New Prince Shri Bhavani College

Of Engineering and Technology

(An Autonomous Institution)

CURRICULUM
&
SYLLABUS (1 to 8 SEM.)

(REGULATION 2023)

FOR

B.E.– ELECTRICAL AND ELECTRONICS ENGINEERING

(CHOICE BASED CREDIT SYSTEM)

(Applicable to the students admitted from the Academic Year: 2023 - 24)

DEPARTMENT OF ELECTRICAL AND ELECTRONICS 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	U23BE103	Basic Civil and Mechanical Engineering	3	0	0	3	3
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								**25**

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	U23PH201	Physics for Electrical and Electronics Engineers	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	U23EE201	Electric Circuit Analysis	3	1	0	4	4
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	U23EE202	Electric Circuits Laboratory	0	0	3	3	1.5
TOTAL CREDITS								**25**

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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 and Partial Differential Equations	3	1	0	4	4
2	PC	U23EE301	Electromagnetic Fields	3	1	0	4	4
3	PC	U23EE302	Electron Devices and Circuits	3	0	2	5	4
4	PC	U23EE303	Electrical Machines – I	3	0	0	3	3
5	PC	U23EE304	Measurements and Instrumentation	3	0	0	3	3
6	PC	U23EE305	Digital Logic Circuits	3	0	2	5	4
PRACTICAL COURSES								
7	PC	U23EE306	Electrical Machines – I Laboratory	0	0	3	3	1.5
EMPLOYABILITY ENHANCEMENT COURSES								
8	EEC	U23EEC301	Employability Skills – I	0	0	2	2	1
TOTAL CREDITS								**24.5**
SEMESTER - IV								
Sl. No.	**Course Category**	**Course Code**	**Course Title**	**L**	**T**	**P**	**Total Contact Periods**	**Credits**
THEORY COURSES								
1	BS	U23MA401	Numerical Methods	3	1	0	4	4
2	PC	U23EE401	Transmission and Distribution	3	1	0	4	4
3	PC	U23EE402	Electrical Machines -II	3	0	0	3	3
4	PC	U23EE403	Linear Integrated Circuits	3	0	2	5	4
5	PC	U23EE404	Microprocessors and Microcontrollers	3	0	2	5	4
6	ES	U23CS306	Object Oriented Programming with Data Structures	3	0	2	5	4
7	MNC	U23MX01	Personal Values	2	0	0	2	0
PRACTICAL COURSES								
8	PC	U23EE405	Electrical Machines – II Laboratory	0	0	3	3	1.5
EMPLOYABILITY ENHANCEMENT COURSES								
9	EEC	U23EEC401	Employability Skills – II	0	0	2	2	1
TOTAL CREDITS								**25.5**

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SEMESTER V								
Sl. No.	Course Category	Course Code	Course Title	L	T	P	Total Contact Periods	Credits
THEORY COURSES								
1	PC	U23EE501	Power System Analysis	3	0	0	3	3
2	PC	U23EE502	Power Electronics & Industrial Control	3	0	0	3	3
3	PC	U23EE503	Control Systems	3	0	2	5	4
4	HS	U23MG501	Professional Ethics and IPR	2	0	0	2	2
5	PE	U23PEEEXX	Professional Elective-I	2	0	2	4	3
6	PE	U23PEEEXX	Professional Elective-II	2	0	2	4	3
PRACTICAL COURSES								
7	PC	U23EE504	Power Electronics and Drives Laboratory	0	0	3	3	1.5
EMPLOYABILITY ENHANCEMENT COURSES								
8	EEC	U23EE505	Mini Project	0	0	3	3	1.5
9	EEC	U23EEC501	Employability Skills - III	0	0	2	2	1
TOTAL CREDITS								22

SEMESTER VI								
Sl. No.	Course Category	Course Code	Course Title	L	T	P	Total Contact Periods	Credits
THEORY COURSES								
1	PC	U23EE601	Protection and Switch Gear	3	0	0	3	3
2	PE	U23PEEEXX	Professional Elective-III	2	0	2	4	3
3	PE	U23PEEEXX	Professional Elective-IV	2	0	2	4	3
4	OE	U23OE1XX	Open Elective-I	3	0	0	3	3
5	HS	U23MX02	Environmental Sciences and Sustainability	2	0	0	2	0
6	PC	U23CB501	Cyber Security	3	0	2	5	4
7	HS	U23FLXX	Foreign Language	2	0	0	2	2
EMPLOYABILITY ENHANCEMENT COURSES								
8	EEC	U23EEC601	Employability Skills - IV	0	0	2	2	1
9	EEC	U23EEC602	Internship	0	0	0	0	1
TOTAL CREDITS								20

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SEMESTER VII								
Sl. No.	Course Category	Course Code	Course Title	L	T	P	Total Contact Periods	Credits
THEORY COURSES								
1	PC	U23EE701	High Voltage Engineering	3	0	0	3	3
2	PC	U23EE702	Power System Operation and Control	3	0	2	5	4
3	HS	U23MG701	Project Management and Finance	2	0	0	2	2
4	PE	U23PEEEXX	Professional Elective-V	2	0	2	4	3
5	PE	U23PEEEXX	Professional Elective-VI	2	0	2	4	3
6	OE	U23OE2XX	Open Elective-II	3	0	0	3	3
PRACTICAL COURSES								
7	EEC	U23EE703	Comprehensive Review	0	0	2	2	1
TOTAL CREDITS								19

SEMESTER VIII								
Sl. No.	Course Category	Course Code	Course Title	L	T	P	Total Contact Periods	Credits
PRACTICAL COURSES								
1	EEC	U23EE801	Project Work	0	0	20	20	8
TOTAL CREDITS								8

TOTAL CREDITS:169

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PROFESSIONAL ELECTIVE COURSES : VERTICALS

Course Code	Vertical I	Course Code	Vertical II	Course Code	Vertical III	Course Code	Vertical IV	Course Code	Vertical V	Course Code	Vertical VI	Course Code	Vertical VII	Course Code	Vertical VIII
	Power Engineering		**Control Engineering**		**Embedded Systems**		**Electric Vehicle**		**Converters & Drives**		**Industrial Automation**		**Green Energy Technologies**		**Diversified Course**
U23PEEE01	Utilization and Conservation of Electrical Energy	U23PEEE07	Advanced Control Systems	U23PEEE13	Digital Signal Processing	U23PEEE19	Design of Motor and Power Converters for Electric Vehicles	U23PEEE25	Multilevel Power Converters	U23PEEE31	Robotics and Automation	U23PEEE37	Green Energy Systems	U23PEEE43	Principles of Artificial Intelligence
U23PEEE02	Advanced Power Engineering Technology	U23PEEE08	Computer Control of Processes	U23PEEE14	Digital Image Processing & its Applications	U23PEEE20	Electric Vehicle Design, Mechanics and Control	U23PEEE26	Special Electrical Machines	U23PEEE32	Substation Design & Automation	U23PEEE38	Solar Energy Technology	U23PEEE44	Data Science
U23PEEE03	Smart Grids	U23PEEE09	Process Modeling and Simulation	U23PEEE15	Embedded C Programming	U23PEEE21	Design of Electric Vehicle Charging System	U23PEEE27	SMPS and UPS	U23PEEE33	Sensors & Actuators	U23PEEE39	Wind Energy Technology	U23PEEE45	Machine Learning Algorithms and its Applications
U23PEEE04	HVDC and FACTS	U23PEEE10	Model Based Control	U23PEEE16	Smart System Automation	U23PEEE22	Testing of Electric Vehicles	U23PEEE28	Control of Power Electronics Circuits	U23PEEE34	Programmable Logic Controllers	U23PEEE40	Bio Energy Conversion Techniques	U23PEEE46	Nano Technology
U23PEEE05	HVAC	U23PEEE11	Adaptive Control	U23PEEE17	Embedded Systems in Automobile Applications	U23PEEE23	Intelligent control of Electric Vehicles	U23PEEE29	Analysis of Electrical Machines	U23PEEE35	Supervisory Control And Data Acquisition (SCADA)	U23PEEE41	Hydrogen and Fuel cell Technologies	U23PEEE47	IoT Concepts & Applications
U23PEEE06	Power Quality	U23PEEE12	Industrial Process Control	U23PEEE18	Embedded System Design	U23PEEE24	Grid Integration of Electric Vehicles	U23PEEE30	Modern Power Converters	U23PEEE36	Industrial Automation System Design	U23PEEE42	Power Electronics For Renewable Energy Systems	U23PEEE48	Artificial Neural Networks & Deep Learning Algorithms

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PROFESSIONAL ELECTIVE COURSES: VERTICALS

VERTICAL1: POWER ENGINEERING

SL. NO.	COURSE CATEGORY	COURSE CODE	COURSE TITLE	L	T	P	TOTAL CONTACT PERIODS	C
1	PE	U23PEEE01	Utilization and Conservation of Electrical Energy	2	0	2	4	3
2	PE	U23PEEE02	Advanced Power Engineering Technology	2	0	2	4	3
3	PE	U23PEEE03	Smart Grids	2	0	2	4	3
4	PE	U23PEEE04	HVDC and FACTS	2	0	2	4	3
5	PE	U23PEEE05	HVAC	2	0	2	4	3
6	PE	U23PEEE06	Power Quality	2	0	2	4	3

VERTICAL2: CONTROL ENGINEERING

SL. NO.	COURSE CATEGORY	COURSE CODE	COURSE TITLE	L	T	P	TOTAL CONTACT PERIODS	C
1	PE	U23PEEE07	Advanced Control Systems	2	0	2	4	3
2	PE	U23PEEE08	Computer Control of Processes	2	0	2	4	3
3	PE	U23PEEE09	Process Modeling and Simulation	2	0	2	4	3
4	PE	U23PEEE10	Model Based Control	2	0	2	4	3
5	PE	U23PEEE11	Adaptive Control	2	0	2	4	3
6	PE	U23PEEE12	Industrial Process Control	2	0	2	4	3

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VERTICAL3: EMBEDDED SYSTEMS

SL. NO.	COURSE CATEGORY	COURSE CODE	COURSE TITLE	L	T	P	TOTAL CONTACT PERIODS	C
1	PE	U23PEEE13	Digital Signal Processing	2	0	2	4	3
2	PE	U23PEEE14	Digital Image Processing & its applications	2	0	2	4	3
3	PE	U23PEEE15	Embedded C Programming	2	0	2	4	3
4	PE	U23PEEE16	Smart System Automation	2	0	2	4	3
5	PE	U23PEEE17	Embedded Systems in Automobile Applications	2	0	2	4	3
6	PE	U23PEEE18	Embedded System Design	2	0	2	4	3

VERTICAL 4: ELECTRIC VEHICLE

SL.	COURSE CATEGORY	COURSE CODE	COURSE TITLE	L	T	P	TOTAL CONTACT PERIODS	C
1	PE	U23PEEE19	Design of Motor and Power Converters for Electric Vehicles	2	0	2	4	3
2	PE	U23PEEE20	Electric Vehicle Design, Mechanics and Control	2	0	2	4	3
3	PE	U23PEEE21	Design of Electric Vehicle Charging System	2	0	2	4	3
4	PE	U23PEEE22	Testing of Electric Vehicles	2	0	2	4	3
5	PE	U23PEEE23	Intelligent control of Electric Vehicles.	2	0	2	4	3
6	PE	U23PEEE24	Grid Integration of Electric Vehicles	2	0	2	4	3

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VERTICAL 5: CONVERTERS & DRIVES

SL. NO.	COURSE CATEGORY	COURSE CODE	COURSE TITLE	L	T	P	TOTAL CONTACT PERIODS	C
1	PE	U23PEEE25	Multilevel Power Converters	2	0	2	4	3
2	PE	U23PEEE26	Special Electrical Machines	2	0	2	4	3
3	PE	U23PEEE27	SMPS and UPS	2	0	2	4	3
4	PE	U23PEEE28	Control of Power Electronics Circuits	2	0	2	4	3
5	PE	U23PEEE29	Analysis of Electrical Machines	2	0	2	4	3
6	PE	U23PEEE30	Modern Power Converters	2	0	2	4	3

VERTICAL 6: INDUSTRIAL AUTOMATION

SL. NO.	COURSE CATEGORY	COURSE CODE	COURSE TITLE	L	T	P	TOTAL CONTACT PERIODS	C
1	PE	U23PEEE31	Robotics and Automation	2	0	2	4	3
2	PE	U23PEEE32	Substation Design & Automation	2	0	2	4	3
3	PE	U23PEEE33	Sensors & Actuators	2	0	2	4	3
4	PE	U23PEEE34	Programmable Logic Controllers	2	0	2	4	3
5	PE	U23PEEE35	Supervisory Control And Data Acquisition (SCADA)	2	0	2	4	3
6	PE	U23PEEE36	Industrial Automation System Design	2	0	2	4	3

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VERTICAL 7: GREEN ENERGY TECHNOLOGIES

SL. NO.	COURSE CATEGORY	COURSE CODE	COURSE TITLE	L	T	P	TOTAL CONTACT PERIODS	C
1	PE	U23PEEE37	Green Energy Systems	2	0	2	4	3
2	PE	U23PEEE38	Solar Energy Technology	2	0	2	4	3
3	PE	U23PEEE39	Wind Energy Technology	2	0	2	4	3
4	PE	U23PEEE40	Bio Energy Conversion Techniques	3	0	0	3	3
5	PE	U23PEEE41	Hydrogen and Fuel cell Technologies	3	0	0	3	3
6	PE	U23PEEE42	Power Electronics for Renewable Energy Systems	2	0	2	4	3

VERTICAL 8: DIVERSIFIED COURSE

SL. NO.	COURSE CATEGORY	COURSE CODE	COURSE TITLE	L	T	P	TOTAL CONTACT PERIODS	C
1	PE	U23PEEE43	Principles of Artificial Intelligence	2	0	2	4	3
2	PE	U23PEEE44	Data Science	2	0	2	4	3
3	PE	U23PEEE45	Machine Learning Algorithms and its Applications	2	0	2	4	3
4	PE	U23PEEE46	Nanotechnology	2	0	2	4	3
5	PE	U23PEEE47	IoT Concepts & Applications	2	0	2	4	3
6	PE	U23PEEE48	Artificial Neural Networks & Deep Learning Algorithms	2	0	2	4	3

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SET I - Open Electives for the Department of EEE							
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	U23OE127	Program Language Principles	3	0	0	3	3
23	U23OE128	Data Warehousing and Data Mining	3	0	0	3	3
24	U23OE129	Foundations of Soft Computing Techniques	3	0	0	3	3
25	U23OE130	Fundamentals of Cloud Computing	3	0	0	3	3
26	U23OE131	Human Computer Interaction	3	0	0	3	3
27	U23OE132	Web Development Fundamentals	3	0	0	3	3
28	U23OE133	Network Management Systems	3	0	0	3	3
29	U23OE134	Fundamentals of Mobile Computing	3	0	0	3	3
30	U23OE135	Electronic Commerce	3	0	0	3	3
31	U23OE136	Machine Learning using Python	2	0	2	4	3
32	U23OE137	Applied Design Thinking	3	0	0	3	3
33	U23OE138	Fire Safety Engineering	3	0	0	3	3
34	U23OE139	Functional Materials	3	0	0	3	3
35	U23OE140	Fundamentals of Aeronautical Engineering	3	0	0	3	3
36	U23OE141	Industrial Design & Rapid Prototyping Techniques	3	0	0	3	3

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SET II - Open Electives for the Department of EEE							
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	U23OE227	Foundation of AI & Problem solving	3	0	0	3	3
23	U23OE228	Introduction to R Programming	3	0	0	3	3
24	U23OE229	Foundations of NLP	3	0	0	3	3
25	U23OE230	Foundations of Speech Recognition	3	0	0	3	3
26	U23OE231	Essentials of Data Science and Analytics	3	0	0	3	3
27	U23OE232	Fundamentals of Network Security	2	0	2	4	3
28	U23OE233	Cyber Laws and Ethics	3	0	0	3	3
29	U23OE234	Trust Management in E-Commerce	3	0	0	3	3
30	U23OE235	Linux Fundamentals	2	0	2	4	3
31	U23OE236	Cyber Threat Intelligence	3	0	0	3	3
32	U23OE237	Nanomaterials and applications	3	0	0	3	3
33	U23OE238	Plastic Materials for Engineers	3	0	0	3	3
34	U23OE239	Production and Operations Management for Entrepreneurs	3	0	0	3	3
35	U23OE240	Quality Engineering	3	0	0	3	3
36	U23OE241	Reverse Engineering	3	0	0	3	3

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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** L T P C

(Common to all branches) 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 AND FREEHAND SKETCHING** **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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U23BE103	BASIC CIVIL AND MECHANICAL ENGINEERING	L	T	P	C
Prerequisites:	**Nil**	3	0	0	3

COURSE OBJECTIVES:

- To impart basic Civil and Mechanical Engineering knowledge.
- To familiarize materials and measurements in Civil Engineering and the fundamental components of civil engineering structures
- To enable the students to distinguish the components and working principle of power plant units, IC engines, and pumps, Refrigerators and Air Conditioner.

UNIT I INTRODUCTION TO CIVIL AND MECHANICAL ENGINEERING 9

Civil Engineering: Civil Engineering contributions to the welfare of Society Specialized sub disciplines in Civil Engineering – Structural, Construction, Geotechnical, Environmental, Transportation and Water Resources Engineering.

Mechanical Engineering: Mechanical Engineering contributions to the welfare of Society – Specialized sub disciplines in Mechanical Engineering – Production, Automobile, Energy Engineering - Interdisciplinary concepts in Civil and Mechanical Engineering.

UNIT II SURVEYING AND BUILDING MATERIALS 9

Surveying: Objects – classification – principles – measurements of distances – angles – levelling – determination of areas– contours - examples.

Building Materials: Bricks – stones – sand – cement – concrete – steel - timber - modern materials.

UNIT III BUILDING COMPONENTS AND STRUCTURES 9

Foundations: Types of foundations - Bearing capacity and settlement – Requirement of good foundations.

Civil Engineering Structures: Brick masonry – stonemasonry – beams – columns – lintels – roofing – flooring – plastering - Types of Bridges and Dams - introduction to highway, railway, airport, docks and harbor.

UNIT IV INTERNAL COMBUSTION ENGINES AND POWER PLANTS 9

Classification of Power Plants - Internal combustion engines as automobile power plant – Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines – Working principle of steam, Gas, Diesel, Hydro – electric and Nuclear Power plants – working principle of Boilers, Turbines, Reciprocating Pumps (single acting and double acting) and Centrifugal Pumps.

UNIT V REFRIGERATION AND AIR CONDITIONING SYSTEM 9

Terminology of Refrigeration and Air Conditioning. Principle of vapour compression and absorption system – Layout of typical domestic refrigerator, Window and Split type room Air conditioner.

TOTAL: 45PERIODS

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TEXT BOOKS:

1 Shanmugam G, Palanichamy M S, "Basic Civil and Mechanical Engineering", 1st Edition, Tata McGraw Hill, 2018.
2 Mamlouk M S, Zaniew Ski J P, "Materials for Civil and Construction Engineering, 4th Edition, Pearson Education, 2021.

REFERENCES:

1 T P Kanetkar, "Surveying and Levelling", Vols. I and II, United Book Corporation, 2014.
2 Ramamrutham S, "Basic Civil Engineering", 4th Edition, Dhanpat Rai Publishing Company Ltd., 2018.
3 Arora C P, "Refrigeration and Air Conditioning", 4th Edition, Tata McGraw Hill, 2021.

ONLINE RESOURCES:

1 https://www.digimat.in/nptel/courses/video/105104101/L01.html
2 https://www.coursera.org/courses?query=civil%20engineering
3 https://www.classcentral.com/subject/mechanical-engineering

COURSEOUTCOMES:

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

CO1 Summarise the specialized sub-disciplines in civil and mechanical engineering and their contribution to the welfare of society.
CO2 Explain the basics of surveying and the civil engineering materials used in construction.
CO3 Summarise the components of the building and the infrastructure facilities.
CO4 Describe the working principles and components used in power plant cycle, petrol and diesel engines, boilers and pumps.
CO5 Explain the refrigeration and Air-conditioning system.

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	-	-	1
CO3	2	2	1	1	-	-	-	-	1	-	-	1
CO4	2	2	1	1	-	-	-	1	1	-	-	1
CO5	2	2	1	1	-	-	-	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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U23PH201 PHYSICS FOR ELECTRICAL AND ELCTRONICS ENGINEERS L T P C

Prerequisites: Engineering Physics 3 0 0 3

COURSE OBJECTIVES:

- To enable the students effectively understand the characteristics, and properties of the conductor, semiconductor.
- To instil knowledge on physics of magnetic and superconducting materials.
- To inculcate an idea of significance of optoelectronic devices, new engineering materials and their applications.

UNIT I ELECTRICAL PROPERTIES OF MATERIALS 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- energy bands in solids.

UNIT II SEMICONDUCTOR PHYSICS 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, applications- experimental verification of Hall effect – Applications.

UNIT III MAGNETIC AND SUPERCONDUCTING MATERIALS 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 OPTICAL PROPERTIES OF MATERIALS 9

Classification of optical materials – carrier generation and recombination processes – Absorption emission and scattering of light in metals, insulators and semiconductors (concepts) – opto electronic devices: photo detectors, solar cell, LED, organic LED, Laser diodes – Optical data storage techniques.

UNIT V NEW ENGINEERING MATERIALS 9

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

TOTAL: 45 PERIODS

TEXT BOOKS:

1 S O Kasap, "Principles of Electronic Materials and Devices ", Tata McGraw Hill, 2020.

2 Donald A Neamen, "Semiconductor Physics and Devices Basic Principles", Jain Book Agency, 2024.

REFERENCES:

1 D W Snoke, "Solid-state Physics: Essential Concepts", 2nd Edition, Cambridge University Press, 2020.

2 Kelly S Potter, Joseph Simmons, "Optical Materials", 2nd Edition, Elsevier, 2021.

3 Visakh P M, Artem Semkin, R Balakrishnan, S Lazovic, "Nanotechnology in Electronics: Materials, Properties, Devices", John Wiley & Sons, 2022.

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 electrical properties of materials based on classical, quantum free electron theories.

CO2 Describe the fundamentals of semiconductor Physics.

CO3 Summarize various types of magnetic and superconducting materials and its applications.

CO4 Apply the optical properties of materials in functioning of optoelectronic devices.

CO5 Explain the various new engineering materials, nano electronic devices and its applications.

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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U23EE201	ELECTRIC CIRCUIT ANALYSIS	L	T	P	C
Prerequisites:	**Engineering Physics**	3	1	0	4

COURSE OBJECTIVES:

- To introduce network topology and key concepts to analyze electrical circuits using basic laws and Theorems.
- To educate on obtaining the transient response of circuits with DC & Sinusoidal excitations.
- To introduce the concepts of resonance, coupled circuits and three phase circuits.

UNIT I **NETWORK TOPOLOGY & DC CIRCUIT ANALYSIS** **12**

Introduction to Network topology, Trees, Resistive elements - Ohm's Law – Network reduction: Resistors in series and parallel circuits, voltage and current division, source transformation, star delta conversion – Kirchoff's laws – Mesh current and node voltage - methods of analysis with dependent and independent sources.

UNIT II **NETWORK THEOREMS FOR DC AND AC CIRCUITS** **12**

Superposition Theorem, Thevenin's and Norton's Theorem – Maximum power transfer theorem – Reciprocity Theorem – Millman's theorem – DC & AC Circuit Analysis using network theorems.

UNIT III **TRANSIENT RESPONSE ANALYSIS** **12**

L and C elements –Transient response of RL, RC and RLC Circuits using Laplace transform for DC input and A.C. sinusoidal input.

UNIT IV **RESONANCE & COUPLED CIRCUITS** **12**

Series and parallel resonance – frequency response – Quality factor and Bandwidth – Self and mutual inductance- Dot rule – Coefficient of coupling – Single tuned circuits – Double tuned circuits.

UNIT V **THREE PHASE CIRCUITS** **12**

A.C. circuits – Average and RMS value - Phasor Diagram – Power, Power Factor - Analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced & unbalanced – phasor diagram of voltages and currents – Power measurement in three phase circuits.

TOTAL: 60 PERIODS

TEXT BOOKS:

1 William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis", Tata McGraw Hill, 6th Edition, New Delhi, 2024.

2 J David Irwin, R Martin Nelms, "Engineering Circuit Analysis", 12th Edition, John Wiley & Sons, 2022.

REFERENCES:

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1 Chakrabarti A, "Circuits Theory (Analysis and Synthesis)", Dhanpat Rai & Sons, 2020.

2 Joseph A. Edminister, Mahmood Nahvi, "Electric circuits: Schaum's Series", 1st Edition Tata McGraw Hill, 2019.

3 Richard C Dorf, James A Svoboda, "Introduction to Electric Circuits", 7th Edition, John Wiley & Sons, 2018.

4 Sudhakar A, Shyam Mohan S P, "Circuits and Networks Analysis and Synthesis", Tata McGraw Hill, 2017.

ONLINE RESOURCES:

1 https://nptel.ac.in/courses/108108112.

2 https://archive.nptel.ac.in/courses/108/104/108104139

3 https://archive.nptel.ac.in/courses/108/105/108105159

COURSE OUTCOMES:

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

CO1 Analyze DC circuits using basic circuit laws.

CO2 Apply network theorems to determine the behaviour of the given DC and AC circuit

CO3 Analyze transient response of RL, RC & RLC circuits to step and sinusoidal input

CO4 Describe the behaviour of resonance & magnetically coupled circuits.

CO5 Analyze the power, line/ phase voltage and currents of three phase circuits.

CO – PO – PSO MAPPING:

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

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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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U23EE202	ELECTRIC CIRCUITS LABORATORY	L	T	P	C
Pre requisites: NIL		0	0	3	1.5

COURSE OBJECTIVES:

- To simulate various electric circuits using Pspice/ Matlab/e-Sim / Scilab
- To gain practical experience on electric circuits, verification of theorems and power measurement.
- To design and implement resonance circuits.

LIST OF EXPERIMENTS

1. Experimental verification of electrical circuits using Kirchoff's Laws.
2. Simulation and experimental verification of electrical circuit problems using Thevenin's theorem.
3. Verification of electrical circuit problems using Norton's theorem through simulation.
4. Experimental verification of electrical circuit problems using Superposition theorem.
5. Experimental verification of Maximum Power transfer theorem.
6. Measurement of sinusoidal voltage and frequency using analog/digital oscilloscope.
7. Observe the R-C electric circuit transients response through simulation
8. Observe the R-L electric circuit transients response through simulation
9. Design and implementation of series resonance circuit.
10. Design and implementation of parallel resonance circuit.
11. Observe the frequency response of series and parallel resonance circuits through simulation.
12. Experimental verification of three phase power measurement using two wattmeter method.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After the completion of this laboratory course, the student will be able to

CO1 Evaluate output current and voltage for electric circuits using fundamental electrical laws & network theorems with experimental set up / simulation.
CO2 Design series and parallel RLC circuit and obtain its frequency response.
CO3 Analyze transient behavior of the given RL & RC circuits using simulation.
CO4 Demonstrate the measurement of sinusoidal voltage and frequency.
CO5 Analyze the performance of the given three-phase circuit experimentally.

CO – PO – PSO MAPPING:

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

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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:

1 Macieg Borodzik, Pawel Goldstein, "Problems on Partial Differential Equations", Springer, 2019.

2 J O Bird, "Higher Engineering Mathematics", 9th Edition, Taylor & Francis, 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	-	-
CO4	3	2	1	1	-	-	-	1	-	-	-	1	1	-
CO5	3	2	1	1	-	-	-	1	-	-	-	1	1	-

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U23EE301	ELECTROMAGNETIC FIELDS	L	T	P	C
Pre requisites:	**Engineering Mathematics**	3	1	0	4

COURSE OBJECTIVES:

- To impart knowledge on the basics of electric and magnetic fields and their applications for utilization in the development of the theory for power transmission lines and electrical machines.
- To analyse the relation between the fields under time varying situations.
- To introduce the concepts of electromagnetic waves and characterizing parameters

UNIT I **INTRODUCTION** **12**

Sources and effects of Electro-Magnetic Fields, Scalar and vector, Unit vector, Mathematical operations of Vector, Scalar and vector fields, Different Coordinate System, Operator Del, Physical interpretation of gradient, divergence and curl, Conversion between coordinate system, Expression for gradient, divergence and curl in three coordinate system.

UNIT II **BASIC ELECTROSTATICS** **12**

Coulomb's law, Electric field, Electric Field Intensity (EFI), EFI due to - point charge, line charge, surface charge and volume charge, Electric displacement, Electric flux density, Gauss's law (scalar and vector form), Applications of Gauss law, Electric field due to – point charge, infinite long straight conductor and infinite plane sheet of charge, Divergence theorem, Stoke's theorem.

UNIT III **APPLIED ELECTROSTATICS** **12**

Electric Potential, Relationship between E and V, Equipotential surfaces, Electric dipole and flux lines, Electric field due to dipole, Energy density in electrostatic field, Energy stored in terms of D and E, Convection and Conduction currents, Current and current density, Continuity equation for current, Poisson's and Laplace's equations, Capacitor and its capacitance, Parallel plate capacitor, Capacitors with multiple dielectrics, Spherical capacitor, Coaxial capacitor.

UNIT IV **MAGNETOSTATICS AND APPLICATIONS** **12**

Magnetic flux density, Magnetic field intensity (MFI), Magnetic permeability, Biot-Savart's law, Applications of Biot-Savart's law, MFI due to - infinite long straight filament, finite length element, on the axis of circular loop, Ampere's Circuital law, Field due to – infinite line current, coaxial cable, Magnetic flux density, Scalar magnetic potential, Vector magnetic potential, Poisson's Equations for Magneto static field, Forces due to magnetic field, Magnetic dipole. Boundary conditions for Magnetostatic Fields.

UNIT V **TIME VARYING FIELDS AND MAXWELL'S EQUATIONS** **12**

Faraday's law, Transformer and motional EMFs – stationary loop in time varying B field, moving loop in static B field and moving loop in time varying field, Displacement current, Maxwell's equations in point form and integral form, Power and Poynting theorem, Concept of uniform plane wave.

TOTAL: 60 PERIODS

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TEXT BOOKS:

1 William H Hayt, John A Buck, "Engineering Electromagnetics", 9th Edition, Tata McGraw Hill, 2020.
2 Mathew N O Sadiku, "Elements of Electromagnetics", 7th Edition, Oxford University Press , 2018.

REFERENCES:

1 Constantine Balanis, "Balani's Engineering Electromagnetics", 3rd Edition, John Wiley & Sons, 2024.
2 Robert Strangeway, Steven S Holland, Kames E Richie, "Electromagnetics and Transmission lines", 2nd Edition, John Wiley & Sons, 2023.
3 Nathan Ida, "Engineering Electromagnetics", 4th Edition, Springer Cham Publishers, 2021.

ONLINE RESOURCES:

1 https://archive.nptel.ac.in/courses/115/104/115104088/
2 http://nitttrc.edu.in/nptel/courses/video/108104099/L38.html
3 https://archive.nptel.ac.in/courses/115/106/115106122/

COURSE OUTCOMES:

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

CO1 Apply the vector operators on electric field and magnetic field in a three dimensional coordinate system.
CO2 Apply the electrostatic laws and theorems to obtain electric field intensity & electric force with discrete and continuous charges.
CO3 Apply the concepts of electrostatics to obtain the electric field, electric potential, boundary conditions & capacitance in different mediums.
CO4 Apply the magneto static laws to obtain magnetic field intensity, flux density, force potential, energy density & torque.
CO5 Explain the different methods of emf generation, Maxwell's equations & its 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	1
CO2	3	2	1	2	-	-	-	1	-	-	-	-	3	1
CO3	3	2	1	2	-	-	-	1	-	-	-	-	3	1
CO4	3	2	1	2	-	-	-	1	-	-	-	-	3	1
CO5	2	2	1	1	-	-	-	-	-	-	-	-	3	1

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U23EE302	ELECTRON DEVICES AND CIRCUITS	L	T	P	C
Pre requisites : Electric Circuit Analysis		3	0	2	4

COURSE OBJECTIVES:

- To understand the structure, operation and applications of basic electronic devices.
- To explore the characteristics of amplifier gain and frequency response.
- To learn the required functionality of positive and negative feedback systems.

UNIT I **PN JUNCTION DEVICES** **9**

PN junction diode –Structure, operation and V-I characteristics, diffusion and transition capacitance Clipping & Clamping circuits - Rectifiers – Half Wave and Full Wave Rectifier– Display devices- LED, Laser diodes, Zener diode characteristics- Zener diode Reverse characteristics – Zener diode as regulator.

UNIT II **TRANSISTORS AND THYRISTORS** **9**

BJT, JFET, MOSFET- structure, operation, characteristics and Biasing UJT, Thyristors and IGBT Structure and characteristics.

UNIT III **AMPLIFIERS** **9**

BJT small signal model – Analysis of CE, CB, CC amplifiers- Gain and frequency response – MOSFET small signal model– Analysis of CS and Source follower – Gain and frequency response- High frequency analysis.

UNIT IV **MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER** **9**

BIMOS cascade amplifier, Differential amplifier – Common mode and Difference mode analysis – FET input stages – Single tuned amplifiers – Gain and frequency response – Neutralization methods, Power amplifiers –Types (Qualitative analysis).

UNIT V **FEEDBACK AMPLIFIERS AND OSCILLATORS** **9**

Advantages of negative feedback – voltage / current, series, Shunt feedback –Positive feedback – Condition for oscillations, phase shift – Wien bridge, Hartley, Colpitts and Crystal oscillators.

45 PERIODS

PRACTICAL EXERCISES:

1. Simulate and Design, Construct and Test a Voltage Regulator with Zener Diode (ZENER/6.1V) using SCILAB/MATLAB.
2. Simulate and Design, Construct and Test a Half Wave Rectifier using diode and to draw its performance characteristics using discrete Components using SCILAB/MATLAB
3. Study and plot the Drain and Transfer characteristics of a Junction Field Effect Transistor using SCILAB/MATLAB.
4. Study and plot the characteristics of Uni- Junction Transistor (UJT) using SCILAB/MATLAB
5. Verify the characteristics of LDR, Photodiode and Phototransistor

6. Analyze the drain characteristics and transfer characteristics of MOSFET using Pspice Software.
7. Verify the working of a Half wave rectifier, Full wave rectifier and full wave bridge rectifier and measure the ripple factor.

30 PERIODS

TOTAL: 75 PERIODS

TEXT BOOKS:

1 Dale R Patrick, Stephen W Fardo, Ray E Richardson, "Electronic Devices and Circuit Fundamentals", 1st Edition, River Publishers, 2023.

2 Sedra, Smith, "Microelectronic Circuits", 7th Edition, Oxford University Press, 2017.

REFERENCES:

1. S Salaivahanan, N Sureshkumar, "Electronic Devices and Circuits", 5th Edition, Tata McGraw Hill, 2022.
2. Thomas L Floyd, "Electronic Devices", 10th Edition, Pearson Education, 2017.
3. Suman Lata Tirupati, Parvej Ahmed Alvi, "Electrical and Electronic Devices, Circuits and Materials", 2nd Edition, CRC Press, 2021.

ONLINE RESOURCES

1 https://onlinecourses.nptel.ac.in/noc21_ee55/preview

2 https://archive.nptel.ac.in/courses/108/102/108102097/

3 https://nptel.ac.in/courses/108101091

COURSE OUTCOMES:

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

CO1 Evaluate the characteristics of PN junction devices (diode, Zener diode, LED and Laser diode)

CO2 Analyze the structure and characteristics BJT, FET, MOSFET, UJT, Thyristor and IGBT

CO3 Analyze the performance of various configurations of BJT and MOSFET based amplifier

CO4 Explain the characteristics of MOS based cascade and differential amplifier

CO5 Explain the operation of various feedback amplifiers and oscillators

CO – PO – PSO MAPPING:

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

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U23EE303 **ELECTRICAL MACHINES - I** L T P C

Pre requisites : Electric Circuit Analysis 3 0 0 3

COURSE OBJECTIVES:

- To introduce the concept of rotating machines and the principle of electromechanical energy conversion in single and multiple excited systems
- To impart knowledge on the generation of D.C. voltages by using different type of generators and study their performance and to study the working principles of D.C. motors and their load characteristics, starting and methods of speed control.
- To familiarize with the constructional details of different type of transformers, working principle and their performance.

UNIT I BASIC CONCEPTS OF ROTATING MACHINES 9

Principles of electromechanical energy conversion – Single and multiple excited systems – m.m.f of distributed A.C. windings – Rotating magnetic field.

UNIT II DC GENERATORS 9

Constructional details – emf equation – Methods of excitation – Self and separately excited generators – Characteristics of series, shunt and compound generators – Armature reaction and commutation – Parallel operation of DC shunt and compound generators.

UNIT III DC MOTORS 9

Principle of operation – Back emf and torque equation – Series, Shunt and Compound motors – Characteristics - Starting – Types of starters – Speed control.

UNIT IV TRANSFORMERS 9

Constructional details of core and shell type transformers – Types of windings – Principle of operation – emf equation – Transformer on no-load – Parameters referred to HV / LV windings – Equivalent circuit – Transformer on load – Regulation – Parallel operation of single phase transformers – Auto transformer – Three phase transformers – Vector group-tap changing.

UNIT V TESTING OF DC MACHINES AND TRANSFORMERS 9

Losses and efficiency in DC machines and transformers – Condition for maximum efficiency – Testing of DC machines – Brake test, Swinburne's test, Retardation test and Hopkinson's test – Testing of transformers – Polarity test, Sumpner's test, load test – All day efficiency.

TOTAL: 45PERIODS

TEXT BOOKS:

1 D P Kothari, I J Nagrath, "Electric Machines", 4th Edition, Tata McGraw Hill, 2018.
2 P S Bimbhra, "Electrical Machinery", 1st Edition, Khanna Publishers, 2021.

REFERENCES

1 A E Fitzgerald, Charles Kingsley, Stephen D Umans, "Electric Machinery", 8th Edition, Tata McGraw Hill , 2017.
2 B L Theraja, A K Theraja, "A Textbook of Electrical Technology", 2nd Volume, S Chand Publications, 2019.
3 J B Gupta, "Theory and Performance of Electrical Machines", S K Kataria & Sons, 2019.

ONLINE RESOURCES:

1 https://archive.nptel.ac.in/courses/108/102/108102146/
2 https://onlinecourses.nptel.ac.in/noc22_ee111/preview
3 https://www.classcentral.com/course/swayam-electrical-machines-i-iitkgp-14031

COURSE OUTCOMES:

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

CO1 Summarize the basics of magnetic circuits and the energy conversion in electromagnetic fields.
CO2 Comprehend the construction and winding structure of the DC Generators.
CO3 Explain the operation, classification and performance analysis of DC motors.
CO4 Summarize the construction, operating principle and performance analysis of transformers.
CO5 Explain the various losses in D.C. machines and transformers and to study the different testing methods to arrive at their performance

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	2
CO2	2	2	1	1	-	-	-	1	-	-	-	-	3	2
CO3	2	2	1	1	-	-	-	1	-	-	-	-	3	2
CO4	2	2	1	1	-	-	-	1	-	-	-	-	3	2
CO5	2	2	1	1	-	-	-	1	-	-	-	-	3	2

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U23EE304	MEASUREMENTS AND INSTRUMENTATION	L	T	P	C
Pre requisites:	**Electric Circuit Analysis**	3	0	0	3

COURSE OBJECTIVES:

- To educate the fundamental concepts and characteristics of measurement and errors
- To impart knowledge on the functional aspects of measuring instruments
- To infer the importance of various bridge circuits used with measuring instruments.

UNIT I CONCEPTS OF MEASUREMENTS 9

Instruments: classification, applications – Elements of a generalized measurement system - Static and dynamic characteristics - Errors in measurement -Statistical evaluation of measurement data.

UNIT II MEASUREMENT OF PARAMETERS IN ELECTRICAL SYSTEMS 9

Classification of instruments–moving coil and moving iron meters – Induction type, dynamometer type watt meters – Energy meter – Megger – Instrument transformers (CT & PT).

UNIT III AC/DC BRIDGES AND INSTRUMENTATION AMPLIFIERS 9

Wheatstone bridge, Kelvin double bridge - Maxwell, Hay, Wien and Schering bridges – Errors and compensation in A.C. bridges - Instrumentation Amplifiers.

UNIT IV TRANSDUCERS FOR MEASUREMENT OF NON- ELECTRICAL PARAMETERS 9

Classification of transducers – Measurement of pressure, temperature, displacement, flow, angular velocity – Digital transducers – Smart Sensors.

UNIT V DIGITAL INSTRUMENTATION 9

A/D converters: types and characteristics – Sampling, Errors- Measurement of voltage, Current,frequency and phase - D/A converters: types and characteristics- DSO- Data Loggers – Basics of PLC programming and Introduction to Virtual Instrumentation - Instrument standards.

TOTAL:45PERIODS

TEXT BOOKS:

1 A K Sawhney, "A Course in Electrical and Electronic Measurements & Instrumentation", Dhanpat Rai and Co., 2023.

2 Mark L Zyla, "Fair Value Measurement: Practical Guidance and Implementation", John Wiley & Sons, 2019.

REFERENCES

1 E O Doebelin, D N Manik, "Measurement Systems – Application and Design", 6th Edition, Tata McGraw Hill, 2020.

2 Chaudhary Nakra, "Instrumentation Measurement and Analysis", 4th Edition, McGraw Hill, 2022

3 S Salivahanan, N Suresh Kumar, "Electronic Devices and Circuits", 4thEdition, Tata McGraw Hill, 2022.

ONLINE RESOURCES:

1 https://archive.nptel.ac.in/courses/108/105/108105064/

2 http://digimat.in/nptel/courses/video/108105153/L12.html

3 http://digimat.in/nptel/courses/video/108105153/L16.html

COURSE OUTCOMES:

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

CO1 Explain the classification static and dynamic characteristics and error of instruments

CO2 Describe the types of moving iron and moving coil instruments .

CO3 Summarize the types of AC/DC bridges and instrumentation amplifiers.

CO4 Explain the classification of transducers and smart sensors

CO5 Describe A/D converters, D/A converters and basics of PLC programming.

CO – PO – PSO MAPPING:

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

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U23EE305	DIGITAL LOGIC CIRCUITS	L	T	P	C
Pre requisites: Engineering Mathematics		3	0	2	4

COURSE OBJECTIVES:

- To understand Basic theorems of Boolean algebra and gate level minimization and implementation.
- To explore the Procedures for the analysis and design of combinational circuits and sequential circuits.
- To introduce digital simulation techniques for development of application oriented logic circuits.

UNIT I BOOLEAN ALGEBRA AND GATE LEVEL MINIMIZATION 9

Boolean theorems and properties –Boolean functions -Logic gates –Gate Level Minimization using Karnaugh map, POS simplification, Don't Care conditions and Quine-McCluskey method. Implementations of Logic Functions using gates-NAND–NOR implementations.

UNIT II COMBINATIONAL LOGIC CIRCUITS 9

Design of adders, subtractor, Adder with Look Ahead Carry, Subtraction using adder, Multiplexers-Combinational logic design using Multiplexers-Demultiplexers and their use in combinational logic design-Magnitude comparators, Code Converters-BCD to Binary and Binary to BCD, Priority Encoders-Decimal to BCD, Octal to Binary, Decoders-BCD to Decimal and BCD to Seven Segment Display driver.

UNIT III SYNCHRONOUS SEQUENTIAL CIRCUITS 9

Sequential logic- SR, JK, D and T flip flops - level triggering and edge triggering - counters - asynchronous and synchronous type - Modulo counters - Shift registers - design of synchronous sequential circuits – Moore and Mealy models- Counters, state diagram; state reduction; state assignment.

UNIT IV ASYNCHRONOUS SEQUENTIAL CIRCUITS AND PROGRAMMABLE LOGIC DEVICES 9

Asynchronous sequential logic Circuits-Transition stability, flow stability-race conditions, hazards & errors in digital circuits; analysis of asynchronous sequential logic circuits introduction to Programmability Logic Devices: PROM – PLA –PAL, CPLD-FPGA.

UNIT V DIGITAL LOGIC FAMILIES AND VHDL 9

Digital Logic Families -comparison of RTL, DTL, TTL, ECL and MOS families - operation, characteristics of digital logic family, RTL Design – combinational logic – Sequential circuit – Operators – Introduction to Packages – Subprograms – Test bench. (Simulation /Tutorial Examples: adders, counters, flip flops, Multiplexers & Demultiplexers).

TOTAL: 45 PERIODS

PRACTICAL EXERCISES

1. Implementation of Adder and Subtractor circuits.
2. Verify Code converters: Excess-3 to BCD and Binary to Gray code converter.
3. Verify the output of Parity generator and parity checking.
4. Verify the truth table of Encoders and Decoders.

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5. Design of Magnitude Comparators.
6. Synchronous and asynchronous Counters: Design and implementation of 3-bit modulo counters.
7. Shift Registers: Design and implementation of 4-bit shift registers in SISO, SIPO, PISO, PIPO modes using suitability IC's.

30 PERIODS
TOTAL:75 PERIODS

TEXT BOOKS:

1 M Morris Mano, "Digital Logic and Computer Design", Pearson Education, 2023.
2 Shamsher S Dillon, "Fundamentals of Digital Logic Design and Computer Organization", 2021.

REFERENCES:

1 Thomas L Floyd, "Digital Fundamentals", 11th Edition, Pearson Education, 2019.
2 Narendra S Jadhav, Alpana P Adsul, "Digital Logic Design", Nirali Prakashan Publication, 2019.
3 Alam Mansaf, Alam Bashir, "Digital Logic Design", Pearson Education, 2015.

ONLINE RESOURCES:

1 https://onlinecourses.nptel.ac.in/noc21_ee75/preview
2 https://freevideolectures.com/course/4238/nptel-digital-electronic-circuits
3 http://www.nitttrc.edu.in/nptel/courses/video/117105080/L06.html

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 Apply Boolean algebra and gate level minimization to design digital circuits.
CO2 Design combinational logic circuits.
CO3 Design various synchronous circuits using Flip Flops.
CO4 Design asynchronous sequential circuits and programmable logic devices.
CO5 Write VHDL code for simulating RTL, combination and sequential circuits.

CO – PO – PSO MAPPING:

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

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U23EE306	ELECTRICAL MACHINES – I LABORATORY	L	T	P	C
Pre requisites:	**Electrical Machines – I**	0	0	3	1.5

COURSE OBJECTIVES:

- To determine the characteristics of DC Machines and Transformers .
- To provide hands on experience to evaluate the performance parameters of machines .
- To provide hands on experience to evaluate performance parameters of transformer.

LIST OF EXPERIMENTS

1. Open and load characteristics of DC shunt generator - Calculation of critical values.
2. Load characteristics of DC differential and Cumulative Compound Generator.
3. Load test on DC shunt motor.
4. Load test on DC compound motor.
5. Load test on DC series motor.
6. Swinburne's test and speed control of DC shunt motor.
7. Hopkinson's test on DC motor – generator set.
8. Load test on single-phase transformer and three phase transformers.
9. Open circuit and short circuit tests on single phase transformer.
10. Sumpner's test on single phase transformers.
11. Separation of no-load losses in single phase transformer.
12. Study of starters and 3-phase transformers connections.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After the completion of this laboratory course, the student will be able to

CO1 Examine the circuit with appropriate connections for DC Machine/ Transformer.
CO2 Analyse experimentally the characteristics of different types of DC Machines.
CO3 Analyse the speed control techniques for a DC Motor for industrial applications.
CO4 Analyse experimentally the performance parameters of Transformers and DC Motor.
CO5 Explain DC Motor starters and 3-phase Transformer connections.

CO – PO – PSO MAPPING:

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

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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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U23MA401	NUMERICAL METHODS	L	T	P	C
Pre Requisites: Engineering Mathematics		3	1	0	4

COURSE OBJECTIVES:

- To introduce the concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals and numerical techniques of interpolation in various intervals and role in engineering and technology disciplines.
- To understand the knowledge of various techniques and methods of solving various types of partial differential equations.

UNIT I SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS 12

Solution of algebraic and transcendental equations - Newton Raphson method - Solution of linear system of equations -Gauss elimination method - Pivoting - Gauss Jordan method - Iterative methods of Gauss Jacobi and Gauss Seidel - Eigenvalues of a matrix by Power method.

UNIT II INTERPOLATION AND APPROXIMATION 12

Interpolation with unequal intervals - Lagrange's interpolation - Newton's divided difference interpolation - Difference operators and relations - Interpolation with equal intervals - Newton's forward and backward difference formulae.

UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION 12

Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal, Simpson's 1/3 rule - Romberg's Method - Evaluation of double integrals by Trapezoidal and Simpson's 1/3 rules.

UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS 12

Single step methods - Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge - Kutta method for solving first order equations -Multi step methods - Milne's and Adams - Bash forth predictor corrector methods for solving first order equations.

UNIT V BOUNDARY VALUE PROBLEMS FOR ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS 12

Finite difference methods for solving second order two - point linear boundary value problems - Finite difference techniques for the solution of two dimensional Laplace's equation on rectangular domain - One dimensional heat flow equation by explicit and implicit (Crank Nicholson) methods.

TOTAL: 60 PERIODS

TEXT BOOKS:

1 Stevan C Chapra, "Numerical Methods for Engineers", 8th Edition, Tata McGraw Hill, 2021.

2 P N Chaterjee, "Numerical Analysis", 3rd Edition, Pragati Prakashan, 2023.

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REFERENCES:

1 Rajesh Kumar Gupta, "Numerical Methods: Fundamentals and Applications", 1st Edition, Cambridge University Press, May 2019.
2 Jeffry J Leader, "Numerical Analysis and Scientific Computation", 2nd Edition, CRC Press, 2022.
3 S S Sastry, "Introductory Methods of Numerical Analysis", 5th Edition, Cambridge University Press, 2019.

ONLINE RESOURCES:

1 https://archive.nptel.ac.in/courses/111/107/111107105/
2 https://archive.nptel.ac.in/courses/127/106/127106019/
3 https://archive.nptel.ac.in/courses/111/104/111104030/

COURSE OUTCOMES:

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

CO1 Solve the algebraic and transcendental equations using different methods.

CO2 Calculate unknown values in interpolation and approximation using various methods.

CO3 Evaluate the numerical integration and differentiation using the numerical techniques.

CO4 Apply the various techniques and methods for solving first and second order ordinary differential equations.

CO5 Solve the partial and ordinary differential equations with initial and boundary conditions using certain techniques with engineering 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	-	-	-	-	-	-
CO2	3	2	1	2	-	-	-	-	-	-	-	-	-	-
CO3	3	3	2	3	-	-	-	-	-	-	-	-	2	-
CO4	3	2	1	2	-	-	-	1	-	-	-	1	-	-
CO5	3	2	1	2	-	-	-	1	-	-	-	1	2	2

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U23EE401	TRANSMISSION AND DISTRIBUTION	L	T	P	C
Pre requisites: Electric Circuit Analysis		3	1	0	4

COURSE OBJECTIVES:

- To impart knowledge about the configuration of the line parameters and mechanical design of performance analysis in transmission lines.
- To learn about line support by different insulators and underground cables.
- To understand and analyse the distribution system.

UNIT I TRANSMISSION LINE PARAMETERS 12

Structure of electric power system - Parameters of single and three phase transmission lines with single and double circuits -Resistance, inductance, and capacitance of solid, stranded, and bundled conductors - Typical configuration, conductor types - Symmetrical and unsymmetrical spacing and transposition – application of self and mutual GMD; skin and proximity effects - Effects of earth on the capacitance of the transmission line.

UNIT II MODELLING AND PERFORMANCE OF TRANSMISSION LINES 12

Performance of Transmission lines – short line, medium line and long line – equivalent circuits, phasor diagram, attenuation constant, phase constant, surge impedance – transmission efficiency and voltage regulation, real and reactive power flow in lines – Ferranti effect – Formation of Corona – Critical Voltages – Effect on line Performance.

UNIT III SAG CALCULATION AND LINE SUPPORTS 12

Mechanical design of overhead lines – Line Supports –Types of towers – Tension and Sag Calculation for different weather conditions – Methods of grounding - Insulators: Types, voltage distribution in insulator string, improvement of string efficiency, testing of insulators.

UNIT IV UNDERGROUND CABLES 12

Underground cables – Types of cables – Construction of single-core and 3-core belted cables – Insulation Resistance – Potential Gradient – Capacitance of single-core and 3-core belted cables – Grading of cables – Power factor and heating of cables.

UNIT V DISTRIBUTION SYSTEMS 12

Distribution Systems – General Aspects –AC and DC distributions –Concentrated and Distributed loading- Techniques of Voltage Control and Power factor improvement – Distribution Loss – Types of Substations.

TOTAL: 60 PERIODS

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TEXT BOOKS:

1 Nicole Gruber, "Fundamentals of Power Transmission and Distribution", Tritech Digital Media, 2018.

2 Anthony J Pansini, "Power Transmission and Distribution", 2nd Edition, Taylor & Francis Group, 2020.

REFERENCES:

1 B R Gupta, "Power System Analysis and Design" , 7th Edition, S Chand, 2019.

2 A S Pabla, "Electric Power Distribution", 7th Edition, Tata McGraw Hill, 2019.

3 Noam Chomsky, "Power Systems: Conversations with David Barsamian on Global Democratic Uprisings and the New Challenges to U.S. Empire Hardcover", Haymarket Books, 2024.

ONLINE RESOURCES:

1 https://www.udemy.com/course/transmission-power-engineering-fundamentals/

2 https://archive.nptel.ac.in/courses/108/102/108102047/

3 https://electrical-engineering-portal.com/courses/transmission-distribution-line-infra/

COURSE OUTCOMES:

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

CO1 Summarize the structure of the power system, computation of transmission line parameters for different configurations.

CO2 Apply the transmission line concepts to determine the line performance and the impact of Ferranti effect and corona.

CO3 Describe a mechanical design of transmission lines, grounding and to understand about the insulators in the transmission system.

CO4 Explain the underground cables and understand the performance analysis of UG cable.

CO5 Apply the modelling, performance analysis and modern trends in the distribution system.

CO – PO – PSO MAPPING:

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

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U23EE402 **ELECTRICAL MACHINES – II**

L	T	P	C
3	0	0	3

Pre requisites : Electrical Machines – I

COURSE OBJECTIVES:

- To impart knowledge on construction, theory of operation and performance of non – salient types of synchronous generators.
- To teach the principle of operation and performance of synchronous motors under varying excitation and load condition.
- To impart knowledge on construction, principle of operation and performance, starting and speed control of of phase induction machines

UNIT I **SYNCHRONOUS GENERATORS** 9

Constructional details – Types of rotors – EMF equation – Synchronous reactance – Armature reaction – Voltage regulation – EMF, MMF, ZPF and ASA methods

UNIT II **SYNCHRONIZING AND PARALLEL OPERATION OF SYNCHRONOUS GENERATORS** 9

Synchronizing and parallel operation – Synchronizing torque - Change of excitation and mechanical input – Two reaction theory – Determination of direct and quadrature axis synchronous reactance using slip test – Operating characteristics - Capability curves

UNIT III **SYNCHRONOUS MOTORS** 9

Principle of operation – Torque equation – Operation on infinite bus bars - V-curves – Power input and power developed equations – Starting methods – Current loci for constant power input, constant excitation and constant power developed

UNIT IV **INDUCTION MOTORS** 9

Constructional details – Types of rotors – Principle of operation – Slip – Equivalent circuit – Slip-torque characteristics - Condition for maximum torque -No load and blocked rotor tests- Load test – Losses and efficiency – Circle diagram – Separation of no load losses –- Induction generators – Self-excited and Grid connected. Constructional details of single phase induction motor – Double revolving field theory and operation – Equivalent circuit – No load and blocked rotor test – Performance analysis

UNIT V **STARTING AND SPEED CONTROL OF INDUCTION MOTORS** 9

Need for starting – Types of starters in three phase induction motors – autotransformer , star-delta and rotor resistance starters – Methods of speed control – Change of voltage, frequency - number of poles and slip – Slip power recovery scheme. Starting methods of single-phase induction motors – Universal motor

TOTAL: 45 PERIODS

TEXT BOOKS:

1 A E Fitzgerald, Charles Kingsley, Stephen. D Umans, "Electric Machinery", 6th Edition, Tata McGraw Hill, 2017.

2 Stephen J Chapman, "Electric Machinery Fundamentals" 4th Edition, Tata McGraw Hill, 2017.

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REFERENCES

1 D P Kothari and I J Nagrath, "Electric Machines", 6th Edition, Tata McGraw Hill, 2018.

2 P S Bhimbhra, "Electrical Machinery", 2nd Edition, Khanna Publishing Ltd., 2021.

3 Slobodan N Vukosavic, "Electrical Machines", Springer, 2013

ONLINE RESOURCES:

1 https://archive.nptel.ac.in/courses/108/105/108105131/

2 https://www.coursera.org/courses?query=electrical%20engineering&productTypeDescription=Degrees

3 https://onlinecourses.nptel.ac.in/noc24_ee53/preview

COURSE OUTCOMES:

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

CO1 Summarise the theory of synchronous machines and will be able to calculate the regulation of non- salient pole alternators by different methods

CO2 Analyse the parallel operation of alternators and will be able to calculate the regulation of salient pole alternators by two reaction theory.

CO3 Comprehend the principle of operation and performance of synchronous motors under varying excitation and load condition.

CO4 Explain the construction and complete working of three phase induction machines, including its performance as induction generators.

CO5 Summarise the methods of starting and speed control of single phase induction motors.

CO – PO – PSO MAPPING:

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

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U23EE403	LINEAR INTEGRATED CIRCUITS	L	T	P	C
Pre requisites: Electronic Devices and Circuits		3	0	2	4

COURSE OBJECTIVES:

- To understand the basic building blocks of linear integrated circuits, characteristics and their configurations.
- To explore the design procedure of applications using operational amplifiers, analog multipliers and PLL
- To learn the concepts of waveform generation operation of ADC , DAC and introduce some special function ICs

UNIT I **IC FABRICATION** **9**

IC classification, fundamental of monolithic IC technology, epitaxial growth, masking and etching, diffusion of impurities. Realisation of monolithic ICs and packaging. Fabrication of diodes, capacitance, resistance, FETs and PV Cell.

UNIT II **CHARACTERISTICS OF OPAMP** **9**

Ideal OP-AMP characteristics, Basic op-amp configurations, Ideal op-amp circuit analysis, Loop gain, General operational amplifier stages -and internal circuit diagrams of IC 741, differential amplifier; frequency response of OP-AMP, DC and AC performance characteristics, slew rate.

UNIT III **APPLICATIONS OF OPAMP** **9**

Applications of op-amp – summer, differentiator and integrator, Instrumentation amplifier, AC amplifier, first order active filters, V/I & I/V converters, comparators, waveform generators, clippers, clampers, peak detector, S/H circuit, Log and anti-log amplifier, Multiplier and divider, Power amplifiers, D/A (R- 2R ladder and weighted resistor types) and A/D converters.

UNIT IV **TIMER AND PLL** **9**

555 Timer circuit – Functional block, characteristics & applications; 566-voltage controlled oscillator circuit; 565- phase lock loop circuit functioning and applications, AD633 Analog multiplier ICs

UNIT V **APPLICATION ICS** **9**

AD623 Instrumentation Amplifier and its application as load cell weight measurement - IC voltage regulators –LM78XX, LM79XX; Fixed voltage regulators its application as Linear power supply - LM317, 723 Variability voltage regulators, switching regulator- SMPS - ICL 8038 function generator IC.

45 PERIODS

PRACTICAL EXERCISES

1. Verify the output of Inverting and Non Inverting amplifiers for AC and DC input.
2. Verify output of Differential Amplifier.
3. Verify the frequency response of the operational amplifier.
4. Timer IC application: Study of NE/SE 555 timer in Astability, Mono Stability operation.

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5. Verify the output of Wien Bridge Oscillator.
6. Verify Voltage to frequency characteristics of NE/ SE 566 IC.
7. Verify the Variable Voltage Regulator using IC LM317.

30 PERIODS
TOTAL: 75 PERIODS

TEXT BOOKS:

1 D Roy Choudhary, Sheil B Jani, "Linear Integrated Circuits", 6th Edition, New Age International Pvt. Ltd., 2021.
2 Ramakant A Gayakward, "Op-amps and Linear Integrated Circuits", 4th Edition, Pearson Education, 2021.

REFERENCES:

1 Christopher Reilly, "Linear Integrated Circuits", American Publisher, 2023.
2 Jacob Millman, Christos C Halkias, "Integrated Electronics - Analog and Digital circuits system", 2nd Edition , Tata McGraw Hill, 2017.
3 Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", 3rd Edition, Tata McGraw Hill, 2017.

ONLINE RESOURCES:

1 https://onlinecourses.nptel.ac.in/noc24_ee73/preview
2 https://onlinecourses.nptel.ac.in/noc23_ee65/preview
3 https://www.digimat.in/nptel/courses/video/108108111/L01.html

COURSE OUTCOMES:

CO1 Explain monolithic IC fabrication process.
CO2 Analyse the AC and DC characteristics and basic op-amp configurations.
CO3 Design op-amp based instrumentation amplifier, log/antilog amplifier, analog multiplier / divider, active filters, comparators, waveform generators, A/D and D/A converters.
CO4 Design of Timer, PLL, analog multiplier ICs.
CO5 Analyze the applications of ICs in Instrumentation amplifier, fixed and variable voltage regulators, SMPS and function generators.

CO – PO – PSO MAPPING:

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

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U23EE404	MICROPROCESSORS AND MICROCONTROLLERS	L	T	P	C
Pre requisites:	**Digital Logic Circuits**	3	0	2	4

COURSE OBJECTIVES:

- To study the addressing modes & instruction set of 8085 & 8051
- To introduce commonly used peripheral/interfacing ICs.
- To develop skills in simple program writing in assembly languages and understand the typical applications of microprocessors and microcontrollers

UNIT I **8085 PROCESSOR** **9**

Functional block diagram – Memory interfacing–I/O ports and data transfer concepts – Timing Diagram – Interrupt structure.

UNIT II **8085 INSTRUCTION SET AND PROGRAMMING** **9**

Instruction format and addressing modes – Assembly language format – Data transfer, data manipulation & control instructions – Programming: Loop structure with counting & Indexing - Look up table - Subroutine instructions, stack.

UNIT III **8051 MICRO CONTROLLER** **9**

Functional block diagram - Instruction format and addressing modes – Interrupt structure – Timer – I/O ports – Serial communication– Data Transfer, Manipulation, Control Algorithms & I/O instructions.

UNIT IV **PERIPHERAL INTERFACING** **9**

Study of Architecture and programming of ICs: 8255 PPI, 8259PIC, 8251USART, 8279 Keyboard display controller and 8254 Timer/Counter – Interfacing with 8085 -A/D and D/A converter interfacing.

UNIT V **MICROCONTROLLER PROGRAMMING & APPLICATIONS** **9**

Simple programming exercises- keyboard and display interface –Control of servo motor and stepper motor - Application to automation systems.

45 PERIODS

PRACTICAL EXERCISES:

1. Simple arithmetic operations with 8085 & 8051.
2. Sorting and Searching programs with 8085.
3. Code conversions with 8085.
4. Sorting and Searching programs with 8051.
5. Code conversions with 8051.
6. Interfacing ADC, DAC with 8085/8051.
7. Interfacing Stepper motor, Keyboard/Display interface with 8085/8051.

30 PERIODS

TOTAL: 75 PERIODS

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TEXT BOOKS:

1 Ramesh S Gaonkar, "Microprocessor Architecture Programming and Application", 6th Edition, Penram International Publishing, 2016.

2 Douglas V Hall, "Micro-processors & Interfacing", 3rd Edition, Tata McGraw Hill, 2017.

REFERENCES:

1 K H Kamal, "Micro-processors, Micro-controller and Interfacing", Notion Press, 2022.

2 B Ram, Sanjaykumar, "Fundamentals of Microprocessors & Microcontrollers", 8th Edition, Dhanpat Rai Publications (P) Ltd., 2021.

3 Nagoor Kani A, "Micro-processors & Micro-controllers", 4th Edition, CBS Publishers, 2022.

ONLINE RESOURCES

1 https://archive.nptel.ac.in/courses/108/105/108105102/

2 https://nptel.ac.in/courses/117104072

3 https://archive.nptel.ac.in/courses/108/103/108103157/

COURSE OUTCOMES:

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

CO1 Describe the architecture, memory organization, I/O ports, interrupts and timing diagram of 8085.

CO2 Write an assembly language program for 8085 processor with loop structure, counting and indexing

CO3 Explain the architecture, memory organization, I/O ports, Interrupts and Timers of 8051.

CO4 Analyse the configuration & Interfacing of Interfacing ICs with 8085 & 8051

CO5 Design the Microprocessor and Microcontroller based application 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	-	-	3	1
CO2	3	3	3	3	1	-	-	1	2	1	-	1	3	1
CO3	2	2	1	1	1	-	-	1	2	1	-	1	3	1
CO4	3	3	1	1	1	-	-	1	2	1	-	1	3	1
CO5	3	3	3	3	1	-	-	1	2	1	-	1	3	1

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U23CS306	OBJECT ORIENTED PROGRAMMING WITH DATA STRUCTURES	L	T	P	C
		3	0	2	4

Prerequisites: Programming in C, Problem Solving and Python Programming

COURSE OBJECTIVES:

- To enable the students to learn the basic concepts of Java programming
- To have an overview of interfaces, packages, multithreading and exceptions.
- To familiarize students with basic data structures and their use in algorithms.

UNIT I INTRODUCTION TO OOP AND JAVA 9

Overview of OOP – Object oriented programming paradigms – Features of Object Oriented Programming – Java Buzzwords – Overview of Java – Data Types, Variables and Arrays – Operators – Control Statements – Programming Structures in Java – Defining classes in Java – Constructors-Methods -Access specifiers.

UNIT II INHERITANCE, PACKAGES AND INTERFACES 9

Overloading Methods – Objects as Parameters – Returning Objects –Static, Nested and Inner Classes. Inheritance: Basics– Types of Inheritance -Super keyword -Method Overriding – Dynamic Method Dispatch –Abstract Classes – final with Inheritance. Packages and Interfaces: Packages – Packages and Member Access –Importing Packages – Interfaces.

UNIT III EXCEPTION HANDLING AND MULTITHREADING 9

Exception Handling basics – Multiple catch Clauses – Nested try Statements – Java's Built-in Exceptions – User defined Exception. Multithreaded Programming: Java Thread Model– Creating a Thread and Multiple Threads – Priorities – Synchronization – Inter Thread Communication Suspending –Resuming, and Stopping Threads

UNIT IV ABSTRACT DATA TYPES 9

Abstract Data Types (ADTs)-List ADT-Array based implementation-linked list implementation-singly linked list-doubly linked list-circular linked list-Stack ADT operations-Applications- Queue ADT-operations-Applications of Queues.

UNIT V TREES 9

Trees-Binary Trees- representation - Operations on Binary Trees- Traversal of a Binary Tree -Binary Search Trees, Graphs-Representation of Graphs - Traversal in Graph - Dijkstra's Algorithm, Depth-First vs Breadth-First Search

45 PERIODS

TEXT BOOKS:

1. Herbert Schildt, "Java: The Complete Reference", 12th Edition, Tata McGraw Hill, 2022.
2. James Cutajar, "Beginning Java Data Structures and Algorithms", 4th Edition, Packt Publishing, 2018.

REFERENCES:

1 Cay S Horstmann, "Core Java Fundamentals", Volume 1, 11th Edition, Prentice Hall, 2018

2 Y Daniel Liang, "Introduction To Java Programming, Comprehensive", 10th Edition, Pearson Education, 2018.

3 Michael T Goodrich, Roberto Tamassia, Michael H Goldwasser, Subhasish Banerjee, "Data Structures and Algorithms in Java", 6th Edition, Wiley & Sons, 2022.

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ONLINE RESOURCES:

1 https: //onlinecourses.nptel.ac.in/noc23_cs74/
2 https://nptel.ac.in/courses/106106127/
3 https://nptel.ac.in/courses/106105191/

PRACTICAL EXCERCISES:

1. Develop a java application with an Employee class with Emp_name, Emp_id, Address, Mail_id, Mobile_no as members. Inherit the classes, Programmer, Assistant Professor, Associate Professor and Professor from employee class. Add Basic Pay (BP) as the member of all the inherited classes with 97% of BP as DA, 10 % of BP as HRA, 12% of BP as PF, 0.1% of BP for staff club funds. Generate pay slips for the employees with their gross and net salary.
2. Write a Java Program to create an abstract class named Shape that contains two integers and an empty method named printArea(). Provide three classes named Rectangle, Triangle and Circle such that each one of the classes extends the class Shape. Each one of the classes contains only the method printArea( ) that prints the area of the given shape.
3. Write a program to Check Prime Number using Interface.
4. Implement exception handling and creation of user defined exceptions.
5. Write a java program that implements a multi-threaded application that has three threads. First thread generates a random integer every 1 second and if the value is even, the second thread computes the square of the number and prints. If the value is odd, the third thread will print the value of the cube of the number.
6. Solve problems by using sequential search and binary search.
7. Develop stack and queue data structures using classes and objects

30 PERIODS
TOTAL: 75 PERIODS

COURSE OUTCOMES:

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

CO1 Comprehend the basic concepts of Java programming
CO2 Summarize interfaces, packages, multithreading and exception
CO3 Apply features of exception handling and multithreading in Java program.
CO4 Apply basic data structures concepts and their algorithms.
CO5 Explain data structure concepts trees for modelling given problem.

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	3	2	2	2	1	2	-	2	2	-	-	2	1	1
CO3	3	2	2	2	1	2	-	2	2	-	-	2	1	1
CO4	3	3	3	3	1	2	-	2	2	-	-	2	1	1
CO5	3	3	3	3	1	2	-	2	2	-	-	2	1	1

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U23MX01	PERSONAL VALUES	L	T	P	C
Prerequisites: Nil		2	0	0	0

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.

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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U23EE405	ELECTRICAL MACHINES - II LABORATORY	L	T	P	C
Pre requisites:	Electrical Machines – I, Electrical Machines - II	0	0	3	1.5

COURSE OBJECTIVES:

- To understand the operation of synchronous machines.
- To understand the analysis of power angle curve of synchronous machines.
- To understand the operation of induction motors.

LIST OF EXPERIMENTS

1. Regulation of three phase alternator by EMF and MMF methods.
2. Regulation of three phase alternator by ZPF and ASA methods.
3. Regulation of three phase salient pole alternator by slip test.
4. Measurements of negative sequence and zero sequence impedance of alternators.
5. V and Inverted V curves of Three Phase Synchronous Motor.
6. Load test on three-phase induction motor.
7. Determine equivalent circuit parameters of 3ϕ IM by No load and blocked rotor tests.
8. Separation of No-load losses of three-phase induction motor.
9. Load test on single-phase induction motor.
10. No load and blocked rotor test on single-phase induction motor.
11. Study of Induction Motor Starters
12. Equivalent Circuit of a single phase induction motor

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After the completion of this laboratory course, the student will be able to

CO1 Analyse EMF and MMF methods.

CO2 Examine V and Inverted V characteristics curves.

CO3 Examine various tests on Synchronous Machines and obtain their performance indices.

CO4 Analyse the single and three phase Induction motors by conducting various tests.

CO5 Analyse the separation of losses.

CO – PO – PSO MAPPING:

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

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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.

U23EE501	POWER SYSTEM ANALYSIS	L	T	P	C
Prerequisites:	**Transmission and Distribution**	3	0	0	3

COURSE OBJECTIVES:

- Impact knowledge on the need for operational studies, per unit analysis and understand and apply iterative techniques for power flow analysis.
- Study of short circuit studies for power systems during symmetrical and unsymmetrical faults.
- Explain about the various methods for analysing power system stability.

UNIT I **INTRODUCTION TO POWER SYSTEMS** 9

Need for system planning and operational studies - Power scenario in India - Power system components, Representation - Single line diagram - per unit quantities - p.u. impedance diagram - p.u. reactance diagram, Network graph Theory - Bus incidence matrices, Primitive parameters, Formation of bus admittance matrix – Direct inspection method – Singular Transformation method.

UNIT II **LOAD FLOW ANALYSIS** 9

Bus classification - Formulation of Power Flow problem in polar coordinates - Power flow solution using Gauss Seidel method - Handling of Voltage controlled buses - Power Flow Solution by Newton Raphson method – Flow charts – Comparison of methods.

UNIT III **SYMMETRICAL FAULT ANALYSIS** 9

Assumptions in short circuit analysis - Symmetrical short circuit analysis using Thevenin's theorem - Bus Impedance matrix building algorithm (without mutual coupling) - Symmetrical fault analysis through bus impedance matrix - Post fault bus voltages - Fault level - Current limiting reactors.

UNIT IV **UNSYMMETRICAL FAULT ANALYSIS** 9

Symmetrical components - Sequence impedance - Sequence networks - Analysis of Unsymmetrical faults at generator terminals: LG, LL and LLG - Unsymmetrical fault occurring at any point in a power system.

UNIT V **STABILITY ANALYSIS** 9

Classification of power system stability – Rotor angle stability - Power-Angle equation – Steady state stability - Swing equation – Solution of swing equation by step by step method - Swing curve, Equal area criterion - Critical clearing angle and time, Multi-machine stability analysis – Modified Euler method.

TOTAL: 45 PERIODS

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TEXT BOOKS:

1 Kothari D P and Nagrath I J, "Modern Power System Analysis", 4th Edition, Tata McGraw Hill, 2022
2 John J Grainger, William D. Stevenson Jr, "Power System Analysis", 3rd Edition, Tata McGraw Hil, 2017.

REFERENCES:

1 A Nagoor Kani, "Power System Analysis & Design", 5th Edition, CBS Publishers, 2022.
2 P Venkatesh, B V Manikandan, A Srinivasan, S Charles Raja, "Electrical Power Systems: Analysis, Security and Deregulation", 2nd Edition, Prentice Hall of India, 2019.
3 Pai M A, "Computer Techniques in Power System Analysis", 2nd Edition, Tata McGraw Hill, 2017.

ONLINE RESOURCES:

1 https://nptel.ac.in/courses/108105104
2 https://archive.nptel.ac.in/courses/108/105/108105067/
3 https://archive.nptel.ac.in/courses/117/105/117105140/

COURSE OUTCOMES:

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

CO1 Explain about the per unit analysis and its need in the power system

CO2 Explain the study of load flow in power system

CO3 Analyse the fault in symmetrical system

CO4 Analyse the power system for symmetrical fault analysis

CO5 Explain about the stability analysis

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	2
CO2	2	2	1	1	-	-	-	1	-	-	-	-	3	2
CO3	3	3	1	1	-	-	-	1	-	-	-	1	3	2
CO4	3	3	1	1	-	-	-	1	-	-	-	1	3	2
CO5	2	2	1	1	-	-	-	1	-	-	-	1	3	2

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U23EE502	POWER ELECTRONICS & INDUSTRIAL CONTROL	L	T	P	C
Prerequisites: Electron Devices and Circuits		3	0	0	3

COURSE OBJECTIVES:

- To understand the operation, characteristics and performance parameters of controlled rectifiers
- To study the operation, switching techniques and basic typologies of DC-DC switching regulators.
- To study the operation of AC voltage controller and various configurations of AC voltage controller.

UNIT I SWITCHING POWER SUPPLIES 9

MOSFET dynamic behavior - driver and snubber circuits - low power high switching frequency switching Power supplies, buck, boost, buck-boost converters – Isolated typologies – resonant converters - switching loss calculations and thermal design.

UNIT II INVERTERS 9

IGBT: Static and dynamic behavior - single phase half bridge and full bridge inverters - VSI :(1phase and three phase inverters square wave operation) - Voltage control of inverters single, multi pulse, sinusoidal, space vector modulation techniques– various harmonic elimination techniques - CSI.

UNIT III UNCONTROLLED RECTIFIERS 9

Power Diode – half wave rectifier – mid-point secondary transformer based full wave rectifier – bridge rectifier – voltage doubler circuit – distortion factor – capacitor filter for low power rectifiers – LC filters – Concern for power quality – three phase diode bridge

UNIT IV CONTROLLED RECTIFIERS 9

SCR - Two transistor analogy based turn- ON – turn ON losses – thermal protection – controlled converters (1 pulse, 2 pulse, 3 pulse, 6 pulse) - displacement factor – ripple and harmonic factor - power factor mitigation, performance parameters – effect of source inductance - inverter angle limit.

UNIT V AC PHASE CONTROLLERS 9

TRIAC triggering concept with positive and negative gate pulse triggering, TRIAC based phase controllers - various configurations for SCR based single and three phase controllers.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Ned Mohan, T M Undeland, W P Robbins,"Power Electronics: Converters, Applications and Design", 3rd Edition, John Wiley & Sons, 2021.

2 Rashid M H, "Power Electronics Circuits", 3rd Edition, Prentice Hall of India, 2019.

REFERENCES:

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1 Cyril W Lander, "Power Electronics", 3rd Edition, Tata McGraw Hill, 2019.

2 P S Bimbhra, "Power Electronics", 3rd Edition, Khanna Publishers, 2021.

3 Philip T Krein, "Elements of Power Electronics", 2nd Edition, Oxford University Press, 2020.

4 P C Sen, "Power Electronics", 3rd Edition, Tata McGraw Hill, 2019.

ONLINE RESOURCES:

1 https://nptel.ac.in/courses/108105066
2 https://nptel.ac.in/courses/108101038
3 https://archive.nptel.ac.in/courses/108/101/108101126/

COURSE OUTCOMES:

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

CO1 Analyze the operation of Semiconductor device, Buck Boost Converter

CO2 Analyze the operation of single phase and three phase inverters with and without PWM techniques

CO3 Analyze the operation of uncontrolled rectifiers, voltage doubler circuit

CO4 Analyze the operation of two pulse, three pulse converter with and without source and load inductance

CO5 Analyze the operation of AC voltage controller and cyclo converter

CO – PO – PSO MAPPING:

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

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U23EE503	CONTROL SYSTEMS	L	T	P	C
Prerequisites: Electric Circuit Analysis		3	0	2	4

COURSE OBJECTIVES:

- To understand the use of transfer function models for analysis of physical systems and introduce the control system components.
- To provide adequate knowledge in the time response of systems and steady state error analysis for open loop and closed–loop frequency responses of systems.
- To introduce stability analysis and design of compensator and state variable representation of physical systems.

UNIT I MODELING OF LINEAR TIME INVARIANT SYSTEM 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 TIME DOMAIN ANALYSIS 9

Standard Test Inputs – Time Response – Time Domain Specifications – Stability Analysis: Concept of Stability – Routh Hurwitz Stability Criterion – Root Locus: Construction and Interpretation - Effect of Adding Poles and Zeros.

UNIT III FREQUENCY DOMAIN ANALYSIS 9

Frequency Domain Specifications: Introduction to Closed Loop Frequency Response - Bode Plot, Polar Plot and Nyquist Plot.

UNIT IV STATE VARIABLE ANALYSIS 9

State Variable Formulation – Non Uniqueness of State Space Model – State Transition Matrix –Eigen Values – Eigen Vectors - Free and Forced Responses for Time Invariant and Time Varying Systems – Controllability – Observability.

UNIT V DESIGN OF FEEDBACK CONTROL SYSTEM 9

Design Specifications – Lead, Lag and Lag - Lead Compensators using Root Locus and Bode Plot Techniques – PID Controller - Design using Reaction Curve and Ziegler-Nichols Technique.

45 PERIODS

PRACTICAL EXERCISES

1. Mathematical modelling and simulation of physical systems. i. Mechanical ii. Electrical
2. Stability analysis using pole zero maps and Routh Hurwitz Criterion in simulation platform.
3. Root Locus based analysis in simulation platform
4. Determination of transfer function of a physical system using frequency response and Bode asymptotes in simulation platform.

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5. Design of Lag, lead compensators and evaluation of closed loop performance in simulation platform.
6 Discretization of continuous systems and effect of sampling in simulation platforms.
7 Test of controllability and observability in continuous and discrete domain in simulation platform.

30 PERIODS
TOTAL: 75 PERIODS

TEXT BOOKS

1 I J Nagrath, M Gopal, "Control Systems Engineering", 8th Multi Colour Edition, New Age International Publishers, 2025.
2 Farid Golnaraghi, Benjamin C Kuo, "Automatic Control Systems", 10th Edition, Tata McGraw Hill, 2018.

REFERENCES

1 Richard C Dorf, Robert H Bishop, "Modern Control Systems", 14th Edition, Pearson Education India, 2022.
2 Katsuhiko Ogata, "Modern Control Engineering", 5th Edition, Pearson Education, 2015.
3 Constantine H Houpis, Stuart N Sheldon, "Linear Control System Analysis and Design with MATLAB", 6th Edition, CRC Press, 2013.

ONLINE RESOURCES:

1 https://www.digimat.in/nptel/courses/video/107106081/
2 https://www.digimat.in/nptel/courses/video/108103007/
3 https://archive.nptel.ac.in/courses/108/101/108101126/

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 Apply the transfer function in modeling of linear time invariant systems.
CO2 Analyze simple systems in the time domain.
CO3 Analyze simple systems in frequency domain.
CO4 Analyse systems using state variable analysis.
CO5 Design of controllers and compensators in the feedback control system.

CO – PO – PSO MAPPING:

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

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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:

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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U23PEE504	POWER ELECTRONICS AND DRIVES LABORATORY	L	T	P	C
Prerequisites: Electron Devices and Circuits		**0**	**0**	**3**	**1.5**

COURSE OBJECTIVES:

- To study the VI characteristics of SCR, TRIAC, MOSFET and IGBT.
- To analyze the performance of semi converter, full converter, step up, step down choppers by simulation and experimentation.
- To design and analyze the speed control of various motors by using MATLAB simulation. SMPS.

LIST OF EXPERIMENTS:

1. Characteristics of SCR and TRIAC.
2. Characteristics of MOSFET and IGBT.
3. AC to DC half controlled converter.
4. AC to DC fully controlled converter.
5. IGBT based single phase PWM inverter.
6. IGBT based three phase PWM inverter.
7. Step up and Step down MOSFET based Chopper.
8. Simulation of three-phase full converter and PWM inverter with R and RL loads by using MATLAB.
9. Simulation of boost, buck, buck boost converter with R and RL loads by using MATLAB.
10. Simulation for Speed control of three-phase induction motor using V/f control.
11. Simulation of Speed Control of separately excited DC motor using Half Controlled Converter.
12. Simulation of Regenerative Braking in DC/AC Drives.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1 Analyze the Characteristics of SCR, TRIAC, MOSFET, and IGBT.
CO2 Design a single-phase AC to DC Half and fully controlled and DC to DC converter.
CO3 Design a Single phase and three phase PWM Inverter
CO4 Design the buck and boost converter with R and RL load by using MATLAB
CO5 Design the various motor speed controls by using MATLAB.

CO – PO – PSO MAPPING:

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

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

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.

U23EE601	PROTECTION AND SWITCHGEAR	L	T	P	C
Prerequisites: Transmission and Distribution		3	0	0	3

COURSE OBJECTIVES:

- To update knowledge about the causes of abnormal operating conditions (faults, lightning and switching surges) of the apparatus and system
- To study the characteristics and functions of relays and protection schemes.
- To prepare the students about apparatus protection, static and numerical relays

UNIT I PROTECTION SCHEMES 9

Principles and need for protective schemes – nature and causes of faults – types of faults – Methods of Grounding - Zones of protection and essential qualities of protection – Protection scheme

UNIT II ELECTROMAGNETIC RELAYS 9

Operating principles of relays - the Universal relay – Torque equation – R-X diagram – Electromagnetic Relays – Over current, Directional, Distance, Differential, Negative sequence and Under frequency relays.

UNIT III APPARATUS PROTECTION 9

Current transformers and Potential transformers and their applications in protection schemes -Protection of transformer, generator, motor, bus bars and transmission line.

UNIT IV STATIC RELAYS AND NUMERICAL PROTECTION 9

Static relays – Phase, Amplitude Comparators – Synthesis of various relays using Static comparators – Block diagram of Numerical relays – Over current protection, transformer differential protection, and distant protection of transmission lines.

UNIT V CIRCUIT BREAKERS 9

Physics of arcing phenomenon and arc interruption - DC and AC circuit breaking – re-striking voltage and recovery voltage - rate of rise of recovery voltage - resistance switching – current chopping - interruption of capacitive current - Types of circuit breakers – air blast, air break, oil,SF6, MCBs, MCCBs and vacuum circuit breakers – comparison of different circuit breakers –Rating and selection of Circuit breakers.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Sunil S Rao, "Switchgear and Protection", 3rd Edition, Khanna Publishers, 2021.

2 Rabindranath, N Chander, "Power System Protection and Switchgear", 4th Edition, New Age International, 2022.

REFERENCES:

1 Badri Ram, B H Vishwakarma, "Power System Protection and Switchgear", 7th Edition, New Age International Publishers, 2021.

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2 Y G Paithankar and S R Bhide, "Fundamentals of Power System Protection", 2nd Edition, Prentice Hall of India, 2019.
3 C L Wadhwa, "Electrical Power Systems", 6th Edition, New Age International Publishers, 2010
4 Ravindra P Singh, "Switchgear and Power System Protection", Prentice Hall of India, 2022.

ONLINE RESOURCES:

1 http://www.digimat.in/nptel/courses/video/108107167/L01.html
2 https://archive.nptel.ac.in/courses/108/107/108107167/
3 https://www.youtube.com/playlist?list=PLLy_2iUCG87BIJ6ZliVIRCx2Crf9_fJMB

COURSE OUTCOMES:

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

CO1 Summarize the principles and need for protective schemes.
CO2 Analyse the characteristics and functions of electromagnetic relays.
CO3 Explain the causes of abnormal operating conditions of the apparatus and system
CO4 Apply the function of static and numerical relays.
CO5 Explain on functioning of circuit breaker

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
CO2	3	3	1	2	-	-	-	-	-	-	-	-	3	1
CO3	2	2	1	1	-	-	-	-	-	-	-	-	3	2
CO4	3	2	1	1	-	-	-	-	-	-	-	-	3	2
CO5	2	2	1	1	-	-	-	-	-	-	-	-	3	1

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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, New Delhi, 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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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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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.

U23EE701	HIGH VOLTAGE ENGINEERING	L	T	P	C
Prerequisites:	**Power System Analysis, Protection Switchgear**	3	0	0	3

COURSE OBJECTIVES:

- To get a fair knowledge about the generation of high voltages and currents
- Understand the generation and measurement of high voltages and currents
- Understand the concept of solid, liquid and gaseous dielectrics. Gain knowledge in testing and Live maintenance work of high voltage equipment

UNIT I LIGHTNING AND SWITCHING OVERVOLTAGES 9

Lightning over voltage: Charge formation in clouds, Stepped leader, Dart leader, Lightning Surges– Switching over voltage: Causes of surges and its effects on power system – Protection against over voltage – Surge diverts – Surge modifiers – Estimation of Over voltages – Reflection and Refraction of Travelling waves - Insulation Coordination.

UNIT II DIELECTRICS AND BREAKDOWN MECHANISM 9

Properties of Dielectrics - Gaseous breakdown in uniform and non-uniform fields – Townsend's Theory – Streamer Mechanism – Corona discharges – Vacuum breakdown - Conduction and breakdown in pure and commercial liquids – Breakdown mechanisms in solid and composite dielectrics – Partial Discharges – Applications and Maintenance of Dielectrics.

UNIT III GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS 9

Generation of high D. C. and A.C. voltages – Generation of impulse voltages – Generation of impulse currents – Tripping and control of impulse generators.

UNIT IV MEASUREMENTS OF HIGH VOLTAGES AND CURRENTS 9

Peak voltage, impulse voltage and high direct current measurement methods – Cathode ray oscilloscope for impulse voltage and current measurement – Measurement of dielectric constant and loss factor - Partial discharge measurements - Digital Measurement Techniques.

UNIT V HIGH VOLTAGE TESTING AND LIVE LINE MAINTENANCE 9

High voltage testing of electrical power apparatus as per International and Indian standards – Power frequency, impulse voltage and DC testing of Insulators, bushing, isolators, circuit breakers and transformers– Online –On Site Transformer Oil Drying, De-Sludging And Re-Refining, Work For Transformers-Live Maintenance Work In EHV Transmission Line And Substations-Live-Line Maintenance In RTV Coating.

TOTAL: 45 PERIODS

TEXT BOOKS:

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1 M S Naid, V Kamaraju, "High Voltage Engineering", 5th Edition, Tata McGraw Hill, 2017.
2 E Kuffel, W S Zaengl, J Kuffel, "High Voltage Engineering Fundamentals", 2nd Edition, Elsevier, 2000.

REFERENCES:

1 T Srinivasa rao,"High Voltage Engineering", 5th Edition, Notion Press, 2022.
2 L L Alston, "High Voltage Technology", 1st Edition, Oxford University Press, 2011.
3 C L Wadhwa, "High Voltage Engineering", 3rd Edition, New Age International Publishers, 2010.

ONLINE RESOURCES:

1 https://archive.nptel.ac.in/courses/108/104/108104048/
2 https://www.udemy.com/course/high-voltage-substations-mastering-level-1/?couponCode=24T5MT200625G1
3 https://optcl.co.in/Downloads/Tender/VolumeIIpartItechnicalspecification.pdf

COURSE OUTCOMES:

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

CO1 Explain the overvoltage phenomenon in electrical power systems
CO2 Describe the various breakdown mechanisms of different dielectrics
CO3 Explain the appropriate methods for high voltage and current generation
CO4 Explain the measurement principles to figure the values of high voltage and current
CO5 Summarize of necessity and methods of testing and Live Maintenance Work

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
CO2	2	2	1	1	-	-	-	-	-	-	-	-	3	1
CO3	2	2	1	1	-	-	-	-	-	-	-	-	3	1
CO4	2	2	1	1	-	-	-	-	-	-	-	-	3	1
CO5	2	2	1	1	-	-	-	-	-	-	-	-	3	1

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U23EE702	POWER SYSTEM OPERATION AND CONTROL	L	T	P	C
Prerequisites:	Power System Analysis	3	0	2	4

COURSE OBJECTIVES:

- The significance of power system operation and control, Real power
- Reactive power– voltage interaction and the compensators for maintaining the voltage profile.
- The generation scheduling by economic operation of the power system and Computer Aided Control.

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

Power scenario in Indian grid – National and Regional load dispatching centres – Requirements of good power system – Necessity of voltage and frequency regulation – real power vs frequency and reactive power vs voltage control loops - System load variation, load curves – Load forecasting – Computational methods in load forecasting – Load shedding and Is-landing – deregulation - Basics of electrical energy tariff.

UNIT II **REAL POWER FREQUENCY CONTROL** **9**

Basics of speed governing mechanisms and modelling – Speed regulation of two generators in parallel Load Frequency Control (LFC) of single area system – Static and dynamic analysis – LFC of two area system –Tie line modelling – Block diagram representation of two area system – Static and dynamic analysis – Tie line with frequency bias control

UNIT III **REACTIVE POWER – VOLTAGE CONTROL** **9**

Generation and absorption of reactive power – Basics of reactive power control – Automatic Voltage Regulator (AVR) – Brush less AC excitation system – Block diagram representation of AVR loop static and dynamic analysis – Stability compensation – Voltage drop in transmission line – Methods of reactive power injection.

UNIT IV **ECONOMIC OPERATION OF POWER SYSTEM** **9**

Statement of economic dispatch problem – Input and output characteristics of thermal plant incremental cost curve – Optimal operation of thermal units without and with transmission losses (no derivation of transmission loss coefficients) – Lambda–iteration method – Base point and participation factors method. Statement of Unit Commitment (UC) problem – Constraints on UC problem – Solution of UC problem using priority list.

UNIT V **COMPUTER AIDED CONTROL OF POWER SYSTEM** **9**

Need of computer control of power system – Concept of energy control centers and functions – PMU system monitoring, Data acquisition and controls – System hardware configurations – SCADA and EMS functions – State estimation – Measurements and errors – Weighted least square estimation – Various operating states – State transition diagram.

TOTAL: 45 PERIODS

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PRACTICAL EXERCISES:

Using SCILAB/MATLAB Simulation Software

1. Computation and modelling of transmission Lines.
2. Formation of Bus Admittance.
3. Formation of Impedance Matrices.
4. Power Flow Analysis Using Gauss-Seidel Method.
5. Economic Dispatch in Power Systems.
6. Load flow analysis using Newton Raphson method.
7. To study characteristics of MCB & HRC Fuse.

30 PERIODS
TOTAL: 75 PERIODS

TEXT BOOKS:

1 Allen J Wood, Bruce F, Wollen berg, "Power Generation, Operation and Control", 3rd Edition, John Wiley & Sons, 2013.
2 Abhijit Chakrabarti, Sunita Halder, "Power System Analysis Operation and Control', 4th Edition, Prentice Hall of India, 2018.

REFERENCES:

1 Kothari D P, Nagrath I J, "Power System Engineering", 2nd Edition, Tata McGraw Hill, 2018.
2 Hadi Saadat, "Power System Analysis", 23rd Edition, Tata McGraw Hill, 2015.
3 Kundur P, "Power System Stability and Control", 12th Edition, Tata McGraw Hill, 2015.

ONLINE RESOURCES:

1 https://archive.nptel.ac.in/courses/108/104/108104052/
2 https://www.tcyonline.com/video-tutorials-power-systems-operation-and-control-8/102604/
3 https://www.udemy.com/course/electrical-power-system/

COURSE OUTCOMES:

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

CO1 Explain the day to day operation of the power system.
CO2 Analyse the control actions that are implemented to meet the minute-to minute variation of system real power demand.
CO3 Analyse the compensators for reactive power control and various devices used for voltage control.
CO4 Analyze day ahead and real time economic generation scheduling
CO5 Describe the necessity of computer control of power systems.

CO – PO – PSO MAPPING:

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

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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U23PEEE01	UTILIZATION AND CONSERVATION OF ELECTRICAL ENERGY	L	T	P	C
Prerequisites: Power System Analysis		2	0	2	3

COURSE OBJECTIVES:

- To understand and gain the knowledge of various electrical drives and traction motors with applications.
- To understand and gain knowledge of various energy saving concepts by different ways of illumination, different methods of heating and welding
- To understand conversion of solar and wind energies into electrical energy for different applications and its domestic utilization.

UNIT I ELECTRIC DRIVES AND TRACTION 6

Fundamentals of electric drive - choice of an electric motor - application of motors for particular services traction generator set, traction motors, power transformers - characteristic features of traction motor - systems of railway electrification - electric braking - train movement and energy consumption - traction motor control - track equipment and collection gear.

UNIT II ILLUMINATION 6

Introduction - definition and meaning of terms used in illumination engineering - classification of light sources - incandescent lamps, sodium vapour lamps, mercury vapour lamps, fluorescent lamps – design of illumination systems - indoor lighting schemes - factory lighting halls - outdoor lighting schemes - flood lighting - street lighting - energy saving lamps, LED

UNIT III HEATING AND WELDING 6

Introduction - advantages of electric heating – modes of heat transfer - methods of electric heating - resistance heating - arc furnaces - induction heating - dielectric heating - electric welding – types - resistance welding - arc welding - power supply for arc welding - radiation welding.

UNIT IV ENERGY CONSERVATION AND ITS IMPORTANCE 6

Energy conservation act 2001 and its Features-Review of Industrial Energy Conservation-Energy conservation in electrical Industries-Simulation study of energy conservation using power factor controller. (Three phase circuit simulation with and without capacitor)

UNIT V DOMESTIC UTILISATION OF ELECTRICAL ENERGY 6

House wiring - working principle of air conditioning system, Induction based appliances, Online and Offline UPS, Batteries - Power quality aspects – nonlinear and domestic loads – Earthing system for Domestic, Industrial and Substation.

30 PERIODS

PRACTICAL EXERCISES:

Using SCILAB/MATLAB Simulation Software

1 Simulation of Switched Reluctance Motor used for Electric Traction.

2 Simulation of Brushless DC Motor used for Electric Traction.

3 Simulation of DC Series Motor used for Electric Traction.

4 Study of Design procedure for lighting scheme via a prototype model/simulation.

5 Study of Design procedure for welding scheme via a prototype model/simulation.

30 PERIODS

TOTAL : 60 PERIODS

TEXT BOOKS:

1 William H Hayt, John A Buck, "Utilization of Electric Power", 9th Edition, Tata McGraw Hill, 2021.

2 J B Gupta, "Utilization Electric power and Electric Traction", 12th Edition, S K Kataria & Sons, 2021.

REFERENCES:

1 G C Karg, "Utilization of Electric Power and Electric Traction", 2nd Edition, Khanna Publishers, 2021.

2 C L Wadhwa,"Generation Distribution and Utilization of Electrical Energy", 3rd Edition, New Age International Publishers, 2021.

3 H Partab, "Art and Science of Utilization of Electrical Energy", 4th Edition, Dhanpat Rai Publishers, 2021.

ONLINE RESOURCES:

1 https://archive.nptel.ac.in/courses/108/105/108105058/

2 https://onlinecourses.nptel.ac.in/noc21_ge04/preview

3 https://archive.nptel.ac.in/courses/108/105/108105061/

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 Summarize suitable electric drives for different applications in electric traction.

CO2 Design of various illumination systems for energy saving.

CO3 Explain the utilization of electrical energy for heating and welding purposes.

CO4 Summarize the effective usage of solar and wind energies for various electrical applications.

CO5 Explain the electric connection for any domestic appliance like refrigerator, battery charging circuit for a specific household application.

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	-	-	3	1
CO2	3	3	3	3	-	-	-	1	1	1	-	-	3	1
CO3	2	2	1	1	-	-	-	1	1	1	-	-	3	1
CO4	2	2	1	1	-	-	-	1	1	1	-	-	3	1
CO5	2	2	1	1	-	-	-	1	1	1	-	-	3	1

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U23PEEE002	ADVANCED POWER ENGINEERING TECHNOLOGY	L	T	P	C
Prerequisites: Power System Analysis		2	0	2	3

COURSE OBJECTIVES:

- To understand and gain knowledge of various basic power plant technologies.
- To understand and gain knowledge of combined cycle power plants and futuristic power plant technologies.
- To understand principles of fluidized bed technology and Energy Storage concept.

UNIT I **BASIC POWER PLANT TECHNOLOGIES** **6**

Classification of Various Power Plants – Gas Turbine Power Plants-Closed cycle Plants and Open cycle Plants-Analysis-Optimum pressure ratio-regeneration-Gas Turbine Plant components. Compressor-combustion chamber-turbine-gas turbine materials.

UNIT II **COMBINED CYCLE POWER PLANTS** **6**

Limitations of Steam Turbine (ST) and gas turbine (GT) power plants. Thermodynamics of multi fluid coupled cycles -Combined Brayton and Rankine Cycle-Advantages of CC Plants-Coal based CC Plants-PFBC and IGCC plants-Scope of CC Plants.

UNIT III **FUTURISTIC POWER PLANT TECHNOLOGIES** **6**

Fuel Cells -MHD Steam Plant-Thermoelectric Steam Plant-Thermionic Steam Plants-Small Modular Reactors and next gen Nuclear reactors. Plasma based Power generation.

UNIT IV **FLUIDIZED BED TECHNOLOGY** **6**

Theory Of fluidization– regimes, packed bed, bubbling bed, turbulent bed and fast bed Hydro-dynamics and heat transfer-Combustion In Fluidized Beds; Pressurized fluidized beds ; Coal gasifies ; IGCC plants ; Fluidized bed boilers– bubbling bed and circulating bed boiler-Advantages scope of boilers.

UNIT V **ENERGY STORAGE** **6**

Energy Storage -Objective and scope- energy management-Methods of energy storage pumped hydro power -compressed air energy storage-flywheels-Electrochemical magnetic-Thermal and chemical Energy Storage-Hydrogen energy storage-production storage and utilization.

30 PERIODS

PRACTICAL EXERCISES

Using SCILAB/MATLAB Simulation Software

1 Simulation on modelling of Rankine cycle of thermal power plant.
2 Simulation on Modelling of Brayton and combined cycle operations.
3 Simulation of pressurized water reactor.
4 Simulation of renewable energy generation system.
5 Simulation of hybrid energy generation systems.

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30 PERIODS
TOTAL: 60 PERIODS

TEXT BOOKS:

1 Tony Giampola, "Gas Turbine Handbook: Principles and Practice", 5th Edition, River Publishers, 2021.

2 P K Nag, "Power Plant Engineering", 5th Edition, Tata McGraw Hill, 2021.

REFERENCES:

1 Gilbert M Masters, Kevin F, "Renewable and Efficient Electric Power Systems", 3rd Edition, John Wiley & Sons, 2023.

2 Rai G D, "Solar Energy Utilization", 5th Edition, Khanna Publishers, 2024.

3 H Khan, "Non-conventional Energy sources", 3rd Edition, Tata McGraw-Hill Publishers, 2021.

ONLINE RESOURCES:

1 https:// onlinecourses.nptel.ac.in/noc23_ee127/preview

2 https:// onlinecourses.nptel.ac.in/noc23_ge47/preview

3 https:// onlinecourses.nptel.ac.in/noc22_ph44/preview

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 Summarize the concept of basic power plant technologies.

CO2 Explain the working principles of combined cycle power plants.

CO3 Demonstrate the principles of futuristic power plant technologies.

CO4 Examine the operation of fluidized bed technology.

CO5 Simulate the various power plant engineering 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	1	1	-	-	3	1
CO2	2	2	1	1	-	-	-	1	1	1	-	-	3	1
CO3	2	2	1	1	-	-	-	1	1	1	-	-	3	1
CO4	2	2	1	1	-	-	-	1	1	1	-	-	3	1
CO5	3	3	3	3	-	-	-	1	1	1	-	-	3	1

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U23PEEE03 **SMART GRIDS** L T P C

Prerequisites: Power Systems Analysis 2 0 2 3

COURSE OBJECTIVES:

- To understand and gain knowledge of evolution of Smart and Interconnected energy systems
- To understand the various challenges and benefits of smart grid also about national and international initiatives taken.
- To understand transmission and distribution in smart grid technologies and various computing technologies for Smart Operation of the Grid.

UNIT I INTRODUCTION 6

Evolution of Energy Systems, Concept, Definitions and Need, Difference between Conventional & Smart Grid, Drivers, structures, functions, opportunities, challenges and benefits of Smart Grid, Basics of Micro grid, National and International Initiatives in Smart Grid.

UNIT II SMART METERING 6

Introduction to Advanced Metering infrastructure (AMI) - drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Real time management and control, Phasor Measurement Unit (PMU)

UNIT III SMART GRID TECHNOLOGIES (Transmission) 6

Technology Drivers, Smart energy resources, Smart substations, Substation Automation, Feeder Automation, Transmission systems: EMS, Wide area Monitoring, Protection and control.

UNIT IV SMART GRID TECHNOLOGIES (Distribution) 6

DMS, Volt/VAR control, Fault Detection, Isolation and service restoration, Outage management, High- Efficiency Distribution Transformers, Phase Shifting Transformers, and Electric Vehicles.

UNIT V HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS 6

Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), IP based Protocols, Computing technologies for Smart Grid applications (Web Service to CLOUD Computing), Role of big data and IoT, Cyber Security for Smart Grid.

30 PERIODS

PRACTICAL EXERCISES

Using SCILAB/MATLAB Simulation Software

1 Simulation of smart meter using (MATLAB/ ETAP/SCILAB/ LABVIEW/ Proteus/Equivalent open source software).
2 Analysing the Automation Technologies like Monitoring, Protection and control of substation.
3 Simulation of electric vehicles and its operation.
4 Understanding the operation of EV, HEV, PHEV by simulation.

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5 Simulation of IoT based digital communication system for smart grid applications.

30 PERIODS

TOTAL : 60 PERIODS

TEXT BOOKS:

1 Bernd M Bucholz, Zbigniew A Styczynski,"Smart Grids Fundamentals and Technologies in Electric Power Systems of the Future", 2nd Edition, Springer, 2021.

2 Shady S Refat, Omar Ellaban,Sertac Bayhan,Haitham Abu Rab, "Smart Grid and Enabling Technologies", 1st Edition, John Wiley & Sons, 2021.

REFERENCES:

1 Mini S Thomas, "Power System SCADA and Smart Grids", 1st Edition, CRC Press, 2021.

2 Stephen F Bush, "Smart Grid: Communication-Enabled Intelligence for the Electric Power Grid", John Wiley & Sons, 2021.

ONLINE RESOURCES:

1 https://onlinecourses.nptel.ac.in/noc21_ee68/preview

2 https://online-learning.tudelft.nl/courses/smart-grids-the-basics/l

3 https://onlinecourses.swayam2.ac.in/arp20_ap10/preview

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 Summarize the importance and objectives of the Power System Grid.

CO2 Explain the concept of a smart grid.

CO3 Analyze smart metering devices and associated technologies.

CO4 Explain the overview of micro grid and Electric Vehicle Technology

CO5 Analyze knowledge on the various computing technologies and also the role of Big Data and IoT for effective and efficient operation of Smart Grids.

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	-	-	3	1
CO2	2	2	1	1	-	-	-	1	1	1	-	-	3	1
CO3	3	3	1	2	-	-	-	1	1	1	-	-	3	1
CO4	2	2	1	1	-	-	-	1	1	1	-	-	3	1
CO5	3	3	1	2	-	-	-	1	1	1	-	-	3	1

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U23PEEE04	HVDC AND FACTS	L	T	P	C
Prerequisites: Transmission and Distribution		2	0	2	3

COURSE OBJECTIVES:

- To understand and gain the knowledge of problems in AC transmission systems and DC transmission systems ,operation and control of SVC and TCSC
- To understand and gain knowledge of concepts of IGBT based FACTS controllers, basic operation of Line Commutated Converter(LCC) based HVDC links
- To understand features of voltage source converter based HVDC link

UNIT I INTRODUCTION 6

Reactive power control in electrical power transmission lines–load & system compensation, Uncompensated transmission line–shunt and series compensation. Need for HVDC Transmission, Comparison between AC & DC Transmission, , Types of HVDC transmission System.

UNIT II STATIC VAR COMPENSATOR AND THYRISTOR CONTROLLED SERIE COMPENSATOR(TCSC) 6

VI characteristics of FC+TSR, TSC+TSR, Voltage control by SVC–Advantages of slope in dynamic characteristics–Influence of SVC on system voltage–Design of SVC voltage regulator, Thyristor - Controlled Series Compensator (TCSC), Concept of TCSC, Operation of the TCSC– Different modes of operation, Applications.

UNIT III VOLTAGE SOURCE CONVERTER BASED FACTS CONTROLLERS 6

Static Synchronous Compensator (STATCOM)–Principle of operation–V-I Characteristics. Applications: Steady state power transfer-enhancement of transient stability-prevention of voltage instability. SSSC-operation of SSSC VI characteristics, Enhancement in Power transfer capability –, UPSC – Operation Principle Applications.

UNIT IV LINE COMMUTATED HVDC TRANSMISSION 6

Operation of Gratz bridge - Effect of delay in Firing Angle – Effect of commutation overlap - Equivalent circuit, Basic concept of HVDC transmission. Model of operations and control of power flow CC and CIA mode of operation

UNIT V VSC BASED HVDC TRANSMISSION 6

Basic 2 level IGBT inverter operation- 4 Quadrant operation- Phase angle control- DQ control- Control of power flow in VSC based HVDC Transmission, Topologies of MTDC system.

30 PERIODS

PRACTICAL EXERCISES

Using SCILAB/MATLAB Simulation Software

1. Simulation of FC+TSR connected to IEEE 5 bus system.
2. Realization of reactive power, supported by SVC in open loop and closed loop control in simulation.
3. Regulation of line flows employing TCSC and TSSC in closed loop control in simulation.

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4 Simulation of two terminal HVDC Link, closed loop control in CC and CIA mode in simulation.

5 Realization of four quadrant operation of VSC in open loop mode in simulation.

30 PERIODS

TOTAL : 60 PERIODS

TEXT BOOKS:

1 S M Chaudhary, "Power System Protection and Switch Gear", 1st Edition, Tech Knowledge Publications, 2021.

2 K Meenendranath Reddy, D Umendra, P Nagamaiah, "Fundamentals of HVDC and FACTS in Power Systems", 2nd Edition, INK Publications, 2024.

REFERENCES:

1 KRPadiyar,"FACTS Controllers in Power Transmission and Distribution", 3rd Edition, New Age International Publishers, 2021.

2 Jose M Maza Ortega, "HVDC /FACTS for Grid Services in Electric Power Systems"1st Edition, MDPI, 2021.

ONLINE RESOURCES:

1 https:// onlinecourses.nptel.ac.in/noc23_ee58/preview

2 https:// www.nptelvideos.com/course

3 https:// archive.nptel.ac.in/courses/108/104/108104013/?utm_source

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 Explain the problems in AC transmission systems and understand the need for Flexible AC transmission systems and HVDC Transmission.

CO2 Describe the operation and control of SVC and TCSC and its applications to enhance the stability and damping.

CO3 Analyze basic operation and control of voltage source converter based FACTS controllers.

CO4 Demonstrate basic operation and control of Line Commutated HVDC Transmission.

CO5 Explain the DQ control based operation of VSC based HVDC Transmission.

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	-	-	3	1
CO2	2	2	1	1	-	-	-	1	1	1	-	-	3	1
CO3	3	3	1	2	-	-	-	1	1	1	-	-	3	1
CO4	2	2	1	1	-	-	-	1	1	1	-	-	3	1
CO5	2	2	1	1	-	-	-	1	1	1	-	-	3	1

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U23PEEE05	HVAC	L	T	P	C
Prerequisites: Power System Analysis		2	0	2	3

COURSE OBJECTIVES:

- To understand and gain the knowledge of basics of high voltage AC transmission.
- To understand and gain knowledge of corona loss, effects and ferro resonance and switching surges.
- To understand and gain knowledge of EHV testing and calculation of line parameters.

UNIT I INTRODUCTION 6

EHV transmission, standard transmission voltage. Comparison of EHV AC and DC transmission systems and its applications. Surface voltage gradients on sub conductors. Distribution of voltage gradients on sub conductors. Mechanical considerations of transmission lines. Modern Trends in EHV AC and DC Transmission Systems. UHVAC transmission system.

UNIT II EHV AC TRANSMISSION 6

Corona loss formulas. Corona current. Audible noise generation and characteristics corona pulses their generation and properties. Radio interference (RI) effects. Over voltage due to switching. Ferro resonance. Reduction of switching surges on EHV system.

UNIT III EXTRA HIGH VOLTAGE TESTING 6

Characteristics and generation of impulse voltages. Generation of High DC and AC voltages. Measurement of high voltage by sphere gaps and potential dividers. Consideration of design of EHV Lines: Design factors under steady state limits. EHV line insulation design based upon transient over voltages. Effects of pollution on performance of EHV lines.

UNIT IV CALCULATION OF LINE PARAMETERS 6

Calculation of resistance, inductance and capacitance of multi conductor lines-Surface voltage gradient on conductors-gradient factors and their use-Distribution of voltage gradient on sub conductors of bundled conductors-voltage gradient on conductors in the presence of ground wires on towers.

UNIT V ELECTROSTATIC FIELD OF EHV LINES 6

Effect of EHV Line on heavy vehicles -Calculation of electrostatic field of AC Lines - Effect of high field on humans, animals, plants-Electrostatic induction in un energized circuit of DC Line-Induced voltages in insulated ground wires.

30 PERIODS

PRACTICAL EXERCISES:

Using SCILAB/MATLAB Simulation Software

1 Simulation of lightning impulse.

2 Simulation of switching impulse.

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3 Simulation of Line Parameters of multi conductor lines.

4 Simulation of parametric analysis of impulse current waveform.

5 Simulation of parametric analysis of impulse voltage waveform.

30 PERIODS

TOTAL : 60 PERIODS

TEXT BOOKS:

1 Rakosh Das Begamudre, "Extra High Voltage AC Transmission Engineering", 2nd Edition, New Age International Publishers, 2021.

2 Roger W Haines, C Lewis Wilson, "HVAC Systems Design Handbook", 4th Edition, Tata McGraw-Hill, 2021.

REFERENCES:

1 Drake Shaw, "High Voltage Engineering Theory and Practice", 2nd Edition, Willford Press, 2023.

2 M S Naidu, "High Voltage Engineering", 6th Edition, Tata McGraw Hill Publishers, 2021.

ONLINE RESOURCES:

1 https:// Advances in UHV Transmission and Distribution - Course (nptel.ac.in)

2 https:// Recent Advances in Transmission Insulators - Course (nptel.ac.in)

3 https://onlinecourses-archive.nptel.ac.in/noc19_ee02/preview

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 Explain the role of EHV AC Transmission and mechanical considerations.

CO2 Explain the concepts of corona and radio interference.

CO3 Describe the concepts of generation of High DC and AC voltages.

CO4 Describe the line parameters of multi conductor lines.

CO5 Explain the effect of electrostatic fields on humans and 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	1	-	-	3	1
CO2	2	2	1	1	-	-	-	1	1	1	-	-	3	1
CO3	2	2	1	1	-	-	-	1	1	1	-	-	3	1
CO4	2	2	1	1	-	-	-	1	1	1	-	-	3	1
CO5	2	2	1	1	-	-	-	1	1	1	-	-	3	1

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U23PEEE06	POWER QUALITY	L	T	P	C
Prerequisites: Electrical Circuit Analysis.		2	0	2	3

COURSE OBJECTIVES:

- To understand causes and mitigation events of various PQ events.
- To understand active and passive power filters.
- To understand voltage sags and swells.

UNIT I INTRODUCTION TO POWER QUALITY 6

Terms and definitions & Sources – Overloading, under voltage, over voltage - Concepts of transients - Short duration variations such as interruption - Long duration variation such as sustained interruption - Sags and swells - Voltage sag - Voltage swell - Voltage imbalance – Voltage fluctuations - Power frequency variations International standards of power quality – Computer Business Equipment Manufacturers Associations (CBEMA) curve.

UNIT II VOLTAGE SAGS AND SWELLS 6

Estimating voltage sag performance - Thevenin's equivalent source - Analysis and calculation of various faulted condition - Estimation of the sag severity - Mitigation of voltage sags, Static transfer switches and fast transfer switches. - Capacitor switching – Lightning - Ferro resonance - Mitigation of voltage swells.

UNIT III HARMONICS 6

Harmonic sources from commercial and industrial loads - Locating harmonic sources – Power system response characteristics - Harmonics Vs transients. Effect of harmonics – Harmonic distortion - Voltage and current distortion - Harmonic indices - Inter harmonics – Resonance - Harmonic distortion evaluation, IEEE and IEC standards

UNIT IV PASSIVE POWER COMPENSATORS 6

Principle of Operation of Passive Shunt and Series Compensators Analysis and Design of Passive Shunt Compensators Simulation, and Performance of Passive Power Filters Limitations of Passive Filters Parallel Resonance of Passive Filters with the Supply System and Its Mitigation. Fundamentals of load compensation – voltage regulation & power factor correction.

UNIT V POWER QUALITY MONITORING & CUSTOM POWER DEVICES 6

Monitoring considerations - Monitoring and diagnostic techniques for various power quality problems - Quality measurement equipment - Harmonic / spectrum analyzer - Flicker meters - Disturbance analyzer - Applications of expert systems for power quality monitoring. Principle & Working DSTATCOM – DSTATCOM in Voltage control mode, current control mode, DVR Structure – Rectifier supported DVR – DC Capacitor supported DVR -Unified power quality conditioner.

30 PERIODS

PRACTICAL EXERCISES:

1 Simulation of Switched Reluctance Motor used for Electric Traction.

2 Simulation of Brushless DC Motor used for Electric Traction.

3 Simulation of DC Series Motor used for Electric Traction.

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4 Study of Design procedure for lighting scheme via a prototype model/simulation.

5 Study of Design procedure for welding scheme via a prototype /simulation.

30 PERIODS

TOTAL : 60 PERIODS

TEXT BOOKS:

1 William H Hayt, John A Buck, "Utilization of Electric Power", 9th Edition, Tata McGraw Hill, 2021.

2 J B Gupta, "Utilization Electric power and Electric Traction", 12th Edition, S K Kataria and Sons, 2021.

REFERENCES:

1 G C Karg, "Utilization of Electric Power and Electric Traction", 2nd Edition, Khanna Publishers, 2021.

2 C L Wadhwa,"Generation Distribution and Utilization of Electrical Energy", 3rd Edition, New Age International Publishers, 2021.

3 H Partab, "Art and Science of Utilization of Electrical Energy", 4th Edition, Dhanpat Rai Publishers, 2021.

ONLINE RESOURCES:

1 https://archive.nptel.ac.in/courses/108/105/108105058/

2 https://onlinecourses.nptel.ac.in/noc21_ge04/preview

3 https://archive.nptel.ac.in/courses/108/105/108105061/

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 Summarize suitable electric drives for different applications in electric traction.

CO2 Design of various illumination systems for energy saving.

CO3 Demonstrate the utilization of electrical energy for heating and welding purposes.

CO4 Summarize the effective usage of solar and wind energies for various electrical applications.

CO5 Explain the electric connection for any domestic appliance like refrigerator, battery charging circuit for a specific household application.

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	-	-	3	1
CO2	3	3	3	3	-	-	-	1	1	1	-	-	3	1
CO3	2	2	1	1	-	-	-	1	1	1	-	-	3	1
CO4	2	2	1	1	-	-	-	1	1	1	-	-	3	1
CO5	2	2	1	1	-	-	-	1	1	1	-	-	3	1

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U23PEEE07	ADVANCED CONTROL SYSTEMS	L	T	P	C
Prerequisites:	**CONTROL SYSTEMS**	2	0	2	3

COURSE OBJECTIVES:

- To provide knowledge on design state feedback control and state observer.
- To provide knowledge in phase plane analysis.
- To give basic knowledge in describing function analysis and optimal controllers.

UNIT I STATE SPACE REPRESENTATION OF SYSTEMS 6

Introduction to state space and state model concepts- State equation of linear continuous time systems, matrix representation- features- Examples of electrical circuits and dc servomotors. Phase variable forms of state representation- Diagonal Canonical forms- Similarity transformations to diagonal canonical form.

UNIT II STATE SPACE ANALYSIS 6

State transition matrix- Properties of state transition matrix- Computation of state transition matrix using Laplace transform and Cayley Hamilton method. Derivation of transfer functions from state equations. Solution of time invariant systems: Solution of time response of autonomous systems and forced systems. State space analysis of Discrete Time control systems: Phase variable form and Diagonal canonical form representations- Pulse transfer function from state matrix- Computation of State Transition Matrix (problems from second order systems only).

UNIT III STATE FEEDBACK CONTROLLER DESIGN 6

Controllability & observability: Kalman's, Gilbert's and PBH tests. - Duality principle State feedback controller design: State feed-back design via pole placement technique State observers for LTI systems- types- Design of full order observer.

UNIT IV NONLINEAR SYSTEMS 6

Types and characteristics of nonlinear systems- Jump resonance, Limit cycles and Frequency entrainment Describing function method: Analysis through harmonic linearization- Determination of describing function of nonlinearities. Application of describing function for stability analysis of autonomous system with single non-linearity (relay, dead zone, and saturation only)

UNIT V PHASE PLANE AND LYAPUNOV STABILITY ANALYSIS 6

Phase plots: Concepts- Singular points – Classification of singular points. Definition of stability- asymptotic stability and instability. Construction of phase trajectories using Isocline method for linear and nonlinear systems. Lyapunov stability analysis: Lyapunov function- Lyapunov methods to stability of nonlinear systems- Lyapunov methods to LTI continuous time systems.

30 PERIODS

PRACTICAL EXERCISES:

1 Design of P, PI and PID controllers.

2 Analyse the Stability control of the closed loop system.
3 Design of Lag, Lead and Lag-Lead Compensators.
4 Design Position Control Systems.
5 Design the Modelling of Systems Machines Sensors and Transducers.

30 PERIODS
TOTAL: 60 PERIODS

TEXT BOOKS:

1 M Gopal, "Digital Control and State Variable Methods," 4th Edition, Tata McGraw Hill, 2025.
2 B S Manke, "Linear Control Systems: With MATLAB Applications," 4th Edition, Khanna Publishers, 2024.
3 K Ogata, "Modern Control Engineering," 5th Edition, Pearson Education, 2020.

REFERENCES:

1 Norman S Nise, "Control Systems Engineering," 1st Edition, John Wiley & Sons, 2025.
2 Priyanka Patankar , Swapnil Kulkarni, "Modern Control Design with Matlab and Simulink", 1st Edition, BPB Publications, 2022.

ONLINE RESOURCES:

1 https://nptel.ac.in/courses/101108047
2 www.digimat.in/nptel/courses/video/108103007/L01.html.
3 https://nitttrc.edu.in/nptel/courses/video/101108047/L01

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 Analyse the state variable representation of physical systems.
CO2 Analyse the performance of linear and nonlinear systems using state variable approach.
CO3 Design state feedback controller for a given system.
CO4 Apply the tools like describing function approach or phase plane approach for assessing the performance of nonlinear systems.
CO5 Apply Lyapunov method for the stability analysis of physical systems.

CO – PO – PSO MAPPING:

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

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U23PEEE08	COMPUTER CONTROL OF PROCESSES	L	T	P	C
Prerequisites:	CONTROL SYSTEMS	2	0	2	3

COURSE OBJECTIVES:

- To design Digital controllers and linear time invariant systems.
- To study the techniques of DAS, DDC, AI and SCADA.
- To design a multi-loop and multi variable controller for a multi variable system.

UNIT I **ANALYSIS OF DISCRETE DATA SYSTEM** 6

State-space representation of discrete data systems: Selection of sampling process – Selection of sampling period – Review of z-transform – Pulse transfer function – Modified z-transform - Stability of discrete data system – Jury's stability test.

UNIT II **DESIGN OF DIGITAL CONTROLLER** 6

Digital PID – Position and velocity form – Deadbeat's algorithm – Dalian's algorithm Kalman's algorithm - Pole placement controller – Predictive controller.

UNIT III **COMPUTER AS A CONTROLLER** 6

Basic building blocks of computer control system – Data acquisition systems – SCADA – Direct digital control – Introduction to AI and expert control system – Case study - Design of computerized multi loop controller

UNIT IV **SYSTEM IDENTIFICATION** 6

Non-Parametric methods: Transient Analysis, Frequency analysis, Correlation analysis, Spectral analysis. Parametric methods: Least Square method, Recursive least square method.

UNIT V **MULTI LOOP REGULATORY CONTROL** 6

Multi-Loop Control: Introduction, Process Interaction, Pairing of Input and Outputs, Relative Gain Array (RGA) - Properties and Application of RGA, Multi loop PID Controller - Decoupler.

30 PERIODS

PRACTICAL EXERCISES:

1. Design and Simulation of Sampled Data Control System with Deadbeat Controller using Tutsim.
2. Design and Simulation of Kalman's Controller Using Tutsim Design.
3. Testing of Inverse Response Compensator Using Simulink.
4. Design of ON/OFF, PI and PID controller for the pressure process.
5. Design of ON/OFF, PI and PID controller for the level process.

30 PERIODS

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Xiangyu Kong , "Process Monitoring and Fault Diagnosis Based on Multi variable Statistical Analysis", 3rd Edition, Springer, 2024.
2. Nathan Ida, "Engineering Electromagnetics", 4th Edition, Springer , 2021.

3 P B Deshpande, R H Ash, "Computer Process Control", 3rd Edition, ISA Publication, 2020.

REFERENCES:

1 Nathan Ida, "Engineering Electromagnetics", 4th Edition, Springer, 2021.

2 Craig Rieger, Indrajit Ray , Quanyan Zhu, Michael A. Haney, "Industrial Control Systems Security and Resiliency", 19th Edition, Springer, 2019.

3 Singh, "Computer Aided Process Control", 1st Edition, Prentice Hall of India, 2004.

ONLINE RESOURCES:

1 https:// Automatic Tuning of Multi-Loop DC Motor Controller - MATLAB

2 https:// Flow Control Schemes using Back Pressure Regulators (equilibar.com)

3 https://nptel.ac.in/courses/108106098

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 Analysis of discrete data systems.
CO2 Design various digital control algorithms.
CO3 Apply the techniques of DAS, DDC, AI and SCADA.
CO4 Apply the build models from Input-Output data.
CO5 Design Multi-loop and multivariable controller for multivariable systems.

CO – PO – PSO MAPPING:

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

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U23PEEE09	PROCESS MODELING AND SIMULATION	L	T	P	C
Prerequisites:	CONTROL SYSTEMS	2	0	2	3

COURSE OBJECTIVES:

- To represent the Introduction of mathematical modelling.
- To study the distributed model process.
- To introduce the model processing and various algorithms.

UNIT I GENERAL PRINCIPLES OF MODELLING 6

Introduction to mathematical modelling; Advantages and limitations of models and applications of process models of stand-alone unit operations and unit processes Classification of models: Linear vs Nonlinear, Lumped parameter vs. Distributed parameter; Static vs. Dynamic, Continuous vs. Discrete; Numerical Methods: Iterative convergence methods, Numerical integration of ODE- IVP and ODEBVP

UNIT II MODELLING OF DISTRIBUTED PROCESSES 6

Steady state models giving rise to differential algebraic equation (DAE) systems; Rate based Approaches for staged processes; Modelling of differential contactors distributed parameter models of packed beds; Packed bed reactors; Modelling of reactive separation processes; Review of solution strategies for Differential Algebraic Equations (DAEs), Partial Differential Equations (PDEs), and available numerical software libraries.

UNIT III INTRODUCTION TO PROCESS MODELLING 6

Concept of degree of freedom analysis: System and its subsystem, System interaction, Degree of freedom in a system e.g., Heat exchanger, Equilibrium still, Reversal of information flow, Design variable selection algorithm, Information flow through subsystems, Structural effects of design variable selection

UNIT IV INTRODUCTION TO PROCESS MODELLING 6

Simple examples of process models; Models giving rise to nonlinear algebraic equation (NAE) systems, -steady state models of flash vessels, equilibrium staged processes distillation columns, absorbers, strippers, CSTR, heat exchangers, etc.; Review of solution procedures and available numerical software libraries

UNIT V MODELLING OF INDUSTRIAL PROCESSES 6

Simulation and their approaches, Modular, Sequential, Simultaneous and Equation solving approach, Simulation softwares and their applications, Review of solution techniques and available numerical software libraries - Case Studies.

30 PERIODS

PRACTICAL EXERCISES:

1. Computer Generation of Random Numbers.
2. Chi-square goodness-of-fit test.
3. One-sample Kolmogorov-Smirnov test.
4. Test for Standard Normal Distribution.
5. Simulation of Single Server Queuing System.

30 PERIODS

TOTAL: 60 PERIODS

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TEXT BOOKS:

1 Pablo A Lopez Perez ,"Advanced Control Methods for Industrial Processes: Modelling, Design and Simulation of Emerging Systems in Real Time," 1st Edition, John Wiley & Sons, 2025.

2 B Bequette, "Process Control: Modeling, Design, and Simulation", 2nd Edition, Addison Wesley, 2024.

REFERENCES:

1 Syed Ahmad Imtiaz ,"Modelling of Chemical Process Systems", 2nd Edition, Elsevier Science, 2023.

2 Frank Witte, "Strategy, Planning and Organization of Test Processes: Basis for Successful Project Execution in Software Testing," 1st Edition, Springer, 2022.

ONLINE RESOURCES:

1 https://archive.nptel.ac.in/courses/103/107/103107096

2 https://nptel.ac.in/courses/103101111

3 https://nptel.ac.in/courses/111107105

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 Apply the Engineering knowledge to various problems in modelling

CO2 Design the modelling process by using MATLAB.

CO3 Apply the formulates and solve engineering problems in design.

CO4 Apply the techniques and skills of modern engineering tools necessary for the Engineering practice

CO5 Design and solving models of problems encountered in aerospace engineering and mechanics.

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	1	-	-	2	1
CO2	3	3	3	3	1	-	-	1	1	1	-	-	2	1
CO3	3	2	1	1	1	-	-	1	1	1	-	-	2	1
CO4	3	2	1	1	1	-	-	1	1	1	-	-	2	1
CO5	3	3	3	3	1	-	-	1	1	1	-	-	2	1

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U23PEEE10	MODEL BASED CONTROL	L	T	P	C
Prerequisites: CONTROL SYSTEMS		2	0	2	3

COURSE OBJECTIVES:

- To represent the Introduction of mathematical modelling.
- To study the distributed model process.
- To introduce the model processing and various algorithms.

UNIT I INTRODUCTION TO MIMO CONTROL 6

Introduction to MIMO Systems - Multivariable control - Multiloop Control-Multivariable IMCIMCPID Case studies

UNIT II MODEL PREDICTIVE CONTROL SCHEMES 6

Introduction to Model Predictive Control - Model Predictive Control Elements - Generalized Predictive Control Scheme – Multivariable Generalized Predictive Control Scheme – Multiple Model based Model Predictive Control Scheme Case Studies.

UNIT III STATE SPACE BASED MODEL PREDICTIVE CONTROL SCHEME 6

State Space Model Based Predictive Control Scheme - Review of Kalman Update based filters – State observer Based Model Predictive Control Schemes – Case Studies

UNIT IV CONSTRAINED MODEL PREDICTIVE CONTROL SCHEME 6

Constraints Handling: Amplitude Constraints and Rate Constraints –Constraints and Optimization – Constrained Model Predictive Control Scheme – Case Studies.

UNIT V ADAPTIVE CONTROL SCHEME 6

Introduction to Adaptive Control-Gain Scheduling-Self tuning regulators–MARS-Adaptive Model Predictive Control Scheme –Case Studies

TOTAL: 30 PERIODS

PRACTICAL EXERCISES:

1. An investigation of different Control System Components.
2. An Experiment on various modes of control action P, I, P+I, P+D, P+I+D.
3. An Experiment on ON/OFF Temperature controller.
4. An Experiment on DC/AC Servo Motor.
5. An experiment on speed control of stepper motor.

30 PERIODS

TOTAL: 60 PERIODS

TEXT BOOKS:

1. M Chidambaram ,"Mathematical Modeling and Simulation in Chemical Engineering", Cambridge English, 2018.
2. Paul M J van den Hof , Carsten Scherer , Peter S C Heuberger ,"Model Based Control: Bridging Rigorous Theory and Advanced Technology", 9th Edition, Springer, 2024.

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REFERENCES:

1 Riding Zhang, Anke Xue Furong Gao, "Model Predictive Control Approaches Based on the Extended State Space Model and Extended Non-minimal State Space Model", 1st Edition, Springer, 2019.

2 Paul Serban Agachi, Zoltan K Nagy, Mircea Vasile Cristea, Arpad Imre Lucaci, "Model Based Control Case Studies in Process Engineering", 1st Edition, Wiley, 2007.

ONLINE RESOURCES:

1 https://nptel.ac.in/courses/103103037

2 https://nptel.ac.in/courses/108103007

3 https://onlinecourses.nptel.ac.in/noc21_ge01/preview

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 Describe the control schemes on MIMO systems.
CO2 Design a controller for the MIMO system.
CO3 Analyze the control schemes available in industries.
CO4 Design MPC, Adaptive controllers for practical engineering problems.
CO5 Apply the suitable controllers for the given problems.

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	3	2
CO2	3	3	3	3	1	-	-	1	1	1	-	2	3	2
CO3	3	3	1	2	1	-	-	1	1	1	-	2	3	2
CO4	3	3	3	3	1	-	-	1	1	1	-	2	3	2
CO5	3	2	1	1	1	-	-	1	1	1	-	2	3	2

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U23PEEE11	ADAPTIVE CONTROL	L	T	P	C
Prerequisites: CONTROL SYSTEMS		2	0	2	3

COURSE OBJECTIVES:

- To impart knowledge on how to recursively estimate the parameters of discrete input – output models using recursive parameter estimation methods
- To make the student understand the principles of STR, MRAC and Gain scheduling.
- To make the student design simple adaptive controllers for linear systems using STR, MRAC and Gain scheduling

UNIT I INTRODUCTION 6

Introduction - Adaptive Schemes - The adaptive Control Problem – Applications Parameter estimation: -LS, RLS: and ERLS

UNIT II GAIN SCHEDULING 6

Introduction- The principle - Design of gain scheduling controllers- Nonlinear transformations - application of gain scheduling - Auto-tuning techniques: Methods based on Relay feedback

UNIT III DETERMINISTIC SELF-TUNING REGULATORS 6

Introduction- Pole Placement design - Indirect Self-tuning regulators - direct self-tuning regulators – Disturbances with known characteristics

UNIT IV STOCHASTIC AND PREDICTIVE SELF-TUNING REGULATORS 6

Introduction – Design of minimum variance controller - Design of moving average controller - stochastic self-tuning regulators

UNIT V MODEL – REFERENCE ADAPTIVE SYSTEM 6

F Introduction - MIT rule – Determination of adaptation gain - Lyapunov theory –Design of MRAS using Lyapunov theory – Relations between MRAS and STR

TOTAL: 30 PERIODS

PRACTICAL EXERCISES:

1 PC Based Control of Simulated Process.
2 Design of Fuzzy Toolbox and Design of Fuzzy Logic.
3 Direction Control of a Dc Motor Using Programmable Logic Controller.
4 Design Position Control Systems.
5 Analyse the Stability control of the closed loop system.

30 PERIODS

TOTAL: 60 PERIODS

TEXT BOOKS:

1 Petros Ioannou , "Adaptive Control Theory and Applications," 2nd Edition, Intechopen, 2024.
2 Nhan T Nguyen, "Model-Reference Adaptive Control: A primer", 1st Edition, Springer, 2018.

REFERENCES:

Approved

1 Ridong Zhang, Anke Xue Furong Gao, "Model Predictive Control Approaches Based on the Extended State Space Model and Extended Non-minimal State Space Model", 1st Edition, Springer , 2019.
2 Paul Serban Agachi, Zoltan K Nagy, Mircea Vasile Cristea, Arpad Imre Lucaci, "Model Based Control Case Studies in Process Engineering", 1st Edition, John Wiley & Sons, 2007.

ONLINE RESOURCES:

1 https://in.mathworks.com/help/slcontrol/adaptive-control-design.html
2 https://in.mathworks.com/videos/nonlinear-model-based-adaptiverobust controller in-an oil and-gas-wireline-operation- 1636077967956.html
3 https://archive.nptel.ac.in/courses/108/102/108102113/

COURSE OUTCOMES:

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

CO1 Apply the estimation algorithm to estimate the parameters of the process.

CO2 Apply the adaptive control concepts to control a process.

CO3 Design of adaptive controllers and analysis of the process.

CO4 Design suitable adaptive schemes for complex instrumentation problem.

CO5 Design adaptive control for multidisciplinary problems for self and lifelong learning to keep in pace with the new technology.

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	1	-	2	3	2
CO2	3	2	1	1	1	-	-	1	1	1	-	2	3	2
CO3	3	3	3	3	1	-	-	1	1	1	-	2	3	2
CO4	3	3	3	3	1	-	-	1	1	1	-	2	3	2
CO5	3	3	3	3	1	-	-	1	1	1	-	2	3	2

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U23PEEE12	Industrial Process Control	L	T	P	C
Prerequisites:	**Control Systems**	2	0	2	3

COURSE OBJECTIVES:

- To understand and gain the knowledge of Control valve gain.
- To understand and gain the knowledge of Design & construction of Globe Valve, Valve trends, trim design, trim flow characteristics.
- To understand and gain the knowledge of Functional description of PLC difference between PLC & computer

UNIT I **CONTROL VALVE DESIGN** 6

Control valve flow characteristics, valve & process characteristics, effect of distortion coefficient on linear and percentage valve, range-ability of control valve, control valve sizing for liquid, Gas, vapor, and steam. Special reference to Masoneilan & Fisher Equation control valve cavitation and flashing flow control cavitation index.

UNIT II **VALVE NOISE CALCULATION & REDUCTION** 6

Sources of valve noise, noise control, path treatment source treatment valve noise calculation. Design & construction of Globe Valve, Valve trends, trim design, trim flow characteristics, flow range ability, standard trim configuration, valve plug stems, Body form of single & double seated Globe valve, construction

UNIT III **PROGRAMMING THE PROGRAMMABLE CONTROLLER** 6

Programming languages, ladder diagram instructions, special functions, data transfer and data manipulation operations, arithmetic operations, flow control operations, Boolean mnemonics. Functional blocks data transfer operations arithmetic and logic operations, Programmable controller's industrial applications.

UNIT IV **MAGNETOSTATICS AND APPLICATIONS** 6

Programmable controller, characteristic function of PLC, Architecture and block diagram of PLC, ladder diagram, ladder diagram elements, Development & analysis of ladder diagram, logic diagram from ladder diagram, Functional description of PLC difference between PLC & computer.

UNIT V **DISCRETE STATE PROCESS CONTROL SYSTEM** 6

Programmable controller, characteristic function of PLC, Architecture and block diagram of PLC, ladder diagram, ladder diagram elements, Development & analysis of ladder diagram, logic diagram from ladder diagram, Functional description of PLC difference between PLC & computer.

30 PERIODS

PRACTICAL EXERCISES:

1 Flow control using P, PI, PD, and PID controllers–Study of output response.
2 Liquid level control using P, PI, PD, and PID controllers–Study of output response.
3 Pressure control using P, PI, PD, and PID controllers–Study of output response.

4 Study of ratio controls.

5 Familiarization of Programmable Logic Controller.

30 PERIODS
TOTAL: 60 PERIODS

TEXT BOOKS:

1 Alan M Kugelman, "Practical Process Control Design with Industrial Applications", 2nd Edition, John Wiley & Sons, 2024.

2 William C Dunn , "Fundamentals of Industrial Instrumentation and Process Control", 2nd Edition, Tata McGraw Hill, 2023.

3 Dale R Patrick, Stephen W Fardo, "Industrial Process Control Systems", 2nd Edition, Wiley, 2019.

REFERENCES:

1 Ridong Zhang, Anke Xue Furong Gao, "Model Predictive Control Approaches Based on the Extended State Space Model and Extended Non-minimal State Space Model", 1st Edition, Springer, 2019.

2 Paul Serban Agachi, Zoltan K Nagy, Mircea Vasile Cristea, Arpad Imre Lucaci, "Model Based Control Case Studies in Process Engineering", 1st Edition, John Wiley & Sons, 2007.

ONLINE RESOURCES:

1 https://nptel.ac.in/courses/103105064

2 https://archive.nptel.ac.in/courses/103/105/103105064/

3 https://jkccollege.digimat.in/nptel/courses/video/103105064/L01.html

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 Apply the estimation algorithm to estimate the parameters of the process.

CO2 Apply the adaptive control concepts to control a process.

CO3 Design of adaptive controllers and analysis of the process.

CO4 Design suitable adaptive schemes for complex instrumentation problem.

CO5 Design adaptive control for multidisciplinary problem for self and lifelong learning to keep in pace with the recent technology.

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	1	-	2	3	2
CO2	3	2	1	1	1	-	-	1	1	1	-	2	3	2
CO3	3	3	3	3	1	-	-	1	1	1	-	2	3	2
CO4	3	3	3	3	1	-	-	1	1	1	-	2	3	2
CO5	3	3	3	3	1	-	-	1	1	1	-	2	3	2

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U23PEEE13	DIGITAL SIGNAL PROCESSING	L T P C
Prerequisites: Transforms and Partial Differential Equations		2 0 2 3

COURSE OBJECTIVES:

- To impart knowledge about signals and systems & their mathematical representation
- To educate on Transformation techniques & their computation.
- To introduce the concepts of Filters and their design for digital implementation

UNIT I INTRODUCTION 6

Classification of systems: Continuous, discrete, linear, causal, stability, dynamic, recursive, time variance; classification of signals: continuous and discrete, energy and power; mathematical representation of signals; sampling techniques, quantization, quantization error, Nyquist rate, aliasing effect.

UNIT II DISCRETE TIME SYSTEM ANALYSIS 6

Z-transform and its properties, inverse z-transforms; difference equation – Solution by z transform, application to discrete systems - Stability analysis, frequency response – Convolution – Discrete Time Fourier transform , magnitude and phase representation.

UNIT III DISCRETE FOURIER TRANSFORM & COMPUTATION 6

Discrete Fourier Transform- properties, magnitude and phase representation - Computation of DFT using FFT algorithm – DIT & DIF using radix 2 FFT – Butterfly structure.

UNIT IV DESIGN OF FIR DIGITAL FILTERS 6

Windowing Techniques — Need and choice of windows — Linear phase characteristic, Analog filter design — Butterworth and Chebyshev approximations

UNIT V DESIGN OF IIR DIGITAL FILTERS 6

Digital design using impulse invariant and bilinear transformation, Warping and pre warping.

30 PERIODS

PRACTICAL EXERCISES:

1 Generation of elementary discrete-time sequences

2 Linear and Circular convolutions

3 Frequency Analysis using DFT

4 Design of FIR filters and demonstrate the filtering operation

5 Design of Butterworth and Chebyshev IIR filters and demonstrate the filtering operation.

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30 PERIODS

TOTAL: 60 PERIODS

TEXT BOOKS:

1 J G Proakis, D G Manolakis, "Digital Signal Processing Principles, Algorithms and Applications", 5th Edition, Pearson Education, 2022.
2 Samir I Abood, "Digital Signal Processing – A Primer with MATLAB', 1st Edition, CRC Press, 2022.

REFERENCES:

1 Maurice Bellanger B, "Digital Signal Processing – Theory & Practice", 10th Edition, John Wiley & Sons, 2024.
2 Li Tan, Jean Jiang, "Digital Signal Processing Fundamentals and Applications", 3rd Edition, Academic Press, 2019.
3 S Palani, "Principles of Digital Signal Processing", 2nd Edition, Springer, 2022.

ONLINE RESOURCES

1 https://archive.nptel.ac.in/courses/108/106/108106151
2 https://nptel.ac.in/courses/108104100
3 https://nptel.ac.in/courses/117102060

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 Comprehend the signals and systems & their mathematical representation
CO2 Analyse the discrete time systems with Z transform
CO3 Analyse the discrete Fourier transformation techniques & their computation
CO4 Design and Implement FIR Filters
CO5 Design and Implement IIR Filters

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	-	-	-	-	3	1
CO2	3	3	1	2	1	-	-	1	1	1	-	-	3	1
CO3	3	3	1	2	1	-	-	1	1	1	-	-	3	1
CO4	3	3	3	3	1	-	-	1	1	1	-	-	3	1
CO5	3	3	3	3	1	-	-	1	1	1	-	-	3	1

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U23PEEE14 DIGITAL IMAGE PROCESSING & ITS APPLICATIONS **L T P C**

Prerequisites: Digital Logic Circuits **2 0 2 3**

COURSE OBJECTIVES:

- To understand about simple image enhancement techniques in Spatial and Frequency domain
- To study the image segmentation and representation techniques
- To introduce the concepts of with image compression and recognition methods

UNIT I **DIGITAL IMAGE FUNDAMENTALS** **6**

Digital Image Representation – Fundamental steps in Image Processing)– Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels - colour models.

UNIT II **IMAGE ENHANCEMENT** **6**

Spatial Domain: grey level transformations – Histogram processing – Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters.

UNIT III **IMAGE RESTORATION** **6**

Image Restoration - degradation model, Properties, Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering

UNIT IV **IMAGE SEGMENTATION** **6**

Edge detection, Edge linking via Hough transform – Thresholding - Region based segmentation – Region growing – Region splitting and merging – Morphological processing- erosion and dilation, Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed Segmentation algorithm.

UNIT V **IMAGE COMPRESSION AND RECOGNITION** **6**

Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard, MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture - Patterns and Pattern classes - Recognition based on matching.

30 PERIODS

PRACTICAL EXERCISES:

1 Study of Open CV computer vision Library for Open CV in Python / PyCharm or C++ / Visual Studio or equivalent

2 Basic Image Processing - loading images, Cropping, Resizing, Thresholding,

3 Image Annotation – Drawing lines, text circle, rectangle, ellipse on images

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4 Image Enhancement - Understanding Colour spaces, colour space conversion.

5 Histogram equalization & Edge Detection

30 PERIODS

TOTAL: 60 PERIODS

TEXT BOOKS:

1 Rafael C Gonzalez, Richard E Woods, Steven L Eddins, "Digital Image Processing Using MATLAB", 3rd Edition, Gatesmark, 2020.

2 Anil Jain K, "Fundamentals of Digital Image Processing", 1st Edition, Pearson Education, 2015.

REFERENCES:

1 Malay K Pakhira, "Digital Image Processing and Pattern Recognition", 2nd Edition, Prentice Hall of India, 2021.

2 Rafael C Gonzalez, Richard E Woods, "Digital Image Processing", 4th Edition, Pearson Education, 2018.

3 Jayaraman S, Esakkirajan S, Veerakumar T, "Digital Image Processing", 2nd Edition, Tata McGraw Hill, 2020.

ONLINE RESOURCES

1 https://archive.nptel.ac.in/courses/117/105/117105135/

2 https://nptel.ac.in/courses/117105079

3 https://archive.nptel.ac.in/courses/106/105/106105032/

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 Comprehend the fundamentals of digital image processing.

CO2 Apply the techniques of smoothing, sharpening and enhancement on images.

CO3 Describe the restoration concepts and filtering techniques.

CO4 Analyse the segmentation concepts, features extraction, compression and recognition methods for colour models.

CO5 Comprehend image compression concepts.

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
CO2	3	2	1	2	1	-	-	1	1	1	-	1	3	1
CO3	2	2	1	1	-	-	-	1	-	-	-	1	3	1
CO4	3	3	1	2	1	-	-	1	1	1	-	1	3	1
CO5	2	2	1	1	-	-	-	1	-	-	-	1	3	1

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U23PEEE15	EMBEDDED C PROGRAMMING	L	T	P	C
Prerequisites: Microprocessors and Microcontrollers		2	0	2	3

COURSE OBJECTIVES:

- To study the basic concepts of embedded C.
- To expose the fundamentals of embedded Programming
- To introduce the concepts for developing 8051 Programming in C

UNIT I **BASIC C PROGRAMMING** 6

Typical C Program Development Environment - Introduction to C Programming - Structured Program Development in C - Data Types and Operators - C Program Control - C Functions - Introduction to Arrays.

UNIT II **EMBEDDED C** 6

Adding Structure to 'C' Code: Object-oriented programming with C, Header files for Project and Port, Examples. Meeting Real-time constraints: Creating hardware delays - Need for timeout mechanism - Creating loop timeouts - Creating hardware timeouts.

UNIT III **8051 PROGRAMMING IN C** 6

Data types and time delay in 8051, I/O programming in 8051, Logic operations in 8051, Data conversion program in 8051 Accessing code ROM space in 8051, Data serialization using 8051

UNIT IV **8051 SERIAL PORT AND INTERRUPT PROGRAMMING IN C** 6

Basics of serial communication, 8051 interface to RS232- serial port programming in 8051. 8051 interrupts and programming, Programming for timer configuration.

UNIT V **8051 INTERFACING** 6

8051: ADC interfacing, DAC interfacing, Sensor interfacing, LCD interfacing, Stepper motor interfacing.

30 PERIODS

PRACTICAL EXERCISES:

Use 8051 microcontroller/Embedded processor/IDE/open source platform

1. Introduction to Programming Environment with simple arithmetic/logic operations
2. Configuring timer for generating hardware delay.
3. Flashing an LED using an interrupt
4. Serial Port Programming in 8051
5. Interfacing a stepper motor with 8051

30 PERIODS

TOTAL: 60 PERIODS

TEXT BOOKS:

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1 Muhammad Ali Mazidi, Janice G Mazidi, Rolin D McKinlay, "The 8051 Microcontroller and Embedded Systems ", 2nd Edition, Pearson Education, 2020.

2 Ivan Cibrario Bertolotti, Tingting Hu, "Embedded Software Development", 1st Edition, CRC Press, 2020.

REFERENCES:

1 Paul Deitel, Harvey Deitel, "C How to Program", 9th Edition, Pearson Education, 2022.

2 Abubeker K M, "Embedded C & ALP Programming", 1st Edition, Notion Press, 2020.

3 Raj Kamal, "Embedded Systems", 4th Edition, Tata McGraw Hill, 2020.

ONLINE RESOURCES

1 https://archive.nptel.ac.in/courses/106/104/106104128/

2 https://archive.nptel.ac.in/courses/108/102/108102169/

3 https://nptel.ac.in/courses/106105193

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 Explain the structured Program development in C with functions and arrays.

CO2 Comprehend the basic concepts of embedded C with programming examples.

CO3 Write Data Conversion and serialization 8051 programs in C using I/O ports, data types & logic operations.

CO4 Write 8051 C programs for serial port & Interrupts

CO5 Write 8051 programs in C for interfacing with peripherals.

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	-	-	3	1
CO2	2	2	1	1	2	-	-	1	1	1	-	1	3	1
CO3	3	3	3	3	2	-	-	1	1	1	-	1	3	1
CO4	3	3	3	3	2	-	-	1	1	1	-	1	3	1
CO5	3	3	3	3	2	-	-	1	1	1	-	1	3	1

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U23PEEE16	SMART SYSTEM AUTOMATION	L	T	P	C
Prerequisites: Microprocessors & Microcontrollers		2	0	2	3

COURSE OBJECTIVES:

- To introduce the architecture and requirements of Home Automation
- To provide an insight into smart appliances and energy management concepts
- To familiarize the basics of robotics and its role for automation

UNIT I **INTRODUCTION** 6

Overview of a smart system - Hardware and software selection - Smart sensors and Actuators – Communication protocols used for smart systems.

UNIT II **HOME AUTOMATION** 6

Home Automation – System Architecture - Essential Components- Design Considerations: Control Unit, Sensing Requirements, Communication, Data Security.

UNIT III **SMART APPLIANCES AND ENERGY MANAGEMENT** 6

Significance of smart appliances for energy management -Smart Meters: Architecture & Energy Measurement Technique – Security Considerations.

UNIT IV **SMART WEARABLE DEVICES** 6

Body Area Networks - Sensors– communication protocol for Wearable devices- Application of Smart Wearable in Healthcare & Activity Monitoring.

UNIT V **EMBEDDED SYSTEMS AND ROBOTICS** 6

Fundamental concepts in Robotics- Robots and Controllers components - Embedded processor based: pick and place robot- Mobile Robot Design..

30 PERIODS

PRACTICAL EXERCISES:

Use Arduino/ Raspberry pi/ any other Embedded processors

1 Hands-on experiments based on Ubidots & Thing speak / Open-source Analytics Platform.
2 Bluetooth Based Home Automation Project.
3 GSM Based Home Devices Control.
4 Pick and place robots using Arduino/ any suitable Embedded processor.
5 Mini project: Design of a Smart Automation system

30 PERIODS

TOTAL: 60 PERIODS

TEXT BOOKS:

1 M M Nayyar, A V Vasilakos, "Smart Automation to Smart Manufacturing: Digital Transformation in Industry 4.0", 1st Edition, Springer, 2021.

2 Charles Nehme, "Industry 4.0: The Future of Smart Manufacturing and Digital Transformation", 1st Edition, Pearson Education, 2025.

REFERENCES:

1 Nilanjan Dey, Amartya Mukherjee, "Embedded Systems and Robotics with Open-Source Tools", 2nd Edition, CRC press, 2021.

2 Masood Saroush, Michael Baldea, Thomas F Edgar, "Smart Manufacturing: Concepts and Methods", 1st Edition, Elsevier, 2020.

3 Raj Kamal, "Embedded Systems", 4th Edition, Tata McGraw Hill, 2020.

ONLINE RESOURCES

1 https://nptel.ac.in/courses/112101098

2 https://nptel.ac.in/courses/108106022

3 https://nptel.ac.in/courses/108102045

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 Explain the concepts of smart system design
CO2 Design a home automation system
CO3 Describe about smart appliances and energy management concepts
CO4 Comprehend about smart wearable devices
CO5 Design a mobile robot and pick and place robots

CO – PO – PSO MAPPING:

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

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U23PEEE17 EMBEDDED SYSTEMS IN AUTOMOBILE APPLICATIONS **L T P C**

Prerequisites: Microprocessors and Microcontrollers **2 0 2 3**

COURSE OBJECTIVES:

- To introduce the fundamentals of automotive and vehicle control systems.
- To explain the concepts of vehicle management systems
- To describe the basics of automotive telematics.

UNIT I AUTOMOTIVE FUNDAMENTALS **6**

Automotive physical configuration, drive train, suspension, brakes, steering system, Systems approach to control and instrumentation: Characteristics of digital electronic system, Instruments.

UNIT II VEHICLE CONTROL SYSTEMS **6**

Vehicle motion control: Cruise control system, Anti-Lock braking system, Electronic suspension system, Electronic steering control, automotive instrumentation, on board and off – board diagnostics, occupant protection systems.

UNIT III VEHICLE MANAGEMENT SYSTEMS **6**

Vehicle cruise control- speed control anti-locking braking system-electronic suspension - electronic steering, wiper control; Vehicle system schematic for interfacing with EMS, ECU, Energy Management system for electric vehicles- for sensors, accelerators, brake Battery management.

UNIT IV AUTOMOTIVE TELEMATICS **6**

Role of Bluetooth, CAN, LIN and flex ray communication protocols in automotive applications; Multiplexed vehicle system architecture for signal and data / parameter exchange between EMS, ECUs with other vehicle system components and other control systems.

UNIT V ELECTRONIC DIAGNOSTICS FOR VEHICLES **6**

System diagnostic standards and regulation requirements –On board diagnosis of vehicles electronic units & electric units - Speedometer, oil and temperature gauges, and audio system.

30 PERIODS

PRACTICAL EXERCISES:

Use Arduino UNO/raspberry Pi/Galileo board

1 Design the Embedded system for Stepper Motor Control.

2 Design the Embedded system to interface the key switch, LED.

3 Design the Embedded system to interface analog linear temperature sensor

4 Design the Embedded system for Collision Detection Warning System.

5 Design the Embedded system for vehicle to vehicle communication.

30 PERIODS

TOTAL: 60 PERIODS

TEXT BOOKS:

1 William B Ribbens, "Understanding Automotive Electronics", 8th Edition , Elsevier, 2020.

2 Ali Emadi, "Advance Electric Drive Vehicles", 2nd Edition, CRC Press, 2019.

REFERENCES:

1 Tom Denton, "Automotive Electricals / Electronics System and Components", 5th Edition, Elsevier, 2018.

2 Daniel Watzenig, Martin Horn, "Automated Driving: Safer and More Efficient Future Driving", 2nd Edition, Springer, 2021.

3 Gianfranco Pistoia, "Electric and Hybrid Vehicles: Power Sources, Models, Sustainability, Infrastructure and the Market", 2nd Edition, Elsevier, 2020.

ONLINE RESOURCES

1 https://archive.nptel.ac.in/courses/107/106/107106088/

2 http://www.digimat.in/nptel/courses/video/107106080/

3 https://www.udemy.com/course/learn-automotive-electrical-diagnostics-and-repairs

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 Explain the basic units in automotive systems.

CO2 Analyse the protection and control of vehicle control systems.

CO3 Analyse the energy management of electric vehicles..

CO4 Analyse the role of communication protocols in automotive systems.

CO5 Describe the electronic diagnosis for 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	-	-	-	-	-	-	-	-	3	1
CO2	3	3	1	2	1	-	-	1	1	1	-	1	3	1
CO3	3	3	1	2	1	-	-	1	1	1	-	1	3	1
CO4	3	3	1	2	1	-	-	1	1	1	-	1	3	1
CO5	2	2	1	1	-	-	-	-	-	-	-	-	3	1

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U23PEEE18	EMBEDDED SYSTEM DESIGN	L	T	P	C
Prerequisites: Microprocessors and Microcontrollers		2	0	2	3

COURSE OBJECTIVES:

- To introduce the Building Blocks of an embedded System and Software Tools
- To explain the basics of a Real-time operating system
- To analyze the applications based on embedded design approaches

UNIT I INTRODUCTION TO EMBEDDED SYSTEMS 6

Introduction to Embedded Systems –Structural units in Embedded processor, selection of processor & memory devices- DMA — Memory management methods- Timer and Counting devices, Real Time Clock, In-circuit emulator, Target Hardware Debugging.

UNIT II EMBEDDED NETWORKING 6

Embedded Networking: Introduction, I/O Device Ports & Buses– Serial Bus communication protocols RS232 standard – RS485 – CAN Bus- Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I^2C).

UNIT III INTERRUPTS SERVICE MECHANISM AND DEVICE DRIVER 6

Programmed-I/O busy-wait approach without interrupt service mechanism-ISR concept-interrupt sources – multiple interrupts – context and periods for context switching, interrupt latency and deadline – Introduction to Device Drivers.

UNIT IV RTOS-BASED EMBEDDED SYSTEM DESIGN 6

Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Pre-emptive and non-pre-emptive scheduling, Task communication- shared memory, message passing- Interprocess Communication- Introduction to process synchronization using semaphores.

UNIT V EMBEDDED SYSTEM APPLICATION DEVELOPMENT 6

Embedded Product Development Life Cycle - Case Study: Precision Agriculture- Autonomous car.

30 PERIODS

PRACTICAL EXERCISES:

Use any Embedded processor/IDE/open source platform

1 Introduction to IDE and Programming Environment

2 Configure timer block for signal generation (with given frequency).

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3 Interrupts programming example using GPIO.

4 I²C communication with peripherals

5 Basic RTOS concept and programming

30 PERIODS

TOTAL: 60 PERIODS

TEXT BOOKS:

1 Peter Marwedel, "Embedded system Design", 4th Edition, Springer, 2021.

2 Raj Kamal,"Embedded Systems", 4th Edition, Tata McGraw Hill, 2020.

REFERENCES:

1 Santanu Chattopadhyay, "Embedded System Design", 3rd Edition, Prentice Hall of India, 2023.

2 Parag H Dave, Himanshu B Dave, "Embedded Systems - Concepts, Design and Programming", 2nd Edition, Pearson Education, 2022.

3 Jacob Beningo, "Embedded Software Design: A Practical Approach to Architecture, Processes, and Coding Techniques", 1st Edition, Apress, 2022.

ONLINE RESOURCES

1 https://archive.nptel.ac.in/courses/108/102/108102169/

2 https://nptel.ac.in/courses/106105159

3 https://archive.nptel.ac.in/courses/106/105/106105193/

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 Explain the basic units in Embedded systems.

CO2 Comprehend the basic differences between various Bus communication standards.

CO3 Describe the Interrupts service mechanism.

CO4 Write Programs with basic RTOS concepts.

CO5 Develop embedded based 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	-	-	-	-	-	-	-	3	1
CO2	2	2	1	1	1	-	-	-	-	-	-	-	3	1
CO3	2	2	1	1	1	-	-	-	-	-	-	-	3	1
CO4	3	3	3	3	1	-	-	1	1	1	-	1	3	1
CO5	3	3	3	3	1	-	-	1	1	1	-	1	3	1

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U23PEEE19 DESIGN OF MOTOR AND POWER CONVERTERS FOR ELECTRIC VEHICLES

L	T	P	C
2	0	2	3

Prerequisites: Electrical Machines –I , Electrical Machines -II

COURSE OBJECTIVES:

- To understand the drive cycles and requirements of EV and to know the working of motors used in Electric Vehicle
- To analyse and model the buck/boost converter operation and to design the same and to learn the simulation basics of control systems
- To derive transfer functions for DC-DC converters

UNIT I **ELECTRIC VEHICLE DYNAMICS** 6

Standard drive cycles-Dynamics of Electric Vehicles - Tractive force-Maximum speed, torque, power, energy requirements of EV.

UNIT II **MOTORS FOR ELECTRIC VEHICLES** 6

Introduction – Speed And Torque control of above and below rated speed-Speed control of EV in the constant power region of electric motors. DC Motors, Induction Motor, Permanent Magnet Synchronous Motors (PMSM), Brushless DC Motors, Switched Reluctance Motors (SRMs). Synchronous Reluctance Machines-Choice of electric machines for EV.

UNIT III **BASICS OF SIMULATION IN CONTROL SYSTEMS** 6

Transfer Function-How to build transfer function, identify Poles, zeros, draw time response plots, bode plot (Bode Plots for Multiplication Factors, Constant, Single and Double Integration Functions, Single and Double Differentiation Functions, Single Pole and Single Zero Functions, RHP Pole and RHP Zero Functions).

UNIT IV **MODELING OF DC-DC CONVERTERS** 6

Overview of PWM Converter Modelling -Power Stage Modelling - PWM Block Modelling - Voltage Feedback Circuit and Small-Signal Model of PWM Converter - Averaging Power Stage Dynamics - Average Models for buck/boost Converter - Small-Signal Model of Converter Power Stage - Frequency Response of Converter .

UNIT V **POWER STAGE TRANSFER FUNCTIONS OF DC – DC CONVERTERS** 6

Power Stage Transfer Functions of buck-boost Converter in CCM Operation, Input-to-Output Transfer Function, Duty Ratio-to-Output Transfer Function, and Load Current-to-Output Transfer Function.

30 PERIODS

PRACTICAL EXERCISES:

Using SCILAB/MATLAB Simulation Software

1. Simple simulation exercises of basic control systems.
2. Bode plots and calculation of Gain margin and Phase margin for power stage transfer function via simulation.
3. Design of buck converter.
4. Design of boost converter.
5. Simulation of buck, boost and buck boost converter-open loop (With power circuit and Transfer function).

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30 PERIODS
TOTAL: 60 PERIODS

TEXT BOOKS:

1 Jigneshkumar P Desai, "Special Electrical Machinery", 1st Edition, John Wiley & Sons, 2023

2 L Ashok Kumar, S Albert Alexander, "Power Converters for Electric Vehicles", 1st Edition, CRC Press, 2021.

REFERENCES:

1 Simmi P Burman, "Special Electrical Machines", 1st Edition, S K Kataria & Sons, 2023.

2 Atif Iqbal,Shaikh, "Electrical Machines Fundamentals with Numerical Solutions using MATLAB/SIMULINK", 1st Edition, John Wiley & Sons , 2021.

3 Md Rabiul Islam, Rakibuzzaman Shah, "Emerging Power Converters for Renewable Energy and Electric Vehicles: Modelling Design and Control", 1st Edition, CRC Press, 2021.

ONLINE RESOURCES

1 https://onlinecourses.nptel.ac.in/noc23_ee38/preview

2 https://www.coursera.org/certificates/power-electronics-motors-ev-iitbombay

3 https://onlinecourses.nptel.ac.in/noc24_ee30/preview

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 Explain appropriate electric machine for electric vehicle application

CO2 Apply transfer function with factors such as constant, integral, differential, first order factor and second order factor (both numerators & denominators)

CO3 Apply transfer function from state models

CO4 Design buck, boost and buck-boost converter

CO5 Design power stage transfer functions for DC-DC converters and to simulate DC-DC converters and to obtain gain margin and phase margin

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	-	3	2	1
CO2	3	2	1	1	3	-	1	1	1	1	-	3	2	1
CO3	3	2	1	1	3	-	1	1	1	1	-	3	2	1
CO4	3	3	3	3	3	-	1	1	1	1	-	3	2	1
CO5	3	3	3	3	3	-	1	1	1	1	-	3	2	1

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U23PEEE20	ELECTRIC VEHICLE DESIGN, MECHANICS AND CONTROL	L	T	P	C
Prerequisites: Electrical Machines –II, Control Systems		2	0	2	3

COURSE OBJECTIVES:

- To understand and gain the knowledge on the basics of EV and vehicle mechanics and the EV architecture
- To study the energy storage system concepts.
- To derive models for batteries and to know the different types of batteries and its charging methods and to learn the control preliminaries for DC-DC converters.

UNIT I **INTERNAL COMBUSTION ENGINES** 6

IC Engines, BMEP and BSFC, Vehicle Fuel Economy, Emission Control Systems, Treatment of Diesel Exhaust Emissions.

UNIT II **ELECTRIC VEHICLES AND VEHICLE MECHANICS** 6

Electric Vehicles (EV), Hybrid Electric Vehicles (HEV), Engine ratings- Comparisons of EV with internal combustion Engine vehicles- Fundamentals of vehicle mechanics.

UNIT III **BATTERY MODELING, TYPES AND CHARGING** 6

Batteries in Electric and Hybrid Vehicles - Battery Basics -Battery Parameters. Types- Lead Acid Battery - Nickel-Cadmium Battery - Nickel-Metal-Hydride (NiMH) Battery - Li-Ion Battery - Li-Polymer Battery, Zinc-Air Battery, Sodium-Sulphur Battery, Sodium-Metal-Chloride, Research and Development for Advanced Batteries. Battery Modelling, Electric Circuit Models. Battery Pack Management, Battery Charging.

UNIT IV **CONTROL PRELIMINARIES** 6

Control Design Preliminaries - Introduction - Transfer Functions – Bode plot analysis for First order and second order systems - Stability - Transient Performance- Power transfer function for boost converter - Gain margin and Phase margin study-open loop mode.

UNIT V **CONTROL OF AC MACHINES** 6

Introduction- Reference frame theory, basics-modelling of induction and synchronous machine in various frames-Vector control- Direct torque control.

30 PERIODS

PRACTICAL EXERCISES:

Using SCILAB/MATLAB Simulation Software

1. Develop a model that could estimate Soc and SoH of Li-Ion Battery
2. Modelling and thermal analysis of Li-Ion Battery
3. Simulation of boost converter and calculating gain and phase margin from the transfer function
4. Simulation of buck boost converter and calculating gain and phase margin from the transfer function.
5. Simulation of direct torque control in synchronous machine

30 PERIODS

TOTAL: 60 PERIODS

TEXT BOOKS:

1 Iqbal Husain, "Electric and Hybrid Vehicles Design Fundamentals", 3rd Edition, CRC Press, 2021.
2 Rolf Isermann,"Automotive Control: Modeling and Control of Vehicles", 1stEdition, Springer Berlin, Heidelberg, 2021.

REFERENCES:

1 Atif Iqbal, Shaikh Moinoddin, Bhimireddy Prathap Reddy, "Electrical Machine Fundamentals with Numerical Simulation using MATLAB/SIMULINK", 1st Edition, John Wiley & Sons,2021.
2 João Pedro F, Trovão, Minh Cao Ta," Electric Vehicle Efficient Power and Propulsion Systems", 1st Edition, MDPI, 2022.
3 Kundan Kumar, Ambrish Devanshu, Sanjeet K, Dwivedi, "Electric Vehicle Propulsion Drives and Charging Systems", 1st ,Edition, CRC Press, 2024.

ONLINE RESOURCES

1 https://onlinecourses.nptel.ac.in/noc22_ee53/preview
2 https://www.coursera.org/certificates/power-electronics-motors-ev-iitbombay
3 https://onlinecourses.nptel.ac.in/noc24_ee30/preview

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 Describe the concepts related with EV, HEV and to compare the same with internal combustion engine vehicles.
CO2 Comprehend electrical engines and IC combustion Engines.
CO3 Explain the concepts related with batteries and parameters of battery.
CO4 Analyse the Transfer function of first order and second order systems.
CO5 Summarize the control of Ac machines.

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

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U23PEEE21 DESIGN OF ELECTRIC VEHICLE CHARGING SYSTEM

L	T	P	C
2	0	2	3

Prerequisites: Power Electronics

COURSE OBJECTIVES:

- To understand the concept of charging station and standards.
- To understand the concepts of power converters in charging and to find the charging scheme in renewable based EV charging.
- To demonstrate the wireless power transfer technique and To design & simulate power factor correction circuits.

UNIT I CHARGING STATIONS AND STANDARDS 6

Introduction-Charging technologies- Conductive charging, EV charging infrastructure, International standards and regulations - Inductive charging, need for inductive charging of EV, Modes and operating principle, Static and dynamic charging, Bidirectional power flow, International standards and regulations.

UNIT II POWER ELECTRONICS FOR EV CHARGING 6

Layouts of EV Battery Charging Systems-AC charging-DC charging systems- Power Electronic Converters for EV Battery Charging- AC–DC converter with boost PFC circuit, with bridge and without bridge circuit - Bidirectional DC–DC Converters- Non-isolated DC–DC bidirectional converter topologies- Half-bridge bidirectional converter.

UNIT III EV CHARGING USING RENEWABLE AND STORAGE SYSTEMS 6

Introduction- - EV charger topologies , EV charging/discharging strategies - Integration of EV charging-home solar PV system , Operation modes of EVC-HSP system , Control strategy of EVCHSP system - fast-charging infrastructure with solar PV and energy storage.

UNIT IV WIRELESS POWER TRANSFER 6

Introduction - Inductive, Magnetic Resonance, Capacitive types. Wireless Chargers for Electric Vehicles - Types of Electric Vehicles - Battery Technology in EV -Charging Modes in EV - Benefits of WPT. - WPT Operation Modes - Standards for EV Wireless Chargers, SAE J2954, IEC 61980. ISO 19363

UNIT V POWER FACTOR CORRECTION IN CHARGING SYSTEM 6

Need for power factor correction- Boost Converter for Power Factor Correction, Sizing the Boost Inductor, Average Currents in the Rectifier and calculation of power losses.

30 PERIODS

PRACTICAL EXERCISES:

Using SCILAB/MATLAB Simulation Software

1. Simulation and analysis for bi-directional charging V2G and G2V.
2. Design and demonstrate solar PV based EV charging stations.
3. Simulate and infer wireless power charging station for EV charging.
4. Simulation of boost converter-based power factor correction.
5. Simulation of Buck Boost converter for charging stations.

30 PERIODS

TOTAL: 60 PERIODS

TEXT BOOKS:

1 Rajiv Singh, Sanjeevikumar Padmanaban,"Cable Based and Wireless Charging Systems for Electric Vehicles", 1st Edition, Institution of Engineering and Technology (IET), 2021.

2 Rui Xiong , "Battery Management Algorithm for Electric Vehicles", 1st Edition, Springer, 2020.

REFERENCES:

1 Chitra A Sanjeevikumar Padmanaban , "Artificial Intelligent Techniques for Electric and Hybrid Electric Vehicles", 1st Edition, John Wiley & Sons, 2020.

2 Alicia Triviño-Cabrera, José M González-González, "Wireless Power Transfer for Electric Vehicles: Foundations and Design Approach", 1st Edition, Springer, 2019.

3 Nil Patel, Akash Kumar Bhoi, Sanjeevikumar Padmanaban, Jens Bo Holm-Nielsen, "Electric Vehicles Modern Technologies and Trends", 1st Edition, Springer, 2020.

ONLINE RESOURCES

1 https://archive.nptel.ac.in/courses/108/106/108106182

2 https://onlinecourses.nptel.ac.in/noc21_ee112/preview

3 https://www.coursera.org/learn/electric-vehicles-mobility

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 Apply various charging techniques and to know charging standards and regulations

CO2 Summarize the working of DC-DC converters used for charging systems and principles

CO3 Illustrate the advantages of renewable system-based charging systems and to demonstrate the principles of wireless power transfer.

CO4 Analyze the standards for wireless charging

CO5 Design and simulate boost converter-based power factor correction.

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	-	1	2	1
CO2	2	2	1	1	-	-	-	1	1	1	-	1	2	1
CO3	2	2	1	1	-	-	-	1	1	1	-	1	2	1
CO4	3	3	1	2	1	-	-	1	1	1	-	1	2	1
CO5	3	3	3	3	1	-	-	1	1	1	-	1	2	1

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U23PEEE22	TESTING OF ELECTRIC VEHICLES	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To understand and gain the knowledge of various standardization procedures in EV
- To understand and gain the knowledge about the testing procedures for EV & HEV components and know the functional safety and EMC
- To study the effect of EMI in motor drives and in DC-DC converter system

UNIT I **EV STANDARDIZATION** 6

Introduction - Current status of standardization of electric vehicles, electric Vehicles and Standardization - Standardization Bodies Active in the Field – Standardization activities in countries like Japan. The International Electro Technical Commission - Standardization of Vehicle Components.

UNIT II **TESTING OF ELECTRIC MOTORS AND CONTROLLERS FOR ELECTRIC AND HYBRID ELECTRIC VEHICLES** 6

Test Procedure Using M-G Set, electric motor, controller, application of Test Procedure, Analysis of Test Items for the Type Test - Motor Test and Controller Test (Controller Only). - Test Procedure Using Eddy Current Type Engine Dynamometer, Test Strategy, Test Procedure, Discussion on Test Procedure. Test Procedure Using AC Dynamometer.

UNIT III **FUNDAMENTALS OF FUNCTIONAL SAFETY AND EMC** 6

Functional safety life cycle - Fault tree analysis - Hazard and risk assessment – software development - Process models - Development assessments - Configuration management - Reliability - Reliability block diagrams and redundancy - Functional safety and EMC - Functional safety and quality - Standards - Functional safety of autonomous vehicles.

UNIT IV **EMC IN ELECTRIC VEHICLES** 6

Introduction - EMC Problems of EV, EMC Problems of Motor Drive, EMC Problems of DC-DC Converter System, EMC Problems of Wireless Charging System, EMC Problem of Vehicle Controller, EMC Problems of Battery Management System, Vehicle EMC Requirements

UNIT V **EMI IN MOTOR DRIVE AND DC-DC CONVERTER SYSTEM** 6

Overview -EMI Mechanism of Motor Drive System, Conducted Emission Test of Motor Drive System, IGBT EMI Source, EMI Coupling Path, EMI Modelling of Motor Drive System. EMI in DC-DC Converter, EMI Source, The Conducted Emission High-Frequency, Equivalent Circuit of DC-DC Converter System, EMI Coupling Path.

30 PERIODS

PRACTICAL EXERCISES:

Using SCILAB/MATLAB Simulation Software

1 Design and simulate motor controller for hybrid electric vehicle applications.
2 Simulation of EMC analysis for Wireless power transfer EV charging.
3 Design and simulation of EMI filter.
4 Design of EMC controller for charging.

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5 Design and simulate EMI modelling pf motor drive system.

30 PERIODS
TOTAL: 60 PERIODS

TEXT BOOKS:

1 Li Zhai, "Electromagnetic Compatibility of Electric Vehicle", 1st Edition, Springer, 2021.
2 Alicia Triviño-Cabrera, José M González-González, José A Aguado, "Wireless Power Transferor Electric Vehicles: Foundations and Design Approach", 1st Edition, Springer, 2020.

REFERENCES:

1 Nil Patel, Akash Kumar Bhoi, Sanjeevikumar Padmanaban, Jens Bo Holm-Nielsen, "Electric Vehicles Modern Technologies and Trends", 1st Edition, Springer Publisher, 2021.
2 Rajiv Singh, Sanjeevikumar Padmanaban, "Cable Based and Wireless Charging Systems for Electric Vehicles, 1st Edition, IET, 2021.
3 James D Halderman, "Electric and Hybrid Electric Vehicles", 1st Edition, Pearson Education, 2022.

ONLINE RESOURCES

1 https://archive.nptel.ac.in/courses/108/106/108106182/
2 https://archive.nptel.ac.in/courses/108/106/108106182/
3 https://www.coursera.org/certificates/power-electronics-motors-ev-iitbombay

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 Describe the status and other details of standardization of EV
CO2 Illustrate the testing protocols for EV and HEV components
CO3 Analyse the safety cycle and need for functions safety for EV
CO4 Analyse the problems related with EMC for EV components
CO5 Evaluate the EMI in motor drive and DC-DC converter system.

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	2	1
CO2	2	2	1	1	-	-	1	1	1	1	-	1	2	1
CO3	3	3	1	2	1	-	1	1	1	1	-	1	2	1
CO4	3	3	1	2	1	-	1	1	1	1	-	1	2	1
CO5	3	3	3	3	1	-	1	1	1	1	-	1	2	1

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U23PEEE23	INTELLIGENT CONTROL OF ELECTRIC VEHICLES	L	T	P	C
Prerequisites: Microprocessors and Microcontrollers		2	0	2	3

COURSE OBJECTIVES:

- To design and drive the mathematical model of a BLDC motor and its characteristics and the different control schemes for BLDC motor
- To understand and gain the knowledge about the basics of fuzzy logic
- To study the FPGA & VHDL basics and to implement fuzzy logic control of BLDC motor in real time

UNIT I **MATHEMATICAL MODEL AND CHARACTERISTICS ANALYSIS OF THE BLDC MOTOR** 6

Structure and Drive Modes - Basic Structure, General Design Method, Drive Modes. Mathematical Model, Differential Equations, Transfer Functions, State-Space Equations. Characteristics Analysis, Starting Characteristics, Steady-State Operation, Dynamic Characteristics, Load Matching Commutation Transients.

UNIT II **SPEED CONTROL FOR ELECTRIC DRIVES** 6

Introduction -PID Control Principle, Anti windup Controller, Intelligent Controller- Vector Control - Control applied to the BLDC motor.

UNIT III **FUZZY LOGIC** 6

Membership functions: features, fuzzification, methods of membership value assignments Defuzzification: lambda cuts - methods - fuzzy arithmetic and fuzzy measures: fuzzy arithmetic - extension principle - fuzzy measures - measures of fuzziness -fuzzy integrals - fuzzy rule base and approximate reasoning : truth values and tables, fuzzy propositions, formation of rules decomposition of rules, aggregation of fuzzy rules, fuzzy reasoning-fuzzy inference systems, overview of fuzzy expert system fuzzy decision making.

UNIT IV **FPGA AND VHDL BASICS** 6

Introduction – FPGA Architecture-Advantages-Review of FPGA family processors Spartan 3, Spartan 6 and Spartan 7. VHDL Basics- Fundamentals-Instruction set-data type-conditional statements- programs like arithmetic, sorting, PWM generation, Speed detection

UNIT V **REALTIME IMPLEMENTATION** 6

Inverter design, identifying rotor position via hall effect sensors, open loop and fuzzy logic control of 48 V BLDC motor using FPGA

30 PERIODS

PRACTICAL EXERCISES:

Using SCILAB/MATLAB Simulation Software

1 Design and simulate speed controller for induction motors in EV for both dynamic and steady state performance.
2 Simulate a fuzzy logic controller based energy storage system for EV.
3 Fuzzy logic control of BLDC motor using FPGA in real time .
4 Design of PID controller for speed control .
5 Simple simulation exercises of basic control systems.

30 PERIODS

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TOTAL: 60 PERIODS

TEXT BOOKS:

1 John G Hayes, G Abas Goodarzi, "Electric Powertrain Energy Systems, Power Electronics and Drives for Hybrid", 1st Edition, John Wiley & Sons, 2019.

2 Alicia Triviño-Cabrera, José M González-González, José A Aguado, "Wireless Power Transferor Electric Vehicles: Foundations and Design Approach", 1st Edition, Springer Publisher, 2020.

REFERENCES:

1 Wei Liu, "Hybrid Electric Vehicle System Modeling and Control", 2nd Edition, John Wiley & Sons, 2018.

2 Emanuele Crisostomi, Robert Shorten, Sonja Stüdli Fabian Wirth, "Electric and Plug-in Hybrid Vehicle Networks Optimization and Control", 1st Edition, CRC Press, 2019.

3 James D Halderman, "Electric and Hybrid Electric Vehicles", 1st Edition, Pearon Education,2022.

ONLINE RESOURCES

1 https://nptel.ac.in/courses/108104049

2 https://onlinecourses.swayam2.ac.in/ntr24_ed16/preview

3 https://onlinecourses.nptel.ac.in/noc23_ee124/preview

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 Analyze the mathematical model of a BLDC motor and to discuss about its characteristics

CO2 Analyze the PID controller, anti windup controller, Intelligent Controller and Vector Control

CO3 Explain the basics of fuzzy logic system

CO4 Describe the basics of VHDL & FPGA applied to control of EV

CO5 Design and implement of fuzzy logic control scheme for BLDC motor using FPGA in real time

CO – PO – PSO MAPPING:

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

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U23PEEE24	GRID INTEGRATION OF ELECTRIC VEHICLES	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To explain the basic details of V2G(Vehicle to Grid) and economical and technical challenges of V2G
- To learn EV & V2G on the smart grids renewable energy systems
- To know the grid integration for EV applications

UNIT I **DEFINITION, AND STATUS OF V2G** **6**

Defining V2G - History and Development of V2G. Incorporating V2G to the EV, Auditing and Metering, V2G in Practice, V2G, Power Markets and Applications. Electricity Markets and V2G Suitability, Long-Term Storage, Renewable Energy, and Other Grid Applications, Beyond the Grid: Other Concepts Related to V2G

UNIT II **BENEFITS AND CHALLENGES OF V2G** **6**

Benefits of V2G, Technical Benefits: Storage Superiority and Grid Efficiency, Economic Benefits: EV Owners and Societal Savings, Environment and Health Benefits: Sustainability in Electricity and Transport, Other Benefits

UNIT III **CHALLENGES TO V2G** **6**

Technical Challenges-Battery Degradation, Charger Efficiency, Aggregation and Communication, V2G in a Digital Society. The Economic and Business Challenges to V2G - Evaluating V2G Cost and Revenues , EV Cost and Benefits , Adding V2G Cost and Benefits, Additional V2G Cost , The Evolving Nature of V2G Cost and Benefits. Regulatory and Political Challenges to V2G, V2G and Regulatory Frameworks, Market Design Challenges. Other V2G Regulatory and Legal Challenges

UNIT IV **IMPACT OF EV AND V2G ON THE SMART GRID AND RENEWABLE ENERGY SYSTEMS** **6**

Introduction - Types of Electric Vehicles - Motor Vehicle Ownership and EV Migration - Impact of Estimated EV on Electrical Network - Impact on Drivers and the Smart Grid - Standardization and Plug-and-Play - IEC 61850 Communication Standard and IEC 61850-7-420 Extension.

UNIT V **GRID INTEGRATION AND MANAGEMENT OF EVS** **6**

Introduction-M2M in distributed energy management systems - M2M communication for EV - M2M communication architecture (3GPP) - Electric vehicle data logging - Scalability of electric vehicles - M2M communication with scheduling

30 PERIODS

PRACTICAL EXERCISES:

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Using SCILAB/MATLAB Simulation Software

1 Simulation of connecting three phase inverter to the grid.

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2 Simulate and analyse the power quality issues of V2G systems Pi/Galileo board.
3 Design and simulate battery management system for smart grid with distributed generation.
4 Design the M2M in distributed energy management systems.
5 Simulate an electrical vehicle charging system integrated with the grid.

30 PERIODS
TOTAL: 60 PERIODS

TEXT BOOKS:

1 Nand Kishor, Jesus Fraile-Ardanuy, "ICT for Electric Vehicle Integration with the Smart Grid", 1st Edition, Institution of Engineering and Technology (IET), 2020.

2 Mohammad Saad Alam, Mahesh Krishnamurthy,"Electric Vehicle Integration in a Smart Microgrid Environment", 1st Edition, CRC Press, 2021.

REFERENCES:

1 Rajiv Singh, Sanjeevikumar Padmanaban," Cable Based and Wireless Charging Systems for Electric Vehicles", 1st Edition, Institution of Engineering and Technology (IET), 2021.
2 Rather Z, Nath A, "Integration of Electric Vehicles Charging Infrastructure with Distribution Grid: Global Review", 1st Edition, International Energy Agency (IEA), 2021.
3 Lance Noel, Gerardo Zarazua de Rubens, Johannes Kester, Benjamin K Sovacool, "Vehicle-to-Grid: A Sociotechnical Transition Beyond Electric Mobility", 1st Edition, Palgrave Macmillan Publication, 2019.

ONLINE RESOURCES

1 https://onlinecourses.nptel.ac.in/noc25_ee79/preview
2 https://onlinecourses.nptel.ac.in/noc23_ee60/preview
3 https://archive.nptel.ac.in/courses/108/106/108106182/

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 Explain the concepts related with V2G
CO2 Comprehend the grid connection of 3 phase Q inverter Study the grid connection of 3 phase Q inverter
CO3 Summarize the technical, economics, business, regulatory & political challenges related with V2G
CO4 Describe the impact of EV and V2G on smart grid and renewable energy system
CO5 Explain the concept of grid integration and management of EV.

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	-	-	2	1
CO2	2	2	1	1	1	-	1	1	1	1	-	1	2	1
CO3	2	2	1	1	1	-	1	1	1	1	-	1	2	1
CO4	2	2	1	1	1	-	1	1	1	1	-	1	2	1
CO5	2	2	1	1	1	-	1	1	1	1	-	1	2	1

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U23PEEE25	MULTI LEVEL POWER CONVERTERS	L	T	P	C
Pre requisites :Power Electronics		2	0	2	3

COURSE OBJECTIVES:

- To learn multilevel topology (Symmetry & Asymmetry) with common DC bus link.
- To study the working of cascaded H Bridge, Diode Clamped and Flying Capacitor MLI
- To study the working of MLI with reduced switch count.

UNIT I **MULTILEVEL TOPOLOGIES** **6**

Introduction – Generalized Topology with a Common DC Bus – Converters derived from the Generalized Topology – Symmetric Topology without a Common DC Link – Asymmetric Topology.

UNIT II **CASCADED H-BRIDGE MULTILEVEL INVERTERS** **6**

Introduction - H-Bridge Inverter, Bipolar Pulse Width Modulation, Unipolar Pulse Width Modulation. Multilevel Inverter Topologies, CHB Inverter with Equal DC Voltage, H-Bridges with Unequal DC Voltages – PWM, Carrier-Based PWM Schemes, Phase-Shifted Multicarrier Modulation, Level Shifted Multicarrier Modulation.

UNIT III **DIODE CLAMPED MULTILEVEL CONVERTER** **6**

Introduction – Converter Structure and Functional Description – Modulation of Multilevel Converters – Voltage Balance Control – Effectiveness Boundary of Voltage balancing in DCMC Converters – Performance Results. .

UNIT IV **FLYING CAPACITOR MULTILEVEL CONVERTER** **6**

Introduction – Flying Capacitor Topology – Modulation Scheme for the FCMC – Dynamic Voltage Balance of FCMC

UNIT V **MULTILEVEL CONVERTER WITH REDUCED SWITCH COUNT** **6**

Multilevel Inverter with reduced Switch Count - Structures, Working Principles and Pulse Generation Methods

30 PERIODS

PRACTICAL EXERCISES:

1 Simulation of Fixed PWM, Sinusoidal PWM for an inverter.
2. Simulation of H bridge inverter with R load.
3. Simulation of three level diode clamped MLI with R load.
4. Simulation of three level capacitor clamped MLI with R load.
5. Simulation of MLI with reduced switch configuration.

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30 PERIODS
TOTAL: 60 PERIODS

TEXT BOOKS:

1 Rashid M H, "Power Electronics Circuits, Devices and Applications", 3rd Edition, Prentice Hall India, 2014.
2 Sergio Alberto Gonzalez, Santiago Andres Verne, Maria Ines Valla, "Multilevel Converters for Industrial Applications", 1st Edition, CRC Press, 2017.

REFERENCES:

1 Thomas A Lipo, "Pulse Width Modulation for Power Converters: Principles and Practice", 1st Edition, John Wiley &Sons, 2019
2 Fang Lin Luo, Hong Ye, "Advanced DC/AC Inverters: Applications in Renewable Energy", 1st Edition, CRC Press, 2017.
3 Hani Vahedi, Mohamed Trabelsi, "Single-DC-Source Multilevel Inverters", 1st Edition, Springer, 2019.

ONLINE RESOURCES

1 https://archive.nptel.ac.in/courses/108/102/108102157/
2 https://web.iitd.ac.in/~anandarup/nptel_course.html
3 https://onlinecourses.nptel.ac.in/noc22_ee16/preview

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 Explain Multilevel Topologies
CO2 Analyze Multilevel Inverter Topologies and PWM Scheme
CO3 Describe Diode Clamped Multilevel Converter
CO4 Explain Flying Capacitor and Multilevel Converter
CO5 Describe Multilevel Converter with Reduced Switch Count

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	-	1	1	1	-	-	3	2
CO2	3	3	1	2	-	-	-	1	1	1	-	-	3	2
CO3	2	2	1	1	-	-	-	1	1	1	-	-	3	2
CO4	2	2	1	1	-	-	-	1	1	1	-	-	3	2
CO5	2	2	1	1	-	-	-	1	1	1	-	-	3	2

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U23PEEE26 **SPECIAL ELECTRICAL MACHINES** **L T P C**

Pre requisites: Electrical Machines I & II **2 0 2 3**

COURSE OBJECTIVES:

- To understand the working of special machines like stepper motor, switched reluctance motor, BLDC motor & PMSM
- To design the controller for special machines
- To study the working principle of synchronous reluctance motor

UNIT I **STEPPER MOTORS** **6**

Constructional Features – Principle of Operation – Types – Torque Predictions – Linear and Non-Linear Analysis – Characteristics – Drive Circuits – Closed Loop Control – Applications

UNIT II **SWITCHED RELUCTANCE MOTORS** **6**

Constructional Features –Principle of Operation - Torque Prediction –Characteristics-Power Controllers – Control of SRM Drive - Speed Control - Current Control - Design Procedures - Sensor Less Operation Of SRM – Current Sensing - Rotor Position Measurement And Estimation Methods - Sensor Less Rotor Position Estimation - Inductance Based Estimation – Applications.

UNIT III **PERMANENT MAGNET BRUSHLESS DC MOTORS** **6**

Fundamentals of Permanent Magnets - Types - Principle of Operation - Magnetic Circuit Analysis EMF and Torque Equations - Characteristics - Controller Design -Transfer Function – Machine, Load and Inverter - Current and Speed Controller.

UNIT IV **PERMANENT MAGNET SYNCHRONOUS MOTORS** **6**

Permanent Magnet AC Machines, Machine Configurations, PMSM - Principle of Operation – EMF and Torque Equations - Phasor Diagram - Torque Speed Characteristics –Evaluation of Control Characteristics- Design of Current and Speed Controllers- Constructional Features, Operating Principle and Characteristics of Synchronous Reluctance Motor

UNIT V **STUDY OF OTHER SPECIAL ELECTRICAL MACHINES** **6**

Principle of Operation and Characteristics of Hysteresis Motor – AC Series Motors – Linear Motor –Applications.

TOTAL: 30 PERIODS

PRACTICAL EXERCISES:

1 Simulation of BLDC Motor
2. Simulation of SRM Motor
3. Simulation of Stepper Motor
4. Simulation of PMSM Motor
5. Simulation of any other Special machines

30 PERIODS

TOTAL: 60 PERIODS

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TEXT BOOKS:

1 Simmy Burman, "Special Electrical Machines ", 1st Edition, S K Kataria & Sons, 2019.

2 E G Janardhan Prentice, "Special Electrical machines", 2nd Edition, Prentice Hall India, 2019.

REFERENCES:

1 Jacek F Gieras, Dr. Rong-Jie Wang, Maarten J. Kamper - "Axial Flux Permanent Magnet Brushless Machines", 2nd Edition, Springer, 2008.

2 Bilgin, Berker Emadi, Ali Jiang, James Weisheng - "Switched Reluctance Motor Drives: Fundamentals to Applications", 3rd Edition, CRC press, 2019.

3 Ramu Krishnan - "Permanent Magnet Synchronous and Brushless DC Motor Drives", 2nd Edition, CRC Press, 2009.

ONLINE RESOURCES

1 https://nptel.ac.in/courses/108102156/

2 https://onlinecourses.nptel.ac.in/noc23_ee114/

3 https://archive.nptel.ac.in/courses/108/105/108105155/

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 Explain the features, principle of operation, types and characteristics of stepper motor.

CO2 Analyze procedures, rotor position measurement and estimation methods

CO3 Describe about permanent magnet brushless dc motor types and characteristics

CO4 Explain principle of operation, EMF, torque equations and characteristics of permanent magnet synchronous motor

CO5 Analyze characteristics other special electrical machines

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	-	-	3	2
CO2	3	3	1	2	-	-	-	2	1	1	-	-	3	2
CO3	2	2	1	1	-	-	-	2	1	1	-	-	3	2
CO4	2	2	1	1	-	-	-	2	1	1	-	-	3	2
CO5	3	3	1	2	-	-	-	2	1	1	-	-	3	2

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U23PEEE27	SMPS AND UPS	L	T	P	C
Prerequisites: Power Electronics and Control Systems		2	0	2	3

COURSE OBJECTIVES:

- To learn the working of isolated & non-isolated DC-DC converters
- To design isolated & non-isolated DC-DC converters.
- To drive the equations related with converter dynamics

UNIT I ANALYSIS OF NON-ISOLATED DC-DC CONVERTERS 6

Basic Topologies: Buck, Boost and Buck-Boost - Principles of operation – Continuous Conduction Mode– Concepts of Volt-Sec Balance and Charge Balance – Analysis and Design based on Steady State Relationships – Introduction to Discontinuous Conduction Mode.

UNIT II ANALYSIS OF ISOLATED DC-DC CONVERTERS 6

Introduction - Classification- Forward - Flyback - Pushpull – Half Bridge – Full Bridge Topologies - Design of SMPS – Introduction to Design of Magnetic Components for SMPS, using Relevant Software - Simulation of Bidirectional DC DC Converter (Both Non-Isolated and Isolated) Considering EV as an Example Application.

UNIT III CONVERTER DYNAMICS 6

AC Equivalent Circuit Analysis – State Space Averaging – Circuit Averaging – Transfer Function Model for Buck, Boost and Buck-Boost Converters – Simulation of Basic Topologies using State Space Model Derived– Comparison with the Circuit Model Based Simulation already Carried Out.

UNIT IV CONTROLLER DESIGN 6

Review of P, PI, and PID Control Concepts – Gain Margin and Phase Margin – Bode Plot Based Analysis – Design of Controller for Buck, Boost and Buck-Boost Converters

UNIT V POWER CONDITIONERS AND UPS 6

Introduction – Power Line Disturbances – Power Conditioners – UPS: Offline and On-line – Need for Filters – Filter for PWM VSI – Front-End Battery Charger – Boost Charger.

30 PERIODS

PRACTICAL EXERCISES:

1 Simulation of Basic Topologies.
2. Simulation of Bi-Directional DC DC Converter
3. Simulation of basic Topologies using State Space Model derived – Comparison with the Circuit Model Based Simulation already carried out.
4. Simulation Study of Controller Design for Basic Topologies.
5. Simulation of Battery Charger for EV Applications.

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30 PERIODS
TOTAL: 60 PERIODS

TEXT BOOKS:

1 Robert W Erickson, Dragon Maksimovic, "Fundamentals of Power Electronics", 3rd Edition, Springer, 2020.
2 Ned Mohan, "Power Electronics: A First Course", 1st Edition, John Wiley &Sons, 2013.

REFERENCES:

1 Marian K Kazimierczuk Agasthya Ayachit, "Laboratory Manual for Pulse-Width Modulated DC– DC Power Converters", 1st Edition, John Wiley &Sons, 2016.
2 S K Varenina, "Power Electronics handbook", Industrial Electronics Series, 2nd Edition, CRC Press, 2021.
3 Teuvo Suntio, Tuomas Messo, Joonas Puukko, "Power Electronic Converters", 1st Edition, John Wiley &Sons, 2017.

ONLINE RESOURCES

1 https://archive.nptel.ac.in/courses/108/108/108108036
2 https://archive.nptel.ac.in/courses/108/105/108105180/
3 https://onlinecourses.nptel.ac.in/noc20_ee97/preview

COURSE OUTCOMES:

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

CO1 Analyze Non Isolated DC to DC Converter
CO2 Design of SMPS and Simulation of Bidirectional DC - DC Converter
CO3 Analyze AC Equivalent Circuit and Simulation of Basic Topology
CO4 Design of Controller for Buck, Boost and Buck-Boost Converters
CO5 Explain Power Conditioners and UPS

CO – PO – PSO MAPPING:

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

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U23PEEE28 CONTROL OF POWER ELECTRONICS CIRCUITS **L T P C**
Prerequisites: Power Electronics & Control Systems **2 0 2 3**

COURSE OBJECTIVES:

- To learn the Basics of Control System Simulation.
- To do Symbolic Calculation.
- To study the Principles of Sliding Mode Control and the Way of Apply SMC For Buck-Converter

UNIT I SIMULATION BASICS IN CONTROL SYSTEMS **6**

Transfer Function - How to build Transfer Function, Identify Poles, Zeros, draw Time Response Plots, Bode Plot(Bode Plots for Multiplication Factors, Constant, Single and Double Integration Functions, Single and Double Differentiation Functions).

UNIT II SYMBOLIC CALCULATIONS **6**

Symbolic Variables - Symbolic Vector Variables, Commands for Handling Polynomial Expressions - Extracting Parts of a Polynomial -. Factorization and Roots of Polynomials, Symbolic Matrix Algebra - Operations with Symbolic Matrices - Other Symbolic Matrix Operations.

UNIT III SLIDING MODE CONTROL BASICS **6**

Introduction - Introduction to Sliding - Mode Control - Basics of Sliding - Mode Theory - Application of Sliding - Mode Control to DC - DC Converters - Principle - Sliding Mode Control of Buck Converter.

UNIT IV POWER FACTOR CORRECTION CIRCUITS **6**

Introduction, Operating Principle of Single - Phase PFCs, Control of Boost Converter based PFCs, Designing the Inner Average - Current - Control Loop, Designing the Outer Voltage - Control Loop, Example of Single - Phase PFC Systems.

UNIT V CONTROLLER DESIGN FOR PFC CIRCUITS **6**

Power Factor Correction Circuit using other SMPS Topologies: C'uk and SEPIC converter - PFC Circuits Employing Bridgeless Topologies.

30 PERIODS

PRACTICAL EXERCISES:

1. Simulation exercises on zero, first and second order basic blocks.
2. Simulation exercises based on symbolic calculations.
3. Simulation of Sliding mode control based buck converter.
4. Simulation of Single-Phase PFC circuit employing boost converter.
5. Simulation of Single-Phase PFC circuit employing C'uk converters.

30 PERIODS

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TOTAL: 60 PERIODS

TEXT BOOKS:

1 Dean Frederick, Joe Chow, "Feedback Control Problems using MATLAB and the Control System Toolbox", 1st Edition, 2019.

2 Ned Mohan, "Power Electronics: A First Course", 1st Edition, John Wiley &Sons, 2019.

REFERENCES:

1 Slew-Chong Tan, Yuk Ming Lai Chi-Kong, "Sliding mode control for Switching Power Converters: Techniques and Implementation", 1st Edition, CRC Press, 2019.

2 Andre Kislovski, "Dynamic Analysis of Switching-Mode DC/DC Converters", 1st Edition, Springer, 2019.

3 Lopez Cesar, "MATLAB Symbolic Algebra and Calculus Tools", 2nd Edition, A press, 2014.

ONLINE RESOURCES

1 https://archive.nptel.ac.in/courses/108/107/108107128/

2 https://archive.nptel.ac.in/courses/108/101/108101126/

3 https://nptel.ac.in/courses/108105066

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 Analyze Transfer Function and Time Response Plots

CO2 Apply Symbolic Calculations in Matrix Operations

CO3 Describe Basics of Slide Mode Control

CO4 Design Inner, Outer Voltage Control Loop

CO5 Design of Power Factor Correction Circuits

CO – PO – PSO MAPPING:

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

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U23PEEE29	ANALYSIS OF ELECTRICAL MACHINES	L	T	P	C
Prerequisites: Electrical Machines -II		2	0	2	3

COURSE OBJECTIVES:

- To model & simulate all types of DC machines
- To develop reference frame equations for various elements like R, L and C
- To model an induction (three phase and 'n' phase) and synchronous machine

UNIT I **MODELING OF BRUSHED-DC ELECTRIC MACHINERY** 6

Fundamentals of Operation – Introduction – Governing Equations and Modeling of Brushed DC-Motor – Shunt, Series and Compound – State Model Derivation – Construction of Model of a DC Machine using State Equations - Shunt, Series and Compound.

UNIT II **REFERENCE FRAME THEORY** 6

Historical Background – Phase Transformation and Commutator Transformation – transformation of Variables from Stationary to Arbitrary Reference Frame.

UNIT III **INDUCTION MACHINES** 6

Three Phase Induction Machine - Equivalent Circuit – Free Acceleration Characteristics – Voltage and Torque Equations in Machine Variables and Arbitrary Reference Frame Variables – Simulation under No Load and Load Conditions - Machine Variable Form, Arbitrary Reference Variable Form

UNIT IV **SYNCHRONOUS MACHINES** 6

Three Phase Synchronous Machine - Voltage and Torque Equations in Machine Variables and Rotor Reference Frame Variables (Park's Equations).

UNIT V **MULTIPHASE (MORE THAN THREE-PHASE) MACHINES CONCEPTS** 6

Preliminary Remarks - Necessity of Multiphase Machines - Evolution of Multiphase Machines - Advantages of Multiphase Machines - Working Principle - Multiphase Induction Machine, Multiphase Synchronous Machine - Modeling of 'n' phase machine. Applications of Multiphase Machines.

30 PERIODS

PRACTICAL EXERCISES:

1 Modelling of DC machines.
2 Simulation under no-load and loaded conditions for a PMDC motor
3 Simulation of smooth starting for DC motor.
4 Simulation under no-load and load conditions of a three phase induction machine in machine variable form and arbitrary reference variable form.
5 Simulation under no-load and load conditions of a three phase synchronous machine in machine variable form and arbitrary reference variable form

30 PERIODS

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TOTAL: 60 PERIODS

TEXT BOOKS:

1 Stephen D Umans, "Fitzgerald & Kingsley's Electric Machinery", 7th Edition, Tata McGraw Hill, 2020.

2 Bogdan M Wilamowski, J David Irwin, "Power Electronics and Motor Drives", 2nd Edition, The Industrial Electronics Handbook, 2019.

REFERENCES:

1 Paul C Krause, Oleg Wasynczuk, Scott D Sudhoff, Steven D Pekarek, "Analysis of Electric Machinery and Drive Systems", 3rd Edition, John Wiley &Sons 2020.

2 P S Bimbra, "Electrical Machinery", 2nd Edition, Tata McGraw Hill, 2021.

ONLINE RESOURCES

1 http://digimat.in/nptel/courses/video/108105131/L01.html

2 https://archive.nptel.ac.in/courses/108/106/108106023/

3 https://www.nptelvideos.com/course.php?id=493

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 Explain Modelling of Brushed DC Electric Machinery

CO2 Describe Reference Frame Theory

CO3 Explain Three Phase Induction Machine and Machine Variable Form

CO4 Describe Three Phase Synchronous Machines

CO5 Apply Multi Phase Machine Concepts

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	-	-	3	2
CO2	2	2	1	1	-	-	-	1	1	1	-	-	3	2
CO3	2	2	1	1	-	-	-	1	1	1	-	-	3	2
CO4	2	2	1	1	-	-	-	1	1	1	-	-	3	2
CO5	3	3	1	2	-	-	-	1	1	1	-	-	3	2

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U23PEEE30	MODERN POWER CONVERTERS	L	T	P	C
Prerequisites: Power Electronics		2	0	2	3

COURSE OBJECTIVES:

- To study the basics of Switched mode power supplies
- To learn Matrix Converter
- To study the types Soft switched converters

UNIT I **SWITCHED MODE POWER SUPPLIES (SMPS)** 6

DC Power Supplies and Classification; Switched Mode DC Power Supplies - with and without Isolation, Single and Multiple Outputs; Closed Loop Control and Regulation; Design Examples on Converter and Closed Loop Performance.

UNIT II **AC-DC CONVERTERS** 6

Switched Mode AC-DC Converters. Synchronous Rectification - Single and Three Phase Topologies - Switching Techniques - High Input Power Factor. Reduced Input Current Harmonic Distortion. Improved Efficiency. With and without Input - Output Isolation. Performance Indices Design Examples.

UNIT III **DC-AC CONVERTERS** 6

Multi-Level Inversion - Concept, Classification of Multilevel Inverters, Principle of Operation, Main Features and Analysis of Diode Clamped, Flying Capacitor and Cascaded Multilevel Inverters; Modulation Schemes.

UNIT IV **AC-AC CONVERTERS WITH AND WITHOUT DC LINK** 6

Matrix Converters. Basic Topology of Matrix Converter; Commutation – Current Path; Modulation Techniques - Scalar Modulation, Indirect Modulation; Matrix Converter as only AC-DC Converter; AC-AC Converter With DC Link - Topologies

UNIT V **SOFT-SWITCHING POWER CONVERTERS** 6

Soft Switching Techniques. ZVS, ZCS, Quasi Resonance Operation; Performance Comparison Hard Switched and Soft Switched Converters. AC-DC Converter, DC-DC Converter, DC-AC Converter.; Resonant DC Power Supplies Thyristor-Controlled Reactor ,Thyristor-Switched Capacitor ,Static VAR Compensator ,Advanced Static VAR Compensator

30 PERIODS

PRACTICAL EXERCISES:

1 Simulation of Single Phase AC Voltage Controller

2. Simulation of Three Phase Full Controlled Rectifier with R, RL loads

3. Simulation of single phase half wave controlled rectifier with R,RL load
4. Simulation of single phase half controlled bridge converter
5. Simulation of single phase fully controlled bridge converter with R,RL load

30 PERIODS
TOTAL: 60 PERIODS

TEXT BOOKS:

1 M.H.Rashid, "Power Electronics Handbook", 2nd Edition, Academic Press, 2020.

2 Fang Lin Luo, Fang Lin Luo, "Advanced DC/DC Converters", 2nd Edition, Productivity Press, 2019.

3 Marian P. Kazmierkowski, R Krishnan, Frede Blaabjerg, "Control in Power Electronics-Selected Problem", 3rd Edition, Academic Press, 2021.

REFERENCES:

1 Issa Batarseh, "Power Electronic Circuits", 2nd Edition, Springer, 2020.

2 Frede Blaabjerg, Zhe Chen, Morgan, Claypool, "Power Electronics for Modern Wind Turbines", 3rd Edition, CRC Press, 2021.

3 Krein Philip T, "Elements of Power Electronics", 2nd Edition, Oxford University Press, 2017.

ONLINE RESOURCES

1 http://www.digimat.in/nptel/courses/video/108108036/L01.html

2 https://archive.nptel.ac.in/courses/117/103/117103148/

3 https://nitttrc.edu.in/nptel/courses/video/117103148/L61

COURSE OUTCOMES:

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

CO1 Describe the Basic of Switched Mode Power Supplies

CO2 Analyze the Concept of AC to DC Converter

CO3 Explain the Concept of DC to AC Converter and Multi Level Inverter

CO4 Analyze AC to AC converter with and without DC link

CO5 Explain the Concept of Soft Switching Converters

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	-	-	3	2
CO2	3	3	1	2	1	-	-	1	1	1	-	-	3	2
CO3	2	2	1	1	-	-	-	1	1	1	-	-	3	2
CO4	3	3	1	2	1	-	-	1	1	1	-	-	3	2
CO5	2	2	1	1	-	-	-	1	1	1	-	-	3	2

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U23PEEE31	ROBOTICS AND AUTOMATION	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To introduce the various Generations of robots and Laws of robotics.
- To study about sensors and sources of robot, manipulators and End effectors
- To study on various path planning techniques,dynamics and Control of Manipulators of robot and its applications

UNIT I INTRODUCTION TO BASIC CONCEPTS IN ROBOTICS 6

Brief history-Types of Robot–Technology-Robot classifications and specifications-Design and control issues-Various manipulators–Sensors-work cell-Programming languages.

UNIT II POWER SOURCES,SENSORS AND ACTUATORS 6

Hydraulic, pneumatic and electric drives: Design and control issues – determination of HP of motor and gearing ratio – variable speed arrangements – path determination – micro machines in robotics – machine vision – ranging – laser – acoustic – magnetic, fibre optic and tactile sensors.

UNIT III MANIPULATOR DIFFERENTIAL MOTION AND STATICS 6

Linear and angular velocities-Manipulator Jacobian-Prismatic and rotary joints–Inverse-Wrist and arm singularity-Static analysis-Force and moment Balance

UNIT IV PATH PLANNING 6

Definition-Joint space technique-Use of p-degree polynomial-Cubic polynomial -Cartesian space technique-Parametric descriptions-Straight line and circular paths-Position and orientation planning.

UNIT V APPLICATIONS OF SERVICE ROBOTS 6

History of service robotics–Present status and future trends–Need for service robots-applications -Examples and Specifications of service and field Robots. Non-conventional Industrial robots.

TOTAL: 30 PERIODS

PRACTICAL EXERCISES

1. Robot programming and simulation for pick and place
2. Robot programming and simulation for machining (cutting, welding)
3. Robot programming and simulation for Colour identification
4. Robot programming and simulation for Shape identification
5. Robot programming and simulation for obstacle tracking

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30 PERIODS
TOTAL : 60 PERIODS

TEXT BOOKS:

1 R K Mittal, I J Nagrath, "Robotics and Control", Tata McGraw Hill, 4th Edition, 2022.

2 John J Craig , "Introduction to Robotics Mechanics and Control", Pearson Education, 4th Edition, 2009.

REFERENCES:

1 Bruno Siciliano, Lorenzo Sciavicco, Luigi Villani, Giuseppe Oriolo, "Robotics: Modelling, Planning and Control", 1st Edition, Springer, 2020 .

2 Christian Laugier, Roland Siegwar, "Service Robots: Technologies and Applications", 1st Edition , Springer, 2022

3 Youn-Long Lin, "Art Sensors and Systems" ,1st Edition , Springer, 2022

ONLINE RESOURCES:

1 https://nptel.ac.in/courses/112101099/

2 https://onlinecourses.nptel.ac.in/noc21_me76/preview

3 https://nptel.ac.in/courses/112105249

COURSE OUTCOMES:

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

CO1 Explain the evolution of robot technology and mathematical representation of different types of robots.

CO2 Analyze the various components required to build a robot.

CO3 Explain about the differential motion and statics in robotics

CO4 Analyze the kinematics, trajectory planning and dynamics of robots

CO5 Explain the basic concepts of working of robot

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	1	2	1	-	-	1	1	1	-	-	2	2
CO3	2	2	1	1	-	-	-	-	-	-	-	-	2	2
CO4	3	3	1	2	1	-	-	1	1	1	-	-	2	2
CO5	2	2	1	1	-	-	-	-	-	-	-	2	2	2

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U23PEEE32	SUBSTATION DESIGN & AUTOMATION	L	T	P	C
Pre requisites:	Power System Operation and Control	2	0	2	3

COURSE OBJECTIVES:

- To understand planning, layout, and selection of components like breakers, switches, and bus configurations.
- Analyze personnel and equipment safety through proper grounding, fault handling, and protective systems.
- Learn about Uses SCADA, protocols, and sensors for efficient monitoring, control, and secure operations.

UNIT I **INTRODUCTION** 6

Background, Need Determination, Budgeting, Financing, Traditional and innovative Substation Design, Site Selection and Acquisition, Design, Construction and Commissioning Process

UNIT II **HIGH VOLTAGE SWITCHING EQUIPMENT** 6

Ambient conditions, Disconnect switches, Load Break switches, high speed grounding switches, power fuses, circuit switches, circuit breakers.

UNIT III **TYPES OF SUBSTATIONS & BUS/SWITCHING CONFIGURATIONS** 6

Transmission substation, distribution substation, collector substation, switching substations, gas insulated substations, air insulated substations, bus configurations: single bus, double bus, double break, main and transfer bus, double bus, single breaker, ring bus, break-and-a-half, Comparison of configurations.

UNIT IV **DESIGN OF SUBSTATION GROUNDING AND PROTECTION** 6

Reasons for substation grounding system, accidental ground circuit, Design criteria-Actual Touch and step voltage, soil resistivity, grid resistance, grid current, use of the design equations, selection of conductors, grounding fence, other design considerations. Lightning stroke protection-lightning parameters, empirical design methods. Substation fire protection-Fire hazards, fire protection measures, fire protection selection criterion.

UNIT V **SUBSTATION AUTOMATION AND COMMUNICATIONS** 6

Introduction , components of substation automation system, automation applications, protocol fundamentals, supervisory control and data acquisition (SCADA) historical perspective, SCADA functional requirements, SCADA communication requirements, components of SCADA system, SCADA communication protocols, the structure of a SCADA communication protocol, security for substation communications, security methods, security assessment.

TOTAL: 30 PERIODS

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PRACTICAL EXERCISES

1. Evaluate performance of disconnect switches, load break switches, and circuit breakers under different ambient conditions.
2. Compare single bus, double bus, and ring bus configurations for transmission and distribution substations.
3. Design grounding systems based on soil resistivity, grid resistance, and lightning stroke protection parameters.
4. Simulate SCADA system components and configure communication protocols for remote monitoring and control.
5. Implement security methods and perform security assessments to safeguard SCADA communications.

30 PERIODS
TOTAL : 60 PERIODS

TEXT BOOKS:

1 John D Mc Donald, "Electric Power Substations Engineering", 4th Edition CRC Press, 2024.
2 Evelio Padilla, "Substation Automation Systems: Design and Implementation", 2nd Edition, CRC Press, 2018.

REFERENCES:

1 Mohamed Kbayer, "The Complete Handbook of Substation Earthing: Design, Safety, and Case Studies", 1st Edition, Lulu Press, 2023.
2 Ossama Gouda, "Optimum Design of Grounding System of High Voltage Substations", 1st Edition, LAP LAMBERT Academic Publishing, 2023.
3 Turan Gonen, "Electric Power Distribution Engineering", 3rd Edition, CRC press, 2014.

ONLINE RESOURCES:

1 https://ieeexplore.ieee.org/document/178016
2 https://archive.nptel.ac.in/courses/108/107/108107112/
3 https://nptel.ac.in/courses/117107148

COURSE OUTCOMES:

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

CO1 Describe the main consideration in the process of substation design
CO2 Summarize the working principles of substation switching equipment
CO3 Examine the different types of bus configurations
CO4 Design criteria of substation grounding and protection
CO5 Explain the substation communication (SCADA)

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	2	2	1	1	-	-	-	-	-	-	-	-	2	2
CO3	3	3	2	3	1	-	-	1	1	1	-	1	2	2
CO4	3	3	3	3	1	-	-	1	1	1	-	1	2	2
CO5	2	2	1	1	-	-	-	-	-	-	-	-	2	2

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U23PEEE33	SENSORS & ACTUATORS	L	T	P	C
Prerequisites:	Control Systems, Measurement and Instrumentation.	2	0	2	3

COURSE OBJECTIVES:

- To understand different types of sensors and actuators for different environments
- To find the different measurements methods using sensors
- To design suitable sensors and actuators for engineering applications

UNIT I **CLASSIFICATION AND PERFORMANCE CHARACTERISTICS OF SENSORS AND ACTUATORS** 6

Classification of Sensors and Actuators - General Requirements for Interfacing - Units and Measures - Transfer function - Impedance and matching - Range, Span, Resolution, Accuracy, Errors, Repeatability, Sensitivity and Sensitivity analysis - Hysteresis , Non linearity and saturation

UNIT II **TEMPERATURE SENSORS AND THERMAL ACTUATORS** 6

Thermo resistive Sensors: Thermistors, Resistance temperature sensors - Silicon resistive sensors - Thermoelectric Sensors - PN Junction Temperature Sensors - Optical and Acoustical Sensors - Thermo mechanical sensors and Actuators

UNIT III **OPTICAL SENSORS AND ACTUATORS** 6

Optical Units and materials - Effects of Optical Radiation - Quantum-Based Optical Sensors - Photoelectric Sensors - Coupled Charge (CCD) Sensors and Detectors - Thermal-Based Optical Sensors - Active Far Infrared (AFIR) Sensors - Optical Actuators

UNIT IV **ELECTRIC & MAGNETIC SENSORS AND ACTUATORS** 6

The Electric Field: Capacitive Sensors and Actuators - Magnetic Fields: Inductive sensors and Hall effect sensors - Magneto hydrodynamic (MHD) Sensors and Actuators - Magnetometers - magnetic Actuators - Voltage and Current Sensors

UNIT V **PROGRAMMING OF IoT SENSORS AND ACTUATORS** 6

Programming for IoT, Interfacing and Programming of IR Sensors, Ultrasonic Sensors, Temperature Sensors, Pressure Sensors. Interfacing and Programming of Actuators: LED, Seven Segment Display, Stepper Motor, DC Motor, Servo Motor

TOTAL: 30 PERIODS

PRACTICAL EXERCISES

1 Simulation of converter and chopper fed DC drive
2 Simulation of Closed Loop Voltage Control for Induction Motor Stator
3 Simulation of Closed Loop V to F Regulation for Induction Motor Drive
4 Modelling and Simulation of Synchronous Motor Control
5 Simulate a servo motor system using software like MATLAB/ SCILAB

30 PERIODS

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TOTAL : 60 PERIODS

TEXT BOOKS:

1 Nathan Ida, "Sensors, Actuators and their Interfaces", 2nd Edition, Institution of Engineering & Technology, 2020.

2 Minwei Zhang, Saeed Olyaee, "Sensors, Actuators, and their Interfaces", 1st Edition, Excelic Press, 2019.

REFERENCES:

1 Horia Chiriac, Nicoleta Lupu, "Magnetic Sensors and Actuators in Medicine: Materials, Devices, and Applications", Ist Edition, Woodhead Publishing, 2023.

2 Volker Ziemann," A Hands-On Course in Sensors Using the Arduino and Raspberry Pi", 2nd Edition, CRC Press, 2023.

3 Vinod Kumar Khanna, "IoT Sensors: An Exploration of Sensors for Internet of Things", 1st Edition, CRC Press, 2024.

ONLINE RESOURCES:

1 https://swayam.gov.in/nd1_noc19_ee41

2 https://archive.nptel.ac.in/courses/108/108/108108147/

3 https://archive.nptel.ac.in/noc/courses/noc19/SEM2/noc19-ee41/

COURSE OUTCOMES:

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

CO1 Analyze the Performance characteristics of Sensors, and Actuators

CO2 Demonstrate the concepts of Thermal sensors and actuators

CO3 Demonstrate the concept of Optical sensors and actuators

CO4 Explain the concept of Electric and magnetic sensors and actuators

CO5 Apply suitable sensors and actuators for engineering applications.

CO – PO – PSO MAPPING:

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

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U23PEEE34	PROGRAMMABLE LOGIC CONTROLLERS	L	T	P	C
Prerequisites	Digital Logic Circuits	2	0	2	3

COURSE OBJECTIVES:

- To know about the basics of PLC and Automation
- To explore various types and manufactures of PLCs
- To know about the instruction set , various applications

UNIT I **INTRODUCTION TO PLC** 6

Concept of PLC, Building blocks of PLC, Functions of various blocks, limitations of relays. Advantages of PLCs over electromagnetic relays. Different programming languages

UNIT II **WORKING OF PLC** 6

Basic operation and principles of PLC - Scan Cycle - Memory structures, I/O structure - Programming terminal, power supply

UNIT III **INSTRUCTION SET** 6

Basic instructions like latch, master control self-holding relays. - Timer instruction like retentive timers, resetting of timers. - Counter instructions like up counter, down counter, resetting of counters. - Arithmetic Instructions (ADD,SUB,DIV,MUL etc.) - MOV instruction - RTC(Real Time Clock Function) - Watch Dug Timer - Comparison instructions like equal, not equal, greater, greater than equal, less than, less than equal

UNIT IV **LADDER DIAGRAM PROGRAMMING** 6

Programming based on basic instructions, timer, counter, and comparison instructions using ladder program.

UNIT V **APPLICATIONS OF PLCs** 6

Object counter - On-off control - Car parking - Sequential starting of motors - Traffic light control - Motor in forward and reverse direction- Filling of Bottles - Room Automation

TOTAL: 30 PERIODS

PRACTICAL EXERCISES

1 Making a complete automated control loop with Supervisory and HMI system.

2 Implementing an Alarm based control scheme and run in a simulated environment.

3 Designing an entire PLC logic for filling and draining water tank automatically.

4 Designing of an Automatic Material Sorting System

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5 Designing a Conveyor Belt Control System

30 PERIODS

TOTAL : 60 PERIODS

TEXT BOOKS:

1 Frank D Petruzella, "Programmable Logic Controllers", 6th Edition, Tata McGraw Hill, 2023.

2 John W Webb, Ronald A Reis, "Programmable Logic Controller", 5th Edition, Pearson Education, 2018.

REFERENCES:

1 Gary Dunning, "Programmable Logic Controllers: An Introduction", 4th Edition, Cengage Learning, 2017.

2 Bolton W, "Programmable Logic Controllers", 6th Edition, Elsevier, 2015

3 Max Rabiee, "Programmable Logic Controllers: Hardware and Programming", 3rd Edition, Delmar Cengage Learning, 2018.

ONLINE RESOURCES:

1 https://onlinecourses.nptel.ac.in/noc21_me67/preview

2 https://onlinecourses.swayam2.ac.in/ntr24_ed02/preview

3 https://nptel.ac.in/courses/112102011

COURSE OUTCOMES:

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

CO1 Explain the basics of PLC.

CO2 Describe the working of PLC

CO3 Explain about the instruction set

CO4 Design the ladder diagram

CO5 Apply the knowledge and design applications using PLC.

CO – PO – PSO MAPPING:

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

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U23PEEE35	Supervisory Control And Data Acquisition (SCADA)	L	T	P	C
Prerequisites	Power System Operation and Control.	2	0	2	3

COURSE OBJECTIVES:

- To introduce the history of SCADA systems.
- To study about protocols used in SCADA.
- To study the framework of metrics and commissioning techniques in SCADA.

UNIT I **SCADA SYSTEMS** 6

Introduction, definitions and history of Supervisory Control and Data Acquisition, typical SCADA system Architecture, Communication requirements, Desirable Properties of SCADA system, features, advantages, disadvantages and applications of SCADA. SCADA Architectures - SCADA systems in operation and control of interconnected power systems, Power System Automation, Petroleum Refining Process, Water Purification System, Chemical Plant.

UNIT II **SCADA PROTOCOLS**

Open systems interconnection(OSI) models, TCP/IP protocol, DNP3 protocol, IEC61850 layered architecture, Control and Information Protocol (CIP), Device Net, Control Net, Ether Net/IP, Flexible Function Block process (FFB), Process Field bus (Profibus). Interfacing of SCADA with PLC.

UNIT III **MANAGEMENT AND MODELLING**

Disaster recovery and business continuity of SCADA, Forensic management, Governance and compliance, Communications and Engineering systems, Metrics framework for a SCADA systems, Network topology and Implementation.

UNIT IV **COMMISSIONING AND OPERATIONS**

Obsolescence and procurement of SCADA, Patching and change management, physical security management, Integrity monitoring.

UNIT V **ISSUES IN SCADA SYSTEMS**

Introduction, SCADA Alarm management, Human Management Interface (HMI), SCADA Network security, SCADA historian, Troubleshooting issues, SCADA System maintenance, SCADA system specification.

TOTAL: 30 PERIODS

PRACTICAL EXERCISES

1. Designing a SCADA system simulator for fast breeder reactor
2. Simulating and Detecting Measurement Attacks in SCADA Testbeds
3. Simulate SCADA system to monitor parameters such as temperature,

pressure, and flow rate in a simulated industrial process.

4. Simulation / Hardware to introduce alarms into the SCADA system to alert operators about abnormal conditions or threshold violations.

5. Simulate water level control using SCADA

30 PERIODS

TOTAL : 60 PERIODS

TEXT BOOKS:

1 Ronald L Krutz, "Securing SCADA System", 1st Edition, Wiley Publications, 2005.

2 Stuart G McCrady, "Designing SCADA Application Software: A Practical Approach", 1st Edition, Elsevier, 2015.

REFERENCES:

1 William T Shaw, "Cybersecurity for SCADA Systems", 2nd Edition, PennWell Books, 2020

2 Gordon Clarke and Deon Reynders, "Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems", 1st Edition, Elsevier, 2004.

3 Robert Radvanovsky and Jacob Brodsky "Handbook of SCADA/Control Systems Security", 4th Edition, Routledge Publisher, 2016.

ONLINE RESOURCES:

1 https://nptel.ac.in/courses/108/105/108105088/

2 https://nptel.ac.in/courses/108/105/108105063/

3 https://archive.nptel.ac.in/courses/108/106/108106022/

COURSE OUTCOMES:

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

CO1 Develop architecture of SCADA

CO2 Explain the use the SCADA protocols

CO3 Develop the knowledge management and framework metrics of SCADA.

CO4 Explain the commissioning and operations.

CO5 Analyse the challenges and issues in SCADA systems

CO – PO – PSO MAPPING:

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

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U23PEEE36	Industrial Automation System Design	L	T	P	C
Pre requisites	Control systems.	2	0	2	3

COURSE OBJECTIVES:

- To impart the basic knowledge in automation of industrial processes.
- To learn the different automated flow lines in manufacturing industries
- To explore the material handling and part identification techniques and testing in modern manufacturing industries.

UNIT I INTRODUCTION 6

Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automations. Production Economics: Methods of Evaluating Investment Alternatives, Costs in Manufacturing, Break Even Analysis, Unit cost of production, Cost of Manufacturing Lead time and Work-in-process.

UNITII DETROIT-TYPE AUTOMATION 6

Automated Flow lines, Methods of Work part Transport, Transfer Mechanism, Buffer Storage, Control Functions, and Automation for Machining Operations, Design and Fabrication Considerations. Analysis of Automated Flow Lines: General Terminology and Analysis, Analysis of Transfer Lines Without Storage, Partial Automation, Computer Simulation of Automated Flow Lines.

UNITIII MATERIAL TECHNOLOGIES HANDLING AND IDENTIFICATION 6

The material handling function, Types of Material Handling Equipment, Analysis for Material Handling Systems, Design of the System, Conveyor Systems, Automated Guided Vehicle Systems. Automated Storage Systems: Storage System Performance, Automated Storage/Retrieval Systems, Work-in-process Storage, Interfacing Handling and Storage with Manufacturing. Product identification system: Barcode, RFID etc.

UNIT IV MICRO CONTROLLER PROGRAMMING & APPLICATIONS 6

Simple programming exercises- key board and display interface –Control of servo motor, stepper motor control- Application to automation systems.

UNIT V DISTRIBUTED CONTROL SYSTEM 6

Introduction to DCS – Centralized versus Distributed control system. Components of DCS – Field Control Station – Operator Station – Communication Bus. Human Interface Station, Engineering Station – Communication Gateway – Bus converter. Programming and Simulation.

TOTAL:30PERIODS

PRACTICAL EXERCISES

1. Alphanumeric and Graphic LCD interfacing using X8051 & PIC Microcontroller.
2. Sensor interfacing with ADC to X8051 & PIC.
3. DAC & RTC interfacing to X8051 & PIC.

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4. Stepper motor (unipolar & bipolar motor) and PWM servo motor control to interfacing with X8051.
5. UART serial programming in X8051 and PIC.

30 PERIODS

TOTAL : 60 PERIODS

TEXT BOOKS:

1 Mikell PGroover, "Automation, Production Systems, and Computer-Integrated Manufacturing", 5thEdition, Pearson Education, 2021.

2 R GJamkar, "Industrial Automation Using PLC, SCADA & DCS", 2nd Edition, Global Education, 2018.

REFERENCES:

1 Sanjay B Katariya, "Industrial Automation Solutions for PLC, SCADA and Field Instruments: Easy to Learn Industrial Automation", 1st Edition, Notion Press, 2020.

2 Ravindra Sharma, "Advanced Industrial Automation and Its Applications", 1st Edition, Laxmi Publications, 2021.

3 John W Webb, Ronald A Reis, "Programmable Logic Controllers: Principles and Applications, 5th Edition, Prentice Hall of India, 2002.

ONLINE RESOURCES:

1 https://nptel.ac.in/content/storage2/courses/112103174/pdf/mod3.pdf

2 https://nptel.ac.in/courses/108105063

3 https://onlinecourses.nptel.ac.in/noc21_me67/preview

COURSEOUTCOMES:

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

CO1 Analyse the cost effective of automated system
CO2 Explain the computer simulation for the automation of given application
CO3 Describe material handling and relevant technologies for the automation
CO4 Evaluate simulation outputs with PLC for different industrial applications.
CO5 Apply the distributed control system for automation.

CO – PO – PSO MAPPING:

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

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U23PEEE37	GREEN ENERGY SYSTEMS	L	T	P	C
Prerequisites:	**Engineering Physics**	2	0	2	3

COURSE OBJECTIVES:

- To apply the concept of renewable energy systems and its applications
- To understand the performance of solar PV system and wind energy system
- To understand the performance of hybrid system and fuel cell

UNIT I **INTRODUCTION** 6

World Energy Use – Reserves of Energy Resources – Environmental Aspects of Energy Utilization – Renewable Energy Scenario in India – Potentials – Achievements – Applications.

UNIT II **SOLAR ENERGY** 6

Solar Thermal – Flat Plate and Concentrating Collectors – Solar Thermal Power Plant – Solar Photovoltaic Conversion – Solar Cells.

UNIT III **WIND ENERGY** 6

Basic Components of Wind Energy Conversion System (WECS); Classification of Wecs- Horizontal Axis- Single, Double And Muliblade System. Vertical Axis- Savonius And Darrieus Types.

UNIT IV **BIOMASS ENERGY** 6

Biomass Direct Combustion – Biomass Gasifier – Biogas Plant – Cogeneration – Biomass Applications.

UNIT V **OTHER RENEWABLE ENERGY SOURCES** 6

Tidal Energy – Wave Energy – Open and Closed OTEC Cycles – Small Hydro – Geothermal Energy – Fuel Cell Systems.

30 PERIODS

PRACTICAL EXERCISES

1. Experiment on VI-Characteristics and Efficiency of 1kWp Solar PV System.
2. Experiment on shadowing effect & diode based solution in 1kWp Solar PV System
3. Experiment on performance assessment of Micro Wind Energy Generator.
4. Experiment on performance assessment of Small Hydro Power Plant.
5. Experiment on performance assessment of 100W Fuel Cell.

30 PERIODS

TOTAL: 60 PERIODS

TEXT BOOKS

1. D S Chauhan, S K Srivastava, "Non-Conventional Energy Resources", 4th Edition, New Age International Publishers, 2021.

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2 Anand Tembulkar & S P Meher, "Non-Conventional Energy Sources", 3rd Edition, S.K. Kataria & Sons Publishers, 2021.

REFERENCES

1 Sailesh Iyer, Anand Nayyar, Mohd Naved, Fadi Al-Turjman, "Renewable Energy and AI for Sustainable Development", 1st Edition, CRC Press, 2023.

2 Barbara Maria Albert, Jon Dee, "Energy Unlimited: Four Steps to 100% Renewable Energy", 2nd Edition, Barbara Albert Publishers, 2017.

3 John Twidell, "Renewable Energy Resources", Routledge, 4th Edition, Routledge Publishers, 2015.

ONLINE RESOURCES:

1 https://nptel.ac.in/courses/103103206

2 https://digimat.in/nptel/courses/video/103103206/L01.html

3 https://www.coursera.org/specializations/renewable-energy

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.

CO4 Summarize the processes of biomass energy sources.

CO5 Explain the process of other renewable energy sources.

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	3	2
CO2	2	2	1	1	-	-	1	1	1	1	-	1	3	2
CO3	2	2	1	1	-	-	1	1	1	1	-	1	3	2
CO4	2	2	1	1	-	-	1	1	1	1	-	1	3	2
CO5	2	2	1	1	-	-	1	1	1	1	-	1	3	2

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U23PEEE38	SOLAR ENERGY TECHNOLOGY	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To learn and study the radiation principles with respective solar energy estimation.
- To understand PV technology principles and techniques of various solar cells / materials for energy conversion.
- To learn the economic and environmental merits of solar energy for various applications.

UNIT I SOLAR RADIATION AND COLLECTORS 6

Solar Angles – Sun Path Diagrams – Radiation – Extraterrestrial Characteristics – Measurement and Estimation on Horizontal and Tilted Surfaces – Flat Plate Collector Thermal Analysis – Testing Methods – Concentrator Collectors – Classification – Design and Performance Parameters – Tracking Systems – Compound Parabolic Concentrators – Parabolic Trough Concentrators – Concentrators with Point Focus – Heliostats – Performance of the Collectors

UNIT II SOLAR THERMAL TECHNOLOGY 6

Principle of Working, Types - Design and Operation of - Solar Heating and Cooling Systems - Solar Water Heaters – Thermal Storage Systems – Solar Still – Solar Cooker – Domestic, Community – Solar Pond – Solar Drying.

UNIT III SOLAR PV FUNDAMENTALS 6

Semiconductor – Properties - Energy Levels - Basic Equations of Semiconductor Devices Physics. Solar Cells - p-n Junction: Homo and Hetro Junctions – Metal Semiconductor Interface - Dark and Illumination Characteristics - Figure of Merits of Solar Cell - Efficiency Limits - Variation of Efficiency with Band-Gap and Temperature - Efficiency Measurements - High Efficiency Cells.

UNIT IV SOLAR PHOTOVOLTAIC SYSTEM DESIGN AND APPLICATIONS 6

Solar Cell Array System Analysis and Performance Prediction- Shadow Analysis: Reliability - Solar Cell Array Design Concepts - PV System Design - Design Process and Optimization - Detailed Array Design - Storage Autonomy - Voltage Regulation - Maximum Tracking - Use of Computers in Array Design - Quick Sizing Method - Array Protection and Troubleshooting - Centralized and Decentralized SPV Systems – Stand Lone - Hybrid and Grid Connected System - System Installation - Operation and Maintenance - Field Experience - PV Market Analysis and Economics of SPV Systems.

UNIT V SOLAR PASSIVE ARCHITECTURE 6

Thermal Comfort - Heat Transmission in Buildings- Bio climatic Classification – Passive Heating Concepts: Direct Heat Gain - Indirect Heat Gain - Isolated Gain and Sun spaces - Passive Cooling Concepts: Evaporative Cooling - Radiative Cooling - Application of Wind, Water and Earth for Cooling; Shading - Paints and Cavity Walls for Cooling - Roof Radiation Traps - Earth Air-Tunnel. – Energy Efficient Landscape Design – Thermal Comfort - Concept of Solar Temperature and its Significance - Calculation of Instantaneous Heat Gain Through Building Envelope.

30 PERIODS

PRACTICAL EXERCISES

1. Study of different Solar Collectors
2. Simulation study on Solar PV Energy System.
3. Experiment on VI-Characteristics and Efficiency of 1kWp Solar PV System.
4. Experiment on Shadowing effect & diode-based solution in PV system.
5. Experiment on passive heating using Solar Energy.

30 PERIODS

TOTAL: 60 PERIODS

TEXT BOOKS

1. S P Sukhatme, J K Nayak, "Solar Energy", 4th Edition, Tata McGraw Hill, 2017.
2. Michael Boxwell, "Solar Electricity Handbook", 1st Edition, Greenstream Publishing, 2023.

REFERENCES

1. Debasish Dutta, "DIY Off-Grid Solar Power for Everyone : Step by Step Guide to Design, Install, and Maintain Solar Systems for Homes, RVs, Vans, and Boats", 1st Edition, Notion Press, 2023.
2. D Yogi Goswami, "Principles of Solar Engineering", 4th Edition, CRC Press, 2022.
3. Robert K McMordie, Mitchel C Brown, Robert S Stoughton, "Solar Energy: Fundamentals", 1st Edition , River Printers, 2012.

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc20_ph14/preview
2. https://www.nrel.gov/news/video/an-energy-transition-made-easy-nrels-educational-resources-for-grid-interconnection-text.html
3. https://plus.nasa.gov/video/stemonstrations-solar-energy/

COURSE OUTCOMES:

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

CO1 Explain Solar radiation data and its measurement.
CO2 Describe the operation of solar thermal energy systems.
CO3 Understand the solar PV fundamentals.
CO4 Explain the photovoltaic theory and implementation process.
CO5 Summarize the design of Solar conscious building.

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	3	2
CO2	2	2	1	1	1	-	1	1	1	1	-	1	3	2
CO3	2	2	1	1	-	-	1	1	1	1	-	1	3	2
CO4	2	2	1	1	-	-	1	1	1	1	-	1	3	2
CO5	2	2	1	1	-	-	1	1	1	1	-	1	3	2

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U23PEEE39	WIND ENERGY TECHNOLOGY	L	T	P	C
		2	0	2	3

Prerequisites: Engineering Physics

COURSE OBJECTIVES:

- To study the wind resources and its conversion, small wind turbines.
- To study the aerodynamics of turbines wind power control strategies .
- To study types of wind power plants and assessment strategies.

UNIT I WIND RESOURCE AND WIND ENERGY CONVERSION 6

Wind Resource: Introduction - Types of Wind - Wind Profiling - Turbulence - Hill and Tunnel Effect - Energy Production.
Wind Energy Conversion: Rotation Principle - Forces on a Rotor Blade - Thrust and Torque on Rotor - Lift-Based VAWT.

UNIT II WIND TURBINE AERODYNAMICS & WIND POWER CONTROL STRATEGIES 6

Aerodynamic Power Regulation - Stall Controlled WPP - Pitch Controlled WPP Power Control Classification - Integrated Aerodynamic and Electric Control strategies - Power Electronics Converters: Constant and Variable Speed WPPs.

UNIT III CONSTANT SPEED & VARIABLE SPEED WIND POWER PLANTS 6

Constant Speed WPPs: Introduction - Type-A WPP - Type-B WPP - Working, Performance.
Variable Speed WPPs: Introduction - Type-C WPP - Type-D WPP - PSMG - Working, Performance.

UNIT IV WIND RESOURCE ASSESSMENT TECHNOLOGIES 6

Introduction - Wind Resource Assessment: Sensors : Temperature Sensor, Barometric Pressure Sensor, Pyranometer, Relative Humidity Sensor - Wind Vane - Anemometer

UNIT V SMALL WIND TURBINES 6

Need of SWT - SWT Classification - VAWT and HAWT - Drag and Lift-based VAWTs - HAWT - Upwind and Downwind SWTs - SWT Components - Speed Regulation - Hybrid Wind Diesel Systems

30 PERIODS

PRACTICAL EXERCISES

1 Simulation study on Wind Energy Conversion System.
2 Simulation study on PMS Wind Energy Generator.
3 Simulation study on DFIG Wind Energy Generator
4 Evaluation of Cut in Speed of the Wind turbine
5 Simulation study on Hybrid (Solar-Wind) Power System.

30 PERIODS

TOTAL: 60 PERIODS

TEXT BOOKS

1 Joshua Earnest, Sthuthi Rachel, "Wind Power Technology", 3rd Edition, Prentice Hall of India, 2019.

2 Banshi D Shukla, "Engineering of Wind Energy", 1st Edition, Jain Brothers Publishers, 2018.

REFERENCES

1 A R Jha, "Wind Turbine Technology", 1st Edition, Taylor & Francis, 2017.

2 Hermann-Josef Wagner, Jyotirmay Mathur, "Green Energy and Technology Introduction to Wind Energy Systems Basics, Technology and Operation", 2009th Edition, Springer, 2012.

3 Peter Musgrove, "Wind Power", 1st Edition, Cambridge University Press, 2009.

ONLINE RESOURCES:

1 https://www.coursera.org/learn/wind-turbine-sensors

2 https://www.coursera.org/learn/wind-energy?

3 https://www.sciencedirect.com/topics/engineering/wind-energy-technology

COURSE OUTCOMES:

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

CO1 Describes various wind resources and wind energy conversions

CO2 Explains the aerodynamics of turbines wind power control strategies .

CO3 Describes the constant speed & variable speed wind power plants

CO4 Explain the wind assessment strategies.

CO5 Summarize on diverse small wind 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	1	1	1	-	1	3	2
CO2	2	2	1	1	1	-	1	1	1	1	-	1	3	2
CO3	2	2	1	1	1	-	1	1	1	1	-	1	3	2
CO4	2	2	1	1	-	-	1	1	1	1	-	1	3	2
CO5	2	2	1	1	1	-	1	1	1	1	-	1	3	2

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U23PEEE40	BIO ENERGY CONVERSION TECHNIQUES	L	T	P	C
Prerequisites: Engineering Chemistry		3	0	0	3

COURSE OBJECTIVES:

- To study in detail on the types of biomass, its surplus availability and characteristics.
- To study the technologies available Technologies for conversion of biomass to energy in terms of its technical competence.
- To study the technologies available in their economic implications.

UNIT I **INTRODUCTION** 9

Biomass: types – advantages and drawbacks – characteristics – carbon neutrality – conversion mechanisms – fuel assessment studies – densification technologies – proximate & ltimate Analysis – Thermo gravimetric Analysis – Differential Thermal Analysis – Differential Scanning Calorimetry.

UNIT II **BIOMETHANATION** 9

Microbial systems – phases in biogas production – parameters affecting gas production – effect of additives on biogas yield – possible feed stocks. Biogas plants – types – design – constructional details and comparison – biogas appliances – burner, luminaries and power generation.

UNIT III **COMBUSTION** 9

Perfect, complete and incomplete combustion - stoichiometric air requirement for biofuels - equivalence ratio – fixed Bed and fluid Bed combustion – fuel and ash handling systems – steam cost comparison with conventional fuels.

UNIT IV **GASIFICATION, PYROLYSIS AND CARBONISATION** 9

Chemistry of gasification - types – comparison – application – performance evaluation - Pyrolysis - Classification - process governing parameters – Typical yield rates. Carbonization Techniques – merits of carbonized fuels.

UNIT V **LIQUIFIED BIOFUELS** 9

Biodiesel production from oil seeds, waste oils and algae - Process and chemistry - Biodiesel health effects / emissions / performance. Production of alcoholic fuels (methanol and ethanol) from biomass.

TOTAL: 45 PERIODS

TEXT BOOKS

1 Andrew L Dicks, David A J Rand, "Fuel Cell Systems Explained", 3rd Edition, John Wiley & Sons, 2018.

2 Bent Sørensen, Giuseppe Spazzafumo, "Hydrogen and Fuel Cells Emerging Technologies and Applications", 3rd Edition, Academic Press, 2018.

REFERENCES

1 Felicia Buchanan, "PEM Fuel Cells: Theory, Performance & Applications", 2nd Edition, Nova Science Publishers, 2015.
2 Frano Barbir, "PEM Fuel Cells: Theory and Practice", 2nd Edition, Academic Press, 2012.
3 Viswanathan B and Aulice Scibioh M, "Fuel Cells: Principles and Applications", Kindle Edition, Universities Press, 2022.

ONLINE RESOURCES:

1 www.digimat.in/nptel/courses/video/103103207/L28.html
2 https://archive.nptel.ac.in/courses/103/103/103103207/
3 https://onlinecourses.nptel.ac.in/noc23_ch76/preview

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 Describe the concept of various biomass energies and conversion technologies and its relevance towards solving the present energy crisis.
CO2 Explain the concept of Biomethanation.
CO3 Describe the process of Combustion.
CO4 Explain the concept of Gasification, Pyrolysis and Carbonisation.
CO5 Explain the concept of liquid biofuels 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	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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U23PEEE41	HYDROGEN AND FUEL CELL TECHNOLOGIES	L	T	P	C
Prerequisites: Electric Circuit Analysis		3	0	0	3

COURSE OBJECTIVES:

- To study in detail on the hydrogen production methodologies, possible applications and various storage options.
- To understand the working principle of a typical fuel cell, its types and to elaborate on its thermodynamics and kinetics.
- To study the cost effectiveness and eco-friendliness of fuel cells.

UNIT I HYDROGEN – BASICS AND PRODUCTION TECHNIQUES 9

Hydrogen – Physical and Chemical Properties, Salient Characteristics. Production of Hydrogen Steam Reforming – Water Electrolysis – Gasification and Woody Biomass Conversion – Biological Hydrogen Production – Photo Dissociation – Direct Thermal or Catalytic Splitting of Water.

UNIT II HYDROGEN STORAGE AND APPLICATIONS 9

Hydrogen Storage Options – Compressed Gas – Liquid Hydrogen – Hydride – Chemical Storage – Comparisons - Safety and Management of Hydrogen - Applications of Hydrogen.

UNIT III FUEL CELLS 9

Principle - Working - Thermodynamics And Kinetics of Fuel Cell Process – Performance Evaluation of Fuel Cell – Comparison on Battery vs Fuel Cell.

UNIT IV FUEL CELL – TYPES 9

Types of Fuel Cells – AFC, PAFC, SOFC, MCFC, DMFC, PEMFC – Relative Merits and Demerits.

UNIT V APPLICATION OF FUEL CELL AND ECONOMICS 9

Fuel Cell Usage for Domestic Power Systems - Large Scale Power Generation - Automobile, Space. Economic and Environmental Analysis on Usage of Hydrogen and Fuel Cell - Future Trends in Fuel Cells.

45 PERIODS

TEXT BOOKS

1. Bent Sorensen, Giuseppe Spazzafumo, "Hydrogen and Fuel Cells: Emerging Technologies", 3rd Edition, Academic Press, 2019.
2. Felicia Buchanan, "PEM Fuel Cells: Theory, Performance and Applications", 1st Edition, Nova Science, 2015.

REFERENCES

1. Ryan O'Hayre, Suk-Won Cha, Whitney Colella, Fritz B Prinz, "Fuel Cell Fundamentals", 3rd Edition, John Wiley & Sons, 2016.
2. B Viswanathan, M Aulice Scibioh, "Fuel Cells:Principles and Applications", 1st Edition, Universities Press, 2006.

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3 Rebecca L Busby, "Hydrogen and Fuel Cells: A Comprehensive Guide", American Edition, PennWell Books, 2005.

ONLINE RESOURCES:

1 www.digimat.in/nptel/courses/video/103101215/L45.html

2 https://www.energy.gov/eere/fuelcells/hydrogen-and-fuel-cell-technologies-office

3 https://www.volvogroup.com/en/sustainable-transportation/sustainable-solutions/hydrogen-fuel-cells.html

COURSE OUTCOMES:

Upon completion of the course,students will be able to

CO1 Explains the basics of hydrogen generation.

CO2 Summarize the hydrogen storage and its applications.

CO3 Describes the fundamentals of fuel cells.

CO4 Explains the working of various fuel cells.

CO5 Summarize the fuel cells applications and its economics.

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	2	1	1	1	-	-	1	-	-	-	-	-	2	1
CO3	2	1	1	1	-	-	1	-	-	-	-	-	2	1
CO4	2	1	1	1	-	-	1	-	-	-	-	-	2	1
CO5	2	1	1	1	-	-	1	-	-	-	-	-	2	1

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U23PEEE42	POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS	L	T	P	C
		2	0	2	3

Prerequisites: Power Electronics

COURSE OBJECTIVES:

- To understand and gain the knowledge of various types of renewable sources of energy.
- To understand and gain knowledge of electrical machines to be used for wind energy conversion systems
- To understand principles of power converters used in solar PV system, wind system and simulation of the AC-DC, AC-AC Converters, Matrix Converters and PWM Inverters

UNIT I **INTRODUCTION TO RENEWABLE ENERGY SYSTEM** 6

Classification of Energy Sources – Importance of Non-Conventional Energy Sources – Advantages and Disadvantages of Conventional Energy Sources - Environmental Aspects of Energy - Impacts of Renewable Energy Generation on the Environment - Qualitative Study of Renewable Energy Resources: Ocean Energy, Biomass Energy, Hydrogen Energy - Solar Photovoltaic(PV), Fuel Cells: Operating Principles and Characteristics, Wind Energy: Nature of Wind, Types, Control Strategy, Operating Area.

UNIT II **ELECTRICAL MACHINES FOR WIND ENERGY CONVERSION SYSTEMS** 6

Construction, Principle of Operation And Analysis: Squirrel Cage Induction Generator (SCIG), Doubly Fed Induction Generator (DFIG) - Permanent Magnet Synchronous Generator (PMSG).

UNIT III **POWER CONVERTERS AND ANALYSIS OF SOLAR PV SYSTEMS** 6

Power Converters Line Commutated Converters (Inversion-Mode) - Boost and Buck Boost Converters - Selection of Inverter, Battery Sizing, Array Sizing. Simulation of Line Commutated Converters, Buck Boost Converters. Analysis, Block Diagram of Solar PV Systems - Grid Connection Issues.

UNIT IV **POWER CONVERTERS FOR WIND SYSTEMS** 6

Power Converters - Three Phase AC Voltage Controllers - AC-DC-AC Converters - Uncontrolled Rectifiers - PWM Inverters - Grid Interactive Inverters - Matrix Converter.

UNIT V **HYBRID RENEWABLE ENERGY SYSTEMS** 6

Need for Hybrid Systems- Range and Type of Hybrid Systems- Case Studies of Diesel - PV, Wind - PV, Micro Hydel - PV, Biomass - Diesel Systems - Maximum Power Point Tracking (MPPT)

30 PERIODS

PRACTICAL EXERCISES

1 Simulation on modelling of Solar PV System- V I Characteristics.
2 Simulation on Modelling of fuel cell- V I Characteristics.
3 Simulation of Self- Excited Induction Generator.

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4 Simulation of DFIG/ PMSG based Wind turbine.

5 Simulation on Grid integration of RES.

30 PERIODS

TOTAL: 60 PERIODS

TEXT BOOKS

1 Rai G D, "Non-Conventional Energy Sources", 6th Edition, Khanna Publishers, 2019.

2 P S Bimbhra, "Power Electronics", 7th Edition, Khanna Publishing, 2022.

REFERENCES

1 Joshua Earnest, Sthuthi' Rachel, "Wind Power Technology", 3rd Edition, Prentice Hall of India, 2019.

2 Muhammad H Rashid, "Power Electronics Handbook", 5th Edition, Butterworth-Heinemann Publishers, 2023.

3 Kumari Namrata , R P Saini , D P Kothari, "Wind and Solar Energy Systems", 1st Edition, Springer, 2024.

ONLINE RESOURCES:

1 https://archive.nptel.ac.in/courses/108/107/108107128/

2 https://onlinecourses.nptel.ac.in/noc23_ge47/preview

3 https://archive.nptel.ac.in/courses/115/105/115105127/

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 Describe the operating principles of renewable energy systems.

CO2 Explain the working principles of electrical machines used for wind energy conversion systems.

CO3 Demonstrate the principles of power converters used for solar PV.

CO4 Demonstrate the principles of power converters used for Wind Systems.

CO5 Explain the working principles of hybrid renewable energy 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	3	2
CO2	2	2	1	1	-	-	-	-	-	-	-	1	3	2
CO3	3	3	2	3	1	-	1	1	1	1	-	1	3	2
CO4	3	3	2	3	1	-	1	1	1	1	-	1	3	2
CO5	2	2	1	1	-	-	-	-	-	-	-	1	3	2

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U23PEEE43	PRINCIPLES OF ARTIFICIAL INTELLIGENCE	L	T	P	C
Prerequisites: Engineering Mathematics		2	0	2	3

COURSE OBJECTIVES:

- To understand the importance, principles, and search methods of AI
- To understand and gain the knowledge on predicate logic and Prolog
- To understand and gain the knowledge of Uncertain knowledge and learning uncertainty.

UNIT I **INTRODUCTION TO AI, INTELLIGENT AGENTS** **6**

Definition of AI, birth of AI, brief history, Turing test, Types of environment, Types of agents, PEAS(Performance measure , Environment, Actuators, Sensors).

UNIT II **INTRODUCTION TO SEARCHING** **6**

Introduction to searching, State Space, SAGP (State, Action, Goal test, Path cost), DFS, BFS (Completeness, Time complexity, Space complexity, Optimality), Heuristics, Local Search Algorithm, Hill Climbing. Applications of Artificial Intelligence in the real world.

UNIT III **CSP, GAME PLAYING** **6**

Constraint Satisfaction Problems examples, Approaches to solve CSPs, Test and generate method, back tracking. Game Playing, Optimal decision in games, Min Max algorithm, Evaluation functions.

UNIT IV **LOGICS** **6**

Introduction to Propositional Logic and First Order Logic, Syntax, Substitution, Unification, Deduction, Soundness, Completeness, Consistency, Satisfiability, Expert Systems.

UNIT V **UNCERTAIN KNOWLEDGE AND LEARNING UNCERTAINTY** **6**

Probabilistic Reasoning, Review of Probability Theory, Probabilistic Inference Rules, Bayes Theorem,examples of Bayes theorem, Introduction to Learning, Taxonomy of Learning Systems,Concept Learning, Find-S algorithm, Candidate Elimination Algorithm.

30 PERIODS

PRACTICAL EXERCISES:

1. Write a program for Family-tree.
2. Write Program for Monkey-banana Problem.
3. Write programs for computation of recursive functions like factorial Fibonacci numbers, etc.
4. Write a program to solve the 5-queens problem.
5. Write a program for travelling salesmen.

30 PERIODS

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TOTAL: 60 PERIODS

TEXT BOOKS:

1 Stuart Russell, Peter Norvig, "Artificial Intelligence: A Modern Approach", 4th Edition, Pearson Education, 2020.

2 Elaine Rich, Kevin Knight, Elaine Rich, Shivashankar B Nair, "Artificial Intelligence", 1st Edition, MedTech Science Press, 2024.

REFERENCES:

1 Denis Rothman, "Artificial Intelligence by Example:A Tutorial Introduction to the Mathematics of Deep Learning", 2nd Edition, Packt Publishers, 2020.

2 James V Stone, "Artificial Intelligence Engines", 3rd Edition, Packt Publishers, 2024.

ONLINE RESOURCES:

1 https://onlinecourses.nptel.ac.in/noc22_cs56/preview

2 http://www.digimat.in/nptel/courses/video/106106126/L01.html

3 https://onlinecourses.nptel.ac.in/noc25_cs07/preview

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 Describe the Intelligent agents

CO2 Explain a search algorithm for a problem and estimate its time and space complexities

CO3 Apply the skill for representing knowledge using the appropriate technique for a given problem

CO4 Solve the gaming problems with the ability to apply AI techniques

CO5 Analyse different computation Techniques in AI

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	1
CO2	2	2	1	1	1	-	-	1	1	1	-	-	1	1
CO3	3	2	1	1	1	-	-	1	1	1	-	-	1	1
CO4	3	2	1	1	1	-	-	1	1	1	-	-	1	1
CO5	3	3	1	2	1	-	-	1	1	1	-	-	1	1

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U23PEEE44	DATA SCIENCE	L	T	P	C
Prerequisites : Object Oriented Programming and Mathematics		2	0	2	3

COURSE OBJECTIVES:

- To describe the life cycle of Data Science and computational environments for data scientists using Python.
- To examine the various data analytics techniques for labeled/columnar data using Python.
- To demonstrate a flexible range of data visualizations techniques and Machine learning algorithms for data modeling in Python.

UNIT I INTRODUCTION TO DATA SCIENCE 6

Introduction to Data Science and its importance - Data Science and Big data-, The life cycle of Data Science- The Art of Data Science - Work with data – data Cleaning, data Munging, and data manipulation. Establishing computational environments for data scientists using Python with IPython and Jupyter.

UNIT II TOWARDS DATA SCIENCE USING NUMPY 6

Understanding Data Types in Python - The Basics of NumPy Arrays - Computation on NumPy Arrays: Universal Functions - Aggregations: Min, Max, and Everything in Between Computation on Arrays: Broadcasting-Comparisons, Masks, and Boolean Logic Fancy Indexing-Sorting Arrays.

UNIT III DATA MANIPULATION WITH PANDAS 6

Installing and Using Pandas, Introducing Pandas Objects, Data Indexing and Selection. Operating on Data in Pandas, Handling Missing Data, Hierarchical Indexing Combining Datasets: Concat and Append, Combining Datasets: Merge and Join. Aggregation and Grouping, Pivot Tables, Vectorised String Operations, Working with Time Series.

UNIT IV DATA VISUALIZATION WITH MATPLOTLIB 6

General Matplotlib Tips, Simple Line Plots, Simple Scatter Plots, Visualizing Errors Density and Contour Plots, Histograms, Binnings, and Density, Customizing Plot Legends Customizing Colorbars, Multiple Subplots, Text and Annotation, Customizing Ticks Customizing Matplotlib: Configurations and Style sheets, Geographic Data with Basemap.

UNIT V MACHINE LEARNING USING PYTHON 6

Intro Machine Learning: Categories of Machine Learning algorithms, Dimensionality reduction-Introducing Scikit Application: Exploring Hand-written Digits. Feature Engineering- Naive Bayes Classification - Linear Regression - kMeans Clustering.

30 PERIODS

PRACTICAL EXERCISES:

1 Develop a python program for Basic plots using Matplotlib.

2 Develop a python program for Frequency distributions.

3 Develop a python program for Correlation and scatter plots.

4 Develop python program for Correlation coefficient.

5 Develop a python program for Simple Linear Regression.

30 PERIODS

TOTAL: 60 PERIODS

TEXT BOOKS:

1 Jake Vander Plas, "Python Data Science Handbook-Essential Tools for Working with Data", 2nd Edition, O'Reilly Media, 2023.

2 Joel Grus, "Data Science from Scratch: First Principles with Python", 2nd Edition, O'Reilly Media, 2019.

REFERENCES:

1 Field Cady, "Data Science Hand Book", 2nd Edition, John Wiley & Sons, 2024.

2 Samuel Burns, "Fundamentals of Data Science", 1st Edition, KDP Publishing, 2019.

ONLINE RESOURCES:

1 https://onlinecourses.nptel.ac.in/noc18_cs28/

2 http://bigdatauniversity.com/

3 http://home.ubalt.edu/ntsbarsh/stat-data/topics.htm#introduction

Upon completion of the course, students will be able to

CO1 Describe phases involved in the life cycle of Data Science.

CO2 Analyse and manage the data for efficient storage and manipulation in Python.

CO3 Apply the various data analysis techniques for labeled/columnar Data using Python Pandas.

CO4 Apply a flexible range of data visualizations approaches in Python.

CO5 Analyse various Machine learning algorithms for data modelling with Python.

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
CO2	3	3	1	2	2	-	-	1	1	1	-	-	1	1
CO3	3	2	1	1	2	-	-	1	1	1	-	-	1	1
CO4	3	2	1	1	2	-	-	1	1	1	-	-	1	1
CO5	3	3	1	2	2	-	-	1	1	1	-	-	1	1

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U23PEEE45	MACHINE LEARNING ALGORITHMS AND ITS APPLICATIONS	L	T	P	C
Prerequisites: Engineering Mathematics		2	0	2	3

COURSE OBJECTIVES:

1 To understand the concepts and mathematical foundations of machine learning and types of problems tackled by machine learning.

2 To explore the different supervised learning and unsupervised learning techniques including ensemble methods.

3 To learn different aspects of reinforcement learning and the role of probabilistic methods for machine learning.

UNIT I INTRODUCTION AND MATHEMATICAL FOUNDATIONS 6

Machine Learning Need - History – Definitions – Applications - Advantages, Disadvantages & Challenges - Types of Machine Learning Problems – Mathematical Foundations - Linear Algebra & Analytical Geometry -Probability and Statistics- Bayesian Conditional Probability -Vector Calculus & Optimization - Decision Theory - Information.

UNIT II SUPERVISED LEARNING 6

Introduction - Discriminative and Generative Models -Linear Regression - Least Squares -Under-fitting / Overfitting -Cross-Validation - Lasso Regression- Classification - Logistic Regression- Gradient Linear Models -Support Vector Machines –Kernel Methods -Instance based Methods - K-Nearest Neighbours - Tree based Methods – Decision Trees –ID3 – CART - Ensemble Methods -Random Forest.

UNIT III UNSUPERVISED LEARNING 6

Introduction - Clustering Algorithms -K – Means – Hierarchical Clustering - Cluster Validity - Dimensionality Reduction -Principal Component Analysis- Linear Discriminant Analysis-Recommendation Systems - EM algorithm.

UNIT IV REINFORCEMENT LEARNING 6

Introduction- RL Framework- Temporal Difference Learning -Active Reinforcement Learning- Markov Decision Process Model - Learning Expectations-Learning Algorithms-Q learning Algorithm.

UNIT V PROBABILISTIC METHODS FOR LEARNING 6

Introduction -Naïve Bayes Algorithm -Maximum Likelihood -Maximum Apriori - Bayesian Belief Networks -Probabilistic Modelling of Problems -Inference in Bayesian Belief Networks – Probability Density Estimation - Sequence Models – Markov Models – Hidden Markov Models.

30 PERIODS

PRACTICAL EXERCISES:

1 Build Linear regression Model.

2 Logistic Regression Model.

3 Classification Models KNN, Naive Bayes,Decision tree algorithm to classify a set of data points according to the given depth of the tree.

4 Train SVM Model with different kernel functions.

5 K-means clustering to determine optimal number of clusters using elbow method.

30 PERIODS
TOTAL: 60 PERIODS

TEXT BOOKS:

1 Anuradha Srinivasarhavan, Vincy Joseph, "Machine Learning", 9th Edition, John Wiley and Sons, 2019.

2 Manaranjan Pradhan, U Dinesh Kumar, "Machine Learning using Python", 1st Edition, John Wiley and Sons, 2019.

REFERENCES:

1 Andriy Burkov, "Machine Learning Engineering", 1st Edition, True Positive Inc., 2020.

2 Shai Shalev-Shwartz, Shai Ben-David, "Understanding Machine Learning: From Theory to Algorithms", 1st Edition, Cambridge University Press, 2014.

ONLINE RESOURCES:

1 https://www.coursera.org/learn/machine-learning/

2 https://archive.nptel.ac.in/courses/106/105/106105152/

3 https://www.coursera.org/learn/unsupervised-learning-recommenders-reinforcement-learning

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 Describe and outline problems for each type of machine learning.

CO2 Design a Supervised learning model for an application.

CO3 Apply a tool to implement typical Clustering algorithms for different types of applications.

CO4 Analyse the reinforcement learning models for real time problems.

CO5 Design and implement probabilistic methods to solve real world problems.

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	1
CO2	3	3	3	3	1	-	-	1	1	1	-	-	1	1
CO3	3	2	1	1	1	-	-	1	1	1	-	-	1	1
CO4	3	3	1	2	1	-	-	1	1	1	-	1	1	1
CO5	3	3	3	3	1	-	-	1	1	1	-	-	1	1

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U23PEEE46	NANOTECHNOLOGY	L	T	P	C
Prerequisites: Engineering Physics		2	0	2	3

COURSE OBJECTIVES:

- To understand the Nano-structured materials, properties, its importance and applications.
- To explore the synthesis of Nanomaterials and Nanocomposites.
- To learn Nanostructures and characteristic techniques.

UNIT I INTRODUCTION OF NANOTECHNOLOGY 6

General definition and size effects–important Nano-structured materials and Nanoparticles importance of Nanomaterials - Size effect on thermal, electrical, electronic, mechanical, optical and magnetic properties of Nanomaterials - surface area - band gap energy and applications.

UNIT II SYNTHESIS OF NANOMATERIALS 6

Bottom up and Top-down approach for obtaining Nanomaterials - 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 6

Definition- importance of Nanocomposites - Nanocomposite 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 6

Classifications of Nanomaterials - Zero dimensional, one-dimensional and two-dimensional Nanostructures- Kinetics in Nanostructured materials- multilayer thin films and superlattices clusters of metals, semiconductors and Nanocomposites.

UNIT V APPLICATIONS OF NANO MATERIALS 6

Overview of Nanomaterials properties and their applications, Nanopainting, Nano coating, Nanomaterials for renewable energy, Molecular Electronics and Nanoelectronics – Nanobots Biological Applications. Emerging technologies for environmental applications

30 PERIODS

PRACTICAL EXERCISES

LED and Solar Cell Experiments:

1 Observe diode behaviour.
2 Determine relative wavelength of light.
3 Determine relative energies of different coloured LEDs.
4 Test and Verify Silicon Photoconductivity.
5 Control light path with an optical fibre.

30 PERIODS

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TOTAL: 60 PERIODS

TEXT BOOKS:

1 Charles P Poole, Frank J Owens, "Introduction to Nanoscience and Nanotechnology An Indian Adaptation", 1st Edition, John Wiley and Sons, 2020.
2 Sulaba K Kulkarni, "Nanotechnology Principles and Practices", 4th Edition, Capital Publishing, 2024.

REFERENCES:

1 Shengjie Peng, Peng Li, "Nanomaterials and Nanotechnology: Basic, Preparation and Applications", 1st Edition, Springer, 2024.
2 Divya Bajpai Tripathy, Anjali Gupta, Arvind Kumar Jain, Anuradha Mishra, Tokeer Ahmad, "Nanotechnology: A Quick Guide to Materials and Technologies", 1st Edition, Bentham Books, 2024.

ONLINE RESOURCES:

1 https://www.coursera.org/learn/nanotechnology
2 https://archive.nptel.ac.in/courses/113/106/113106093/
3 https://www.digimat.in/nptel/courses/video/113106093/L01.html

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 Explain the basic properties such as structural, physical, chemical properties of Nanomaterials and their applications.
CO2 Comprehend the different types of Nanomaterial synthesis
CO3 Describe the shape, size, structure of composite Nanomaterials and their interference.
CO4 Comprehend the different characterization techniques for Nanomaterials
CO5 Develop a deeper knowledge in 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	-	-	-	-	-	-	-	-	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	3	3	1	-	-	1	1	1	-	-	1	1

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U23PEEE47	IOT CONCEPTS & APPLICATIONS	L	T	P	C
Prerequisites: Measurements and Instrumentation		2	0	2	3

COURSE OBJECTIVES:

- To apprise students with basic knowledge of IoT and to analyse its requirements
- To introduce the technology behind Internet of Things(IoT)
- To learn to code for an IoT application and to apply the concept in real world scenario

UNIT I **INTRODUCTION TO INTERNET OF THINGS** 6

Evolution of Internet of Things – Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT Models – Simplified IoT Architecture and Core IoT Functional Stack – Fog, Edge and Cloud in IoT

UNIT II **COMPONENTS IN INTERNET OF THINGS** 6

Functional Blocks of an IoT Ecosystem – Sensors, Actuators, and Smart Objects – Control Units - Communication modules (Bluetooth, Zigbee, Wifi, GPS, GSM Modules)

UNIT III **PROTOCOLS AND TECHNOLOGIES BEHIND IOT** 6

IOT Protocols - IPv6, 6LoWPAN, MQTT, CoAP - RFID, Wireless Sensor Networks, BigData Analytics, Cloud Computing, Embedded Systems.

UNIT IV **OPEN PLATFORMS AND PROGRAMMING** 6

IOT deployment for Raspberry Pi /Arduino platform-Architecture–Programming Interfacing – Accessing GPIO Pins – Sending and Receiving Signals Using GPIO Pins – Connecting to the Cloud.

UNIT V **IOT APPLICATIONS** 6

Business models for the internet of things, Smart city, Smart mobility and transport, Industrial IoT, Smart health, Environment monitoring and surveillance – Home Automation – Smart Agriculture.

30 PERIODS

PRACTICAL EXERCISES:

1. Interfacing Arduino to GSM module
2. Interfacing Arduino to Bluetooth Module
3. Interfacing sensors to Raspberry PI
4. Setup a cloud platform to log the data
5. Design an IOT based system.

30 PERIODS
TOTAL: 60 PERIODS

TEXT BOOKS:

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1 Renaldi Gondosubroto, "Internet of Things from Scratch: Build IoT Solutions for Industry 4.0 with ESP32, Raspberry Pi, and AWS", 1st Edition, Packt Publishers, 2024.
2 Chinmay Chakraborty, Sree Ranjani Rajendran, Muhammad Habibur Rehman, "Security of Internet of Things Nodes: Challenges, Attacks, and Countermeasures",1st Edition, CRC Publishers, 2021.

REFERENCES:

1 Azzam Hannoon, Abdullah Mahmood, "Artificial Intelligence, Internet of Things, and Society 5.0", 1st Edition, Springer, 2023.
2 Thaddeus Hoffmeister, "Internet of Things and the Law", 2nd Edition, Practising Law Institute(PLI), 2023.

ONLINE RESOURCES:

1 https://www.coursera.org/specializations/iot
2 https://onlinecourses.nptel.ac.in/noc22_cs53/preview
3 https://www.youtube.com/watch?v=91aXs9E0qAI

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 Explain the concept of IoT.
CO2 Describe the communication models and various protocols for IoT.
CO3 Apply portable IoT using Arduino/Raspberry Pi /open platform.
CO4 Apply data analytics and use cloud offerings related to IoT.
CO5 Analyse applications of IoT in real time scenarios.

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

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U23PEEE48 ARTIFICIAL NEURAL NETWORKS & DEEP LEARNING ALGORITHMS L T P C

2 0 2 3

Prerequisites: Engineering Mathematics

COURSE OBJECTIVES:

- To understand the basics in deep neural networks.
- To explain the basics of a Real-time operating system
- To analyze the applications based on embedded design approaches

UNIT I INTRODUCTION 6

Neural Networks-Application Scope of Neural Networks-Artificial Neural Network: An Introduction Evolution of Neural Networks-Basic Models of Artificial Neural Network-Important Terminologies of ANNs - Supervised Learning Network.

UNIT II ASSOCIATIVE MEMORY AND UNSUPERVISED LEARNING NETWORKS 6

Training Algorithms for Pattern Association - Autoassociative Memory Network - Heteroassociative Memory Network-Bidirectional Associative Memory (BAM), Fixed Weight Competitive Nets - Kohonen Self-Organizing Feature Maps.

UNIT III THIRD-GENERATION NEURAL NETWORKS 6

Spiking Neural Networks - Convolutional Neural Networks-Deep Learning Neural Networks-Extreme Learning Machine Model - Convolutional Neural Networks: The Convolution Operation – Motivation – Pooling – Variants of the basic Convolution Function – Structured Outputs – Data Types – Efficient Convolution Algorithms.

UNIT IV DEEP FEEDFORWARD NETWORKS 6

History of Deep Learning- A Probabilistic Theory of Deep Learning- Gradient Learning – Chain Rule and Backpropagation - Regularization: Dataset Augmentation – Noise Robustness -Early Stopping, Bagging and Dropout - batch normalization- VC Dimension and Neural Nets.

UNIT V RECURRENT NEURAL NETWORKS 6

Recurrent Neural Networks: Introduction – Recursive Neural Networks – Bidirectional RNNs – Deep Recurrent Networks – Applications: Image Generation, Image Compression, Natural Language Processing. Complete Auto encoder, Regularized Autoencoder, Contractive Encoders

30 PERIODS

PRACTICAL EXERCISES:

1 Implement a regression model in Keras.

2 Implement a perceptron in TensorFlow/Keras Environment.

3 Implement an Image Classifier using CNN in TensorFlow/Keras.

4 Implement a Feed-Forward Network in TensorFlow/Keras.

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5 Implement a Transfer Learning concept in Image Classification.

30 PERIODS

TOTAL: 60 PERIODS

TEXT BOOKS:

1 Francois Chollet, "Deep Learning with Python", 2nd Edition, Manning Publications, 2021.

2 Vinita Silaparasetty, "Deep Learning Projects Using TensorFlow 2", 1st Edition, Apress, 2020.

REFERENCES:

1 Charu C Aggarwal, "Neural Networks and Deep Learning", 2nd Edition, Springer, 2024.

2 Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems", 3rd Edition, O'Reilly Media, 2022.

ONLINE RESOURCES

1 https://archive.nptel.ac.in/courses/106/106/106106184/

2 https://nptel.ac.in/courses/117105084

3 https://nptel.ac.in/courses/108103192

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 Apply Convolution Neural Network for image processing

CO2 Explain the basics of associative memory and unsupervised learning networks.

CO3 Apply CNN and its variants for suitable applications.

CO4 Analyse the key computations underlying deep learning and use them to build and train deep neural networks for various tasks

CO5 Apply auto encoders and generative models for suitable applications.

CO – PO – PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	2	-	-	1	2	1	-	-	2	1
CO2	2	2	1	1	-	-	-	-	-	-	-	1	2	1
CO3	3	2	1	1	2	-	-	1	2	1	-	-	2	1
CO4	3	3	1	2	2	-	-	1	2	1	-	1	2	1
CO5	3	2	1	1	2	-	-	1	2	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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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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U23OE137	APPLIED DESIGN THINKING	L	T	P	C
		3	0	0	3

Course Objectives:

- Introduce tools & techniques of design thinking for innovative products.
- Development Illustrates customer-centric product innovation using simple.
- Describe system thinking principles as applied to complex systems.

UNIT I DESIGN THINKING PRINCIPLES 9

Exploring Human-centered Design - Understanding the Innovation process, discovering areas of opportunity, Interviewing & empathy-building techniques, Mitigate validation risk with FIR [Forge Innovation rubric] - Case studies.

UNIT II END USER-CENTRIC INNOVATION 9

Importance of customer-centric innovation - Problem Validation and Customer Discovery - Understanding problem significance and problem incidence - Customer Validation. Target user, User persona & user stories. Activity: Customer development process - Customer interviews and field visit.

UNIT III APPLIED DESIGN THINKING TOOLS 9

Concept of Minimum Usable Prototype [MUP] - MUP challenge brief - Designing & Crafting the value proposition - Designing and Testing Value Proposition; Design a compelling value proposition; Process, tools and techniques of Value Proposition Design.

UNIT IV CONCEPT GENERATION 9

Solution Exploration, Concepts Generation and MUP design- Conceptualize the solution concept; explore, iterate and learn; build the right prototype; Assess capability, usability and feasibility. Systematic concept generation; evaluation of technology alternatives and the solution concepts.

UNIT V SYSTEM THINKING 9

System Thinking, Understanding Systems, Examples and Understandings, Complex Systems.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Maurício Vianna, Ysmar nVianna, Brenda Lucena, Beatriz Russo, "Design thinking: Business innovation", 1st Edition, MJV Technologies and innovation press, 2021.
2. George E Dieter, "Engineering design", 4th Revised edition, Tata McGraw Hill, 2019.

REFERENCES:

1. Len Bass, Ingo Weber, Liming Zhu G, DevOps, "A Software Architect's Perspective", 1st Edition, Addison-Wesley Professional, 2019.
2. Tim Brown, "Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation", 2nd Edition, Harper Business, 2019.
3. Stephen Fleming, Pravin, "Introduction of DevOps Resource Management", 1st Edition, Create space Independent Publication, 2021.

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ONLINE RESOURCES:

1 https://archive.nptel.ac.in/courses/112/105/112105316/

2 https://www.shutterstock.com/video/search/design-thinking

3 https://onlinecourses.nptel.ac.in/noc22_mg32/preview

COURSE OUTCOMES:

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

CO1 Design various hypotheses to mitigate the inherent risks in product innovations.

CO2 Design the solution concept based on the proposed value by exploring alternate solutions to achieve value-price fit.

CO3 Apply the critical thinking, analysing, storytelling & pitching.

CO4 Apply system thinking in a real-world scenario.

CO5 Create the right prototype with Assess capability with solution concept.

CO – PO - PSO MAPPING:

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

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U23OE138	FIRE SAFETY ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

- To enable the students to acquire knowledge of Fire and Safety Studies.
- To learn about the effect of fire on materials used for construction, the method of test for non-combustibility & fire resistance.
- To learn about fire areas, fire stopped areas and different types of fire-resistant doors

UNIT I **INHERENT SAFETY CONCEPTS** **9**

Compartment fire-factors controlling fire severity, ventilation controlled and fuel controlled fires; Spread of fire in rooms, within buildings and between buildings. Effect of temperature on the properties of structural materials- concrete, steel, masonry and wood; Behaviour of non-structural materials on fire- plastics, glass, textile fibres and other household materials.

UNIT II **PLANT LOCATIONS** **9**

Compartment temperature-time response at pre-flashover and post flashover periods; Equivalence of fire severity of compartment fire and furnace fire; Fire resistance test on structural elements standard heating condition, Indian standard test method, performance criteria.

UNIT III **WORKING CONDITIONS** **9**

Fire separation between building- principles of calculation of safe distance. Design principles of fire resistant walls and ceilings; Fire resistant screens- solid screens and water curtains; Local barriers; Fire stopped areas-in roof, in fire areas and in connecting structures; Fire doors- Low combustible, Non-combustible and Spark-proof doors; method of suspension of fire doors; Air-tight sealing of doors.

UNIT IV **FIRE SEVERITY AND REPAIR TECHNIQUES** **9**

Fabricated fire proof boards-calcium silicate, Gypsum, Vermiculite, and Perlite boards; Fire protection of structural elements - Wooden, Steel and RCC.. Reparability of fire damaged structures Assessment of damage to concrete, steel, masonry and timber structures, Repair techniques- repair methods to reinforced concrete Columns, beams and slabs, Repair to steel structural members, Repair to masonry structures.

UNIT V **WORKING AT HEIGHTS** **9**

Safe Access - Requirement for Safe Work Platforms- Stairways - Gangways and Ramps- Fall Prevention & Fall Protection - Safety Belts - Safety nets - Fall Arrestors- Working on Fragile Roofs -Work Permit Systems-Accident Case Studies.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Roytman M Y,"Principles of fire safety standards for building construction", 1st Edition, Amerind Publishing Co. Pvt. Ltd., 2018.
2. John A Purkiss,"Fire safety engineering design of structures", 2nd Edition, Butter worth Heinemann, 2019.

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REFERENCES:

1. Smith E E, and Harmathy T Z,"Design of buildings for fire safety", 1st Edition, ASTM Special Publication, 2018.
2. Jain V K,"Fire safety in buildings", 1st Edition, New Age International Pvt. Ltd., 2020.
3. Hazop & Hazan,"Identifying and Assessing Process Industry Hazards", 4th Edition, CRC Press, 2019.

ONLINE RESOURCES:

1. https://archive.nptel.ac.in/courses/105/102/105102176/
2. https://3danimation.in/projects/safety-animation-fire-safety-video/
3. https://onlinecourses.nptel.ac.in/noc20_ce09/preview

COURSE OUTCOMES:

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

CO1 Describe the effect of fire on materials used for construction.

CO2 Describe the method of test for non-combustibility and fire resistance.

CO3 Describe the design concept of fire walls, fire screens, local barriers and fire doors and able to select to prevent fire spread.

CO4 Apply the method of fire protection to RCC, steel, and wooden structural elements and their repair methods if damaged due to fire.

CO5 Describe the safety techniques and improve the analytical and intelligence to take the right decision at right time.

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	2	2	1	1	1	1	-	1	-	1	-	-	2	1
CO3	2	2	1	1	1	1	-	1	-	1	-	-	2	1
CO4	3	2	1	2	1	1	-	1	-	1	-	-	2	1
CO5	2	2	1	1	1	1	-	1	-	1	-	-	2	1

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U23OE139	FUNCTIONAL MATERIALS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To impart an insight in differentiating among various functional properties
- To describe the selection of appropriate material for certain functional applications.
- To study about the analysis of the nature and potential of functional materials.

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

Historical Perspectives, Lessons from the Nature, Engineering the Functions, Tuning the functions, Multiscale Modelling and Computation, Classification of Functional Materials, Functional Diversity of Materials, Hybrid Materials, Technological Relevance, Societal Impact.

UNIT II **MOLECULAR SELF ASSEMBLY** **9**

Molecular Organization, Self-Assembly in Biology, Energetics of self-Organization, A few case studies, Synthetic Protocols and challenges, Solvent assisted self-assembly, Directed assembly-Langmuir-Blodgett and Langmuir-Schaefer techniques, Technological applications of SAMs.

UNIT III **BIO-INSPIRED MATERIALS** **9**

Bio-inspired materials, Classification, Biomimicry, Spider Silk, Lotus Leaf, Gecko feet, Synovial fluid, 'Bionics'-Bio-inspired Information Technologies, Artificial Sensory Organs, Biomineralization- En route to Nanotechnology.

UNIT IV **SMART OR INTELLIGENT MATERIALS** **9**

Criteria for Smartness, Significance of Smart Materials, Representative Examples like Smart Gels and Polymers, Electro/Magneto Rheological Fluids, Smart Electro ceramics, Technical Limitations and Challenges, Functional Nanocomposites, Polymer-carbon nanotube composites.

UNIT V **MATERIALS FOR POLYMER ELECTRONICS** **9**

Polymers for Electronics, Organic Light Emitting Diodes, Working Principle of OLEDs, Illustrated Examples, Organic Field-Effect Transistors Operating Principle, Design Considerations, Polymer FETs vs Inorganic FETs, Liquid Crystal Displays, Engineering Aspects of Flat Panel Displays, Intelligent Polymers for Data Storage, Polymer-based Data Storage-Principle, Magnetic Vs. Polymer-based Data Storage.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 Vijayamohanan K Pillai, Meera Parthasarathy, "Functional Materials: A chemist's perpective", 1st Edition, Universities Press, 2018.

2 Deborah D L Chung, "Functional Materials: Electrical, Dielectric, Electromagnetic, Optical and Magnetic applications", 1st Edition, World Scientific Publishing, 2020.

REFERENCES:

1 Stephen Manne, "Biomimetic Materials Chemistry", 1st Edition, Wiley-VCH, 2018.
2 S Banerjee, A K Tyagi, "Functional Materials: Preparation, Processing and Applications," 1st Edition, Elsevier Science, 2018.
3 Dipti Ranjan Sahu, "Functional Materials," 1st Edition, Intech Open, 2019.
4 Mohsen Shahinpoor, "Fundamentals of Smart Materials," 1st Edition, Royal Society of Chemistry, 2020.

ONLINE RESOURCES:

1 https://onlinecourses.nptel.ac.in/noc23_ph34/preview
2 https://royalsociety.org/news-resources/projects/animate-materials/
3 https://nptel.ac.in/courses/112104173

COURSE OUTCOMES:

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

CO1 Explain Multi-scale Modelling and Computation and classify the functional materials.
CO2 Explain the molecular self-assembly and technological applications of SAMs.
CO3 Apply the various bio inspired materials, artificial sensory organs and nano technology in bio mineralization.
CO4 Describe the applications of smart materials, nano composites and nano-tube composites.
CO5 Apply the concept polymer electronics in Organic and Light Emitting Diodes, transistors and LEDs.

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

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U23OE140	FUNDAMENTALS OF AERONAUTICAL ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

- To acquire the knowledge on the Historical evaluation of Airplanes.
- To learn the different component structures, construction, systems and functions.
- To study about the analysis of the nature and potential of functional materials.

UNIT I HISTORY OF FLIGHT 9

Balloon flight-ornithopter-Early Airplanes by Wright Brothers, biplanes and monoplanes, Developments in aerodynamics, materials, structures and propulsion over the years.

UNIT II AIRCRAFT CONFIGURATIONS AND ITS CONTROLS 9

Different types of flight vehicles, classifications-Components of an airplane and their functions- Conventional control, powered control- Basic instruments for flying-Typical systems for control actuation.

UNIT III BASICS OF AERODYNAMICS 9

Physical Properties and structures of the Atmosphere, Temperature, pressure and altitude relationships, Newton's Law of Motions applied to Aeronautics-Evolution of lift, drag and moment. Aerofoils, Mach number, Maneuvers.

UNIT IV BASICS OF AIRCRAFT STRUCTURES 9

General types of construction, Monocoque, semi-monocoque and geodesic constructions, typical wing and fuselage structure. Metallic and non-metallic materials. Use of Aluminium alloy, titanium, stainless steel and composite materials. Stresses and strains-Hooke's law- stress-strain diagrams- elastic constants-Factor of Safety.

UNIT V BASICS OF PROPULSION 9

Basic ideas about piston, turboprop and jet engines – use of propeller and jets for thrust production- Comparative merits, Principle of operation of rocket, types of rocket and typical applications, Exploration into space.

TOTAL : 45 PERIODS

TEXT BOOKS:

1 Anderson J D, "Introduction to Flight", 8th Edition, Tata McGraw-Hill, 2018.

2 Rathakrishnan E, "Introduction to Aerospace Engineering: Basic Principles of Flight", 1st Edition, John Wiley & sons, 2021.

REFERENCES:

1 Stephen A Brandt, "Introduction to aeronautics: A design perspective", 2nd Edition, AIAA Education Series, 2019.

2 Sadhu Singh, "Internal Combustion Engines and Gas Turbine", 1st Edition, SS Kataraia & Sons, 2018.

3 Shevell, "Fundamentals of Flight", 2nd Edition, Pearson Education, 2018.

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ONLINE RESOURCES:

1 http://digimat.in/nptel/courses/video/101106033/L01.html

2 http://www.digimat.in/nptel/courses/video/101101083/L20.html

3 http://www.digimat.in/nptel/courses/video/101101001/A01.html

COURSE OUTCOMES:

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

CO1 Describe the history of aircraft & developments over the years.

CO2 Describe the types & classifications of components and control systems.

CO3 Explain the basic concepts of flight & Physical properties of Atmosphere.

CO4 Explain the types of fuselage and constructions.

CO5 Describe the types of Engines and the Rocket.

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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U23OE141	INDUSTRIAL DESIGN & RAPID PROTOTYPING TECHNIQUES	L	T	P	C
		3	0	0	3

Course Objectives:

- Outline Fundamental concepts in UI & UX and Introduce the principles of Design and Building an mobile app.
- Illustrate the use of CAD in product design Outline the choice and use of prototyping tools.
- Understanding design of electronic circuits and fabrication of electronic devices.

UNIT I **UI/UX** **9**

Fundamental concepts in UI & UX - Tools - Fundamentals of design principles - Psychology and Human Factors for User Interface Design - Layout and composition for Web, Mobile and Devices - Typography - Information architecture - Color theory - Design process flow, wireframes, best practices in the industry -User engagement ethics - Design alternatives.

UNIT II **APP DEVELOPMENT** **9**

SDLC - Introduction to App Development - Types of Apps - web Development understanding Stack -Frontend - backend - Working with Databases - Introduction to API Introduction to Cloud services - Cloud environment Setup- Reading and writing data to cloud - Embedding ML models to Apps - Deploying application.

UNIT III **INDUSTRIAL DESIGN** **9**

Introduction to Industrial Design - Points, lines, and planes - Sketching and concept generation - Sketch to CAD - Introduction to CAD tools - Types of 3D modelling - Basic 3D Modelling Tools - Part creation – Assembly - Product design and rendering basics - Dimensioning & Tolerancing.

UNIT IV **MECHANICAL RAPID PROTOTYPING** **9**

Need for prototyping - Domains in prototyping - Difference between actual manufacturing and prototyping - Rapid prototyping methods - Tools used in different domains - Mechanical Prototyping; 3D Printing and classification - Laser Cutting and engraving - RD Works - Additive manufacturing.

UNIT V **ELECTRONIC RAPID PROTOTYPING** **9**

Basics of electronic circuit design - lumped circuits - Electronic Prototyping - Working with simulation tool - simple PCB design with EDA.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Peter Fiell, "Charlotte Fiell, Industrial Design A-Z", 1st Edition, TASCHEN, 2018.
2. Madou M J, "Fundamentals of micro fabrication", 1st Edition, CRC Press, 2019.

REFERENCES:

1. Jaeger R C, "Introduction to microelectronic Fabrication", 1st Edition, Addision Wesley Publishing Co., 2020.
2. Amstead B H, Ostwald Phylips, Bageman R, "Manufacturing Processes", 1st Edition, John Wiley & Sons, 2018.
3. Serope Kalpakjian, "Manufacturing Engineering and Technology", 3rd Edition, Addison Wesley Publishing Co., 2019.

ONLINE RESOURCES:

1. http://www.digimat.in/nptel/courses/video/112107217/L20.html
2. https://onlinecourses.nptel.ac.in/noc22_mm33/preview
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 Create quick UI/UX prototypes for customer needs.

CO2 Create web application to test product traction / product feature.

CO3 Design a 3D models for prototyping various product ideas.

CO4 Create prototypes using Tools and Techniques in a quick iterative methodology.

CO5 Describe the electronic rapid prototyping.

CO – PO - PSO MAPPING:

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

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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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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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U23OE237 NANOMATERIALS AND APPLICATIONS	L	T	P	C
	3	0	0	3

Course Objectives:

- To understand about the nanomaterials, synthesis and its characterization.
- To describe the fabrication of nano composites and nano structures for advanced devices.
- To study about the application of nano materials in various fields of Engineering.

UNIT I BASICS OF NANOTECHNOLOGY 9

Introduction–Scientific revolutions–Time and length scale in structures –Definition of a nano system –Dimensionality and size-dependent phenomena –Surface to volume ratio - Fraction of surface atoms – Surface energy and surface stress – surface defects – Properties at nanoscale (optical, mechanical, electronic and magnetic).

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 APPLICATIONS 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, Burkhard Raguse, " Nano Technology: Basic Science & Engineering Technology", 1st Edition, Overseas Press, 2018.
2. G Cao, "Nanostructures & Nanomaterials: Synthesis, Properties &Applications", 1st Edition, Imperial College Press, 2019.

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REFERENCES:

1. William A Goddard, "Handbook of Nanoscience, Engineering and Technology", 3rd Edition, CRC Taylor and Francis group, 2018.
2. R H J Hannink, A J Hill, "Nanostructure Control", 1st Edition, Wood Head Publishing Ltd., 2016.
3. Ivor Brodie, Julius J Muray, 'The physics of Micro/Nano – Fabrication", 1st Edition, Springer International Edition, 2020.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/118104008
2. https://onlinecourses.nptel.ac.in/noc22_mm33/preview
3. https://link.springer.com/book/10.1007/978-981-10-6214-8

COURSE OUTCOMES:

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

CO1 Describe the basic properties such as structural, physical, chemical properties of nano materials and their applications.

CO2 Explain the knowledge about the different types of nano material synthesis.

CO3 Describe about the shape, size, structure of composite nano materials and their interference.

CO4 Describe the different characterization techniques for nanomaterials.

CO5 Explain 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	-
CO2	2	2	1	1	-	-	-	-	-	-	-	-	2	-
CO3	2	2	1	1	-	-	-	-	-	-	-	-	2	-
CO4	2	2	1	1	-	-	-	-	-	-	-	-	2	-
CO5	2	2	1	1	-	-	-	-	-	-	-	-	2	-

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U23OE238	PLASTIC MATERIALS FOR ENGINEERS	L	T	P	C
		3	0	0	3

Course Objectives:

- Understand the advantages, disadvantages and general classification of plastic materials, manufacturing, sources, and applications of engineering thermoplastics.
- Understand the basics as well as the advanced applications of various plastic materials in the industry.
- To understand the preparation methods of thermosetting materials, Select suitable specialty plastics for different end applications.

UNIT I INTRODUCTION TO PLASTIC MATERIALS 9

Introduction to Plastics – Brief history of plastics, advantages and disadvantages, thermoplastic and thermosetting behaviour, amorphous polymers, crystalline polymers and cross-linked structures. General purpose thermoplastics/ Commodity plastics: manufacture, structure, properties and applications of polyethylene (PE), cross-linked PE, chlorinated PE, polypropylene, polyvinyl chloride-compounding, formulation, polypropylene (PP).

UNIT II ENGINEERING THERMOPLASTICS AND APPLICATIONS 9

Engineering thermoplastics – Aliphatic polyamides: structure, properties, manufacture and applications of Nylon 6, Nylon 66. Polyesters: manufacture, structure, properties and uses of PET, PBT. Manufacture, structure, properties and uses of Polycarbonates, actual resins, polyimides, PMMA, polyphenylene oxide, thermoplastic polyurethane (PU).

UNIT III THERMOSETTING PLASTICS 9

Thermosetting Plastics – Manufacture, curing, moulding powder, laminates, properties and uses of phenol formaldehyde resins, urea formaldehyde, melamine formaldehyde, unsaturated polyester resin, epoxy resin, silicone resins, polyurethane resins.

UNIT IV MISCELLANEOUS PLASTICS FOR END APPLICATIONS 9

Miscellaneous plastics- Manufacture, properties and uses of polystyrene, HIPS, ABS, SAN, poly(tetrafluoroethylene) (PTFE), TFE and copolymers, PVDF, PVA, poly (vinyl acetate), poly (vinyl carbazole), cellulose acetate, PEEK, High energy absorbing polymers, super absorbent polymers- their synthesis, properties and applications.

UNIT V PLASTICS MATERIALS FOR BIOMEDICAL APPLICATIONS 9

Sources, raw materials, methods of manufacturing, properties and applications of bio-based polymers- poly lactic acid (PLA), poly hydroxy alkanoates (PHA), PBAT, Bio plastics- bio-PE, bio-PP, bio-PET, polymers for biomedical applications.

TOTAL : 45 PERIODS

TEXT BOOKS:

1 Marianne Gilbert, Brydson's, "Plastics Materials", 8th Edition, Elsevier, 2018.

2 J A Brydson, "Plastics Materials", 7th Edition, Butterworth Heinemann. 2019.

REFERENCES:

1. Manas Chanda, Salil K Roy, "Plastics Technology Handbook", 4th Edition, CRC press, 2018.
2. A Brent Strong, "Plastics: Materials and Processing", 3rd Edition, Pearson Prentice Hall of India, 2019.
3. Olagoke Olabisi, Kolapo Adewale, "Handbook of Thermoplastics", 2nd Edition, CRC press, 2018.

ONLINE RESOURCES:

1. https://archive.nptel.ac.in/courses/112/103/112103279/
2. https://nptel.ac.in/courses/112107221
3. https://www.sciencedirect.com/materials-science/engineering-plastic

COURSE OUTCOMES:

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

CO1 Describe the importance, advantages and classification of plastic materials.

CO2 Summarize the raw materials, sources, production, properties and applications of various engineering thermoplastics.

CO3 Describe the application of polyamides, polyesters and other engineering thermoplastics, thermosetting resins.

CO4 Explain the manufacturing properties and uses of thermosetting resins based on polyester, epoxy, silicone and PU.

CO5 Describe the engineering applications of various polymers in miscellaneous areas and applications of different biopolymers.

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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U23OE239	PRODUCTION AND OPERATIONS MANAGEMENT FOR ENTREPRENEURS	L	T	P	C
		3	0	0	3

Course Objectives:

- Discuss the basic concept and function of Production and Operation Management for entrepreneurship.
- Understand the Production process and planning.
- Describe the Production and Operations Management Control for business owners

UNIT I INTRODUCTION TO PRODUCTION AND OPERATIONS MANAGEMENT **9**

Functions of Production Management - Relationship between production and other functions – Production management and operations management, Characteristics of modern production and operation management, organisation of production function, recent trends in production /operations management - production as an organisational function, decision making in production Operations research.

UNIT II PRODUCTION & OPERATION SYSTEMS **9**

Production Systems- principles – Models - CAD and CAM- Automation in Production - Functions and significance- Capacity and Facility Planning: Importance of capacity planning- Capacity measurement – Capacity Requirement Planning (CRP) process for manufacturing and service industry.

UNIT III PRODUCTION & OPERATIONS PLANNING **9**

Facility Planning – Location of facilities – Location flexibility – Facility design process and techniques – Location break even analysis-Production Process Planning: Characteristic of production process systems – Steps for production process- Production Planning Control Functions – Planning phase- Action phase- Control phase - Aggregate production planning.

UNIT IV PRODUCTION & OPERATIONS MANAGEMENT PROCESS **9**

Process selection with PLC phases- Process simulation tools- Work Study – Significance – Methods, evolution of normal/ standard time – Job design and rating - Value Analysis - Plant Layout: meaning – characters -- Plant location techniques - Types- MRP and Layout Design - Optimisation and Theory of Constraints (TOC)– Critical Chain Project Management (CCPM)- REL (Relationship) Chart – Assembly line balancing- – Plant design optimisation -Forecasting methods.

UNIT V CONTROLLING PRODUCTION & OPERATIONS MANAGEMENT **9**

Material requirement planning (MRP)- Concept- Process and control - Inventory control systems and techniques – JIT and Lean manufacturing - Network techniques - Quality Management: Preventive Vs Breakdown maintenance for Quality – Techniques for measuring quality - Control Chart (X , R , p , np and C chart) - Cost of Quality, Continuous improvement (Kaizen) - Quality awards - Supply Chain Management - Total Quality Management - 6 Sigma approach and Zero Defect Manufacturing.

TOTAL : 45 PERIODS

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TEXT BOOKS:

1. Mikell P Groover, "Automation Production Systems, and Computer-Integrated Manufacturing", 1st Edition, Pearson Education, 2018.
2. Amitabh Raturi, "Production and Inventory Management", 1st Edition, Tata McGraw Hill Publications, 2018.

REFERENCES:

1. Adam Jr Ebert, "Production and Operations Management", 1st Edition, Prientice Hall of India Publication, 2020.
2. Muhlemann, Okland, Lockyer, "Production and Operation Management", 1st Edition, Macmillan, 2019.
3. Chary S N, "Production and Operations Management", 1st Edition, Tata McGraw Hill Publications, 2019.

ONLINE RESOURCES:

1. https://openstax.org/books/introduction-business/pages/10-1-production-and- operations-management-an-overview
2. https://onlinecourses.nptel.ac.in/noc20_mg06/preview
3. https://www.vssut.ac.in/lecture_notes/lecture1429900757.pdf

COURSE OUTCOMES:

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

- **CO1** Explain the basics and functions of Production and Operation Management for owners.
- **CO2** Summarize the concept of the Production & Operation Systems.
- **CO3** Explain the Production & Operations Planning Techniques followed by entrepreneurs in Industries.
- **CO4** Describe the Production & Operations Management Processes in organisations.
- **CO5** Explain the techniques of controlling, Production and Operations in industries.

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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U23OE240	QUALITY ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

- Developing a clear knowledge in the basics of various quality concepts.
- Facilitating the students in understanding the application of control charts and its techniques.
- Analysing and understanding the process capability study.

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

Quality Dimensions–Quality definitions–Inspection-Quality control–Quality Assurance– Quality planning-Quality costs–Economics of quality– Quality loss function.

UNIT II **CONTROL CHARTS** **9**

Chance and assignable causes of process variation, statistical basis of the control chart, control charts for variables- X , R and S charts, attribute control charts - p, np, c and u- Construction and application.

UNIT III **SPECIAL CONTROL PROCEDURES** **9**

Warning and modified control limits, control chart for individual measurements, multi- vari chart, Xchart with a linear trend, chart for moving averages and ranges, cumulative- sum and exponentially weighted moving average control charts.

UNIT IV **STATISTICAL PROCESS CONTROL** **9**

Process stability, process capability analysis using a Histogram or probability plots and control chart. Gauge capability studies, setting specification limits.

UNIT V **ACCEPTANCE SAMPLING** **9**

The acceptance sampling fundamental, OC curve, sampling plans for attributes, simple, double, multiple and sequential, sampling plans for variables,MIL-STD-105DandMIL- STD-414E&IS2500 standards.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Douglus C Montgomery, "Introduction to Statistical Quality Control", 7th Edition, Jone Wiley & sons, 2018.
2. Krishnaiah K, "Applied Statistical Quality Control and Improvement", 1st Edition, Prientice Hall of India, 2020.

REFERENCES:

1. Amitava Mitra, "Fundamentals of Quality Control and Improvement", 3rd Edition, John Wiley& sons, 2018.
2. Eugene L Grant and Richard S. Leaven Worth, "Statistical Quality Control", 7th Edition, Tata McGraw- Hill, 2019.
3. Manohar Mahajan, "Statistical Quality Control", 1st Edition, Dhanpal Rai & Sons, 2021.

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ONLINE RESOURCES:

1 https://nptel.ac.in/courses/116102019

2 https://github.com/johnros/qualityEngineering/blob/master/Class_notes/notes.pdf

3 https://archive.nptel.ac.in/courses/112/107/112107259/

COURSE OUTCOMES:

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

CO1 Describe the quality of processes using control charts for variables in manufacturing industries.

CO2 Describe the occurrence of defective products and the defects in manufacturing companies.

CO3 Describe the occurrence of defects in services.

CO4 Analyze the statistical and process capability study.

CO5 Create the acceptance sampling procedures for incoming raw material.

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	3	3	3	3	-	-	-	1	-	-	-	-	2	1

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U23OE241	REVERSE ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

- Applying the fundamental concepts and principles of reverse engineering in product design and development.
- Applying the concept and principles material characteristics, part durability and life limitation in reverse engineering of product design and development.
- Analysing the various legal aspects and applications of reverse engineering in product design and development and discuss about 3D scanning hardware & software operations and procedure to generate 3D models.

UNIT I INTRODUCTION & GEOMETRIC FORM 9

Definition – Uses – The Generic Process – Phases – Computer Aided Reverse Engineering - Surface and Solid Model Reconstruction – Dimensional Measurement – Prototyping.

UNIT II MATERIAL CHARACTERISTICS AND PROCESS IDENTIFICATION 9

Alloy Structure Equivalency – Phase Formation and Identification – Mechanical Strength – Hardness –Part Failure Analysis – Fatigue – Creep and Stress Rupture – Environmentally Induced Failure Material Specification - Composition Determination - Microstructure Analysis - Manufacturing Process Verification.

UNIT III DATA PROCESSING 9

Statistical Analysis – Data Analysis – Reliability and the Theory of Interference – Weibull Analysis – Data Conformity and Acceptance – Data Report – Performance Criteria – Methodology of Performance Evaluation – System Compatibility.

UNIT IV 3D SCANNING AND MODELLING 9

Introduction, working principle and operations of 3D scanners: Laser, White Light, Blue Light - Applications- Software for scanning and modelling: Types- Applications- Preparation techniques for Scanning objects- Scanning and Measuring strategies - Calibration of 3D Scanner- Step by step procedure: 3D scanning - Geometric modelling – 3D inspection- Case studies.

UNIT V INDUSTRIAL APPLICATIONS 9

Reverse Engineering in the Automotive Industry; Aerospace Industry; Medical Device Industry. Case studies and Solving Industrial projects in Reverse Engineering. Legality: Patent – Copyrights –Trade Secret – Third-Party Materials.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Robert W Messler, "Reverse Engineering: Mechanisms, Structures, Systems & Materials", 1st Edition, Tata McGraw-Hill Education, 2019.
2. Wego Wang, "Reverse Engineering Technology of Reinvention", 1st Edition, CRC Press, 2019.

REFERENCES:

1 Scott J Lawrence, "Principles of Reverse Engineering", 1st Edition, Kindle, 2022.

2 Kevin Otto, Kristin Wood, "Product Design: Techniques in Reverse Engineering and New Product Development", 1st Edition, Prentice Hall of India, 2019.

3 Linda Wills, "Reverse Engineering", 1st Edition, Kluver Academic Publishers, 2020.

ONLINE RESOURCES:

1 https://nptel.ac.in/courses/112104265

2 https://archive.nptel.ac.in/courses/112/104/112104265/

3 http://www.digimat.in/nptel/courses/video/112104230/L49.html

COURSE OUTCOMES:

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

CO1 Explain the fundamental concepts and principles of reverse engineering in product design and development.

CO2 Apply the concept of material characteristics, part durability and life limitation in reverse engineering of product design and development.

CO3 Apply the concept and principles of material identification and process verification in reverse engineering of product design and development.

CO4 Describe the concept and principles of data processing, part performance and system compatibility in reverse engineering of product design and development.

CO5 Summarize the various legal aspect and Applications of reverse engineering in product design and development.

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	2	2	1	1	-	-	-	1	-	-	-	-	2	1

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