method,direct -methods, Electronic manometer. Pressure amplifiers-systolic, diastolic, mean detector circuit. Blood flow and cardiac output measurement. Indicator dilution, Thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurement.

UNIT V **BIOCHEMICAL MEASUREMENT** **9**

Biochemical sensors-pH,pO2 and pCO2,Ion selective Field Effective Transistor(ISFET)Immunologically sensitive FET (IMFET),Blood Glucose sensors-Blood Gas Analyzers, Calorimeter, Flame Photometer, Spectrophotometer, Blood cell counter, Auto Analyzer(simplified schematic description).

TOTAL: 45 PERIODS

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REFERENCES:

1 R Khandpur, "Biomedical Instrumentation Technology and Applications", 4th Edition, Tata McGraw Hill, 2021.
2 Raghbir Singh Khandpur, "Compendium of Biomedical Instrumentation", 1st Edition, John Wiley & Sons, 2020.
3 John G Webster, "Medical Instrumentation: Application and Design", 5th Edition, John Wiley & Sons , 2020.

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 Explain the characteristics of bio-signals and their importance in medical diagnosis

CO2 Describe various electrode configurations and its working methods.

CO3 Comprehend concepts and types of bio amplifiers in medical instrumentation.

CO4 Explain different measurement methods of non- electrical parameters in medical instrumentation.

CO5 Summarize concepts about different biochemical measurements.

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	-	-	-	-	-	-	-
CO2	2	2	1	1	-	-	-	-	-	-	-	-
CO3	2	2	1	1	-	-	-	-	-	-	-	-
CO4	2	2	1	1	-	-	-	-	-	-	-	-
CO5	2	2	1	1	-	-	-	-	-	-	-	-

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U23OE127	PROGRAM LANGUAGE PRINCIPLES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn syntax and semantics of programming language.
- To comprehend data, data types, basic statements, explore call-return architecture and ways of implanting them.
- To gain knowledge about object-orientation, concurrency, event handling in Programming language and a non-procedural programming paradigm.

UNIT I SYNTAX AND SEMANTICS 9

Evolution of programming languages – describing syntax – context-free grammars– attribute grammars – describing semantics – lexical analysis – parsing – recursive- bottom-up parsing.

UNIT II DATA, DATA TYPES AND BASIC STATEMENTS 9

Names – variables – binding – type checking – scope – scope rules – lifetime and garbage collection – primitive data types – strings – array types– Arithmetic expressions – overloaded operators –type conversions – Relational and Boolean expressions – assignment statements.

UNIT III SUBPROGRAMS AND IMPLEMENTATIONS 9

Subprograms – design issues – local referencing – parameter passing – overloaded methods – generic methods – design issues for functions – semantics of call and return– implementing simple subprograms.

UNIT IV OBJECT-ORIENTATION, CONCURRENCY AND EVENT HANDLING 9

Object-orientation – design issues for OOP languages – implementation of object-oriented constructs – concurrency – semaphores – monitors – message passing – threads –statement level concurrency – exception handling – event handling.

UNIT V FUNCTIONAL AND LOGIC PROGRAMMING LANGUAGES 9

Introduction to lambda calculus – fundamentals of functional programming languages – Programming with Scheme – Introduction to logic and logic programming – Programming with Prolog.

TOTAL:45 PERIODS

TEXT BOOKS:

1. Robert W Sebesta, "Concepts of Programming Languages", 10th Edition, Addison Wesley, 2014.
2. Michael L. Scott, "Programming Language Pragmatics", 3rd Edition, Morgan Kaufmann Publishers, 2015.

REFERENCES:

1. R Kent Dybvig, "The Scheme programming language", 4th Edition, MIT Press, 2009.

2 Jeffrey D. Ullman, "Elements of ML programming", 2nd Edition, Prentice Hall, 1998.

ONLINE RESOURCES:

1 https://archive.nptel.ac.in/courses/106/102/106102067/

2 https://www.geeksforgeeks.org/introduction-to-programming-languages/

3 https://bgibhopal.com/principles-of-programming-languages-and-their-significance-in-computer-science-engineering/

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Comprehend the syntax and semantics of programming languages.

CO2 Describe data, data types, and basic statements of programming languages

CO3 Explain Subprogram Constructs and Methods.

CO4 Explain object-oriented, concurrency, and event handling programming constructs.

CO5 Summarize the Functional and logic Programming and Prolog.

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	-	-	1	-	-	-	-
CO2	2	2	1	1	-	-	-	1	-	-	-	-
CO3	2	2	1	1	-	-	-	1	-	-	-	-
CO4	2	2	1	1	-	-	-	1	-	-	-	-
CO5	2	2	1	1	-	-	-	1	-	-	-	-

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U23OE128 **DATA WAREHOUSING AND DATA MINING** L T P C

3 0 0 3

COURSE OBJECTIVES:

- To understand the concepts of data warehousing architecture, frequent pattern mining and regression
- To learn to use and implement various machine learning based classification techniques and evaluation metrics.
- To understand enhancing the classification algorithms, clustering and recent trends of Data mining.

UNIT I **DATAWAREHOUSING** 9

Data warehousing - Data warehousing Components — Data Warehouse Modeling — Design and implementation Mapping the Data Warehouse to Multiprocessor Architecture — Online Analytical Processing and Tools — Data Cube Technologies — Multidimensional Data Analysis — Introduction to KDD process — Knowledge discovery from databases — Data mining functionalities — Technologies used — Applications

UNIT II **FREQUENT PATTERN MINING TECHNIQUES AND REGRESSION** 9

Knowing Data: Data Sets, Data objects and attributes — Statistical description of data — Measuring similarity and dissimilarity —Mining frequent item sets: Apriority algorithm, FP Growth Tree — Frequent Pattern evaluation methods — Support, Confidence, Association Mining various kinds of association rules — Regression techniques: Linear Regression: Least Square Regression — Logistic — other regression types — Regression Performance: MSE, RMSE— Bias and Variance curve

UNIT III **CLASSIFICATION TECHNIQUES I AND EVALUAITON METRICS** 9

Lazy-Active Learners — k Nearest Neighbour — Decision tree induction: ID3, C4.5, CART — Bayesian classification: Naïve Bayes — Model Evaluation and Selection: Accuracy, AUC, Error rate, Sensitivity, Specificity, Precision, Recall — Cross validation — Confusion Matrix

UNIT IV **CLASSIFICATION II AND CLUSTERING TECHNIQUES** 9

Ensemble classifiers: Bagging, Adaboost — Cluster analysis — Clustering techniques: Partitioning methods — kMeans — kMeans++ — kMedoids — Hierarchical methods — Agglomerative Clustering - Dendrogram Evaluation of clustering algorithms — DBSCAN — Outlier detection: Outliers and Outlier analysis - Outlier detection methods

UNIT V **CASE STUDIES** 9

Mining Complex Data Types — Sequential pattern mining in symbolic sequences, Time Series — Mining graphs and networks — Visual and audio data mining - Data mining

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for intrusion detection and prevention - Data mining and Recommender systems.

TOTAL:45 PERIODS

TEXT BOOKS:

1 Jiawei Han, Micheline Kamber, "Data Mining: Concepts and Techniques", 3rd Edition, Morgan Kaufmann Publishers, 2011.

2 G K Gupta, "Introduction to Data Mining with Case Studies", Easter Economy Edition, Prentice Hall of India, 2014.

REFERENCES:

1 Alex Berson, Stephen J Smith, "Data Warehousing, Data Mining & OLAP", 21st Edition, Tata McGraw Hill, 2011.

2 Ian Witten, Eibe Frank, "Data Mining: Practical Machine Learning Tools and Techniques", 3rd Edition, Morgan Kaufmann, 2011.

3 George M Marakas, "Modern Data Warehousing, Mining and Visualization", 1st Edition, Prentice Hall of India, 2003.

ONLINE RESOURCES:

1 https://www.coursera.org/specializations/data-mining

2 https://nptel.ac.in/courses/106105174

3 https://www.geeksforgeeks.org/dbms/data-warehousing/

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the components of data warehousing architecture.

CO2 Explain the frequent pattern mining and regression techniques.

CO3 Apply the various supervised classification models and measure the Model's Performance.

CO4 Apply and implement enhanced classification methods and other clustering techniques.

CO5 Explain the recent trends of Data mining in business applications.

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	-	-	-	-	-	-	-
CO2	2	2	1	1	-	-	-	-	-	-	-	-
CO3	3	2	1	2	-	-	-	1	-	-	-	-
CO4	3	2	1	2	-	-	-	1	-	-	-	-
CO5	2	2	1	1	-	-	-	-	-	-	-	-

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U23OE129	FOUNDATIONS OF SOFT COMPUTING TECHNIQUES	L T P C
		3 0 0 3

COURSE OBJECTIVES:

- To learn the basic concepts of Soft Computing
- To become familiar with various techniques like neural networks, genetic algorithms and fuzzy systems
- To apply soft computing techniques to solve problems.

UNIT I **INTRODUCTION TO SOFT COMPUTING** **9**

Introduction-Artificial Intelligence - Artificial Neural Networks - Fuzzy Systems - Genetic Algorithm and Evolutionary Programming - Swarm Intelligent Systems - Classification of ANNs - McCulloch and Pitts Neuron Model - Learning Rules - Hebbian and Delta - Perceptron Network - Adaline Network - Madaline Network

UNIT II **ARTIFICIAL NEURAL NETWORKS** **9**

Back propagation Neural Networks - Kohonen Neural Network - Learning Vector Quantization -Hamming Neural Network - Hopfield Neural Network - Bi-directional Associative Memory - Adaptive Resonance Theory Neural Networks - Support Vector Machines - Spike Neuron Models.

UNIT III **FUZZY SYSTEMS** **9**

Introduction to Fuzzy Logic, Classical Sets and Fuzzy Sets - Classical Relations and Fuzzy Relations -Membership Functions - Defuzzification - Fuzzy Arithmetic and Fuzzy Measures - Fuzzy Rule Base and Approximate Reasoning - Introduction to Fuzzy Decision Making.

UNIT IV **GENETIC ALGORITHMS** **9**

Basic Concepts - Working Principles – Encoding - Fitness Function - Reproduction - Inheritance Operators - Cross Over - Inversion and Deletion Mutation Operator - Bit-wise Operators - Convergence of Genetic Algorithm

UNIT V **HYBRID SYSTEMS** **9**

Hybrid Systems - Neural Networks, Fuzzy Logic and Genetic - GA Based Weight Determination - LR-Type Fuzzy Numbers - Fuzzy Neuron - Fuzzy BP Architecture - Learning in Fuzzy BP - Inference by Fuzzy BP - Fuzzy Art Map - A Brief Introduction - Soft Computing Tools - GA in Fuzzy Logic Controller Design - Fuzzy Logic Controller

TOTAL:45 PERIODS

TEXT BOOKS:

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1 N.P.Padhy, S P Simon, "Soft Computing with MATLAB Programming", 1st Edition, Oxford University Press, 2015.
2 S N Sivanandam , S N Deepa, "Principles of Soft Computing", 2nd Edition, Wiley & sons, 2011.

REFERENCES:

1 Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani," Neuro-Fuzzy and Soft Computing", 1st Edition, Prentice-Hall of India, 2021.
2 Kwang H Lee, First course on Fuzzy Theory and Applications, 1st Edition, Springer, 2021.
3 Sujatha Dash," Advanced Soft Computing Techniques in Data Science, IoT and Cloud Computing", 1st Edition, Springer, 2021

ONLINE RESOURCES:

1 https://onlinecourses.nptel.ac.in/noc25_ma54/preview

2 https://www.geeksforgeeks.org/software-engineering/need-for-soft-computing/

3 https://onlinecourses.swayam2.ac.in/ntr25_ed107/preview

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Apply suitable soft computing techniques for various applications

CO2 Integrate various soft computing techniques for complex problems.

CO3 Analyze various genetic and hybrid systems.

CO4 Analyze different Fuzzy and Neural algorithms

CO5 Analyze the various Neuron model systems.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	1	-	-	1	1	1	-	-
CO2	3	3	2	2	-	-	-	1	1	1	-	2
CO3	3	2	2	2	-	-	-	1	1	1	-	-
CO4	3	2	1	2	-	-	-	1	1	1	-	-
CO5	3	2	1	2	-	-	-	1	1	1	-	-

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U23OE130	FUNDAMENTALS OF CLOUD COMPUTING	L T P C
		3 0 0 3

COURSE OBJECTIVES:

- To introduce fundamental concepts and models of cloud computing, including its goals, benefits, and risks.
- To familiarize with key cloud enabling technologies and infrastructure mechanisms.
- To develop the ability to analyze and determine various cloud maintenance strategies

UNIT I **UNDERSTANDING CLOUD COMPUTING** **9**

Cloud Origins and Influences - Basic Concepts and Terminology - Goals and Benefits - Risks and Challenges - Fundamental Concepts and Models: Roles and Boundaries - Cloud Characteristics - Cloud Delivery Models - Cloud Deployment Models.

UNIT II **CLOUD ENABLING TECHNOLOGY** **9**

Data Center Technology - Virtualization Technology – Utility Computing - Automation - Web Technology - Multitenant Technology - Service Technology – Web 2.0.

UNIT III **CLOUD INFRASTRUCTURE MECHANISMS** **9**

Logical Network Perimeter - Virtual Server - Cloud Storage Device - Cloud Usage Monitor - Resource Replication – Ready-made Environment.

UNIT IV **SPECIALIZED CLOUD MECHANISMS** **9**

Automated Scaling Listener -Load Balancer - SLA Monitor - Pay-Per- Use Monitor - Audit Monitor - Fail Over System – Hypervisor - Resource Cluster - Multi-Device Broker - State Management Database.

UNIT V **FUNDAMENTAL CLOUD ARCHITECTURES** **9**

Workload Distribution Architecture - Resource Pooling Architecture - Dynamic Scalability Architecture - Elastic Resource Capacity Architecture - Service Load Balancing Architecture - Cloud Bursting Architecture - Elastic Disk Provisioning Architecture - Redundant Storage Architecture.

TOTAL:45 PERIODS

TEXT BOOKS:

1 Thomas Erl, Ricardo Puttini, Zaigham Mahmood, Cloud Computing: Concepts, Technology& Architecture, 1st Edition, Prentice Hal of India, 2013.

2 Kalani Kirk Hausman, Susan L Cook, Telmo Sampaio, Cloud Essentials, 1st Edition, Sybex, 2013.

REFERENCES:

1 John W Ritting house, James F.Ransome, Cloud Computing: Implementation, Management and Security, 1st Edition, CRC Press,2012.

2 Anthony T. Velte, Toby J Velte Robert Elsenpeter, Cloud Computing a practical approach, 1st Edition, Tata McGrawHill,2010.

3 Michael Miller, Cloud Computing: Web-based Applications That Change the Way You Work and Collaborate Online, 1st Edition, Que Publishing, 2008.

ONLINE WEB RESOURCES:

1 https://onlinecourses.nptel.ac.in/noc25_cs11/preview

2 https://www.geeksforgeeks.org/cloud-computing/cloud-computing/

3 https://www.spiceworks.com/tech/cloud/articles/what-is-cloud-computing/

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain fundamental concepts and models of cloud computing and cloud enabling technologies, infrastructure mechanisms

CO2 Explain Cloud Infrastructure Mechanisms

CO3 Explain different Cloud Maintenance strategies

CO4 Analyze Cloud Architectures and Delivery Model

CO5 Explain cloud architecture fundamentals

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	-	-	-	-	-	-	-
CO2	2	2	1	1	-	-	-	-	-	-	-	-
CO3	2	2	1	1	-	-	-	-	-	-	-	-
CO4	3	2	1	2	-	-	-	1	1	1	-	-
CO5	2	2	1	1	-	-	-	-	-	-	-	-

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U23OE131	HUMAN COMPUTER INTERACTION	L T P C
		3 0 0 3

COURSE OBJECTIVES:

- To understand human cognitive functions, interaction models, and usability principles in Human-Computer Interaction (HCI).
- To apply HCI techniques in designing and evaluating interactive, mobile, and web-based user interfaces.
- To explore ergonomics, software prototyping, and modern tools for improving user experience.

UNIT I **FOUNDATIONS OF HCI** **9**

The Human: I/O channels – Memory – Reasoning and problem solving; The Computer: Devices –Memory – processing and networks; Interaction: Models - frameworks – Ergonomics – styles –elements – interactivity- Paradigms. - Case Studies.

UNIT II **DESIGN SOFTWARE PROCESS** **9**

Interactive Design: Basics – process – scenarios – navigation – screen design – Iteration and prototyping. HCI in software process: Software life cycle – usability engineering – Prototyping in practice – design rationale. Design rules: principles, standards, guidelines, rules. Evaluation Techniques – Universal Design.

UNIT III **MODELS AND THEORIES** **9**

HCI Models: Cognitive models: Socio-Organizational issues and stakeholder requirements –Communication and collaboration models-Hypertext, Multimedia and WWW.

UNIT IV **MOBILE HCI** **9**

Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets,Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools. - Case Studies.

UNIT V **WEB INTERFACE DESIGN** **9**

Designing Web Interfaces – Drag Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow - Case Studies.

TOTAL:45 PERIODS

TEXT BOOKS:

1 Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, "Human-Computer Interaction", 3rd Edition, Pearson Education, 2004.

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2 Ben Shneiderman, Catherine Plaisant, "Designing the User Interface: Strategies for Effective Human-Computer Interaction", 6th Edition, Pearson, 2016.

REFERENCES:

1 Donald A. Norman, The Design of Everyday Things, 2nd Edition, Basic Books, Revised Edition, 2013.

2 Jeff Johnson, Designing with the Mind in Mind: Simple Guide to Understanding User Interface Design Guidelines, 2nd Edition, Morgan Kaufmann, 2013.

3 Rex Hartson, Pardha S. Pyla, The UX Book: Process and Guidelines for Ensuring a Quality User Experience, 2nd Edition, Morgan Kaufmann, 2018.

ONLINE RESOURCES:

1 https://www.interaction-design.org/

2 https://nptel.ac.in/courses/106103115

3 https://www.coursera.org/courses?query=human-computer-interaction

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the fundamental principles of Human-Computer Interaction, including human cognitive functions and ergonomics.

CO2 Apply user-centered design principles to develop interactive software applications.

CO3 Analyze cognitive and socio-organizational models to improve user experience and interface usability.

CO4 Apply appropriate tools and techniques to design and evaluate mobile applications and web interfaces.

CO5 Analyze usability engineering methodologies and universal design principles to create inclusive and effective interfaces.

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	-	-	-	-	-	-	-
CO2	3	2	1	2	-	-	-	-	-	-	-	-
CO3	3	2	1	2	-	-	-	1	-	-	-	-
CO4	3	2	1	2	-	-	-	1	-	-	-	-
CO5	3	2	1	2	-	-	-	1	-	-	-	-

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U23OE132 **WEB DEVELOPMENT FUNDAMENTALS** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To understand the fundamentals of internet
- To learn HTML, CSS, Java script for front end development
- To distinguish web security concepts and learn about vulnerabilities

UNIT I **INTRODUCTION TO INTERNET** **9**

Network Address Translation-Subnet Masking-Difference between Internet and Intranet-Working of Internet-Static and Dynamic Routing- Domain Name Server-Networking Tools-ipconfig, ping, netstat, traceroute.

UNIT II **INTERNET PROTOCOLS** **9**

HTTP-HTTPs-FTP-SMTP-IMAP-POP3-VoIP-ICMP-IGMP

UNIT III **WEB SERVERS AND PROXY SERVERS** **9**

Web Servers: Introduction, Working, Configuring, Hosting and Managing a Web Server, Proxy Servers: Introduction, Working, Types of Proxies, setting up and managing a Proxy server-Client- side Technologies-Server-side Technologies-Hybrid Technologies.

UNIT IV **JAVASCRIPT BASICS** **9**

Java script-jQuery-JSON-Node.js-Bootstrap-Introduction to forums-Blogging-Portfolio-Developing a responsive website-Combining web applications and mobile applications.

UNIT V **SEARCH ENGINES, COOKIES AND E-COMMERCE** **9**

Search Engines-Components, Working Optimization, Crawling, BOTS, Introduction to Cookies and Sessions-Introduction to E-Commerce Websites and E-Carts.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 M Ganesh Karthik, C Silpa, Dr B Lalitha, "Web Technologies", 1st Edition, Book Rivers, 2023.

2 P Meenakshi Devi, D Balakrishnan, S Nandhagopal, "Web Essentials", 1st Edition, ARS Publications, 2021.

REFERENCES:

1 Sammulal Porika, Peddi Kishor, "Web Technologies and Applications", 1st Edition, BS Publications, 2022.

2 Menal Dahiya, "Getting Started with Web Technologies", 1st Edition, Notion Press, 2022.

ONLINE RESOURCES:

1 https://www.tutorialspoint.com/internet_technologies/internet_quick_guide.ht
2 https://www.techtarget.com/whatis/definition/Web-server
3 https://archive.nptel.ac.in/courses/106/105/106105183/

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S. M

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Summarize the notions of NAT, routing, DNS and networking tools

CO2 Explain the fundamental concepts of the Internet and networking protocols

CO3 Analyze interactive and responsive websites using HTML, CSS, and JavaScript

CO4 Describe dynamic web applications using server-side languages

CO5 Explain the basic concepts of crawling and BOTS

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	-	-	1	-	-	-	1
CO2	2	2	1	1	-	-	-	1	-	-	-	1
CO3	3	3	2	2	-	-	-	1	-	-	-	1
CO4	2	2	1	1	-	-	-	1	-	-	-	1
CO5	2	2	1	1	-	-	-	1	-	-	-	1

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U23OE133	NETWORK MANAGEMENT SYSTEMS	L T P C
		3 0 0 3

COURSE OBJECTIVES:

- To learn the interoperable network management as a typical distributed application
- To understand concepts and terminology associated with SNMP
- To understand the current trends in network management technologies.

UNIT I OSI NETWORK MANAGEMENT 8

OSI Network management model - Organizational model - Information model, Communication model. Abstract Syntax Notation - Encoding Structure, Macros Functional Model CMIP/CMIS.

UNIT II BROADBAND NETWORK MANAGEMENT 9

Broadband networks and services, ATM Technology - VP, VC, ATM Packet, Integrated service, ATM LAN emulation, Virtual LAN, ATM Network Management - ATM Network reference model, Integrated local Management Interface. ATM Management Information base, Role of SNMP and ILMI in ATM Management, M1, M2, M3, M4 interface. ATM Digital Exchange Interface Management.

UNIT III SIMPLE NETWORK MANAGEMENT PROTOCOL 10

SNMPv1 Network Management: Communication and Functional Models. The SNMP Communication Model, Functional model, SNMP Management SNMPv2: SNMPv2 System Architecture, SNMPv2 Structure of Management Information, The SNMPv2 Management Information Base, SNMPv2 Protocol, Configuration management, Fault management, Performance management, Security management, Report Management, Policy Based Management, Services Level Management.

UNIT IV NETWORK MANAGEMENT SYSTEMS 9

Network Management Tools, Network Statistics Measurement Systems, History of Enterprise Management, Commercial Network management Systems, System Management and Enterprise Management Solutions.

UNIT V WEB-BASED MANAGEMENT 9

NMS with Web Interface and Web-Based Management, Web Interface to SNMP Management, Embedded Web-Based Management, Desktop management Interface, Web-Based Enterprise Management, WBEM: Windows Management Instrumentation, Java management Extensions, Management of a Storage Area Network.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Mani Subramanian, "Network Management: Principles and Practices", 1st Edition, Pearson Education, 2020.

2 Alexander Clemm, "Network Management Fundamentals", 1st Edition, Cisco Press, 2021.

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REFERENCES:

1 Benoit Claise, Ralf Wolter, "Network Management: Accounting and Performance Strategies", 1st Edition, Pearson Education, 2022.

2 Vikas Kumar Jha, Bishwajeet Kumar Pandey, Ciro Rodriguez, "Network Evolution and Applications", 1st Edition, CRC Press, 2022.

ONLINE RESOURCES:

1 https://onlinecourses.nptel.ac.in/noc25_ee54/preview

2 https://www.youtube.com/watch?v=meFgK8z1pDc

3 https://nptel.ac.in/courses/117106116

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the various OSI Network management models.

CO2 Describe the Services provided by Broadband Network.

CO3 Summarize the concepts and terminology associated with SNMP.

CO4 Explain the current trends in network management technologies.

CO5 Explain the Various Web based management in Network.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	-	-	1	-	-	-	1
CO2	2	2	1	1	-	-	-	1	-	-	-	1
CO3	2	2	1	1	-	-	-	1	-	-	-	1
CO4	2	2	1	1	-	-	-	1	-	-	-	1
CO5	2	2	1	1	-	-	-	1	-	-	-	1

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U23OE134	FUNDAMENTALS OF MOBILE COMPUTING	L T P C
		3 0 0 3

COURSE OBJECTIVES:

- To understand the basic concepts of mobile computing and mobile telecommunication system
- To learn about the network layer protocols and Ad-Hoc networks and basis of transport and application layer protocols.
- To learn the knowledge about different mobile platforms and application development.

UNIT I **INTRODUCTION** 9

Introduction to Mobile Computing-Applications of Mobile Computing-Generations of Mobile Communication Technologies-MAC Protocols-SDMA- TDMA- FDMA- CDMA.

UNIT II **MOBILE TELECOMMUNICATION SYSTEM** 9

Introduction to Cellular Systems – GSM – Services & Architecture – Protocols – Connection Establishment – Frequency Allocation – Routing – Mobility Management –– GPRS- UMTS – Architecture – Handover – Security.

UNIT III **MOBILE NETWORK LAYER AND TRANSPORT LAYER** 9

Mobile IP – Dynamic Host Configuration Protocol - Routing – DSDV – DSR – WTLS-Traditional TCP, Mobile TCP.

UNIT IV **APPLICATION LAYER** 9

WAP – Architecture, Gateway, protocols, user agent profile – WDP –WTP –WSP – WAE – WTA Architecture – WML.

UNIT V **MOBILE PLATFORMS AND APPLICATIONS** 9

Mobile Device Operating Systems – Special Constraints & Requirements – Software Development Kit: iOS, Android, BlackBerry, Windows Phone – MCommerce – Structure – Pros & Cons – Mobile Payment System – Security Issues.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Manish Soni, "Mobile Computing: Concepts, Applications and Exercises", 1st Edition, Poorav Publications, 2025.

2 Subarna Shakya, "Mobile Computing and Sustainable Informatics", 1st Edition, Springer publications, 2023.

REFERENCES:

1 Mladen Bozanic, "Mobile Communication Networks: 5G and a Vision of 6G", 3rd Edition, Springer publications, 2021.

2 Prabhakar Sharma, "Mobile and Wireless Communication", 1st Edition, Notion Press, 2023.

ONLINE RESOURCES:

1 https://archive.nptel.ac.in/courses/106/106/106106147/

2 https://www.geeksforgeeks.org/what-is-a-mobile-operating-system/

3 https://www.slideshare.net/slideshow/mobile-network-layer/28141434#2

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S.M

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the basic of mobile telecommunication system

CO2 Summarize the generations of telecommunication systems in wireless networks.

CO3 Describe the functionality of MAC, network layer and identify a routing protocol for a given Ad hoc network.

CO4 Explain the functionality of transport and application layers.

CO5 Describe the mobile application using android/blackberry/ios/Windows SDK.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	-	-	1	-	-	-	1
CO2	2	2	1	1	-	-	-	1	-	-	-	1
CO3	2	2	1	1	-	-	-	1	-	-	-	1
CO4	2	2	1	1	-	-	-	1	-	-	-	1
CO5	2	2	1	1	-	-	-	1	-	-	-	1

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U230E135	ELECTRONIC COMMERCE	L T P C 3 0 0 3

COURSE OBJECTIVES:

- To learn the E-Commerce Platform and its concepts
- To understand the Security and Challenges in E-Commerce
- To build an Own E-Commerce using Open-Source Frameworks

UNIT I **INTRODUCTION TO E-COMMERCE AND TECHNOLOGY INFRASTRUCTURE** **9**

Working of Web-HTML Markup for structure-Creating simple page-Marking up text-Adding Links-Adding Images-Table Markup-Forms-HTML5.

UNIT II **BUILDING AN E-COMMERCE WEBSITE, MOBILE SITE AND APPS** **9**

Systematic Approach to build an E-commerce: Planning- System Analysis- System Design- Building the System-Testing the system-Implementation and Maintenance-Optimize Web Performance-Choosing hardware and software-Other E-Commerce Site Tools-Develop a Mobile Website and Mobile App.

UNIT III **E-COMMERCE SECURITY AND PAYMENT SYSTEMS** **9**

E-Commerce Security Environment – Security threats in E-Commerce – Technology Solutions: Encryption, Securing Channels of Communication, Protecting Networks, Protecting Servers and Clients – Management Policies, Business Procedure and Public Laws - Payment Systems.

UNIT IV **BUSINESS CONCEPTS IN E-COMMERCE** **9**

Digital Commerce Marketing and Advertising strategies and tools – Internet Marketing Technologies – Social Marketing – Mobile Marketing – Location based Marketing – Ethical, Social, Political Issues in E-Commerce.

UNIT V **PROJECT CASE STUDY** **9**

Case Study: Identify Key components, strategy, B2B, B2C Models of E-commerce Business model of any e-commerce website - Mini Project: Develop E-Commerce project in any one of Platforms like Woo-Commerce, Magento or Open cart.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Kenneth C Laudon, "E-Commerce 2023: Business, Technology and Society", 1st Edition, Pearson Education, 2022.

2 V Rajaraman, "Essentials of E-Commerce Technology", 2nd Edition, Prentice Hall of India, 2022.

REFERENCES:

1 M Suyal, "Fundamentals of E-Commerce", 1st Edition, ABH Books, 2023.

2 Krishna Gupta, "E-Commerce Technologies", 2nd Edition, Neelkanth Publishers, 2023.

ONLINE RESOURCES:

1 http://docs.opencart.com/

2 http://devdocs.magento.com/

3 http://doc.prestashop.com/display/PS15/Developer+tutorials

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Describe the concepts of HTML 5.0.

CO2 Analyze the mobile website and mobile app with respect to E-commerce tools.

CO3 Explain the strategies of E-commerce Security and Payment Systems.

CO4 Summarize the business concept in E-Commerce.

CO5 Describe the key components of B2B and B2C.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	-	-	1	-	-	-	1
CO2	3	3	2	2	-	-	-	1	-	-	-	1
CO3	2	2	1	1	-	-	-	1	-	-	-	1
CO4	2	2	1	1	-	-	-	1	-	-	-	1
CO5	2	2	1	1	-	-	-	1	-	-	-	1

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U230E136 **MACHINE LEARNING USING PYTHON** L T P C
2 0 2 3

COURSE OBJECTIVES:

- To understand the basic concepts of machine learning
- To understand the fundamentals of supervised learning
- To understand the algorithms based on corresponding metrics identified

UNIT I INTRODUCTION TO MACHINE LEARNING 9

Machine Learning-Types of Machine Learning-Machine Learning Pipeline-Introduction to python packages used in Machine Learning- Examples of machine learning applications-Vapnik-Chervonenkis (VC) dimension-Probably Approximately Correct (PAC) learning- Hypothesis spaces- Inductive bias- Generalization-Bias variance trade-off.

UNIT II SUPERVISED LEARNING 9

Supervised Learning and its Applications-Preparing and Shaping the Data-Overfitting and Underfitting-Detecting and Preventing Overfitting and Underfitting-Regularization.

UNIT III REGRESSION AND APPLICATIONS 9

Regression and its types-Linear Regression-Logistic Regression-Data Exploration and Over Sampling-Polynomial Regression- Data Preparation Model Building and Performance Evaluation-Ridge Regression-LASSO Regression.

UNIT IV CLASSIFICATION AND APPLICATIONS 9

Classification Algorithms-Classification Types- Selection of Performance Parameters-Naïve Bayes Classifier-Stochastic Gradient Descent-K-Nearest Neighbor-Decision Tree-Random Forest-Support Vector Machine-Cohens Kappa Measure.

UNIT V UNSUPERVISED ALGORITHMS AND ENSEMBLE LEARNING 9

Unsupervised Algorithms- Visualizing Outputs-Performance Parameters-Clustering Types-Hierarchical Clustering-K-Means Clustering-Outlier Detection-Ensemble Learning-Sequential and Parallel Ensemble Techniques-Types of Ensemble Methods-Bagging-Boosting-Stacking-Reducing Errors with Ensembles.

TOTAL:45 PERIODS

PRACTICAL EXERCISES:

1. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.
2. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
3. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.
4. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Python ML library classes/API in the program.
5. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Python ML library classes can be used for this problem.

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30 PERIODS
TOTAL: 75 PERIODS

TEXT BOOKS:

1 Ethem Alpaydin, "Introduction to Machine Learning", 4th Edition, MIT Press, 2020.

2 Manaranjan Pradhan, "Machine Learning using Python", 2nd Edition, John Wiley & Sons, 2020.

REFERENCES:

1 Sebastain Raschka, Vahid Mirjalili, "Python Machine Learning", 3rd Edition, Packt publishing, 2019.

2 Mark E Fenner, "Machine Learning with Python for Everyone", 1st Edition, Pearson Education, 2020.

ONLINE RESOURCES:

1 https://onlinecourses.nptel.ac.in/noc21_cs24/preview

2 https://www.tutorialspoint.com/machine_learning/machine_learning_regression_analysis.htm

3 https://colab.research.google.com/github/deepmind/educational/blob/master/colabs/summer_schools/intro_to_unsupervised_learning.ipynb

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the fundamental concepts of machine learning.
CO2 Apply supervised learning techniques.
CO3 Apply various kinds of regression to the following database
CO4 Analyze the concepts of Classification and its applications.
CO5 Analyze the algorithms in unsupervised learning and ensemble learning.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	1	-	-	1	-	1	-	1
CO2	3	2	1	2	1	-	-	1	-	1	-	1
CO3	3	2	1	2	1	-	-	1	-	1	-	1
CO4	3	3	2	2	1	-	-	1	-	1	-	1
CO5	3	3	2	2	1	-	-	1	-	1	-	1

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U23OE201	STATISTICS AND NUMERICAL METHODS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To acquaint the knowledge of testing of hypothesis for small and large samples and design of experiments which plays an important role in real life applications.
- To introduce the basic concepts of solving algebraic and transcendental equations and introduce the numerical techniques of interpolation in various intervals and to solve differentiation and integration.
- To understand the knowledge of various techniques and methods of solving ordinary differential equations.

UNIT I TESTING OF HYPOTHESIS 9

Sampling distributions – Tests for single mean, proportion and difference of means (Large and small samples) – Tests for single variance and equality of variances – Chi square test for goodness of fit – Independence of attributes.

UNIT II DESIGN OF EXPERIMENTS 9

One way and two – way classifications – Completely randomized design –Randomized block design – Latin square design.

UNIT III SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 9

Solution of algebraic and transcendental equations – Fixed point iteration method – Newton – Raphson method – Solution of linear system of equations – Gauss elimination method – Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel – Eigen values of a matrix by Power method and Jacobi's method for symmetric matrices.

UNIT IV INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION 9

Lagrange's and Newton's divided difference interpolations – Newton's forward and backward difference interpolation – Approximation of derivatives using interpolation polynomials – Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules.

UNIT V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 9

Single step methods: Taylor's series method – Euler's method – Modified Euler's method – Fourth order Runge – Kutta method for solving first order differential equations – Multi step methods: Milne's and Adams – Bash forth predictor corrector methods for solving first order differential equations.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 B S Grewal, J S Grewal, "Numerical Methods in Engineering and Science", 11th Edition, Khanna Publishers, 2021.

2 R A Johnson, I Miller, J Freund "Miller and Freund's Probability and Statistics for Engineers", 9th Edition, Pearson Education, 2017.

REFERENCES:

1. Chaitanya Kumar, Harindejit Kaur Chawla, Indarpal Singh, "A text book on Numerical Methods and Analysis", Sultan Chand & Sons, 2024.
2. P Sivaramakrishna Das, C Vijayakumari, "Statistics and Numerical Methods", 9th Edition, Pearson Education, 2020.
3. S C Gupta , V K Kapoor, "Fundamentals of Mathematical Statistics", 12th Edition, Sultan Chand & Sons, 2020.

ONLINE RESOURCES:

1. https://swayam.gov.in/nd2_cec20_ma01/preview
2. https://www.coursera.org/learn/intro-to-numerical-analysis
3. https://www.mooc-list.com/tags/numerical-methods

COURSEOUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Analyze the concepts of sampling, mean and variance using various statistical tests.
CO2 Analyze the concepts of design of experiments using ANOVA.
CO3 Solve the algebraic and numerical equations by numerical techniques.
CO4 Evaluate the numerical integration and differentiation using different methods.
CO5 Solve the first order differential equations by various methods.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	-	-	1	-	-	-	1
CO2	3	3	2	2	-	-	-	1	-	-	-	1
CO3	3	2	1	1	-	-	-	-	-	-	-	-
CO4	3	3	2	3	-	-	-	1	-	-	-	1
CO5	3	2	1	1	-	-	-	-	-	-	-	-

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U23OE202	RESOURCE MANAGEMENT TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Learn to formulate linear programming problems and solve LPP using simple algorithm.
- Learn to solve networking problems.
- Learn to formulate and solve integer programming problems.

UNIT I **LINEAR PROGRAMMING** **9**

Principal components of decision problem – Modeling phases – LP formulation and graphic solution – Resource allocation problems – simplex method – sensitivity analysis.

UNIT II **DUALITY AND NETWORKS** **9**

Definition of dual problems – primal – Dual relationships – Dual simplex method – post optimality analysis – Transportation and assignment model – Shortest route problem.

UNIT III **INTEGER PROGRAMMING** **9**

Cutting plan algorithm – Branch and bound methods, Multistage (Dynamic) programming.

UNIT IV **CLASSICAL OPTIMISATION THEROY** **9**

Unconstrained external problems, Newton – Ralphson method – Equality constraints –Jacobean methods – Lagrangian method – Kuhn – Tucker conditions – Simple problems.

UNIT V **OBJECTS SCHEDULING** **9**

Network diagram representation – Critical path method – Time charts and resource leveling – PERT

TOTAL: 45 PERIODS

TEXT BOOKS:

1. H A Eiselt, Carl Louis Sandblom, "Operation Research", Springer, 2022.
2. Girish G.Pathak, "Operation Research", Tech Knowledge Publications, 2021.

REFERENCES:

1. Pundir S K, "Operation Research", CBS, 2020.
2. Bhupander Singh, S K Pundir, Amardeep, "Operation Research", A Pragati Edition, 2020.
3. S Hillier Frederick, J Lieberman Gerald, Nag Bodhibroto, Basu Preetam, "Introduction to Operation Research" Tata McGraw Hill, 2021.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/112106134
2. https://nptel.ac.in/courses/112106134
3. https://archive.nptel.ac.in/courses/111/104/111104027/

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COURSEOUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Solve LPP using simple algorithm
CO2 Solve networking problems.
CO3 Solve integer programming problems.
CO4 Solve Non Linear programming problems.
CO5 Solve project management problems.

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	-	-	-	2	-	-	-	-
CO2	3	2	1	1	-	-	-	1	-	-	-	-
CO3	3	2	1	1	-	-	-	1	-	-	-	-
CO4	3	2	1	1	-	-	-	1	-	-	-	-
CO5	3	2	1	1	-	-	-	1	-	-	-	-

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U23OE203	GRAPH THEORY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand and apply the fundamental concepts in graph theory.
- Able to demonstrate their knowledge of algorithms by solving concrete problems.
- To apply graph theory based tools in solving practical problems.

UNIT I **INTRODUCTION** **9**

Spanning trees – Fundamental circuits – Spanning trees in a weighted graph – cut sets – Properties of cut set – All cut sets – Fundamental circuits and cut sets – Connectivity and separability – 1-Isomorphism – 2-Isomorphism – Combinational and geometric graphs – Planar graphs – Different representation of a planar graph.

UNIT II **TREES, CONNECTIVITY& PLANARITY** **9**

Spanning trees – Fundamental circuits – Spanning trees in a weighted graph – cut sets Properties of cut set – All cut sets – Fundamental circuits and cut sets Connectivity and separability – 1-Isomorphism – 2-Isomorphism –Combinational and geometric graphs – Planar graphs – Different representation of a planar graph.

UNIT III **MATRICES, COLOURING & COVERING** **9**

Incidence matrix – Sub matrices – Circuit Matrix - Fundamental circuit matrix – Cut set, Path, Adjacency Matrix - Chromatic number – Chromatic partitioning – Chromatic polynomial – Matching – Covering – Four colour problem .

UNIT IV **DIRECTED GRAPH** **9**

Directed graphs – Types of directed graphs – Digraphs and binary relations – Directed paths and connectedness – Euler graphs – Trees with Directed edges – Matrices of Digraphs.

UNIT V **GENERATING FUNCTIONS & RECURRENCE RELATIONS** **9**

Generating functions - Partitions of integers - Exponential generating function – Summation operator – Recurrence relations – First order and second order – Non-homogeneous recurrence relations –Method of generating functions.

TOTAL: 45PERIODS

TEXT BOOKS:

1. N P Shrimal, Nita H Shah,"Recent Advancements in Graph Theory ", CRC Press, 2020.
2. S B Singh, "Combinatorics and Graph Theory ", Khanna Publishing House, 2022.

REFERENCES:

1. Harun Pirim, "Recent Applications in Graph Theory", Intechopen, 2022.
2. Mark Anderson, Jonathan L Gross, Jay Yellen, "Graph Theory and its Applications", CRC Press, 2024.
3. Karin R Saoup, "Graph Theory", Chapman and Hall/CRC, 2021.

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ONLINE RESOURCES:

1 https://swayam.gov.in/nd1_noc20_ma05/preview
2 https://dzone.com/articles/the-top-13-resources-for-understandinggraph-theory
3 http://www.nitttrc.edu.in/nptel/courses/video/106104170/L22.html

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain concepts of graph theory that is walk, path, isomorphism etc.
CO2 Apply various substructures of trees and investigate the planarity of graphs.
CO3 Apply the concepts of Colouring, matching and chromatic number in theorems.
CO4 Explain digraphs and Euler graphs.
CO5 Solve recurrence relations using generating functions.

CO - PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	-	-	-	-	-	-	-
CO2	3	2	1	2	-	-	-	1	-	-	-	-
CO3	3	2	1	2	-	-	-	1	-	-	-	1
CO4	2	2	1	1	-	-	-		-	-	-	1
CO5	3	2	1	1	-	-	-	1	-	-	-	-

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U23OE204 **OPERATIONS RESEARCH** L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand different methods involved in linear programming models, transportation and assignment models.
- To appropriately formulate various OR models and apply optimization techniques and algorithms to solve decision theory and project scheduling.
- To enhance the students to acquire the knowledge about inventory controls and queuing models.

UNIT I **LINEAR PROGRAMMING MODELS** 9

Introduction – Mathematical formulation of LPP – graphical solution – simplex method – duality.

UNIT II **TRANSPORTATION AND ASSIGNMENT MODELS** 9

Mathematical formulation of transportation problem – Methods for finding initial basic feasible solution – optimum solution – degeneracy – mathematical formulation of assignment models – Hungarian Algorithm – Travelling salesman problem.

UNIT III **DECISION THEORY AND PROJECT SCHEDULING** 9

Decision trees – Game theory – two people zero sum – mixed strategies – 2xn and mx2 games. Project scheduling: CPM and PERT – crashing networks and cost considerations – resource levelling and resource smoothening.

UNIT IV **SEQUENCING AND INVENTORY MODELS** 9

Sequencing model – 2 machines n jobs, m machines n jobs – n jobs 2 machines. Inventory model – deterministic and probabilistic models.

UNIT V **QUEUEING MODELS** 9

Queuing models – Poisson arrival and exponential service times – single & multi-server models.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. H A Eiselt ,Carl Louis Sandblom, "Operation Research", Springer, 2022.
2. Girish G Pathak, "Operation Research", Tech Knowledge Publications, 2021.

REFERENCES:

1. S Hillier Frederick, J Lieberman Gerald, Nag Bodhibroto, Basu Preetam, "Introduction to Operation Research", Tata McGraw Hill, 2021.
2. Bhupander Singh, Pundir S K, Amardeep, "Operation Research", A Pragati Edition, 2020.
3. Pundir S.K, "Operation Research", CBS, 2020.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/111/105/111105100/
2. https://nptel.ac.in/courses/112/106/112106134/
3. https://freevideolectures.com/course/2678/advanced-operations research

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Solve linear programming models.
CO2 Apply the concepts of transportation and assignment models in real life applications.
CO3 Analyze the project schedule and the cost-time trade-offs in the context of a project network and optimal decisions using graphical approach.
CO4 Estimate the total elapsed time for the problems of multiple jobs and machines in a production line and understand the various selective inventory control techniques and its applications.
CO5 Analyze the quantitative metrics of performance for queuing systems.

CO- PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	-	-	-	-	-	-	-	1
CO2	3	2	1	2	-	-	-	-	-	-	-	1
CO3	3	3	2	2	-	-	-	1	-	-	-	-
CO4	3	3	2	3	-	-	-	1	-	-	-	1
CO5	3	3	2	2	-	-	-	1	-	-	-	-

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U23OE205	SCIENTIFIC PRINCIPLES IN HISTORICAL MONUMENTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To recall the historical background of the monuments.
- To recognize the different scientific principles in the maintenance of historical monuments.
- To identify the knowledge of construction techniques used in historical period.

UNIT I **CHARACTERISTICS OF MONUMENTS** 9

Definition - Materials used - Purpose-Functions - Types: religious, secular, palaces, forts, tombs, bridges - irrigation systems - need for conservation.

UNIT II **HISTORY OF CONSTRUCTION TECHNOLOGIES** 9

Chronological development - Ancient civilizations - Ancient period - Medieval construction-construction in the modern period - technical achievements.

UNIT III **BASIC PHYSICS PRINCIPLES** 9

Stability and equilibrium: leaning tower of Pisa – Tension, stress and strain: bridges – Overcoming forces: sledges, pulleys and elevators.

UNIT IV **TECHNIQUES OF CONSTRUCTION** 9

Mechanical energy to move large stones –use of counter weights and counter ramps.

UNIT V **ANCIENT TECHNIQUES** 9

Hydraulic transport of building material –use of levers and pivot walking.

TEXT BOOKS:

1 Halliday , Resnick, "Principles of Physics", 12th Edition , John Wiley & Sons, 2023.
2 Mila Powers, "Conservation science for Cultural Heritage", Willford Press, 2022.

REFERENCES:

1. Paula Pires, Joao Mascarenhas, "History of Construction Cultures", Taylor & Francis, 2021.
2. Claire Smith, "Encyclopedia of Global Archaeology", Springer, 2021.
3. Paul G Hewitt, "Conceptual Physics", 13th Edition, Pearson Education, 2024.

ONLINE RESOURCES:

1 https://doi.org/10.1038/s40494-025-01640-y

2 https://orcid.org/0000-0003-0049-8171

3 https://doi.org/10.70102/afts.2024.1631.036

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Summarize the characteristics of historical monuments.

CO2 Summarize the different scientific principles in designing and construction of historical monuments.

CO3 Apply the basic physics principles in maintenance of historical monuments.

CO4 Describe the history of construction technologies in various era.

CO5 Explain the techniques of construction used in olden days.

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	-	-	-	-	-	-	-
CO2	2	2	1	1	-	-	-	-	-	-	-	-
CO3	3	2	1	2	-	-	-	-	-	-	-	1
CO4	2	2	1	1	-	-	-	-	-	-	-	-
CO5	2	2	1	1	-	-	-	-	-	-	-	-

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U23OE206	NON-CONVENTIONAL ENERGY SOURCES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To compare different forms of energy.
- To acquire knowledge of different methods of harvesting energy.
- To recognize the use of alternate sources of energy.

UNIT I **SOLAR ENERGY** **9**

Sun Earth radiation spectra – Solar Radiation Data – Measurement of Solar Radiation data – Solar collectors – Solar water Heater – Solar cookers – Solar Greenhouse effect – Solar Cell fundamentals – a typical solar electric installation for home (solar panels, battery and inverter)

UNIT II **WIND ENERGY** **9**

Origin of wind – Nature of wind – Wind Turbine Siting – Major Applications of Wind Power – Main components of the horizontal axis wind turbine – Wind Energy Conversion systems – Wind – Diesel Hybrid System.

UNIT III **BIOMASS ENERGY** **9**

Introduction – Photosynthesis Process – Biofuels – Biomass Resources – Biomass conversion technologies – Urban Waste to Energy Conversion – Biomass Gasification – Biomass to Ethanol production – Biogas Production from Waste Biomass.

UNIT IV **CHEMICAL ENERGY SOURCES** **9**

Fuel cells – design and principle of operation of a fuel cell – Classification of fuel cells – Types of Fuel cells – Hydrogen and fossil fuel cell – Advantages and disadvantages of fuel cells.

UNIT V **DIFFERENT TYPES OF BATTERY** **9**

Batteries : Basic battery theory – Different types of battery arrangement – classification of batteries – Lead – Acid battery – Nickel cadmium battery – Li-ion battery – batteries used in portable devices (laptops, cell phones, pace makers).

TOTAL:45 PERIODS

TEXT BOOKS:

1. B H Khan , "Non-Conventional Energy Resources", Tata McGraw Hill, 2024.
2. G D Rai , "Non-Conventional Energy Sources", 4th Edition, Khanna Publishers, 2023.

REFERENCES:

1. D P Kothari, K C Singal, Rakesh Ranjan, "Renewable energy sources and emerging technologies", 3rd Edition, Prentice Hall of India, 2022.
2. Mehmet Kanoglu, Yunus A Cengel, John M Imbala, "Fundamentals and Applications of Renewable Energy", 2nd Edition, Tata McGraw Hill, 2023.
3. G S Sawhney, "Non-Conventional Energy Resources", Prentice Hall of India, 2024.

ONLINE RESOURCES:

1. https://www.ipcc.ch/site/assets/uploads/2018/03/Chapter-7-Wind-Energy-1.pdf
2. https://archive.nptel.ac.in/content/storage2/courses/108108078/pdf/S
3. https://ebooks.inflibnet.ac.in/esp07/chapter/biomass-as-an-energy-source/

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the fundamentals of different forms of solar energy.
CO2 Describe the origin, nature and applications of wind energy.
CO3 Explain the process involved in production and conversion of biomass energy.
CO4 Describe the design and principles of fuel cells.
CO5 Explain the basic theory and types of batteries.

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	-	-	-	-	-	-	-
CO2	2	2	1	1	-	-	-	-	-	-	-	-
CO3	2	2	1	1	-	-	-	-	-	-	-	1
CO4	2	2	1	1	-	-	-	-	-	-	-	-
CO5	2	2	1	1	-	-	-	-	-	-	-	-

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U23OE207 **ENVIRONMENTAL PHYSICS** L T P C
3 0 0 3

COURSE OBJECTIVES:

- To relate the connection between physics and human environment.
- To recognize the structure, composition of the atmosphere and the global weather conditions.
- To identify the use of renewable energy resources.

UNIT I **PHYSICS IN HUMAN ENVIRONMENT** 9

Laws of thermodynamics – thermodynamics and the human body – Energy and metabolism - Energy transfers: Concepts of Conduction, Convection, Radiation and Evaporation – Survival in cold and hot climates.

UNIT II **THE URBAN ENVIRONMENT** 9

Townscape – Energy in the city – Transportation – Water for urban environment – Lighting – Urban pollution – Smog – Acid rain – Car as an urban pollutant – Noise pollution.

UNIT III **ENERGY FOR LIVING** 9

World energy demand – World energy supplies – Basic concepts of Energy sources: Fossil fuels – Wind energy – Solar energy – Tidal energy.

UNIT IV **GEOTHERMAL AND HYDRO ENERGY** 9

Geothermal Resources – Geothermal Technologies – Hydro Energy: Hydropower resources – hydropower technologies – environmental impact of hydro power sources.

UNIT V **RADIATION PROTECTION** 9

Nuclear radiation: exposure rate, dose rate, equivalent dose rate, population dose – quantitative effects of radiation on the human species – calculation – nuclear reactor – shielding.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Abel Rodrigues, Gabriel Pita, Raul Albuquerque Sardinha, "Fundamental Principles of Environmental Physics", Springer, 2022.

2 Pranav Kumar, "Fundamentals of Ecology and Environment" , 2nd Edition, Pathfinder Publication, 2021.

REFERENCES:

1 Khan B H, "Non-Conventional Energy Resources", Tata McGraw Hill, 2024.

2 Kyle Forinash, "Foundations of Environmental Physics", Island Press, 2022.

3 C Francesco, "Advances in Environmental Applied Physics", MDPI, 2023.

ONLINE RESOURCES:

1 http://en.wikipedia.org/wiki/Renewable_energy

2 https://www.uprm.edu/aret/docs/Ch_3_Ocean.pdf

3 https://ebooks.inflibnet.ac.in/esp07/chapter/applications-of- solar- energy/

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the different laws related to human environment.
CO2 Describe the importance of physics in urban living.
CO3 Summarize the basic concepts of energy sources.
CO4 Apply the basic concepts of geothermal and hydro energy on environmental impact.
CO5 Explain about the radiation protection and dosage measurements.

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	-	-	-	-	-	-	-
CO2	2	2	1	1	-	-	-	-	-	-	-	-
CO3	2	2	1	1	-	-	-	-	-	-	-	-
CO4	3	2	1	2	-	-	-	-	-	-	-	1
CO5	2	2	1	1	-	-	-	-	-	-	-	-

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U23OE208	ENTREPRENEURSHIP DEVELOPMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To equip and develop the learners entrepreneurial skills and qualities essential to undertake business.
- To Gain knowledge on innovation, its types, role of technology in innovation, patents and licensing.
- To be able to prepare a business plan.

UNIT I **INTRODUCTION** **9**

The Entrepreneur – Definition – Characteristics of Successful entrepreneur. Entrepreneurial scene in India; MSME; Analysis of entrepreneurial growth in different communities – Case histories of successful entrepreneurs. Similarities and Differences between Entrepreneur and Intrapreneur.

UNIT II **INNOVATION IN BUSINESS** **9**

Types of Innovation – Creating and Identifying Opportunities for Innovation – Design Thinking- The Technological Innovation Process – Creating New Technological Innovation and Intrapreneurship – Licensing – Patent Rights – Innovation in Indian Firms.

UNIT III **NEW VENTURE CREATION** **9**

Identifying Opportunities for New Venture Creation: Environment Scanning – Generation of New Ideas for Products and Services. Creating, Shaping, Recognition, Seizing and Screening of Opportunities. Feasibility Analysis: Technical Feasibility of Products and Services – Marketing Feasibility: Marketing Methods – Pricing Policy and Distribution Channels.

UNIT IV **BUSINESS PLAN PREPARATION** **9**

Benefits of a Business Plan – Elements of the Business Plan – Developing a Business Plan – Guidelines for preparing a Business Plan – Format and Presentation; Start-ups and ecommerce Start-ups. Business Model Canvas.

UNIT V **FINANCING THE NEW VENTURE** **9**

Capital structure and working capital Management: Financial appraisal of new project, Role of Banks – Credit appraisal by banks. Institutional Finance to Small Industries – Incentives – Institutional Arrangement and Encouragement of Entrepreneurship.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 R D Hisrich, "Entrepreneurship", 11th Edition, Tata McGraw Hill, 2020.

2 C B Gupta, "Entrepreneurship – Text and Cases", Sultan Chand & Sons, 2023.

REFERENCES:

1 Desai V, "Small Scale Industries and Entrepreneurship", Himalaya Publishing House, 2018.
2 Bruce R Barringer, R Duane Ireland "Entrepreneurship: Successfully Launching New Ventures", 6th Edition, Pearson Education, 2018.
3 Roy R, "Entrepreneurship", 2nd Edition, Oxford University Press, 2011.

ONLINE RESOURCES:

1 http://www.cengage.com/highered
2 https://roadmapresearch.com/entrepreneurship-beyond-curriculum
3 https://onlinecourses.swayam2.ac.in/cec20_mg19/preview

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain about growth of entrepreneurship in India..

CO2 Describe about innovation, its types, role of technology in innovation, patents and licensing.

CO3 Summarize the concepts of new venture.

CO4 Design a business plan.

CO5 Comprehend the various types of financing available for new ventures.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	1	-	2	-	-	2	2	2	2
CO2	2	2	1	1	-	1	-	2	-	-	2	2	2	2
CO3	2	2	1	1	-	1	-	2	-	-	2	2	2	2
CO4	2	2	1	1	-	1	-	2	-	-	2	2	2	2
CO5	2	2	1	1	-	1	-	2	-	-	2	2	2	2

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U23OE209	BASICS OF BIOENERGY AND BIOFUELS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the concepts of biofuels and bio based products.
- To recognize the advancement of biofuels and illustrate the chemistry involved in converting them.
- To impart the knowledge about bioenergy and biofuel technology and its applications.

UNIT I **INTRODUCTION** **9**

Bio power, Bio heat, Biofuel, advanced liquid fuels, drop-in fuels, bio based products.

UNIT II **BIOMASS** **9**

Harvested Feed stocks: First generation biofuels, second generation biofuels, and third generation biofuels. Residue Feedstocks: Agricultural wastes, forestry wastes, farm waste, organic components of residential, commercial, institutional and industrial waste.

UNIT III **PROCESSING TECHNIQUES** **9**

Biochemical conversion – hydrolysis, enzyme and acid hydrolysis, fermentation, anaerobic digestion and trans-esterification, Thermo chemical conversion – Combustion, Gasification, Pyrolysis

UNIT IV **BIOFUELS** **9**

Pros and cons of Biofuels, Algal biofuels, Cyanobacteria and producers of biofuels, Bioethanol, Biomethane, biohydrogen, biobutanol, metabolic engineering of fuel molecules, Engineering aspects of biofuels.

UNIT V **BIO ENERGY SUSTAINABILITY** **9**

Environmental Sustainability, bio energy sustainability, emissions of biomass to power generation applications, emissions from biofuels. Carbon footprint, Advanced low carbon fuels.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. R William Oswald, "Introduction to Bioenergy", Springer, 2023.
2. A K S R Reddy, "Principles and Practice", 2nd Edition , CRC Press, 2022.

REFERENCES:

1. Ashok Pandey, R C Kuhad, Vinod Kumar "Biofuels: Biochemistry and Biotechnology", 2nd Edition , Springer, 2023.
2. Anuj Kumar, R K Singh, S K Saha, "Bioenergy and Biofuels: Advanced Biorefineries for sustainable production", 1st Edition , Elsevier, 2022.

3. L David klass, M John Farewell, "Fundamentals of Bioenergy and Biofuels", 1st Edition, Academic Press (Elsevier), 2022.

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc19_bt16/preview
2. https://www.renewableinstitute.org/training/biomass-course/
3. https://www.eesi.org/topics/bioenergy-biofuels-biomass/description

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Summarize the concept of bioenergy.
CO2 Evaluate the value of biomass.
CO3 Describe the chemistry involved in the production of bioenergy.
CO4 Explain the principle of biofuel technologies on a small and large scale.
CO5 Describe the use of biofuels in a sustainable manner.

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	-	-	-	-	-	-	1
CO2	3	3	2	3	-	-	-	-	-	-	-	1
CO3	2	2	1	1	-	-	1	-	-	-	-	1
CO4	2	2	1	1	-	-	2	-	-	-	-	1
CO5	2	2	1	1	-	-	3	1	-	-	-	1

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U23OE210	FOOD SCIENCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- This course will enable the students with good scientific and engineering knowledge so as to create new food products and design equipment's for food industries.
- This is necessary for effective understanding of a detailed study of food processing and technology subjects.
- This course will enable students to appreciate the importance of food with respect to the producer, manufacturer and consumer.

UNIT I FOOD PROCESS ENGINEERING OPERATIONS 9

Materials and Energy Balances - Fluid flow applications, Heat transfer applications, Drying, Evaporation, Equilibrium stage process, leaching and Extractions - Application of Mechanical separations and Mixing, in Diary, Meat Industry, Oil and Fat Industry, Cereal processing.

UNIT II FOOD WASTES IN VARIOUS PROCESSES 9

Waste disposal-solid and liquid waste - rodent and insect control - use of pesticides – ETP - selecting and installing necessary equipment.

UNIT III FOOD PRESERVATION AND ITS IMPORTANCE 9

Introduction: Food safety and food poisoning - reasons for food poisoning and its effects. Deterioration and spoilage of processed foods - Shelf life of food products - Types of food based on its perishability. Food Preservation: Preservation methods - Thermal Methods - Pasteurization - Dehydrofreezing -Dosimetry - Transport of food and Preservation Strategies.

UNIT IV DEVELOPMENTS IN FOOD PROCESSING 9

Food Constituents and processing Food emulsions - Food Rheology, Advances in thermal Operation, Extrusion, cooking Spray dryer design - Energy expenditure and Saving Food for developing countries - Food Detoxification - Production of Sweeteners - Starch, Microbial Polysaccharides, Amino acid, Rice bran Tocopherols.

UNIT V FOOD HYGIENE AND QUALITY CONTROL 9

Quality Control in Food Industry - Dose Response Relationship, Health Problem, Chemical and Micro biological aspects - Food analysis, Instruments and Enzymatic Analysis - Food Safety. Food laws and standards.

TOTAL: 45 PERIODS

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TEXT BOOKS:

1. A David Ledford, "Food Science", 8th Edition, Springer International Publishing, 2023.
2. Owen R Fennema, Srinivasan Damodaran, "Food Chemistry", 7th Edition, CRC Press, 2022.

REFERENCES:

1. Srilakshmi B, "Food Science", 8th Edition, New Age International Publishers, 2023.
2. Sanjeev Kumar Sharma, Harshad Kiran Kalwit, "Objective Food Science", 12th Edition, Jain Brothers Publication, 2023.
3. P R Ashoh Kumar, K Suresh Babu, "Food Processing Technology: Principles and practice", 3rd Edition, CRC Press, 2022.

ONLINE RESOURCES:

1 https://nptel.ac.in/courses/103107088
2 https://archive.nptel.ac.in/courses/126/105/126105015/
3 https://onlinecourses.nptel.ac.in/noc21_ag01/preview

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Summarize the food constituents and their energy levels.
CO2 Explain the food waste disposal in various processes.
CO3 Describe the preservative techniques to improve the shelf life of food products.
CO4 Explain the various methods of food processing and storage.
CO5 Describe the food quality control and its importance.

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	1	1	-	-	-	-	1
CO2	2	2	1	1	-	1	1	-	-	-	-	1
CO3	2	2	1	1	-	1	1	-	-	-	-	1
CO4	2	2	1	1	-	1	1	-	-	-	-	1
CO5	2	2	1	1	-	1	1	1	-	-	-	1

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U23OE211	FUNDAMENTALS OF CROP PRODUCTION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- The goal of the course is to provide knowledge about the fundamentals of agricultural production.
- Students will learn about influence of weather on crop growth, soil-water-plant relationships, disease and crop weed management.
- Outlining the function of agricultural engineers in connection to different methods of crop production

UNIT I **INTRODUCTION** **9**

Introduction to agriculture and its crop production sub-sectors - field crop production and horticulture -Factors affecting crop growth and production. Benefits of agriculture - economic benefits, environmental benefits, social and cultural benefits, health, nutrition and food accessibility benefits.

UNIT II **CROP SELECTION AND SETTLEMENT** **9**

Regional and seasonal selection of crops - Systems of crop production - Competition among crop plants - Spacing and arrangement of crop plants - Field preparation for crops including systems of tillage - Establishment of an adequate crop stand and ground cover, including selection and treatment of seed, and nursery growing.

UNIT III **HORTICULTURAL CROPS PRODUCTION** **9**

Important groups of horticultural crops in Tamil Nadu such as vegetable crops, fruit crops, flower crops -Cultivation practices of representatives of each group - Special features of production of horticultural crops - green house cultivation.

UNIT IV **MODERN CONCEPTS** **9**

Growth of plants in vertical pipes in terraces and inside buildings, micro irrigation concepts suitable for roof top gardening, rain hose system, Green house, polyhouse and shade net system of crop production on roof tops.

UNIT V **AGRICULTURAL WASTE MANAGEMENT** **9**

Concept, scope and maintenance of waste management - recycle of organic waste, garden wastes- solid waste management - scope, microbiology of waste, other ingredients like insecticide, pesticides and fungicides residues, waste utilization.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Dr Rajendra Prasad, "Textbook of Field Crops Production Food Grains Crops", 2020.
2. Alok Kumar, Abhishek Pratap Singh, Abhishek Sonkar, Mohit Pal, Chahak Tandon, "Text Book on Production Technology of Fruit Crops", 2022.

REFERENCES:

1. Dr Panda S C, "Modern concepts and advance principles of crop production", M/s AGROBIOS (INDIA), 2023.
2. Beena Nair, K P Singh, P Chand, "Fundamentals of Vegetable Crop Production", Scientific Publishers, 2019.
3. S R Reddy , C Nagamani, "Principles of Crop Production", Kalyani Publishers, 2019.

ONLINE RESOURCES:

1. https://www.classcentral.com/course/youtube-agriculture-crop-production-fundamentals-bcpp-47529
2. https://onlinecourses.nptel.ac.in/noc24_ag08/preview
3. https://onlinecourses.nptel.ac.in/noc23_ag08/preview

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Summarize the principles behind crop production and various parameters that influence the crop growth on roof tops.
CO2 Explain the methods of land preparation.
CO3 Evaluate weed establishment and its management.
CO4 Describe crop water requirement and irrigation water management on roof tops.
CO5 Describe the concept of waste management on roof tops.

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	-	3	-	-	-	1	1
CO2	2	2	1	1	-	-	3	-	-	-	1	1
CO3	3	3	2	3	-	-	3	-	-	-	1	1
CO4	2	2	1	1	-	-	3	-	-	-	-	1
CO5	2	2	1	1	-	-	3	-	-	-	-	1

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U23OE212	WATER POLLUTION AND CONTROL MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- The goal of the course is to provide knowledge about the fundamentals of water pollution.
- To impart knowledge on the causes, effects and control or prevention measures of water pollution.
- Outlining the function of agricultural engineers in connection to different methods of water treatments.

UNIT I **SOURCES OF WATER** **9**

Public water supply system – Planning, Objectives, Design period, Population forecasting; Water demand – Sources of water and their characteristics, Surface and Groundwater – Impounding Reservoir – Development and selection of source – Source Water quality – Characterization – Significance – Drinking Water quality standards.

UNIT II **WATER POLLUTION** **9**

Water Pollution: Classification of Water Pollution - Pathogenic organisms, oxygen demanding Substance - plant nutrients - toxic organics, inorganic chemicals, radioactive substance – thermal pollution – steam pollution. Sources of contamination: Water borne diseases and health effects.

UNIT III **PROCESSES OF WATER TREATMENT** **9**

Objectives – Unit operations and processes – Principles, functions, and design of water treatment plant units, aerators of flash mixers, Coagulation and flocculation - sand filters - Disinfection - –Construction, Operation and Maintenance aspects.

UNIT IV **ADVANCED WATER TREATMENT** **9**

Water softening – Desalination- R.O. Plant – demineralization – Adsorption - Ion exchange – Membrane Systems - Iron and Manganese removal - Defluoridation – Construction, Operation and Maintenance aspects.

UNIT V **LAWS AND ACTS** **9**

Centre ground - water board and organizational set up – guidelines for water abstraction, clearance for ground water abstraction - national water policy – Tamil Nadu ground water authority and its function. River linking projects – National and International conflicts and issues. Water act 1974 and rules 1983, act 1977 and rules 1978.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. S K Gupta, I C Gupta, "Water Pollution and Quality Management", Scientific Publishers, 2023.
2. Margaret Barton, "Water Pollution: Effects, control and Treatment", 2nd Edition, Larsen and Keller Education Publishers, 2020.

REFERENCES:

1. Neha Saxena, M D Merajul Islam, Deepa Sharma, "Water Pollution and Remediation: A Gobal Concern", Springer, 2024.
2. G L Asawa, "Irrigation and Water Resources Engineering", New Age International Publishers, 2024.
3. O P Gupta, "Elements of Water Pollution Control Engineering", Khanna Publisher, 2019.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105107207
2. https://archive.nptel.ac.in/courses/105/104/105104102
3. https://archive.nptel.ac.in/courses/105/105/105105201

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the sources of water and their characteristics.
CO2 Summarize the various pollutants present in water.
CO3 Describe the Principles, functions and design of a water treatment plant.
CO4 Explain the different methods of water purification process.
CO5 Describe the guidelines for water abstraction.

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	1	3	-	-	-	-	1
CO2	2	2	1	1	-	1	3	-	-	-	-	1
CO3	2	2	1	1	-	1	3	-	-	-	-	1
CO4	2	2	1	1	-	1	3	-	-	-	-	1
CO5	2	2	1	1	-	1	3	-	-	-	-	1

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U23OE213	PERSONALITY DEVELOPMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To identify their own potentials and accept their own limitations.
- To overcome their limitations and move towards self-esteem.
- To maximize their own potential in enabling a holistic development.

UNIT I **INTRODUCTION TO PERSONALITY DEVELOPMENT** 9

Personality-meaning-Definition-Determinants of personality - The concept of personality – Dimensions and Significance of personality development - Becoming aware of strengths and weaknesses, talents and problems, emotions and ideas - the concept of success and failure, factors responsible for success - What is failure and causes of failure.

UNIT II **ATTITUDE, MOTIVATION AND SELF - MOTIVATION** 9

Attitude - Concept - Significance - Positive attitude – Advantages –Negative attitude-Disadvantages Concept of motivation - Significance – Internal and external motives - Importance of self-motivation-Factors leading to de-motivation Managing change, confusion and uncertainty Socializing the individual.

UNIT III **EMPLOYABILITY QUOTIENT** 9

Memory – Art of listening, learning and writing guidelines – Note making – Seminar presentation, Resume building- The art of participating in Group Discussion – Facing the Personal (HR & Technical) Interview -Frequently Asked Questions - Psychometric Analysis - Mock Interview Sessions.

UNIT IV **ASPECTS OF PERSONALITY DEVELOPMENT** 9

Body language - Problem-solving - Conflict and Stress Management - Decision-making skills - Leadership and qualities of a successful leader – Character building -Team-work – Time management - Work ethics –Good manners and etiquette.

UNIT V **INTEGRATED PERSONALITY DEVELOPMENT** 9

Different dimension personality – Physical, Intellectual, Emotional, Moral, Social and Spiritual and Cultural - Learning the Development process - Tools and Skills - Helping to maximize one's potentials - Enhancing one's self image, self-esteem and self- confidence.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Ark, "Personality Development and Character Building" Finger print Publishing, 2024.

2 Prashant Sharma, "Soft Skills: Personality Development for Life Success", 1st Edition, BPB Publications, 2022.

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REFERENCES:

1 Soma Mahesh Kumar, "Soft Skills: Enhanching Personal and Professional Success" 1st Edition, Tata McGraw Hill, 2023.

2 Sabharwal. D P, "Personality Developmen", Finger print Publishing, 2021.

3 Jeff Butterfield, "Soft Skills for Everyone", 2nd Edition, Cengage India Private Limited 2020.

ONLINE RESOURCES:

1 https://onlinecourses.nptel.ac.in/noc22_hs77/preview

2 https://old podcast.com/best-free-ebooks-personal-development

3 https://www.sircicai.org/images/cabf/Soft%20Skills%20&%20Personality%20Development.pdf

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Describe the significance of personality and its development.
CO2 Analyze the different facets of personality development.
CO3 Apply employability skills of resume, job application and presentation.
CO4 Apply the aspects of personality development in their jobs.
CO5 Apply the technique and skills of personality development to improve their progress.

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	3	3	3	-	1
CO2	-	-	-	-	-	-	-	3	3	3	-	1
CO3	-	-	-	-	-	-	-	3	3	3	-	1
CO4	-	-	-	-	-	-	-	3	3	3	-	1
CO5	-	-	-	-	-	-	-	3	3	3	-	1

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U23OE214 **WORKPLACE COMMUNICATION** L T P C

3 0 0 3

COURSE OBJECTIVES:

- To develop in students the competence to select the appropriate language and strategies for effective communication in daily workplace contexts.
- To View real-world facets of challenges faced when communicating in the workplace.
- To Learn how to work in different business environments.

UNIT I **IDENTIFY WORKPLACE PERSONALITIES** 9

Communication process; Analysis of purpose, audience, information and context; Strategies for verbal and nonverbal communication; Selection of communication channels - How communication should be developed, assignment - Studying types of personalities.

UNIT II **NEW MEDIA IN COMMUNICATION** 9

Impact of Technology, Enabled Communication Types: Internet, Blogs, E-mail; social media - Facebook, Twitter and What's App -Advantages & Disadvantages.

UNIT III **WORKPLACE CORRESPONDENCE** 9

Business Letter Writing, Email Writing, Principles of Effective Letter Writing, Email Writing, Four C's of Communication – Correctness, Completeness, Conciseness, Courtesy Parts of a Business Letter, Letter of Recommendation, Letter of Appointment, Letter of Acceptance of Job Offer, Letter of Appreciation, & Letter of Resignation.

UNIT IV **COMMUNICATION AT THE WORKPLACE** 9

Education and Training, Motivation, Persuasion, Raising Morale, Order and Instruction, Warning, Advice, Business Etiquette Office Etiquette, Internet Etiquette/Netiquette, Business Card Etiquette, Handshake Etiquette, Mobile Phone Etiquette and How to Overcome Them.

UNIT V **WORKPLACE CHALLENGES** 9

Working With Others : Leaders And Followers; Managing Your Emotions : Negative Emotions ; Challenging Conversations : Challenging Opposing Views, Sharing Bad News, Dealing With An Angry Customer Or Colleague; Personal Development Planning, Presentations; Telephone Skills; Job Interviews. Group Communication, Planning And Decision Making.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Tena Crews, Cara Norton.,"Professional Communication", Good heart-Willcox Publisher, 2023.
2. Jeanne Marquardt Elmhorst Ronald B. Adler, Jeanne Marquardt Elmhorst "ISE Communicating at Work"., Tata McGraw Hill, 2022.

REFERENCES:

1. Bovee, L Courtland, Thill, V John , Raina, Lal Rosha, "Business Communication Today" 15th Edition, Pearson Education, 2021.
2. James W Williams, communication Skills Training Series", Alakai Publishing, 2021.
3. McKinsey Company "Building workforce skills at scale to thrive during and after the COVID-19 crisis." 2021.

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc20_hs15/preview
2. https://www.coursera.org/learn/challenges-of-leading-individuals-in-the-tech-industry
3. https://www.udemy.com/course/business-english-writing/

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Apply The Basic Knowledge Of Workplace Communication.
CO2 Apply Different Types Of Media Communication.
CO3 Write Effective Letters Related To Workplace Environment.
CO4 Apply Various Types Of Workplace Etiquette.
CO5 Explain The Strategies Of Overcoming Challenges In The Workplace.

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	3	3	3	-	1
CO2	3	-	-	-	-	-	-	3	3	3	-	1
CO3	3	-	-	-	-	-	-	3	3	3	-	1
CO4	3	-	-	-	-	-	-	3	3	3	-	1
CO5	3	-	-	-	-	-	-	3	2	3	-	1

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U23OE215	ENGLISH FOR COMPETITIVE EXAMINATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To train the students in the language components essential to face competitive examinations both at the national (UPSC, Banking, Railway, Defence) and the international level (GRE, TOEFL, IELTS).
- To enhance an awareness of the specific patterns in language testing and the respective skills to tackle verbal reasoning and verbal ability tests.
- To inculcate effective practices in language-learning in order to improve accuracy in usage of grammar and coherence in writing.

UNIT I **BASIC VOCABULARY** **9**

Orientation on different formats of competitive exams - Vocabulary – Verbal ability – Verbal reasoning - Exploring the world of words – Essential words – Meaning and their usage – Synonyms-antonyms – Word substitution – Word analogy – Idioms and phrases – Commonly confused words – Spellings – Word expansion – New words in use.

UNIT II **GRAMMAR AND USAGE** **9**

Grammar – Sentence improvement –Sentence completion – Rearranging phrases into sentences – Error identification –Tenses – Prepositions – Adjectives – Adverbs – Subject-verb agreement – Voice – Reported speech – Articles – Clauses – Speech patterns.

UNIT III **EFFECTIVE READING** **9**

Reading - Specific information and detail – Identifying main and supporting ideas – Speed reading techniques – Improving global reading skills – Linking ideas – Summarising – Understanding argument – Identifying opinion/attitude and making inferences - Critical reading.

UNIT IV **WRITING VARIOUS TEXT** **9**

Writing – Pre-writing techniques – Mind Map - Describing pictures and facts -Paragraph structure – organizing points – Rhetoric writing – Improving an answer – Drafting, writing and developing an argument – Focus on cohesion – Using cohesive devices –Analytic writing – Structure and types of essay – Mind maps – Structure of drafts, letters, memos, emails – Statements of Purpose – Structure, Content and Style.

UNIT V **INTERACTIVE LISTENING** **9**

Listening and Speaking – Contextual listening – Listening to instructions – Listening for specific information – Identifying detail, main ideas – Following signpost words – Stress, rhythm and intonation - Speaking to respond and elicit ideas – Guided speaking – Opening phrases – Interactive communication –Sentence stress – Speaking on a topic – Giving opinions – Giving an oral presentation – Telling a story or a personal anecdote – Talking about oneself - Utterance – Speech acts- Brainstorming ideas – Group discussion.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Dr. Veena Selvam, "English for Science and Technology", Cambridge University Press, 2021.
2. Wren, Martin, "English for Competitive Examinations", S Chand Publishing, 2020.

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REFERENCES:

1. Bovee, Courtland L, Thill, John V Raina, Lal Roshan, "Business Communication Today", 15th Edition, Pearson Education: Upper Saddle River, 2021.
2. Disha, " General English for Competitive Exams" Disha Publication, 2021.
3. Yashpal,Sharma, "Easy to learn General English" Agrawal Group Of Publications (Agrawal Examcart), 2020.

ONLINE RESOURCES:

1. http://www.examenglish.com/, http://www.ets.org/ , http://www.bankxams.com/
2. http://civilservicesmentor.com/, http://www.educationobserver.com
3. http://www.cambridgeenglish.org/in/

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Apply the intricacies of vocabulary in order to develop language skills.
CO2 Analyze the technique of grammar to face competitive examination
CO3 Apply the basic ideas and strategies of reading.
CO4 Write different types of reconstructing passages, report writing and essay writing.
CO5 Apply interactive communication skills in listening texts.

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	3	3	3	-	1
CO2	3	-	-	-	-	-	-	3	3	3	-	1
CO3	3	-	-	-	-	-	-	3	3	3	-	1
CO4	3	-	-	-	-	-	-	3	3	3	-	1
CO5	3	-	-	-	-	-	-	3	3	3	-	1

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U23OE216 **ENGLISH FOR PROFESSIONAL EXCELLENCE** L T P C
3 0 0 3

COURSE OBJECTIVES:

- To enhance students' ability to listen and speak professionally related to workplace concerns and interactions.
- To improve articulation and comprehension through motivational texts, technical articles, and leadership talks.
- To enable students to write reviews, emails, reports, resumes with cover letters and projects.

UNIT I **FOUNDATIONS OF PROFESSIONAL COMMUNICATION** 9

Listening to concerns and complaints – Responding with thought-provoking solutions – Reading short motivational anecdotes to improve pronunciation – Writing paragraphs based on motivational ideas and proverbial expressions.

UNIT II **EXPRESSIVE AND PERSUASIVE COMMUNICATION** 9

Listening to famous motivational speeches – Practice short speeches like welcome address, vote of thanks and farewell address – Reading technical articles with intonation - Writing reviews and reflections on travel, books or current topics.

UNIT III **WORKPLACE COMMUNICATION AND ETIQUETTE** 9

Listening workplace conversations and discussions – Simulate meetings and practice giving polite instructions– Reading workplace memos and notices – Writing professional emails and reports.

UNIT IV **COMMUNICATION FOR COLLABORATION AND LEADERSHIP** 9

Listening to interview recordings and career talks – Practice introducing yourself and mock interviews – Reading job postings – Drafting resumes and cover letter.

UNIT V **CAREER COMMUNICATION AND PERSONAL BRANDING** 9

Listening to panel discussions – Practice group discussions – Reading leadership talks – Project writing and formal presentation.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Rajendran, Jayanthi, Jeya Santhi V, Nagalakshmi B, "The Art of English Communication: A Practical Approach", https://notionpress.com, 2025.
2. Horine, Greg, "Project Management Absolute Beginner's Guide" (Updated Edition), Que Publishing, 2023.

REFERENCES:

1. Bryan A. Garner, "HBR Guide to Better Business Writing", Harvard Business Review Press, 2021.
2. Nair, Bhaskaran, P. "Functioning in English" (A Multi-skill Language Course for Undergraduate Programmes), Emerald Publishers, 2018.
3. Enelow, Wendy, Louise Kursmark, "Modernize Your Resume: Get Noticed... Get Hired" (3rd Edition), Emerald Career Publishing, 2023.

ONLINE RESOURCES:

1. https://reedsy.com/discovery/blog/book-review-examples
2. https://www.indeed.com › Career Guide › Interviewing
3. https://nevonprojects.com/project-ideas/

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Apply listening and reading skills to enhance clarity in writing.
CO2 Analyze and internalize motivational speech techniques to develop their oral and written communication proficiency.
CO3 Apply professional communication strategies and compose effective emails and reports.
CO4 Analyze career-oriented communication and draft resumes and cover letter.
CO5 Design engaging formats to present their prepared projects.

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	3	-	3	-	1
CO2	3	-	-	-	-	-	-	3	-	3	-	1
CO3	2	-	-	-	-	-	-	3	-	3	-	2
CO4	3	-	-	-	-	-	-	3	-	3	-	2
CO5	3	-	-	-	-	-	-	3	-	3	-	2

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U23OE217	TOOLS FOR COMPUTING AND DESIGN PLATFORM	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand the basics of electronic circuit assembly, ARM, DSP and embedded processors.
- Study about the Xilinx ISE design suite for programming and simulation of HDL designs and the implementation of VHDL and simulation using Altera Quartus.
- Understand the role of cloud in the design development of IC and IOT based embedded system.

UNIT I **TINKERCAD** **9**

Create a breadboard circuit, Circuit build, Virtual circuit design, programming, simulation, Arduino electronic circuits, Programme your Arduino, Test your Arduino circuit and code, 3D Design

UNIT II **XILINX ISE DESIGN SUITE** **9**

Synthesis and analysis of HDL designs, enabling the developer to synthesize ("compile") their designs, perform timing analysis, examine RTL diagrams, simulation, Spartan family of FPGAs, CPLDs.

UNIT III **CODE COMPOSER STUDIO IDE** **9**

Implementation of VHDL and Verilog for hardware description, visual edition of logic circuits and vector waveform simulation. Cyclone family of FPGAs, MAX family of CPLDs.

UNIT IV **GSM AND 3G COMMUNICATIONS SYSTEMS** **9**

IDE for developing applications for Texas Instruments embedded processors. Texas Instruments embedded processors include DSPs, ARM based devices, MSP430.

UNIT V **ROLE OF THE CLOUDS IN ELECTRONIC DESIGN** **9**

History of high-performance computing, Cloud service model basics - user's interest, service type, service providers, Cloud concerns, Pros and Cons with electronics design - on-premises, all cloud, Hybrid cloud, Cadence Cloud in IC design.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Shaun C. Bryant, "Tinkercad For Dummies", John Wiley & Sons, 2018.

2 Michael J Kavis, "Architecting the Cloud: Design Decisions for Cloud Computing Service Models (SaaS, PaaS, and IaaS)", John Wiley & Sons, 2014.

REFERENCES:

1 ISE In-Depth Tutorial, https://www.xilinx.com/support/documentation/ sw_manuals /xilinx13_3/ ise_tutorial_ug695.pdf

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2 Code-Composer-Studio-v6.0-for-MSP430-Users-Guide, https://www.ti.com/lit/ug /slau157as/slau157as.pdf?ts=1707371916957

3 Introduction to Quartus II Software, http:// www. ee.ic.ac.uk /cheung /teaching /ee2_ digital/R2_3%20 quartus 2 introduction.pdf.

ONLINE RESOURCES:

1 https://archive.nptel.ac.in/courses/117/108/117108040/

2 https://www.tinkercad.com/learn

3 https://elearn.nptel.ac.in/shop/iit-workshops/completed/digital-controller-for-power-applications/

Upon the completion of the course, the students will be able to

CO1 Analyze the fundamentals electronic circuit build, Arduino board programming and simulation.

CO2 Describe the concepts of HDL design, Spartan family of FPGA and CPLD.

CO3 Analyze VHDL and Verilog programming.

CO4 Analyze the IDE for the Texas Instruments processors, ARM and embedded processors.

CO5 Describe the latest evolution cloud in the development of IOT based embedded system.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	1	-	-	-	-	-	1
CO2	3	3	3	3	3	1	-	-	-	-	-	1
CO3	3	3	3	3	3	1	-	-	-	-	-	1
CO4	3	3	3	3	3	1	-	-	-	-	-	1
CO5	3	3	3	3	3	1	-	-	-	-	-	1

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U23OE218 **INTRODUCTION TO SENSORS AND ACTUATORS** L T P C
3 0 0 3

COURSE OBJECTIVES:

- To study different types of sensors and actuators.
- To gain knowledge on type of optical sensors to be used for practical applications.
- To understand the design concepts of micro sensors and micro actuators and packaging and characterization of MEMS/NEMS.

UNIT I **STRAIN, PRESSURE AND TEMPERATURE** 9

Introduction, Stress & Pressure sensors: Resistance strain gauge, piezoelectric strain gauge, characteristics. Fiber-optic sensor, Pressure gauges. Temperature Sensors: Bimetallic strip, thermocouples, Resistance thermometers, thermistors, bolometer, Pyroelectric detector.

UNIT II **OPTICAL SENSORS** 9

Colour temperature, light flux, photo sensors, photomultiplier, photo resistor and photoconductors, photodiodes, phototransistors, photovoltaic devices, fiber optic sensors, electro optic sensors & fiber-optic applications, light transducer, solid-state transducers and liquid crystal devices.

UNIT III **MICRO SENSORS** 9

Acoustic sensor – Quartz crystal microbalance, surface acoustic wave, Flexural plate wave, shear horizontal; Vibratory gyroscope, Capacitive and Piezo Resistive Pressure sensors.

UNIT IV **MICRO ACTUATORS** 9

Electrostatic actuators – parallel plate capacitor, Interdigitated finger capacitor, piezoelectric actuators, Thermal actuators, Actuators using shape memory alloys; Micro grippers, Micro motors, Micro valves, Micro pumps

UNIT V **PACKAGING AND CHARACTERIZATION** 9

Micro / nano systems packaging, Essential packaging technologies, Selection of packaging materials; SEM, TEM, AFM, STM, Spectroscopic techniques for Nano characterization.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Tai Ran Hsu, "MEMS and Microsystems Design and Manufacture", 1st Edition, Tata McGraw Hill, 2002.

2 Ian R Sinclair, "Sensors and Transducers", 3rd Edition, Newnes publishers, 2001.

REFERENCES:

1 Vinod Kumar Khanna, "Nanosensors: Physical, Chemical, and Biological", 1st Edition, CRC Press, 2012.

2 Doebelin E O, "Measurement Systems, Application and Design", 5th Edition, Tata McGraw Hill, 2004.
3 Chang Liu, "Foundations of MEMS", 2nd Edition, Pearson Education, 2006.

ONLINE RESOURCES:

1 https://onlinecourses.nptel.ac.in/noc21_ee32/preview
2 https://www.udemy.com/course/exploring-sensors-and-actuators-theory-and-practice/
3 https://www.coursera.org/learn/internet-of-things-sensing-actuation

Upon the completion of the course, the students will be able to

CO1 Explain the measurement of physical variables for real time applications using sensors.
CO2 Analyse optical sensors for electronic applications.
CO3 Analyse micro sensors for electronic applications.
CO4 Apply actuators for engineering applications.
CO5 Describe the packaging and characterization requirements.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	3	1	3	-	-	-	-	-	1
CO2	3	2	2	3	2	3	-	-	-	-	-	1
CO3	3	2	2	3	2	3	-	-	-	-	-	1
CO4	3	2	2	3	2	3	-	-	-	-	-	1
CO5	3	2	2	3	2	3	-	-	-	-	-	1

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U23OE219 **UNDERWATER COMMUNICATION** L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand the properties of underwater acoustic signal and the characteristics of noises in sea.
- To understand the principles of SONAR and acoustic modem.
- To understand the challenges in underwater signal processing and sensor networks.

UNIT I FUNDAMENTALS OF UNDERWATER ACOUSTICS 9

The Ocean acoustic environment, measuring sound level, Sources and receivers, relevant units, sound velocity in sea water, typical vertical profiles of sound velocity, Sound propagation in the Ocean, Sound attenuation in sea water, Bottom Loss, Surface bottom and volume scattering, Snell's law for range dependent ocean.

UNIT II UNDERWATER NOISE IN THE SEA 9

Sources of ambient noise-introduction, different frequency bands of ambient noise, spatial Coherence of underwater noise, directional characteristics of underwater noise, intermittent sources of noise – biological & non biological (rain, earthquakes, explosions and volcanos).

UNIT III CHARACTERISTICS OF SONAR SYSTEMS 9

Sonar systems, active and passive sonar equations, transducers and their directivities, Sensor, array characteristics – array gain, receiving directivity index, beam patterns, adaptive beamforming.

UNIT IV ACOUSTIC MODEM 9

Underwater Wireless Modem- Sweep spread carrier signal – transmission characteristics in shallow water channel-separation of time varying multipath arrivals – Typical acoustics modems – characteristics and specifications – Applications, Acoustic Releases-Real time wireless current monitoring system.

UNIT V UNDERWATER SENSOR NETWORK 9

Underwater Networking – Ocean Sampling Networks, Pollution Monitoring, Environmental Monitoring and Tactical surveillance systems, Major challenges in the design of Underwater Sensor Networks, Factors that affect the UWSN.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Yi Lou, Niax Ahmed, "Underwater Communications and Networks", 1st Edition, Springer, 2021.

2 William S Burdic, "Underwater Acoustic Systems", Prentice Hall of India, 2002.

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REFERENCES:

1 Rahul Sharma, "Deep Sea Mining Handbook", 1st Edition, Springer, 2017

2 Robert J Urick, "Principles of Underwater Sound", 3rd Edition, Peninsula Publishing, 2013.
3 L M Brekhovskikh, Yu P Lysanov, "Fundamentals of ocean acoustics", 3rd Edition, Springer, 2003

ONLINE RESOURCES:

1 https://www.everand.com/book/324344346/Digital-Underwater-Acoustic-Communications
2 https://edfuturetech.com/courses/from-sonar-to-satellite-a-deep-dive-into-underwater-communication-systems-and-their-uses/
3 https://www.youtube.com/watch?v=VExBwR2Gs24

Upon the completion of the course, the students will be able to

CO1 Summarize the properties of underwater acoustic signal.

CO2 Explain the characteristics of noises in sea.

CO3 Explain the principles of SONAR and acoustic modem.

CO4 Explain the concepts of adaptive modem.

CO5 Analyse the challenges in underwater signal processing and sensor networks.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	3	1	3	-	-	-	-	-	1
CO2	3	2	2	3	2	3	-	-	-	-	-	1
CO3	3	2	2	3	2	3	-	-	-	-	-	1
CO4	3	2	2	3	2	3	-	-	-	-	-	1
CO5	3	2	2	3	2	3	-	-	-	-	-	1

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U23OE220 **CONSUMER ELECTRONICS** L T P C
3 0 0 3

COURSE OBJECTIVES:

- To Understand the fundamental concepts of consumer electronics.
- To Learn the basics and operations of home appliances.
- To learn the operation of various audio, video & recording systems.

UNIT I CONSUMER ELECTRONICS FUNDAMENTALS 9

History of Electronic Devices, Semiconductor Devices, Diodes, Rectifiers, Transistors, Integrated Circuits, Logic Gates, Combinational Circuits, ADC, DAC and Microprocessors, Microcontrollers in consumer electronics, Energy management, Intelligent Building Perspective.

UNIT II ENTERTAINMENT ELECTRONICS 9

Audio systems – Construction and working principle of Microphone, Loud speaker, AM and FM receiver, Stereo, 2.1 home theatre, 5.1 home theatre, Display systems – CRT, LCD, LED, Graphics displays, Video Players, DVD, Blue RAY Recording Systems – Digital Cameras and Camcorders.

UNIT III SMART HOME 9

Technology involved in Smart home, Home Virtual Assistants – Alexa and Google Home, Home Security Systems – Intruder Detection, Automated blinds, Motion Sensors, Thermal Sensors and Image Sensors, PIR, IR and Water Level Sensors.

UNIT IV HOME APPLIANCES 9

Home Enablement Systems – RFID Home, Lighting control, Automatic Cleaning Robots, Washing Machines, Microwave Owen, Dishwasher, Induction Stoves, Smart Refrigerators, Smart alarms, Smart toilet, Smart floor, Smart locks.

UNIT V COMMUNICATION SYSTEMS 9

Cordless Telephones, Fax Machines, PDAs – Tablets, Smart Phones and Smart Watches, Introduction to Smart OS-Android and iOS, Video Conferencing Systems – Web/IP Camera, Video security, Internet Enabled Systems, Wi-Fi, IoT, Li-Fi, GPS and Tracking Systems.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Mitchel E Schultz, "Basic Electronics", McGraw Hill Publishers, 10th Edition, 2017.
2 Bali S P, "Consumer Electronics", Pearson Education Asia Pvt. Ltd., 2008.

REFERENCES:

1 Thomas L Floyd, "Electronic Devices", 10th Edition Pearson Education, 2018.
2 Thomas M Coughlin, "Digital Storage in Consumer Electronics", Springer, 2017.
3 Jordan Frith, "Smartphones as Locative Media", John Wiley & Sons, 2014.

ONLINE RESOURCES:

1 https://www.edx.org/learn/electronics
2 https://www.coursera.org/learn/electronics
3 https://archive.nptel.ac.in/courses/117/105/117105144

Upon the completion of the course, the students will be able to

CO1 Apply the fundamentals of electronics to construct the audio and video systems.

CO2 Explain working of various colour television system.

CO3 Analyze the technology for smart home.

CO4 Describe the working principles of various home appliances.

CO5 Describe the basic functional blocks of home based communication systems.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	3	1	3	-	-	-	-	-	1
CO2	3	2	2	3	2	3	-	-	-	-	-	1
CO3	3	2	2	3	2	3	-	-	-	-	-	1
CO4	3	2	2	3	2	3	-	-	-	-	-	1
CO5	3	2	2	3	2	3	-	-	-	-	-	1

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U23OE221 **BASICS OF EMBEDDED SYSTEMS AND IOT** L T P C
3 0 0 3

COURSE OBJECTIVES:

- Understand the concepts of embedded system design and analysis
- Learn the architecture and programming of ARM processor.
- Learn the concepts of IoT and embedded programming.

UNIT I **INTRODUCTION TO EMBEDDED SYSTEM** 9

Complex systems and microprocessors– Embedded system design process – Design methodologies – Design flows – Requirement Analysis – Specifications-System analysis and architecture design – Quality Assurance techniques–Design example: Model train controller.

UNIT II **BASICS OF ARM ARCHITECTURE AND PERIPHERAL INTERFACING** 9

ARM Architecture Versions – ARM Architecture – Instruction Set – Stacks and Subroutines – Features of the LPC 214X Family – Peripherals – The Timer Unit – Pulse Width Modulation Unit – UART – Block Diagram of ARM9 and ARM Cortex M3 MCU

UNIT III **EMBEDDED PROGRAMMING CONCEPTS** 9

Components for embedded programs- Models of programs- Assembly, linking and loading – compilation techniques – Program level performance analysis – Software performance optimization – Program level energy and power analysis and optimization – Analysis and optimization of program size- Program validation and testing

UNIT IV **INTRODUCTION TO IoT** 9

Functional blocks of an IoT system - Basics of Physical and logical design of IoT – IoT enabled domains – Difference between IoT – Passive and active sensors - Different applications of sensors – IoT front-end hardware Case Studies – Smart Parking, Air Pollution Monitoring.

UNIT V **COMMUNICATION PROTOCOLS FOR EMBEDDED AND IoT** 9

Embedded Networking: Introduction-Serial/Parallel Communication – Serial communication protocols – RS485 – Synchronous Serial Protocols – Serial Peripheral Interface (SPI) – Inter-Integrated Circuit (I2C), IoT Infrastructure - 6LowPAN - IPv6 – Wi-Fi, Bluetooth, ZigBee.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Arshdeep Bahga, Vijay Madisetti, "Internet of Things, A Hands-on-Approach", 1st Edition, Universities Press Pvt. Ltd., India, 2015.

2 Marilyn Wolf, "Computers as Components - Principles of Embedded Computing System Design", 3rd Edition, Morgan Kaufmann Publisher (An imprint from Elsevier), 2012.

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REFERENCES:

1 Adrian McEwen and Hakim Cassimally, "Designing the Internet of Things", 1st Edition, John Wiley & Sons, 2014.

2 Peter Waher, "Learning Internet of Things", 1st Edition, Packt Publishing Ltd., UK, 2015.

3 Raj Kamal, "Internet of Things, Architecture and Design Principles", Tata McGraw Hill, 2017.

ONLINE RESOURCES:

1 https://nptel.ac.in/courses/108102045

2 https://www.udemy.com/course/embedded-system-for-internet-of-things-pna/

3 https://www.coursera.org/learn/iot

Upon the completion of the course, the students will be able to

CO1 Explain the embedded System Design Process.

CO2 Describe the architecture and programming of ARM processor.

CO3 Explain the concepts of embedded system programming

CO4 Explain the basic concepts of IOT.

CO5 Describe model networked systems with basic protocols

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	3	1	3	-	-	-	-	-	1
CO2	3	2	2	3	2	3	-	-	-	-	-	1
CO3	3	2	2	3	2	3	-	-	-	-	-	1
CO4	3	2	2	3	2	3	-	-	-	-	-	1
CO5	3	2	2	3	2	3	-	-	-	-	-	1

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U23OE222	INDUSTRIAL SAFETY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To Understand the Introduction and basic Terminologies safety.
- To provide wide exposure to the students about various legislation applicable to an industrial unit.
- To enable students to Conduct and participate in various Safety activities in the Industry and through various Risk Assessment Techniques.

UNIT I **SAFETY TERMINOLOGIES** **9**

Hazard-Types of Hazard- Risk-Hierarchy of Hazards Control Measures-Lead indicators- lag Indicators-Flammability- Toxicity Time-weighted Average (TWA) - Threshold Limit Value (TLV) - Short Term Exposure Limit (STEL)- Immediately dangerous to life or health (IDLH)- acute and chronic Effects- Routes of Chemical Entry-Personnel Protective Equipment- Health and Safety Policy-Material Safety Data Sheet MSDS

UNIT II **STANDARDS AND REGULATIONS** **9**

FACTORIES ACT – 1948

Statutory authorities – inspecting staff, health, safety, provisions relating to hazardous processes, welfare – special provisions – penalties and procedures-

Tamil Nadu Factories Rules 1950 under Safety and health chapters of Factories Act 1948 - Tamil Nadu safety officer rules 2005.

ENVIRONMENT ACT – 1986

General powers of the central government, prevention, control and abatement of environmental pollution Biomedical waste (Management and handling Rules), 1989- The noise pollution (Regulation and control) Rules, 2000- The Batteries (Management and Handling Rules)

UNIT III **OTHER ACTS AND RULES** **9**

Indian Boiler (Amendments) Act 2007, static and mobile pressure vessel rules (SMPV), motor vehicle rules, the Mines and Minerals (Development & Regulation) Amendment Act, 2015, workman compensation act, rules – electricity act and rules – hazardous wastes (management, handling and transboundary) rules, 2008 - the building and other construction workers act 1996., Petroleum rules, Gas cylinder rules 2016, Explosives Act 1884 - Pesticides Act – E waste (management) rules 2016.

UNIT IV **SAFETY ACTIVITIES** **9**

Toolbox Talk- Role of safety Committee- Responsibilities of Safety Officers and Safety Representatives- Safety Training and Safety Incentives- Mock Drills- On-site

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Emergency Action Plan- Off-site Emergency Action Plan- Safety poster and Display- Human Error Assessment

UNIT V **HAZARD IDENTIFICATION TECHNIQUES** **9**

Job Safety Analysis-Preliminary Hazard Analysis-Failure mode and Effects Analysis-Hazard and Operability- Fault Tree Analysis- Event Tree Analysis Qualitative and Quantitative Risk Assessment- Checklist Analysis- Root cause analysis- What-If Analysis- and Hazard Identification and Risk Assessment

TOTAL: 45 PERIODS

REFERENCES:

1 Frank P Lees, "Loss Prevention in Process Industries", 4th Edition, Butterworth Heinemann Publications, 2012.
2 John Ridley, John Channing, "Safety at Work", 7th Edition, BH Publications, 2008.
3 Dan Petersen, "Techniques of Safety Management: A System Approach", 4th Edition, Amer Society of Safety Engineers, 2003.

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 Explain the basic concept of safety.

CO2 Summarize important legislation related to health, Safety and Environment.

CO3 Explain various legislation applicable to an industrial unit

CO4 Describe the safety Activities of the Working Place and to prepare onsite and offsite emergency plans

CO5 Explain the Risk Assessment Techniques

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	-	3	2	-	-	-	3
CO2	2	2	1	1	-	-	3	2	-	-	-	3
CO3	2	2	1	1	-	-	3	2	-	-	-	3
CO4	2	2	1	1	-	-	3	2	-	-	-	3
CO5	2	2	1	1	-	-	3	2	-	-	-	3

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U23OE223	RENEWABLE ENERGY TECHNOLOGIES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn the various solar energy and Wind technologies and its applications.
- To explore the various biomass energy technologies and fuel cell.
- To study the ocean and geothermal technologies.

UNIT I **ENERGY SCENARIO** **9**

Control System: Open Loop and Closed Loop – Feedback Control System Characteristics – First Principle Modeling: Mechanical, Electrical and Electromechanical Systems – Transfer Function Representations: Block Diagram and Signal Flow Graph.

UNIT II **SOLAR ENERGY** **9**

Solar Thermal – Flat Plate and Concentrating Collectors – Solar Thermal Power Plant – Solar Photovoltaic Conversion – Solar Cells – PV Applications.

UNIT III **WIND ENERGY** **9**

Basic Components of Wind Energy Conversion System (WECS) - Classification Of WECS - Horizontal Axis - Single, Double And Multi-Blade System. Vertical Axis - Savonius and Darrieus Types.

UNIT IV **BIOMASS ENERGY AND FUEL CELL** **9**

Biomass Direct Combustion – Biomass Gasifier – Biogas Plant – Cogeneration – Biomass Applications - Fuel Cell.

UNIT V **OCEAN AND GEOTHERMAL ENERGY** **9**

Tidal Energy – Wave Energy – Open and Closed OTEC Cycles – Small Hydro – Geothermal Energy - Types of Geothermal Power Plants.

TOTAL: 45 PERIODS

REFERENCES

1. John Twidell, "Renewable Energy Resources", 4th Edition, Routledge Publishers, 2021.
2. Bent Sorensen, "Renewable Energy: Physics, Engineering, Environmental Impacts, Economics and Planning", 5th Edition, Academic Press, 2017.
3. Godfrey Boyle, "Renewable Energy: Power for a Sustainable Future",3rd Edition, Oxford University Press, 2012.

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 Explain the Environmental aspects of energy utilization and Renewable energy scenario.

CO2 Describe the concepts and applications of solar energy systems.

CO3 Describe the concepts and applications of wind energy systems.

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CO4 Summarize the processes of biomass and Fuel Cell.

CO5 Explain on other possible renewable energy sources.

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	-	1	-	-	-	-	-
CO2	2	2	1	1	-	-	1	-	-	-	-	-
CO3	2	2	1	1	-	-	1	-	-	-	-	-
CO4	2	2	1	1	-	-	1	-	-	-	-	-
CO5	2	2	1	1	-	-	1	-	-	-	-	-

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U230E224	INTRODUCTION TO SMART GRID	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To know the power industry to observe and control parts of the system at higher resolution in time and space
- To purposes of the smart grid is real time information exchange to make operation as efficient as possible
- To know how to improve reliability of the Electricity networks and make the grid amenable to renewable energy inputs through distributed generation.

UNIT I INTRODUCTION TO SMART GRID 9

Evolution of Electric Grid – Concept - Definitions and Need for Smart Grid- Smart grid drivers - functions - opportunities - challenges and benefits- Difference between conventional & Smart Grid- National and International Initiatives in Smart Grid.

UNIT II SMART GRID TECHNOLOGIES 9

Technology Drivers - Smart energy resources- Smart substations - Substation Automation - Feeder Automation -Transmission systems: EMS - FACTS and HVDC - Wide area monitoring- Protection and control- Distribution systems: DMS- Volt/VAR control- Fault Detection- Isolation and service restoration-

UNIT III SMART METERS AND ADVANCED METERING INFRASTRUCTURE 9

Introduction to Smart Meters- Advanced Metering infrastructure (AMI) drivers and benefitsAMI protocols- standards and initiatives- AMI needs in the smart grid- Phasor Measurement Unit (PMU)- Intelligent Electronic Devices(IED)& their application for monitoring & protection.

UNIT IV POWER QUALITY MANAGEMENT IN SMART GRID 9

Power Quality & EMC in Smart Grid- Power Quality issues of Grid connected Renewable Energy Sources- Power Quality Conditioners for Smart Grid- Web based Power Quality monitoring- Power Quality Audit.

UNIT V CONTROLLERS AND THEIR COORDINATION 9

Introduction and role of SCADA in smart grid - Local Area Network (LAN) - House Area Network (HAN) - Wide Area Network (WAN) - Broad band over Power line (BPL) - IP based Protocols- Basics of Web Service, CLOUD Computing - and Cyber Security Issues.

TOTAL: 45 PERIODS

REFERENCES:

1. Stuart Borlase, "Smart Grid: Infrastructure, Technology and Solutions", 1st Edition, CRC Press, 2017.
2. James A Momoh, "Smart Grid: Fundamentals of Design and Analysis", 1st Edition, John Wiley & Sons, 2012.

3. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", 1st Edition, John Wiley & Sons, 2012.

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the concepts of Smart Grid and its present developments.

CO2 Describe about the different smart grid technologies.

CO3 Explain about the different smart meters and apply them in advanced metering infrastructure.

CO4 Analyze power quality management in smart grid.

CO5 Summarize LAN, WAN and cloud computing for smart grid.

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	-	-	1	-	-	-	1
CO2	2	2	1	1	-	-	-	-	-	-	-	1
CO3	2	2	1	1	-	-	-	-	-		-	1
CO4	3	3	1	2	-	-	-	-	-	-	-	1
CO5	2	2	1	1	-	-	-	-	-	-	-	1

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U230E225	BASICS OF POWER PLANT ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To provide knowledge on the operation of thermal power plant and the subsystems including fuel Preparation and handling, boiler types.
- To impart knowledge on layout and operation of diesel and gas turbine power plants and nuclear power plants.
- To educate the environmental and cost economics of using renewable energy sources compared to fossil fuels and to introduce the importance of instrumentation, measurement and control techniques in power plants.

UNIT I COAL BASED THERMAL POWER PLANTS 9

Layout of modern coal power plant, Supercritical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants – Fuel and ash handling, Draught system, Feed water treatment.

UNIT II DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS 9

Otto, Diesel, Dual & Brayton Cycle – Analysis & Optimization. Components of Diesel and Gas Turbine power plants.

UNIT III NUCLEAR POWER PLANTS 9

Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors : Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANada Deuterium – Uranium reactor (CANDU), Safety measures for Nuclear Power plants.

UNIT IV ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS 9

Power tariff types, Load distribution parameters, load curve, Comparison of site selection criteria, relative merits & demerits, Capital & Operating Cost of different power plants.

UNIT V POWER PLANT INSTRUMENTATION AND CONTROL 9

Plant Automation, Plant Optimization, Safety & Protection, Instrumentation & Controls. Importance of measurement and instrumentation in power plants, measurement of water purity, CO2 measurements, measurement of smoke and dust.

TOTAL: 45 PERIODS

REFERENCES:

1 P K Nag, "Power Plant Engineering", 4th Edition, Tata McGraw Hill, 2020.

2 M M El Wakil, "Power Plant Technology", 3rd Edition, Tata McGraw Hill, 2021.

3 Arora, Domkundwar, "A Course in Power Plant Engineering", 3rd Edition, Dhanpat Rai & Co, 2019.

4 R S Khurmi, J K Gupta, "Thermal Engineering", 3rd Edition, S Chand Publishing, 2021.

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Comprehend the layout, construction and working of the components inside a thermal power plant.

CO2 Summarize the process of diesel, gas turbine and combined cycle power plants.

CO3 Explain the different nuclear reactors.

CO4 Summarize the environmental and economic issues of using renewable energy sources compared to fossil fuels.

CO5 Describe the various power plant instrumentation and control techniques.

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	-	1	-	-	-	-	-
CO2	2	2	1	1	-	-	1	-	-	-	-	-
CO3	2	2	1	1	-	-	-	-	-	-	-	-
CO4	2	2	1	1	-	-	1	-	-	-	-	-
CO5	2	2	1	1	-	-	1	-	-	-	-	-

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U230E226	AUTOMOTIVE ELECTRONICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To provide knowledge on the operation of thermal power plant and the subsystems including fuel Preparation and handling, boiler types.
- To impart knowledge on layout and operation of diesel and gas turbine power plants and nuclear power plants.
- To educate the environmental and cost economics of using renewable energy sources compared to fossil fuels and to introduce the importance of instrumentation, measurement and control techniques in power plants.

UNIT I **INTRODUCTION** **9**

Evolution of electronics in automobiles – emission laws – introduction to Euro I, Euro II, Euro III, Euro IV, Euro V standards – Equivalent Bharat Standards. Charging systems: Working and design of charging circuit diagram – Alternators – Requirements of starting system - Starter motors and starter circuits.

UNIT II **IGNITION AND INJECTION SYSTEMS** **9**

Ignition systems: Ignition fundamentals - Electronic ignition systems - Programmed Ignition – Distribution less ignition - Direct ignition – Spark Plugs. Electronic fuel Control: Basics of combustion – Engine fuelling and exhaust emissions – Electronic control of carburetion – Petrol fuel injection – Diesel fuel injection.

UNIT III **SENSOR AND ACTUATORS IN AUTOMOTIVES** **9**

Working principle and characteristics of Airflow rate, Engine crankshaft angular position, Hall effect, Throttle angle, temperature, exhaust gas oxygen sensors – study of fuel injector, exhaust gas recirculation actuators, stepper motor actuator, and vacuum operated actuator.

UNIT IV **ENGINE CONTROL SYSTEMS** **9**

Control modes for fuel control-engine control subsystems – ignition control methodologies – different ECU's used in the engine management – block diagram of the engine management system. In vehicle networks: CAN standard, format of CAN standard – diagnostics systems in modern automobiles.

UNIT V **CHASSIS AND SAFETY SYSTEMS** **9**

Traction control system – Cruise control system – electronic control of automatic transmission – anti-lock braking system – electronic suspension system – working of airbag and role of MEMS in airbag systems – centralized door locking system – climate control of cars.

TOTAL: 45 PERIODS

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REFERENCES:

1 James D Halderman, "Automotive Electricity & Electronics", 6th Edition, Pearson Education, 2021.

2 James E Duffy, "Automotive Electricity & Electronics", 7th Edition, GW Publishers, 2021.

3 William B Ribbens, "Understanding Automotive Electronics", 8th Edition, Elsevier, 2019.

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 Comprehend the importance of emission standards in automobiles.

CO2 Explain the electronic fuel injection/ignition components and their function

CO3 Summarize the sensors and equipment for measuring mechanical quantities, temperature and appropriate actuators.

CO4 Describe the chassis and vehicle safety system.

CO5 Explain the various methods of power system earthing.

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	-	-	-	-	-	-	-
CO2	2	2	1	1	-	-	-	-	-	-	-	1
CO3	2	2	1	1	-	-	-	-	-	-	-	1
CO4	2	2	1	1	-	-	-	-	-	-	-	1
CO5	2	2	1	1	-	-	-	-	-	-	-	1

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U23OE227	FOUNDATION OF AI & PROBLEM SOLVING	L	T	P	C
Prerequisites: Nil		3	0	0	3

COURSE OBJECTIVES:

- To understand basics of intelligent agents.
- To gain knowledge about search strategies.
- To learn about the applications of AI.

UNIT I **INTRODUCTION** 9

Introduction–Definition –Agent based approach - Characteristics of Intelligent Agents– Typical Intelligent Agents – Problem Solving Approach to Typical AI problems – AI Environments.

UNIT II **PROBLEM SOLVING METHODS** 9

Problem solving Methods - Search Strategies- Uninformed - Informed - Heuristics - Local Search Algorithms and Optimization Problems - A* Search – Performance of search algorithms.

UNIT III **KNOWLEDGE REPRESENTATION** 9

First Order Predicate Logic –Unification – Forward Chaining-Backward Chaining – Resolution – Knowledge Representation using First order Predicate logic - Reasoning Systems – Second Order Logic.

UNIT IV **SOFTWARE AGENTS** 9

Architecture for Intelligent Agents – Agent communication – Negotiation and Bargaining – Argumentation among Agents – Trust and Reputation in Multi-agent systems.

UNIT V **APPLICATIONS** 9

AI applications – Language Models – Information Retrieval- Information Extraction – Natural Language Processing - Machine Translation – Speech Recognition – Robot – Hardware – Perception – Planning – Moving

TOTAL: 45 PERIODS

TEXT BOOKS:

1 S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach", 3rd Edition, Pearson Education, 2019.

2 I. Bratko, "Prolog: Programming for Artificial Intelligence", 4th Edition, Addison Wesley Educational Publishers, 2021.

REFERENCES:

1 M. Tim Jones, "Artificial Intelligence: A Systems Approach", 5th Edition, Jones and Bartlett Publishers, 2018.

2 Nils J. Nilsson, "The Quest for Artificial Intelligence", 2nd Edition, Cambridge University Press, 2019.

3 Robert T Nakatsu, "Diagrammatic Reasoning in AI: Decision-making and Problem-solving with Diagrams", 3rd Edition, John Wiley & Sons, 2019.

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ONLINE RESOURCES:

1 https://www.geeksforgeeks.org/problem-solving-in-artificial-intelligence/

2 https://www.udemy.com/course/foundations-of-ai-from-problem-solving-to-machine-learning/?srsltid=AfmBOoozqjf7LO_2TMVunFo1pihQUzpFNu_6p8xYR_4tyDV5eFaTdEpD&couponCode=ST5MT020225BROW

3 https://skillfloor.com/blog/the-foundation-of-artificial-intelligence

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain appropriate search algorithms for any AI problem.

CO2 Explain various problem-solving methods.

CO3 Analyze a problem using first order and predicate logic.

CO4 Analyze various software agents.

CO5 Design applications for NLP that use Artificial Intelligence.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	-	-	-	-	-	-	-
CO2	2	2	1	1	-	-	-	-	-	-	-	-
CO3	3	3	2	2	-	-	-	-	-	-	-	-
CO4	3	3	2	2	-	-	-	-	-	-	-	-
CO5	3	3	3	3	-	-	-	-	-	-	-	-

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U23OE228 **INTRODUCTION TO R PROGRAMMING**

L	T	P	C
3	0	0	3

Pre requisites: Nil

COURSE OBJECTIVES:

- To understand the R Studio basics.
- To learn the significance of data manipulation.
- To understand about data analysis.

UNIT I **INTRODUCTION** **9**

Overview of R and its IDEs (RStudio), Basics of R syntax and programming concepts, Data types, variables, and operations in R.

UNIT II **DATA MANIPULATION AND PREPARATION** **9**

Importing and exporting data in R, Data cleaning and preparation with dplyr, Data transformation using tidyr.

UNIT III **DATA ANALYSIS AND STATISTICS** **9**

Descriptive statistics and exploratory data analysis, Hypothesis testing and inferential statistics, Regression analysis and ANOVA.

UNIT IV **DATA VISUALIZATION WITH R** **9**

Principles of effective data visualization, Introduction to ggplot2 and advanced visualization techniques, Creating interactive visualizations with packages like plotly.

UNIT V **ADVANCED ANALYTICS AND MACHINE LEARNING** **9**

Overview of machine learning in R, Classification, regression, and clustering techniques, Model evaluation and tuning.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Hadley Wickham, Garrett Grolemund, " R for Data Analysis," 2nd Edition, O'Reilly Media, 2023.

2 Fischetti, Tony, "R: Data Analysis and Visualization," 2nd Edition, Packt Publishing, 2021.

REFERENCES:

1 Lander, Jared. "R for Everyone: Advanced Analytics and Graphics," 2nd Edition, Pearson Education, 2017.

2 Singh, Ajit. "R Programming: Simply in Depth," 1st Edition, Amazon Digital Services LLC - KDP, 2020,

3 G. Grolemund, " R Programming an Approach to Data Analytics," 1st Edition, MIP Publisher, 2021.

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ONLINE RESOURCES:

1 https://www.datacamp.com/blog/all-about-r
2 https://www.geeksforgeeks.org/r-programming-language-introduction/
3 https://www.w3schools.com/r/r_intro.asp

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the basics of R Programming

CO2 Apply the data manipulation and preparation in R programming.

CO3 Evaluate the need of data analysis and statistics

CO4 Design data visualisation with R

CO5 Design advance analytics and machine learning algorithms.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	-	-	-	-	-	-	-
CO2	3	2	1	2	-	-	-	-	-	-	-	-
CO3	3	3	2	2	-	-	-	-	-	-	-	-
CO4	3	3	3	3	-	-	-	-	-	-	-	-
CO5	3	.3	3	3	-	-	-	-	-	-	-	-

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U23OE229 **FOUNDATIONS OF NLP** L T P C

Pre requisites: Nil 3 0 0 3

COURSE OBJECTIVES:

- To learn the fundamentals of NLP, and also to make them for understanding CFG, PCFG in NLP.
- To understand the role of semantics of sentences and pragmatic.
- To learn the basic concepts of speech processing along with analysis and modelling.

UNIT I **INTRODUCTION** 9

Origins and challenges of NLP – language modeling: grammar-based lm, statistical lm – regular expressions, finite-state automata – English morphology, transducers for lexicon and rules, tokenization, detecting and correcting spelling errors, minimum edit distance.

UNIT II **WORD LEVEL ANALYSIS** 9

Unsmoothed n-grams, evaluating n-grams, smoothing, interpolation and backoff – word classes, part-of-speech tagging, rule-based, stochastic and transformation-based tagging, issues in pos tagging – hidden Markov and maximum entropy models.

UNIT III **SYNTACTIC ANALYSIS** 9

Context free grammars, grammar rules for English, treebanks, normal forms for grammar – dependency grammar – syntactic parsing.

UNIT IV **SEMANTICS AND PRAGMATICS** 9

Requirements for representation, first-order logic, description logics – syntax-driven semantic analysis, semantic attachments – word senses, relations between senses, thematic roles, selection restrictions.

UNIT V **SPEECH PROCESSING** 9

Speech fundamentals: articulatory phonetics – production and classification of speech sounds; acoustic phonetics – acoustics of speech production; review of digital signal processing concepts; short-time Fourier transform, filter- bank and lpc methods.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Daniel Jurafsky, James H. Martin," Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech", 4th Edition, Pearson Education, 2021.
2. Steven Bird, Ewan Klein and Edward Loper, "Natural Language Processing with Python", 1st Edition, O'Reilly Media, 2022.

REFERENCES:

1 Richard M Reese, "Natural Language Processing with Java", 3rd Edition, OReilly Media, 2020.

2 Nitin Indurkhya and Fred J. Damerau, "Handbook of Natural Language Processing", 2nd Edition, Chapman and Hall/CRC Press, 2019.

3 Tanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", 2nd Edition, Oxford University Press, 2018.

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ONLINE RESOURCES:

1 https://medium.com/@pingsubhak/foundations-of-natural-language-processing-4c575f642f84
2 https://onlinecourses.nptel.ac.in/noc19_cs56/preview
3 https://www.omdena.com/course/foundations-of-natural-language-processing-theory-and-applications

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the fundamentals of natural language processing.

CO2 Apply the use of CFG and PCFG in NLP.

CO3 Analyze the need of syntactic analysis.

CO4 Evaluate the role of semantics of sentences and pragmatic.

CO5 Analyze speech production and related parameters of speech.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	-	-	-	-	-	-	-
CO2	3	2	1	2	-	-	-	-	-	-	-	-
CO3	3	3	2	2	-	-	-	-	-	-	-	-
CO4	3	3	2	2	-	-	-	-	-	-	-	-
CO5	3	3	2	2	-	-	-	-	-	-	-	-

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U23OE230 **FOUNDATIONS OF SPEECH RECOGNITION** L T P C

Prerequisites: Nil 3 0 0 3

COURSE OBJECTIVES:

- To Understand about the Speech Signal
- To Learn about Signal Processing for Speech Recognition
- To understand Pattern Comparison Techniques

UNIT I **THE SPEECH SIGNAL** 9

Fundamentals of Speech recognition, the process of speech production and perception in human beings, the speech production process, representing speech in time and frequency domains, speech sounds and features

UNIT II **SIGNAL PROCESSING AND ANALYSIS METHOD FOR SPEECH RECOGNITON** 9

Spectral analysis models, The Bank-of-filters front-end processor, Linear predictive coding model for Speech recognition, Vector quantization.

UNIT III **PATTERN COMPARISON TECHNIQUES** 9

Introduction, Speech detection, Distortion measures- Mathematical considerations, Distortion measures- Perceptual considerations, Spectral distortion measures.

UNIT IV **THEORY AND IMPLEMENTATION OF HIDDEN MARKOV MODELS** 9

Introduction, Discrete time Markov processes, Extensions to Hidden Markov models, Three basic problems for HMMs, Types of HMMs, Continuous observation densities in HMMs, comparison of HMMs.

UNIT V **CONTIUOUS SPEECH RECOGNITION** 9

Introduction, Sub word speech units, sub word unit models based on HMMs, Training of sub word units, Language models for large vocabulary speech recognition, Statistical language modelling.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Lawrence Rabiner and Biing-Hwang Juang, "Fundamentals of Speech Recognition", 1st Edition, Pearson Education, 2017.

2 Lawrence Rabiner, Biing-Hwang Juang, B. Yegnanarayana, "Fundamentals of Speech Recognition", 3rd Edition, Pearson Education, 2019.

REFERENCES:

1 Claudio Becchetti and Lucio Prina Ricotti, "Speech Recognition", 1st Edition, John Wiley and Sons, 2018.

2 Rederick Jelinek, "Statistical Methods of Speech Recognition", 1st edition, MIT Press, 2015.

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3 Thomas F Quatieri, "Discrete-time speech signal processing: principles and practice", 4th Edition, Pearson Education, 2023

ONLINE RESOURCES

1 https://www.coursera.org/courses?query=speech%20recognition

2 https://www.futurelearn.com/courses/speech-recognition-systems

3 https://www.simplilearn.com/tutorials/python-tutorial/speech-recognition-in-python

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain speech recognition principles, methods, models and implementation.

CO2 Apply speech recognition principles and methods to characterize the speech signal and to recognize the speech.

CO3 Apply the Pattern Comparison Techniques and Hidden Markov Models to recognise the speech.

CO4 Analyze the speech recognition methods, pattern comparison techniques and Hidden Markov Models.

CO5 Apply Continuous speech recognition on HMMs.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	-	-	-	-	-	-	-
CO2	3	2	1	2	-	-	-	-	-	-	-	-
CO3	3	2	1	2	-	-	-	-	-	-	-	-
CO4	3	3	2	2	-	-	-	-	-	-	-	-
CO5	3	2	1	2	-	-	-	-	-	-	-	-

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U23OE231	ESSENTIALS OF DATA SCIENCE AND ANALYTICS	L	T	P	C
Prerequisites:	Nil	3	0	0	3

COURSE OBJECTIVES:

- To understand the data science fundamentals and process.
- To learn to describe the data for the data science process.
- To learn to describe the relationship between data.

UNIT I **INTRODUCTION** **9**

Data Science: Benefits and uses – facets of data - Data Science Process: Overview – Defining research goals – Retrieving data – Data preparation - Exploratory Data analysis – build the model– presenting findings and building applications - Data Mining - Data Warehousing – Basic Statistical descriptions of Data.

UNIT II **DESCRIBING DATA** **9**

Types of Data - Types of Variables -Describing Data with Tables and Graphs –Describing Data with Averages - Describing Variability - Normal Distributions and Standard (z) Scores.

UNIT III **DESCRIBING RELATIONSHIP** **9**

Correlation –Scatter plots –correlation coefficient for quantitative data –computational formula for correlation coefficient – Regression –regression line –least squares regression line – Standard error of estimate – interpretation of r2 –multiple regression equations – regression towards the mean.

UNIT IV **DATA PRE-PROCESSING** **9**

Data cleaning – data integration – Data Reduction Data Transformation and Data Discretization. Evaluation of classification methods – Confusion matrix, Students T-tests and ROC curves.

UNIT V **DATA ANALYSIS** **9**

Basic tools (plots, graphs and summary statistics) of EDA, Philosophy of EDA – The Data Science Process. Importing Matplotlib – Line plots – Scatter plots – visualizing errors – density and contour plots – Histograms – legends – colors – subplots – text and annotation – customization – three dimensional plotting - Geographic Data with Basemap - Visualization with Seaborn.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Cathy O'Neil and Rachel Schutt, "Doing Data Science, Straight Talk from the Frontline", 2nd Edition, O'Reilly Media, 2021.

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REFERENCES:

1 Matt Harrison, "Learning the Pandas Library: Python Tools for Data Munging, Analysis, and Visualization, 2nd Edition, O'Reilly Media, 2016.

2 Joel Grus, "Data Science from Scratch: First Principles with Python", 1st Edition, O'Reilly Media, 2015.

3 Luca Massaron, John Paul Mueller, "Python for Data Science for Dummies", 2nd Edition, John Wiley & Sons, 2019.

ONLINE RESOURCES:

1 https://www.coursera.org/learn/foundations-of-data-science
2 https://www.geeksforgeeks.org/data-science-fundamentals/
3 https://www.datacamp.com/blog/what-is-data-science-the-definitive-guide

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the basics of Data Science.
CO2 Explain different types of data description for data science process.
CO3 Apply the knowledge of describing data in normal distributions.
CO4 Describe data pre-processing techniques.
CO5 Apply visualization Libraries for data analysis.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	-	-	-	-	-	-	-
CO2	2	2	1	1	-	-	-	-	-	-	-	-
CO3	3	2	1	2	-	-	-	-	-	-	-	-
CO4	2	2	1	1	-	-	-	-	-	-	-	-
CO5	3	2	1	2	-	-	-	-	-	-	-	-

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U23OE232	FUNDAMENTALS OF NETWORK SECURITY	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To understand the basic concepts of security
- To learn various network security attacks.
- To understand the IP and Web security.

UNIT I **FUNDAMENTALS OF NETWORKING SECURITY** **6**

Overview of networking security- Security Services -Confidentiality, Authentication, Integrity, Non-repudiation, access Control - Availability and Mechanisms- Security Attacks -Interruption, Interception

UNIT II **AUTHENTICATION AND SECURITY** **6**

Authentication overview - Authentication protocols - Authentication and key establishment - key exchange - mediated key exchange - User Authentication –password based authentication - password security - Certificate Authority and key management - digital signatures - digital Certificates.

UNITIII **PUBLIC-KEY CRYPTOGRAPHY** **6**

Basics of cryptography -cryptographic hash functions - symmetric and public-key encryption - public key cryptography principles & algorithms - cipher block modes of operation - Secure Hash Functions – HMAC.

UNIT IV **SECURITY ATTACKS** **6**

Buffer overflow attacks & format string vulnerabilities - Denial-of-Service Attacks - Hijacking attacks: exploits and defences - Internet worms – viruses – spyware –phishing – botnets - TCP session hijacking - ARP attacks.

UNIT V **IP SECURITY AND WEB SECURITY** **6**

Network defence tools: Firewalls, VPNs, Intrusion Detection, and filters - Email privacy: Pretty Good Privacy (PGP) and S/MIME - Network security protocols in practice- Introduction to Wire shark – SSL - IPsec, and IKE -DNS security.

30 PERIODS

PRACTICAL EXERCISES:

1. Implementation of Symmetric Key Algorithms.
2. Implementation of Asymmetric Key Using RSA Algorithm.
3. Implementation of Digital Signatures Schemes using Secure Hash Algorithm.
4. Installation of wire shark, TCP dump and observe data transferred in client-server communication using UDP/TCP and identify the UDP/TCP datagram.
5. Check message integrity and confidentiality using SSL.
6. Implementation of Eaves dropping attack.
7. Implementation of Man in the middle attacks.

30 PERIODS

TOTAL: 60 PERIODS

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TEXT BOOKS:

1 Anand Shinde, "Introduction to Cyber Security Guide to the World of Cyber Security", 1st Edition, Notion Press, 2021.

2 Nina Godbole, Sunit Belapure, "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", 2nd Edition, John Wiley & Sons, 2016.

REFERENCES:

1 David Kim, Michael G. Solomon, "Fundamentals of Information Systems Security", 1st Edition, Jones & Bartlett Learning, 2018.

2 Patrick Engebretson, "The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made easy", 2nd Edition, Elsevier B.V, 2019.

3 Kimberly Graves, "CEH Official Certified Ethical Hacker Review Guide", 1st Edition, John Wiley & Sons, 2017.

ONLINE RESOURCES:

1 https://www.udemy.com/topic/network-security

2 https://www.coursera.org/courses?query=network%20security

3 https://archive.nptel.ac.in/courses/106/105/106105162/

COURSEOUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Describe network security fundamental concepts and principles.

CO2 Explain the concept of authentication protocols and digital signatures.

CO3 Apply cryptographic principles, including public-key encryption, hash functions, to design secure systems.

CO4 Describe various network security attacks.

CO5 Explain about IP security and Web security.

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	-	-	-	-	-	-	-
CO2	2	2	1	1	-	-	1	-	-	-	-	-
CO3	3	2	1	2	-	-	-	-	-	-	-	-
CO4	2	2	1	1	1	-	1	-	-	-	-	-
CO5	2	2	1	1	1	-	-	-	-	-	-	1

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U23OE233	CYBER LAWS AND ETHICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamentals of cyber security and the importance of securing information and systems.
- To expose the theoretical and practical aspects of cyber law.
- To learn the importance of ethical values in digital age.

UNIT I **CYBER SECURITY** **6**

Basic Cyber Security Concepts, layers of security, Vulnerability, threat, Harmful acts, Internet Governance – Challenges and Constraints, Computer Criminals, CIA Triad, Assets and Threat, motive of attackers, active attacks, passive attacks, Software attacks, hardware attacks.

UNIT II **INFORMATION TECHNOLOGY ACT** **6**

Overview of IT Act, 2000, Amendments and Limitations of IT Act, Digital Signatures, Cryptographic Algorithm, Public Cryptography, Private Cryptography, Electronic Governance, Legal Recognition of Electronic Records, Legal Recognition of Digital Signature, Certifying Authorities, Cyber Crime and Offences.

UNIT III **CYBER LAW AND RELATED LEGISLATION** **6**

Patent Law, Trademark Law, Copyright, and Software – Copyright or Patented, Domain Names and Copyright disputes, Electronic Data Base and its Protection, IT Act and Civil Procedure Code, IT Act and Criminal Procedural Code, Relevant Sections of Indian Evidence Act.

UNIT IV **CYBERSPACE AND THE LAW & CYBER FORENSICS** **6**

Introduction, Cyber Security Regulations, Roles of International Law. The INDIAN Cyberspace, National Cyber Security Policy. Introduction, Historical background of Cyber forensics, Digital Forensics Science.

UNIT V **CYBER ETHICS** **6**

The Importance of Cyber Law, Significance of cyber-Ethics, Need for Cyber regulations and Ethics. Ethics in Information society, Introduction to Artificial Intelligence Ethics: Ethical Issues in AI and core Principles, Introduction to Block chain Ethics.

TOTAL: 30 PERIODS

TEXT BOOKS:

1 Anirudh Rastogi, "Cyber Law: The Law of the Internet and Information Technology" 1st Edition, Lexis Nexis, 2014.
2 Agarwala Kamlesh N. & Lal Ajay Kumar "Cybersecurity and Cyber Laws", 1st Edition, Whitesmann, 2024.
3 Sumit Belapure, Nina Godbole, "Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", 1st Edition, John Wiley & Sons, 2011.

REFERENCES

1 Mark Grabowski, Eric P. Robinson, "Cyber Law and Ethics: Regulation of the Connected", 1st Edition, Routledge (Taylor& Francis), 2021.

2 Sushma Arora and Raman Arora," Cyber Crimes & Laws", 4th Edition, Whitesmann, 2021.
3 Richard A. Spinello, "Cyber Ethics-Morality and Law in cyberspace", 7th Edition, Jones & Bartlett, 2020.

ONLINE RESOURCES:

1 https://www.udemy.com/topic/network-security
2 https://www.coursera.org/courses?query=network%20security
3 https://archive.nptel.ac.in/courses/106/105/106105162/

COURSEOUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Explain the concepts and assess various harmful acts in cyber space.
CO2 Analyze cybercrime and offences in the context of IT law.
CO3 Comprehend a thorough understanding of cyber law and their scope and limitations.
CO4 Analyze the significance of cyber security policy and regulation.
CO5 Apply the need of cyber regulations in the real-world applications.

CO-PO-PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	-	-	1	-	-	-	-
CO2	3	2	1	2	-	2	2	-	-	-	-	-
CO3	2	2	1	1	-	-	-	1	-	-	-	-
CO4	3	3	2	2	-	1	-	1	-	-	-	-
CO5	3	2	1	2	-	2	1	-	-	-	-	-

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U23OE234	TRUST MANAGEMENT IN E-COMMERCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand basic concepts of trust management in E-Commerce and Security techniques.
- To learn Reputation Systems in E-Commerce and vendor verification.
- To understand various advanced trust technologies.

UNIT I **INTRODUCTION** **9**

Overview of E-Commerce, Importance of Trust in E-Commerce, Types of Trust: Cognitive, Institutional and Personal Trust -Challenges in Establishing Trust Online.

UNIT II **SECURITY IN E-COMMERCE** **9**

Fundamentals of Cybersecurity in E-Commerce, Secure Socket Layer (SSL) and Transport Layer Security (TLS), Encryption Techniques (Symmetric and Asymmetric), Authentication Mechanisms: Passwords, OTP, and 2FA.

UNIT III **REPUTATION MANAGEMENT** **9**

Reputation Systems in E-Commerce (e.g., eBay, Amazon), Role of Feedback and Reviews in Building Trust, Fake Reviews and Counterstrategies, Role of User Interface (UI) in Building Trust, Designing Intuitive and Accessible E-Commerce Platforms.

UNIT IV **VENDOR AND PRODUCT AUTHENTICATION** **9**

Vendor Verification Techniques-Product Authentication and Anti-Counterfeiting Measures- Block chain for Supply Chain Transparency.

UNIT V **ADVANCED TRUST TECHNOLOGIES** **9**

Artificial Intelligence in Trust Management, Machine Learning Models for Fraud Detection, Block chain Applications in E-Commerce Trust, Contracts for Secure Transactions.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 David Whiteley, "E-Commerce Strategy, Technologies and Applications", 1st Edition, Tata McGraw Hill, 2015.
2 P.T.Joseph, S.J., "E-Commerce - An Indian Perspective", 4th Edition, Prentice Hall of India, 2012.

REFERENCES:

1 Ravi Kalakotar and Andrew B.Whinston, "Frontiers of Electronic Commerce", 1st Edition, Pearson Education, 2017.
2 Kenneth C. Laudon, "E-Commerce: Business, Technology, Society", 4th Edition, Pearson Education, 2019.
3 Li, Fen, "Trust in E-services: Technologies, Practices and challenges", 1st Edition, Pearson Education, 2018.

ONLINE RESOURCES:

1 https:// nptel/courses/video/110105148/lec35

2 https:// nptel.ac.in/courses/106/105/106105162/

3 https:// nptel.ac.in/courses/110/105/110105083

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Describe basic concepts of E-Commerce.
CO2 Comprehend various security techniques of E-Commerce.
CO3 Analyze repudiation management in E-Commerce.
CO4 Summarize vendor verification and product Authentication.
CO5 Describe various technologies of trust management in E-Commerce.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	-	-	-	-	-	-	-
CO2	2	2	1	1	-	-	-	-	-	-	-	-
CO3	3	3	2	2	1	-	-	-	-	-	-	1
CO4	2	2	1	1	2	-	-	-	-	-	-	-
CO5	2	2	1	1	-	-	-	-	-	-	-	1

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U23OE235	LINUX FUNDAMENTALS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To know the knowledge of Linux helps to understand OS level programming.
- To learn about the kernel concepts, basics commands, shell scripting, file processing, Socket programming, Processes, Inter process communication.

UNIT I **INTRODUCTION TO LINUX AND LINUX UTILITIES** 6

A brief history of LINUX, architecture of LINUX, features of LINUX, introduction to vi editor. Linux commands - PATH, man, echo, printf, script, passwd , uname, who, date, stty, pwd, cd, mkdir, rmdir, ls, cp, mv, rm, cat, more, wc, , tar, gzip, file handling utilities, security by file permissions, process utilities, disk utilities, networking commands, unlink, du, df, mount, umount, find, unmask, ulimit, ps, w, finger, arp.Text Processing utilities and backup utilities , tail, head , sort, nl, uniq, grep, , cut, paste, join, pg, comm, cmp, diff, tr, awk, cpio.

UNIT II **INTRODUCTION TO SHELLS** 6

Linux Session, Standard Streams, Redirection, Pipes, Tee Command, Command Execution, Command-Line Editing, Quotes, Command Substitution, Job Control, Aliases, Variables, Predefined Variables, Options, Shell/Environment Customization. Filters: Filters and Pipes, Concatenating files, Display Beginning and End of files, Cut and Paste, Sorting, Translating Characters.

UNIT III **FILE STRUCTURE** 6

GREP: Operation, grep Family, Searching for File Content. Sed :Scripts, Operation, Addresses, commands, Applications, grep and sed. UNIX FILE STRUCTURE: Introduction to UNIX file system, inode (Index Node), file descriptors, system calls and device drivers. File Management :File Structures, System Calls for File Management – create, open, close, read, write, lseek, link, symlink, unlink, stat, fstat, lstat, chmod, chown, Directory API – opendir, readdir , closedir, mkdir, rmdir, umask.

UNIT IV **PROCESS AND SIGNALS** 6

Process, process identifiers, process structure: process table, viewing processes, system processes, process scheduling, starting new processes: waiting for a process, zombie processes, orphan process, fork, exit, wait, waitpid, exec, signals functions, kill, raise, alarm, pause, abort,signal sets. File locking: creating lock files, locking regions, use of read and write with locking, deadlocks.

UNIT V **INTER PROCESS COMMUNICATION** 6

Pipe, process pipes, the pipe call, parent and child processes, and named pipes: fifos, semaphores: semget, semop, semctl, message queues: ms

30 PERIODS

PRACTICAL EXERCISES:

1. Linux Basics Commands and File Management.
2. Text Processing and Backup Utilities Commands.
3. Shell Basics and Scripting.
4. Filters and File Comparison (file sorting and line manipulation).
5. File Structures and System Calls. (use of link, symlink, unlink)
6. Process and Signal Handling (Implement zombie and orphan process scenarios).

7. Implement semaphore and message queue operations using system calls.

30 PERIODS

TOTAL: 60 PERIODS

TEXT BOOKS:

1 W. Richard. Stevens, Advanced Programming in the UNIX Environment, 3rd Edition, Pearson Education, 2017.

2 Behrouz A. Forouzan, Richard F. Gilberg.Thomson," Unix and shell Programming ", 1st Edition, Cengage Learning, 2018.

REFERENCES:

1 Daniel J. Barrett," Linux System Programming, Robert Love, 4th Edition, O'Reilly Media, SPD", 2013.

2 Advanced Programming in the UNIX environment, 2nd Edition, W.R. Stevens, Pearson Education, 2017.

3 William E. Shotts Jr "The Linux Command Line: A Complete Introduction", 1st Edition, Pearson Education, 2019.

ONLINE RESOURCES:

1 https://archive.nptel.ac.in/courses/117/106/117106113/

2 https://www.classcentral.com/course/youtube-electronics-linux-programming-scripting-47539

3 https:// nptel.ac.in/courses/106/105/106105162/

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Describe various Linux commands that are used to manipulate system operations.

CO2 Analyze Shell Programming using Linux commands.

CO3 Design application to manipulate internal kernel level Linux File System.

CO4 Analyze IPC- APIs to control various processes for synchronization.

CO5 Apply Network Programming on different machines in a network.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	-	-	-	-	-	-	-
CO2	3	3	2	2	-	-	-	-	-	-	-	-
CO3	3	3	3	3	1	-	-	1	-	-	-	-
CO4	3	3	2	2	2	-	-	1	-	-	-	-
CO5	3	2	1	2	-	-	-	-	-	-	-	-

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U23OE236	CYBER THREAT INTELLIGENCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basics of Information Security and legal and ethical issues in Information Security.
- To understand the information security policy and concepts of access control.

UNIT I INTRODUCTION 9

Security Trends, OSI security architecture, Security attacks, security services, security mechanisms, Security System Development Life cycle – Legal, Ethical and Professional issues

UNIT II THREAT ANALYSIS 9

Risk Management - Identifying and Assessing Risk - Assessing and Controlling Risk. Blueprint for Information Security - Information Security Policy

UNIT III SECURITY TECHNOLOGY 9

Intrusion Detection and Prevention Systems (IDPS)-Terminology-Types-Detection methods. Honeypots, Honeynets and padded cell systems. Scanning and Analysis Tools Port Scanners-Firewall analysis tools, Operating system detection tools-Vulnerability Scanners-Packet Sniffers-Wireless security tools.

UNIT IV AUDITING 9

Overview, Access control, IT Audit, Authentication. Open Web Application Security Project (OWASP), Web Site Audit and Vulnerabilities Assessment-Case study: Wireshark, FAW.

UNIT V ANALYSIS AND VALIDATION 9

Validating Forensics Data – Data Hiding Techniques – Performing Remote Acquisition – Network Forensics – Email Investigations – Cell Phone and Mobile Devices Forensics. Case Study: Toolsley

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Michael E Whitman and Herbert J Mattord, "Principles of Information Security", 1st Edition, Cengage Learning, 2011.

2 Nelson, Phillips, Enfinger, Steuart, "Computer Forensics and Investigations",1st Edition, Cengage Learning, 2008.

REFERENCES:

1 Micki Krause, Harold F. Tipton, "Handbook of Information Security Management", 6th Edition, CRC Press, 2007.

2 John R. Vacca, "Computer Forensics", 1st Edition, Cengage Learning, 2005.

3 Scott J. Roberts, Rebekah Brown, "Intelligence- Driven Incident Response: Outwitting the Adversary", 1st Edition, Pearson Education, 2017.

ONLINE RESOURCES:

1 https://www.coursera.org/projects/web-application-security-testing-with-owsap-zap

2 http://www.infocobuild.com/education/audio-video-courses/computer-science/InformationSecurity1-IIT-Madras/lecture-59.html

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3 https://github.com/hslatman/awesome-threat-intelligence

COURSE OUTCOMES:

Upon the completion of the course, the students will be able to

CO1 Describe the basics of information security and legal and ethical issues in Information Security.

CO2 Analyze the risk management and information security policy.

CO3 Analyze intrusion detection and prevention techniques using different tools.

CO4 Summarize Vulnerabilities Assessment using web applications.

CO5 Analyze forensics data.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	-	-	-	-	-	-	-
CO2	3	3	2	2	-	-	-	-	-	-	-	-
CO3	3	3	2	2	-	-	-	-	-	-	-	-
CO4	2	2	1	1	-	-	-	-	-	-	-	-
CO5	3	3	2	2	-	-	-	-	-	-	-	-

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