



NPR **College of Engineering and Technology**

(AN AUTONOMOUS INSTITUTION)

NBA Accredited (B.E. - CSE, ECE, EEE & Mechanical Engg.) | Accredited by NAAC with 'N' Grade
Recognized by UGC under 2 (f) | ISO 9001:2015 Certified | Approved by All India Council for Technical Education, New Delhi
Affiliated to Anna University, Chennai

Natham, Dindigul (Dist.) - 624 401, Tamil Nadu.



DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

B.E -ELECTRONICS AND COMMUNICATION ENGINEERING

REGULATIONS 2023 CHOICE BASED CREDIT SYSTEM (CBCS) CURRICULUM AND SYLLABUS

Chairperson - Board of Studies,
Department of Electronics and Communication Engineering,
NPR College of Engineering & Technology
(Autonomous),
Natham, Dindigul - 624401

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I - Department Vision

To impart quality technical education and nurture excellence to meet the impending challenges in emerging technologies

II - Department Mission

M1: To instill the thirst for advancement in Electronics and Communication technologies to address the social needs.

M2: To increase industrial interaction to ascertain prevailing technologies.

M3: To inculcate ethics and transform lives through value-based education.

M4: To enhance analytical and practical skills to solve real time problems in the society.

III - Programme Name: B.E – Electronics and Communication Engineering

IV - Programme Educational Objectives

Graduates of Electronics and Communication Engineering Programme will be able

1. To have a successful career in academia or industries associated with Electronics and Communication Engineering, or as entrepreneurs.
2. To build solutions or systems of varying complexity with strong fundamental concepts and advanced techniques.
3. To analyze existing literature in an area of specialization and ethically develop innovative and research-oriented methodologies to solve the real time problems.

V - Programme Outcomes

B.E-Electronics and Communication Engineering

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an Understand of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. Project management and finance: Demonstrate knowledge and Understand of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

VI - Programme Specific Outcomes

B.E-Electronics and Communication Engineering

At the end of the programme,

1. Our students will be highly proficient in Electronic circuits, Embedded and communication systems and able to find solutions for real time complexities.
2. Our students will be able to utilize MATLAB, Xilinx tools and techniques to develop innovative research ideas for new applications.

VII - Mapping of PEOs, POs, and PSO - Tabular Format

POs PEOs	PO- 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO- 10	PO- 11	PO- 12	PSO- 1	PSO- 2
I						✓	✓	✓	✓	✓	✓	✓	✓	✓
II	✓	✓	✓	✓	✓							✓	✓	✓
III	✓	✓	✓	✓	✓	✓	✓	✓					✓	✓

VIII - Programme Scope

- Graduates can pursue careers in electronics, telecommunications, signal processing, control systems, embedded systems, and research and development.
- They can work in industries such as telecommunications, consumer electronics, manufacturing, aerospace, defense, and research organizations.
- The programme equips students with the necessary technical skills and knowledge to design and develop electronic systems, analyze and process signals, and contribute to advancements in communication technology.

IX - Programme Specific Criteria

Core Technical Knowledge: The curriculum should cover fundamental areas of electronics and communication engineering, including analog and digital electronics, electronic devices and circuits, signals and systems, communication systems, microprocessors, electromagnetic fields, and microwave engineering.

Mathematics and Science Foundation: The programme should provide a strong foundation in mathematics, including calculus, differential equations, linear algebra, and probability theory. Relevant scientific principles such as physics and basic principles of chemistry may also be included.

Electronic Devices and Circuits: The curriculum should include courses that focus on electronic devices, semiconductor physics, transistor circuits, integrated circuits, and electronic circuit design. Students should gain an Understand of device characteristics, circuit analysis, and design methodologies.

Communication Systems: The programme should cover topics related to analog and digital communication systems, modulation techniques, signal processing, wireless communication, optical communication, and networking. Students should acquire knowledge of system design, modulation/demodulation techniques, and communication protocols.

Signal Processing and Control Systems: The curriculum should include courses on digital signal processing, control systems, and system modeling. Students should learn about signal analysis, filtering, transform techniques, feedback control systems, and system stability.

Microelectronics and VLSI Design: The programme may include courses on microelectronics and Very Large Scale Integration (VLSI) design. Students should gain knowledge of semiconductor technology, transistor-level design, integrated circuit fabrication, and VLSI design methodologies.

Professional Skills and Ethics: ECE programmes should emphasize the development of professional skills, including communication, teamwork, problem-solving, critical thinking, and ethical considerations. Students should understand the ethical responsibilities of engineers and the social impact of their work.

Continuous Improvement and Assessment: ECE programmes should have mechanisms in place for continuous improvement and assessment of student learning outcomes. This involves regular evaluation of the curriculum, feedback from industry professionals, alumni, and students, and incorporation of emerging technologies and industry trends.



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X - Curriculum I Semester to VIII Semester**Semester - I**

S. No.	Course Code	Course Title	Curricular Category	Period Per Week			Total Contact Periods	Credits
				L	T	P		
1	23IP100	Induction Programme	-	-	-	-	-	0
THEORY								
2	23HS101	Professional English - I	HSMC	3	0	0	3	3
3	23MA101	Matrices and Calculus	BSC	3	1	0	4	4
4	23PH102	Physics for Electronics Engineering	BSC	3	0	0	3	3
5	23CY101	Engineering Chemistry	BSC	3	0	0	3	3
6	23GE101	Problem Solving and C Programming	ESC	3	0	2	5	4
7	23GE103	தமிழர்மரபு /Heritage of Tamils	HSMC	1	0	0	1	1
PRACTICALS								
8	23BS112	Physics and Chemistry Laboratory for Electronics Engineering	BSC	0	0	4	4	2
9	23GE112	English Laboratory -I	EEC	0	0	2	2	1
Total				16	1	8	25	21

Semester – II

S. No.	Course Code	Course Title	Curricular Category	Period Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1	23HS201	Professional English - II	HSMC	2	0	0	2	2
2	23MA203	Partial Differential Equations and Transforms	BSC	3	1	0	4	4
3	23BE204	Electronic Devices	ESC	3	0	0	3	3
4	23CS201	Python Programming	ESC	3	0	0	3	3
5	23EC201	Circuits Analysis	PCC	3	0	2	5	4
6	23GE901	Environmental Sciences and Sustainability	BSC	2	0	0	2	2
7	23GE201	தமிழரும் தொழில்நுட்பமும் /Tamil and Technology	HSMC	1	0	0	1	1
8		NCC Credit Course Level 1#	-	2	0	0	2	2#
PRACTICALS								
9	23BE213	Electronic Devices Laboratory	ESC	0	0	3	3	1.5
10	23CS211	Python Programming Laboratory	ESC	0	0	3	3	1.5
11	23GE212	English Laboratory –II	EEC	0	0	2	2	1
Total				17	1	10	28	23

- NCC Credit Course level 1 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA



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Semester – III

S. No.	Course Code	Course Title	Curricular Category	Period Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1	23MA303	Random Processes and Linear Algebra	BSC	3	1	0	4	4
2	23AD306	Data Structures using Python	ESC	3	0	0	3	3
3	23EC301	Electronics Circuits	PCC	3	0	0	3	3
4	23EC302	Digital System Design	PCC	3	0	2	5	4
5	23EC303	Signals and Systems	PCC	3	1	0	4	4
6	23GE902	Human Values and Ethics	HSMC	2	0	0	2	2
PRACTICALS								
7	23AD313	Data Structures using Python Laboratory	ESC	0	0	3	3	1.5
8	23EC311	Circuits Design & Simulation Laboratory	PCC	0	0	3	3	1.5
9		Value Added Course-I ^{\$}	EEC	0	0	0	0	1 ^{\$}
Total				17	2	8	27	23

^{\$} - The grades earned by the students in Value Added Course-I will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA

Semester – IV

S. No.	Course Code	Course Title	Curricula r Category	Period Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1	23CS401	Artificial Intelligence & Machine Learning	ESC	3	0	2	5	4
2	23EC401	Electromagnetic Fields	PCC	3	0	0	3	3
3	23EC402	Linear Integrated Circuits	PCC	3	0	0	3	3
4	23EC403	Digital Signal Processing	PCC	3	1	0	4	4
5	23EC404	Embedded Systems	PCC	3	0	2	5	4
6	23EC405	Control Systems	PCC	3	0	0	3	3
7		NCC Credit Course Level 2 [#]	-	3	0	0	3	3 [#]
PRACTICALS								
8	23EC411	Linear Integrated Circuits Laboratory	PCC	0	0	3	3	1.5
9	23EC412	Digital Signal Processing Laboratory	PCC	0	0	3	3	1.5
10		Value Added Course-II ^{\$}	EEC	0	0	0	0	1 ^{\$}
Total				18	1	10	29	25

- NCC Credit Course level 2 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA

\$ - The grades earned by the students in Value Added Course-II will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA



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Semester – V

S. No.	Course Code	Course Title	Curricular Category	Period Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1	23EC501	Networks and Security	PCC	3	0	2	5	4
2	23EC502	Communication Systems	PCC	3	0	0	3	3
3	23EC503	Transmission Lines and RF Systems	PCC	3	1	0	4	4
4	23EC504	VLSI Design	PCC	3	0	0	3	3
5		Professional Elective-I	PEC	3	0	0	3	3
6		Open Elective-I	OEC	3	0	0	3	3
PRACTICALS								
7	23EC511	Communication Systems Laboratory	PCC	0	0	3	3	1.5
8	23EC512	VLSI Design Lab	PCC	0	0	3	3	1.5
Total				18	1	8	27	23

Semester – VI

S. No.	Course Code	Course Title	Curricular Category	Period Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1	23EC601	Internet of Things and Architecture	PCC	3	0	0	3	3
2	23EC602	Antenna and Microwave Engineering	PCC	3	1	0	4	4
3	23EC603	Optical Communication and Networks	PCC	3	0	0	3	3
4		Professional Elective-II	PEC	2/3	0	2/0	4/3	3
5		Professional Elective-III	PEC	2/3	0	2/0	4/3	3
6		Open Elective-II	OEC	3	0	0	3	3
7		Mandatory Course*	MC	3	0	0	0	0*
PRACTICALS								
8	23EC611	IoT Laboratory	PCC	0	0	3	3	1.5
9	23EC612	Advanced Communication Lab	PCC	0	0	3	3	1.5
10	23EC613	Mini Project	EEC	0	0	4	4	2
Total								24

Semester – VII

S. No.	Course Code	Course Title	Curricular Category	Period Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1		Elective- Management	HSMC	3	0	0	3	3
2		Professional Elective-IV	PEC	2/3	0	2/0	4/3	3
3		Professional Elective-V	PEC	2	0	2	4	3
4		Professional Elective-VI	PEC	2	0	2	4	3
5		Open Elective-III	OEC	3	0	0	3	3
PRACTICALS								
6	23EC711	Internship*	EEC	0	0	0	0	2
Total								17

*-Students should complete Internship/In-plant Training before the end of Semester VII

Semester –VIII

S. No.	Course Code	Course Title	Curricular Category	Period Per Week			Total Contact Periods	Credits
				L	T	P		
PRACTICALS								
1	23EC811	Project Work*	EEC	0	0	20	20	10
Total				0	0	20	20	10

*-Students shall do Industry/In-house Project

XI - Elective - Management Courses

S. No.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	23GE701	Principles of Management	HSMC	3	0	0	3	3
2.	23GE702	Total Quality Management	HSMC	3	0	0	3	3
3.	23GE703	Engineering Economics and Financial Accounting	HSMC	3	0	0	3	3
4.	23GE704	Human Resource Management	HSMC	3	0	0	3	3
5.	23GE705	Knowledge Management	HSMC	3	0	0	3	3
6.	23GE706	Industrial Management	HSMC	3	0	0	3	3

XII- Elective - Mandatory Courses

S. No.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	23MC901	English for Communication - SWAYAM/BEC	MC	3	0	0	3	0
2.	23MC902	Introduction to Women and Gender Studies	MC	3	0	0	3	0
3.	23MC903	Disaster Risk Reduction and Management	MC	3	0	0	3	0
4.	23MC904	History of Science and Technology in India	MC	3	0	0	3	0
5.	23MC905	Political and Economic Thought for a Humane Society	MC	3	0	0	3	0
6.	23MC906	Wellbeing with Traditional Practices- Yoga, Ayurveda and Siddha	MC	3	0	0	3	0
7.	23MC907	State, Nation building and Politics in India	MC	3	0	0	3	0
8.	23MC908	Industrial Safety	MC	3	0	0	3	0
9.	23MC909	Indian Constitution	MC	3	0	0	3	0
10.	23MC910	Elements of Literature	MC	3	0	0	3	0

XIII - Professional Elective Courses: Verticals

Vertical - I	Vertical - II	Vertical - III	Vertical - IV	Vertical - V	Vertical - VI
Semiconductor Technologies	Signal Processing Technologies	RF Technologies	Bio Medical Technologies	Sensor Technologies and IoT	High Speed Communication Technologies
Display systems	Advanced Digital Signal Processing	Antenna Design	Wearable Devices	IoT Processors	Wireless Communication
Wide Band Gap Devices	Image Processing	Microwave Integrated Circuits	Human Assist Devices	IoT based System Design	4G/5G Communication Networks
IC Technology and Validation	Speech Processing	RF Transceivers	Therapeutic Equipment	Wireless Sensor Network Design	Satellite Communication
Low Power IC Design	Software Defined Radio	Signal Integrity	Medical Imaging Systems	Industrial IoT and Industry 4.0	Radar Technologies
VLSI Testing and Design for Testability	DSP Architecture and Programming	EMI/EMC Pre Compliance Testing	Brain Computer Interface and Applications	MEMS Design	Massive MIMO Networks
Analog IC Design	Multimedia Compression and Communication	RFID System Design & Testing	Body Area Networks	Fundamentals of Nano Electronics	Advanced Wireless Communication Techniques

Registration of Professional Elective Courses from Verticals:

Professional Elective Courses will be registered in Semesters V, VI and VII. These courses are listed in groups called verticals that represent a particular area of specialization / diversified group. Students are permitted to choose all the Professional Electives from a particular vertical or from different verticals. Further, only one Professional Elective course shall be chosen in a semester horizontally (row-wise). However, two courses are permitted from the same row, provided one course is enrolled in ONE Semester and another in NEXT semester.

Professional Elective Courses**Vertical - I: Semiconductor Technologies**

S/N	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	23PEC01	Display Systems	PEC	3	0	0	3	3
2.	23PEC02	Wide Band Gap Devices	PEC	2	0	2	4	3
3.	23PEC03	IC Technology and Validation	PEC	2	0	2	4	3
4.	23PEC04	Low Power IC Design	PEC	2	0	2	4	3
5.	23PEC05	VLSI Testing and Design for Testability	PEC	2	0	2	4	3
6.	23PEC06	Analog IC Design	PEC	2	0	2	4	3

Vertical 2: Signal Processing Technologies

S/N	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	23PEC07	Advanced Digital Signal Processing	PEC	2	0	2	4	3
2.	23PEC08	Image Processing	PEC	3	0	0	3	3
3.	23PEC09	Speech Processing	PEC	2	0	2	4	3
4.	23PEC10	Software Defined Radio	PEC	3	0	0	3	3
5.	23PEC11	DSP Architecture and Programming	PEC	2	0	2	4	3
6.	23PEC12	Multimedia Compression and Communication	PEC	3	0	0-	3	3

Vertical 3: RF Technologies

S/N	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	23PEC13	Antenna Design	PEC	3	0	0	3	3
2.	23PEC14	Microwave Integrated Circuits	PEC	2	0	2	4	3
3.	23PEC15	RF Transceivers	PEC	2	0	2	4	3
4.	23PEC16	Signal Integrity	PEC	3	0	0	3	3
5.	23PEC17	EMI/EMC Pre Compliance Testing	PEC	2	0	2	4	3
6.	23PEC18	RFID System Design and Testing	PEC	2	0	2	4	3

Vertical 4: Bio Medical Technologies

S/N	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	23PEC19	Wearable Devices	PEC	3	0	0	3	3
2.	23PEC20	Human Assist Devices	PEC	3	0	0	3	3
3.	23PEC21	Therapeutic Equipment	PEC	3	0	0	3	3
4.	23PEC22	Medical Imaging Systems	PEC	3	0	0	3	3
5.	23PEC23	Brain Computer Interface and Applications	PEC	3	0	0	3	3
6.	23PEC24	Body Area Networks	PEC	3	0	0	3	3

Vertical 5: Sensor Technologies and IoT

S/N	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	23PEC25	IoT Processors	PEC	3	0	0	3	3
2.	23PEC26	IoT based System Design	PEC	3	0	0	3	3
3.	23PEC27	Wireless Sensor Network Design	PEC	3	0	0	3	3
4.	23PEC28	Industry 4.0 and Industrial IoT	PEC	2	0	2	4	3
5.	23PEC29	MEMS Design	PEC	2	0	2	4	3
6.	23PEC30	Fundamentals of Nano Electronics	PEC	2	0	2	4	3

Vertical 6: High Speed Communication Technologies

S/N	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	23PEC31	Wireless Communication	PEC	2	0	2	4	3
2.	23PEC32	4G/5G Communication Networks	PEC	2	0	2	4	3
3.	23PEC33	Satellite Communication	PEC	3	0	0	3	3
4.	23PEC34	Radar Technologies	PEC	3	0	0	3	3
5.	23PEC35	Massive MIMO Networks	PEC	2	0	2	4	3
6.	23PEC36	Advanced Wireless Communication Techniques	PEC	3	0	0	3	3

XIV - Open Electives (for ECE students)

S. No.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			CONTACT PERIODS	CREDITS
				L	T	P		
1.	230CS01	Artificial Intelligence and Machine Learning Fundamentals	OEC	3	0	0	3	3
2.	230CS02	Fundamentals of Augmented Reality/ Virtual Reality	OEC	3	0	0	3	3
3.	230CS03	Data Science Fundamentals	OEC	3	0	0	3	3
4.	230CS04	Introduction to Data Structures using Python	OEC	3	0	0	3	3
5.	230CS05	IoT Concepts and Applications	OEC	3	0	0	3	3
6.	230CE01	Cartography & GIS	OEC	3	0	0	3	3
7.	230CE02	Environment, Health and Safety	OEC	3	0	0	3	3
8.	230CE03	Environmental Impact Assessment	OEC	3	0	0	3	3
9.	230CE04	Industrial waste water management	OEC	3	0	0	3	3
10.	230CE05	Remote sensing concepts	OEC	3	0	0	3	3
11.	230EE01	AI with MATLAB	OEC	3	0	0	3	3
12.	230EE02	Applied Soft Computing	OEC	3	0	0	3	3
13.	230EE03	Electric Vehicle Technology	OEC	3	0	0	3	3
14.	230EE04	Electrical Safety	OEC	3	0	0	3	3
15.	230EE05	E-waste Management	OEC	3	0	0	3	3
16.	230EE06	Industrial Automation	OEC	3	0	0	3	3
17.	230EE07	Power Plant Instrumentation	OEC	3	0	0	3	3
18.	230EE08	Principles of Robotics	OEC	3	0	0	3	3
19.	230EE09	Sensors and Transducers	OEC	3	0	0	3	3
20.	230EE10	Solar and Wind Energy Resources	OEC	3	0	0	3	3
21.	230HS01	English for Competitive Examinations	OEC	3	0	0	3	3
22.	230HS02	Project Report Writing	OEC	3	0	0	3	3
23.	230MA01	Algebra and Number Theory	OEC	3	0	0	3	3
24.	230MA02	Graph Theory	OEC	3	0	0	3	3
25.	230MA03	Linear Algebra	OEC	3	0	0	3	3
26.	230MA04	Operations Research	OEC	3	0	0	3	3
27.	230MA05	Queuing and Reliability Modelling	OEC	3	0	0	3	3
28.	230MA06	Resource Management Techniques	OEC	3	0	0	3	3
29.	230ME01	Energy Conservation and Management	OEC	3	0	0	3	3
30.	230ME02	Energy Technology	OEC	3	0	0	3	3
31.	230ME03	Engineering Graphics Design	OEC	3	0	0	3	3
32.	230ME04	Foundation of Robotics	OEC	3	0	0	3	3
33.	230ME05	Industrial Design & Rapid Prototyping Techniques	OEC	3	0	0	3	3
34.	230ME06	Industrial Management	OEC	3	0	0	3	3
35.	230ME07	Industrial Safety and Hazard Management	OEC	3	0	0	3	3
36.	230ME08	Introduction to Industrial Automation Systems	OEC	3	0	0	3	3

37.	23OME09	Introduction to Non- Destructive Testing	OEC	3	0	0	3	3
38.	23OME10	Mechatronics	OEC	3	0	0	3	3
39.	23OME11	Nanomaterials and Applications	OEC	3	0	0	3	3
40.	23OME12	Nano Technology	OEC	3	0	0	3	3
41.	23OME13	Operations Management	OEC	3	0	0	3	3
42.	23OME14	Production Planning and Control	OEC	3	0	0	3	3
43.	23OME15	Quality Engineering	OEC	3	0	0	3	3
44.	23OME16	Sustainable Manufacturing	OEC	3	0	0	3	3

Open Electives (for other department students)

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			CONTACT PERIODS	CREDITS
				L	T	P		
1.	23OEC01	Antenna Fundamentals	OEC	3	0	0	3	3
2.	23OEC02	Consumer Electronics	OEC	3	0	0	3	3
3.	23OEC03	Display Devices Fundamentals	OEC	3	0	0	3	3
4.	23OEC04	Basics of Embedded Systems	OEC	3	0	0	3	3
5.	23OEC05	Basics of Nano Electronics	OEC	3	0	0	3	3
6.	23OEC06	Fundamentals of Image Processing	OEC	3	0	0	3	3
7.	23OEC07	Internet of Things	OEC	3	0	0	3	3
8.	23OEC08	Sensors and Actuators	OEC	3	0	0	3	3
9.	23OEC09	Fundamentals of Wearable Devices	OEC	3	0	0	3	3
10.	23OEC10	Wireless Sensor Networks	OEC	3	0	0	3	3

XV Value Added Courses

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	TOTAL CONTACT PERIODS	CREDITS
1	23ECA01	Embedded Systems with Arduino	EEC	14	1
2	23ECA02	PCB Design for IoT Applications	EEC	14	1
3	23ECA03	Drone Technology	EEC	14	1
4	23ECA04	Tinker CAD	EEC	14	1
5	23ECA05	AI with Robotics	EEC	14	1
6	23ECA06	AR-VR	EEC	14	1

XVI Summary of Curriculum Components with Credits

S. No.	Curricular Components	Semester wise								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1.	HSMC	4	3	2				3		12
2.	BSC	12	6	4						22
3.	ESC	4	9	4.5	4					21.5
4.	PCC		4	12.5	20	17	13			66.5
5.	PEC					3	6	9		18
6.	OEC					3	3	3		9
7.	EEC	1	1				2	2	10	16
8.	NON-CREDIT									-
9.	Total	21	23	23	24	23	24	17	10	165



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Semester - I

SEMESTER - I

I - Course Name: 23HS101 Professional English - I

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E./B.TECH. -Common to all Branches	I	HSMC	3	0	0	3

II - Course Objectives

1.	To improve the communicative competence of learners.
2.	To learn to use basic grammatic structures in suitable contexts.
3.	To acquire lexical competence and use them appropriately in a sentence and understand their meaning in a text.
4.	To help learners use language effectively in professional contexts.
5.	To develop learners' ability to read and write complex texts, summaries, articles, blogs, definitions, essays and user manuals.

III - Course Content

Preamble:

This course is designed to impart required levels of Communication Skills in Reading and Writing and Proficiency in English language in writing necessary for different professional contexts.

Unit - I	Introduction to Effective Communication	9 Periods
Fundamentals of Communication- effective communication- seven C's of effective communication Reading - Reading brochures (technical context), telephone messages / social media messages relevant to technical contexts and emails. Writing - Writing emails / letters. Grammar - Simple Tenses (Present / Past /Future); Question types: Why/ Yes or No/- Question Tags. Vocabulary - Synonyms (word -meaning- sentence making); (One word substitution; Abbreviations & Acronyms (as used in technical contexts) -Silent letters		
Unit - II	Narration and Summation	9 Periods
Reading -Reading biographies, travelogues, newspaper reports, Excerpts from literature, and travel & technical blogs. Writing - Guided writing-- Paragraph writing Short Report on an event (field trip etc.) Grammar -Progressive tenses (Present / Past /Future); Subject-Verb Agreement; Prepositions. Vocabulary -Word forms (prefixes & suffixes); Phrasal verbs.		
Unit - III	Description of a Process/Product	9 Periods
Reading - Reading advertisements, gadget reviews; user manuals. Writing - Writing definitions; instructions; and Product /Process description. Grammar - Imperatives; Adjectives; Degrees of comparison; Perfect Tenses (Present / Past /Future); Vocabulary -Compound Nouns, Homonyms; and Homophones.		
Unit - IV	Classification and Recommendations	9 Periods
Reading -Newspaper articles; Journal reports-and Non-Verbal Communication (tables, pie charts etc.,) Note-making. Writing -Writing recommendations; Transferring information from non-verbal (chart, graph etc., to verbal mode), Transcoding, Grammar - Perfect continuous tenses (Present / Past /Future); Articles; Pronouns-Possessive & Relative pronouns. Vocabulary - Collocations; Fixed /Semi fixed expressions - Idioms and Phrases		



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Unit - V	Expression	9 Periods
Reading –Reading editorials; and Opinion Blogs; Writing –Essay Writing (Descriptive or narrative). Grammar – Punctuation; Simple, Compound & Complex Sentences. Vocabulary –Cause & Effect Expressions–Content vs Function words – British & American vocabulary (spelling and word changes)		
TOTAL: 45 Periods		

Text Books:	[1] English for Engineers & Technologists Orient Blackswan Private Ltd. Department of English, Anna University,(2023edition)
	[2] English for Science & Technology Cambridge University Press, 2021. Authored by Dr.Veena Selvam, Dr.Sujatha Priyadarshini, Dr.Deepa Mary Francis, Dr.KN.Shoba, and Dr.Lourdes Jovani, Department of English, Anna University.
Reference Books:	[1] Ashraf Rizvi, "Effective Technical Communication", 2nd Edition, McGraw-Hill India, 2017.
	[2] A Course Book On Technical English By Lakshminarayanan, Scitech Publications (India) Pvt. Ltd.
	[3] English For Technical Communication (With CD) By Aysha Viswamohan, Mcgraw Hill Education, ISBN :0070264244.
	[4] Effective Communication Skill, Kulbhusan Kumar, RSSalaria, Khanna Publishing House
	[5] Learning to Communicate–Dr.V.Chellammal, Allied Publishing House, NewDelhi, 2003.
MOOC/Web Platforms:	https://onlinecourses.nptel.ac.in/noc23_hs115/preview

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	To use appropriate words in a professional context and communicate in a professional context.	Apply (K3)
CO2	To gain understanding of basic grammatic structures and use them in right context.	Understand (K2)
CO3	To read and infer the denotative and connotative meanings of technical texts and use technical words in describing products with appropriate definitions.	Apply (K3)
CO4	To write definitions, descriptions, narrations and essays on various topics.	Create (K6)
CO5	To express their opinions effectively in both oral and written medium of communication.	Create (K6)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	-	-	-	-	-	-	-	-	3	3	-	2	-	-
CO2	-	-	-	-	-	-	-	-	3	3	-	2	-	-
CO3	-	-	-	-	-	-	-	-	3	3	-	2	-	-
CO4	-	-	-	-	-	-	-	-	3	3	-	2	-	-
CO5	-	-	-	-	-	-	-	-	3	3	-	2	-	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23MA101 Matrices and Calculus

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E./B.TECH. Common to all Branches	I	BSC	3	1	0	4

II - Course Objectives

1.	To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
2.	To familiarize the student with functions of several variables. This is needed in many branches of engineering.
3.	To familiarize the students with integral calculus and various techniques of integration.
4.	To make the students understand the concepts of vector calculus and applications.
5.	To acquaint the student with mathematical tools needed in evaluating ordinary differential equations and their applications.

III - Course Content**Preamble:**

This course introduces basic concepts and techniques of multivariable calculus, matrices, and ordinary differential equations and highlights their applications in various field of engineering such as Design Engineering, Electric Circuit Theory, Cryptography, Resistor conversion, Robotics etc.

Unit - I	Matrices	12 Periods
Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley – Hamilton theorem – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.		
Unit - II	Functions of Several Variables	12 Periods
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 - III	Integral Calculus and Multiple Integrals	12 Periods
Definite integrals – Properties – Problems- Double and Triple integrals – Cartesian, polar coordinates – change of order of integration – Applications: Area between curves, Volume of integrals.		
Unit - IV	Vector Calculus	12 Periods
Gradients - Divergence - Curl – Directional derivative - Irrotational and Solenoidal vector fields- Vector Integration (Line integral, Surface integral, Volume integral, Simple Problems only) – Green's theorem in plane, Gauss divergence theorem and Stoke's Theorem (excluding proof) – Simple applications involving cubes and rectangular parallelopipeds.		
Unit - V	Ordinary Differential Equations	12 Periods
Higher order linear differential equations with constant coefficients – Method of variation of parameters. Homogenous equation of Euler's and Legendre's type – System of simultaneous linear differential equations with constant coefficients.		

TOTAL: 60 Periods

Text Books:	[1] Kreyszig, E, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016. [2] Grewal, B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2018. [3] James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 8th Edition, New Delhi, 2015. [For Units II & IV - Sections 1.1, 2.2, 2.3, 2.5, 2.7 (Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1 (Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.1 - 7.4 and 7.8].
Reference Books:	[1] Anton. H, Bivens. I and Davis. S, "Calculus", Wiley, 10th Edition, 2016. [2] Bali. N., Goyal. M. and Watkins. C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.), New Delhi, 7th Edition, 2009. [3] Jain. R.K. and Iyengar. S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 5th Edition, 2016. [4] Narayanan. S. and Manicavachagom Pillai. T. K., "Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2009. [5] Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016. [6] Srimantha Pal and Bhunia. S.C, "Engineering Mathematics" Oxford University Press, 2015. [7] Thomas. G. B., Hass. J., and Weir. M.D, "Thomas Calculus", 14th Edition, Pearson India, 2018.
MOOC/Web Platforms:	https://nptel.ac.in/courses/122104018 https://archive.nptel.ac.in/courses/111/106/111106146/ https://onlinecourses.nptel.ac.in/noc21_ma16/preview https://digimat.in/nptel/courses/video/111105122/L01.html

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Use the matrix algebra methods for solving practical problems.	Apply (K3)
CO2	Able to use differential calculus ideas on several variable functions.	Apply (K3)
CO3	Apply integral calculus and multiple integral tools in solving various application problems.	Apply (K3)
CO4	Understand the concepts of Gradient, divergence and curl of a vector point function and related applications.	Understand (K2)
CO5	Apply various techniques in solving ordinary differential equations.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	1	1	-	-	-	-	2	-	2	3	-	-
CO2	3	3	1	1	-	-	-	-	2	-	2	3	-	-
CO3	3	3	1	1	-	-	-	-	2	-	2	3	-	-
CO4	3	3	1	1	-	-	-	-	2	-	2	3	-	-
CO5	3	3	-	-	-	-	-	-	2	-	-	2	-	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23PH102 Physics for Electronics Engineering

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E. ECE	I	BSC	3	0	0	3

II - Course Objectives

1.	To instill the essentials of properties of matter.
2.	To describe the principles of quantum mechanics and their various applications.
3.	To provide the fundamental understanding of crystals and their numerous crystal formations.
4.	To recognize the modelling of conducting materials' transport properties using both classical and quantum theories.
5.	To become knowledgeable about semiconductors and understands the applications of magnetic materials.

III - Course Content**Preamble:**

The aim of the Physics for electronics engineering Programme is to offer students a solid background in the fundamentals of Physics and to impart that knowledge in electronics engineering disciplines. The **programme** is designed to develop scientific attitudes and enable the students to correlate the concepts of Physics with the core programme.

Unit - I	Properties of Matter	9 Periods
Elasticity – stress - strain - Hooke 's law- S-S diagram - factors affecting elastic modulus and tensile strength – Torsion pendulum - moment of inertia of a body - young's modulus – cantilever method, uniform and non-uniform bending – I-shaped girders - Poisson's ratio.		
Unit - II	Quantum Physics	9 Periods
Comparison between classical and quantum theory – Compton scattering: experimental description-uncertainty principle – physical significance of wave function - Schrödinger's wave equation – time dependent and time independent equations – particle in a box - quantum confinement.		
Unit - III	Crystal Physics	9 Periods
Crystallography – unit cell, primitive cell - crystal systems, Bravais lattices, Miller indices – inter-planar distances - coordination number and packing factor for SC, BCC, FCC, HCP structures- diamond & NaCl Crystal structure - crystal defect and dislocation. crystal growth techniques: Bridgman method.		
Unit - IV	Conducting Materials	9 Periods
Classical free electron theory - electrical and thermal conductivity, expression - Wiedemann-Franz law - electrons in metals - particle in a three-dimensional box - degenerate states - Fermi-Dirac statistics - density of energy states - electron in periodic potential: Bloch theorem - metals and insulators - energy bands in solids - electron effective mass.		
Unit - V	Semiconducting and Magnetic Materials	9 Periods
Direct and indirect band gap semiconductors- carrier concentration in intrinsic semiconductors- carrier concentration in n-type & p-type semiconductors- Hall effect and applications - classification of magnetic materials: diamagnetic, paramagnetic and ferromagnetic materials - domain theory - hysteresis (based on domain theory) - soft and hard magnetic materials		

TOTAL: 45 Periods

Books for study & Reference:	[1] Tipler Mosca, Physics For Scientists and Engineers 6th Edition, 2015 [2] Gaur R.K. and Gupta S.L, Engineering Physics, Dhanpat Rai Publications, 2013. [3] Bhattacharya D.K. & Poonam T., Engineering Physics, Oxford University Press, 2015. [4] S. O. Pillai, Solid State Physics, New Age International Private Limited, 10 th edition, 2022 [5] Marikani A, Engineering Physics, PHI, New Delhi, 2013.
MOOC/Web Platforms:	https://onlinecourses.nptel.ac.in/noc20_mm13/preview https://www.livescience.com/33816-quantum-mechanics-explanation.html https://archive.nptel.ac.in/courses/115/104/115104109/ https://onlinecourses.nptel.ac.in/noc20_ph10/previewsemiconductors-insulators/semiconductor-materials-types-groups.php

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Choose the correct materials based on their qualities for any intended applications and learn the basics of elasticity and its engineering-related applications.	Apply (K3)
CO2	Apply quantum theory's sophisticated physics notions to the matter's characterization.	Apply (K3)
CO3	Know the fundamentals of crystal formations and growth methods.	Understand (K2)
CO4	To understand about the creation of energy band structures, free electron theory and quantum theory.	Understand (K2)
CO5	To gain knowledge about semiconductor and magnetic materials, as well as the applications for them.	Understand (K2)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	3	3	-	-	2	-	-	-	-	3	-	-
CO2	3	3	3	2	-	-	3	-	-	-	-	2	-	-
CO3	3	2	3	3	-	-	-	-	-	-	-	1	-	-
CO4	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	3	-	3	-	-	-	-	-	-	-	-	3	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23CY101 Engineering Chemistry

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E./B.TECH. Common to all Branches	I	BSC	3	0	0	3

II - Course Objectives

1.	To inculcate sound understanding of water quality parameters and water treatment techniques.
2.	To impart knowledge on the basic principles and preparatory methods of nanomaterials.
3.	To introduce the basic concepts and applications of polymers and composites.
4.	To facilitate the understanding of different types of fuels, their preparation, properties and combustion characteristics.
5.	To familiarize the students with the operating principles, working processes and applications of energy conversion and storage devices.

III - Course Content**Preamble:**

The objective of this course is to bestow the better understanding of basic concepts of chemistry and its applications in Engineering and Technology. This course provides exposure on properties of water and its treatment methods. It also imparts knowledge on properties and application of nano-materials in data storage devices. This course also highlights preparation, properties and applications of polymers and composite materials. It also imparts knowledge on fuel types and applications of energy conversion and storage devices.

Unit - I	Water and Its Treatment	9 Periods
Water: sources and impurities, water quality parameters: colour, odour, turbidity, pH, hardness, alkalinity, TDS, COD and BOD, flouride and arsenic. Municipal water treatment: primary treatment and disinfection (UV, Ozonation, break-point chlorination). Desalination of brackish water: reverse osmosis. Boiler troubles: scale and sludge, boiler corrosion, caustic embrittlement, priming & foaming. Treatment of boiler feed water: internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) and external treatment: ion exchange demineralisation and zeolite process.		
Unit - II	Nano Chemistry	9 Periods
Basics: distinction between molecules, nanomaterials and bulk materials; size-dependent properties (optical, electrical, mechanical and magnetic); types of nanomaterials: definition, properties and uses of - nanoparticle, nanocluster, nanorod, nanowire and nanotube. Preparation of nanomaterials: sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro spinning. Applications of nanomaterials in medicine, agriculture, energy, electronics and catalysis.		
Unit - III	Polymers and Composites	9 Periods
Introduction: classification of polymers - natural and synthetic; thermoplastic and thermosetting. Functionality - preparation properties and uses of PVC, teflon, nylon 6,6 and epoxy resins. Composites: introduction: definition & need for composites; constitution: matrix materials (Polymer matrix, metal matrix and ceramic matrix) and reinforcement (fiber, particulates, flakes and whiskers). Properties and applications of: metal matrix composites (MMC), ceramic matrix composites and polymer matrix composites. Hybrid composites - definition and examples.		
Unit - IV	Fuels and Combustion	9 Periods
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; ignition temperature: spontaneous ignition temperature, explosive range; flue gas analysis - ORSAT Method. CO ₂ emission and carbon foot print.		
Unit - V	Energy Storage Devices	9 Periods
Nuclear energy: light water nuclear power plant, breeder reactor. Solar energy conversion: principle, working and applications of solar cells; recent developments in solar cell materials. Wind energy; geothermal energy; batteries: types of batteries, primary battery – dry cell, secondary battery -lead acid storage battery and lithium-ion-battery; electric vehicles-working principles; fuel cells: H ₂ -O ₂ fuel cell, super capacitors		

TOTAL: 45 Periods

Text Books:	[1] P. C. Jain and Monica Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 17th Edition, 2018. [2] Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 6th Edition 2012. [3] S.S. Dara, "A text book of Engineering Chemistry", S. Chand Publishing, 12th Edition, 2018.
Reference Books:	[1] B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, "Text book of nanoscience and nanotechnology", Universities Press-IIM Series in Metallurgy and Materials Science, 2018. [2] O.G. Palanna, "Engineering Chemistry" McGraw Hill Education (India) Private Limited, 2nd Edition, 2017. [3] Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2nd Edition, 2017. [4] Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, 2nd Edition, 2019. [5] O.V. Roussak and H.D. Gesser, Applied Chemistry-A Text Book for Engineers and Technologists, Springer Science Business Media, New York, 2nd Edition, 2013. [6] Gowariker V.R., Viswanathan N.V. and Jayadev Sreedhar, "Polymer Science", New Age International P (Ltd.,) Chennai, 4th Edition, 2021.
MOOC/Web Platforms:	https://nptel.ac.in/courses

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	Summarize the water related problems in boilers and their treatment techniques.	Remember (K1)
C02	Discuss the applications of nanomaterials in medicine, agriculture, energy, electronics and catalysis.	Understand (K2)
C03	Discuss the types, properties and applications of polymers and composites.	Apply (K3)
C04	Summarize the fuels used for engineering processes and applications of fuels.	Understand (K2)
C05	Summarize the principles and generation of energy in batteries, nuclear reactors, solar cells, wind mills and fuel cells.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C01	2	1	1	-	-	-	3	-	-	-	-	2	-	-
C02	2	1	1	-	-	-	3	-	-	-	-	2	-	-
C03	2	1	1	-	-	-	3	-	-	-	-	2	-	-
C04	2	1	1	-	-	-	1	-	-	-	-	2	-	-
C05	3	2	2	-	-	-	3	-	-	-	-	3	-	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23GE101 Problem Solving and C Programming

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E./B.TECH. Common to all Branches	I	ESC	3	0	2	4

II - Course Objectives

1.	To make the students understand the fundamentals of problem solving using Algorithm and Flowchart
2.	To teach the basic programming constructs for solving simple problems
3.	To introduce the basic concepts of arrays and strings
4.	To acquaint the students about functions, pointers, structures and their relationship
5.	To impart knowledge on the concepts of file handling

III - Course Content

Unit - I	Introduction to Algorithm and C	10 Periods
Algorithms, building blocks of algorithms, notation, algorithmic problem solving, simple strategies for developing algorithms. Structure of C programme - C programming: Data Types - Constants - Enumeration Constants - Keywords - Operators: Precedence and Associativity - Expressions - Input/Output statements, Assignment statements - Decision making statements - Switch statement - Looping statements - Preprocessor directives - Compilation process		
Unit - II	Arrays and Strings	8 Periods
Introduction to Arrays: Declaration, Initialization - One dimensional array - Two dimensional arrays - String operations: length, compare, concatenate, copy - Selection sort, linear and binary search		
Unit - III	Functions and Pointers	9 Periods
Modular programming - Function prototype, function definition, function call, Built-in functions (string functions, math functions) - Recursion, Binary Search using recursive functions - Pointers - Pointer operators - Pointer arithmetic - Arrays and pointers - Array of pointers - Parameter passing: Pass by value, Pass by reference		
Unit - IV	Structures and Union	9 Periods
Structure - Nested structures - Pointer and Structures - Array of structures - Self referential structures - Dynamic memory allocation - Singly linked list - typedef - Union - Storage classes and Visibility		
Unit - V	File Processing	9 Periods
Files - Types of file processing: Sequential access, Random access - Sequential access file - Random access file - Command line arguments		
TOTAL:45 Periods		

List of Experiments:**30 Periods**

Note: The lab instructor is expected to design problems based on the topics listed. The Examination shall not be restricted to the sample experiments designed.

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
6. Functions: call, return, passing parameters by (value, reference), passing arrays to function.
7. Recursion

8. Pointers: Pointers to functions, Arrays, Strings, Pointers to Pointers, Array of Pointers
 9. Structures: Nested Structures, Pointers to Structures, Arrays of Structures and Unions.
 10. Files: reading and writing, File pointers, file operations, random access, processor directives.

TOTAL: 75 Periods

Text Books:	1. Reema Thareja, "Programming in C", Oxford University Press, Second Edition, 2016. 2. Kernighan, B.W and Ritchie, D.M, "The C Programming language", Second Edition, Pearson Education, 2015.
Reference Books:	1. B. Gottfried, Programming with C, Schaum Outline Series, Fourth Edition, 2018 2. Yashwant Kanetkar, Let us C, 17th Edition, BPB Publications, 2020. 3. Byron S. Gottfried, "Schaum's Outline of Theory and Problems of Programming with C", McGraw-Hill Education, 1996. 4. Pradip Dey, Manas Ghosh, "Computer Fundamentals and Programming in C", Second Edition, Oxford University Press, 2013. 5. Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", 1st Edition, Pearson Education, 2013.

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the basic concepts of C programming tokens, control statements Input/ Output statements, and Preprocessor directives	Apply (K3)
CO2	Develop C Programmes using basic programming constructs for solving simple problems	Apply (K3)
CO3	Develop C programmes for solving computational problems by using arrays and strings	Apply (K3)
CO4	Develop simple real-time applications in C using functions, arrays, and strings	Apply (K3)
CO5	Develop applications for real time problems in C using pointers and structures	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	-	3	-	-	-	-	-	2	-	2	-
CO2	3	3	3	-	3	-	-	-	-	-	2	-	2	-
CO3	3	3	2	-	3	-	-	-	-	-	2	-	2	-
CO4	3	2	2	-	3	-	-	-	-	-	2	-	2	-
CO5	3	3	3	-	3	-	-	-	-	-	2	-	2	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23GE103 தமிழர் மரபு /Heritage of Tamils

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E./B.TECH. Common to all Branches	I	HSMC	1	0	0	1

II - Course Content

Unit - I	Language and Literature	3 Periods
Language Families in India - Dravidian Languages – Tamil as a Classical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.		
Unit - II	Heritage - Rock Art Paintings to Modern Art – Sculpture	3 Periods
Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.		
Unit - III	Folk and Martial Arts	3 Periods
Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.		
Unit - IV	Thinai Concept of Tamils	3 Periods
Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.		
Unit - V	Contribution of Tamils to Indian National Movement and Indian Culture	3 Periods
Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.		

TOTAL: 15 Periods

Text Books:	[1] தமிழக வரலாறு மக்களும் பண்பாடும் கே.கே. பிள்ளை (வெளியீடு-தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்). [2] கணினித் தமிழ் முனைவர் இலகந்தரம் (விகடன் பிரசுரம்). [3] கீழடி-வெகை நதிக்கரையில் சங்க கால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு) [4] பொருளை-ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு) [5] Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL [6] Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
Reference Books:	[1] Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D.Thirunavukkarasu) (Published by: International Institute of Tamil Studies). [2] The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies) [3] Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu) [4] Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author) [5] Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu) [6] Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL)

I - Course Name: 23BS112 Physics and Chemistry Laboratory for Electronics Engineering

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E. ECE	I	BSC	0	0	4	2

II - Course Content**Physics Laboratory****Preamble:**

This course aims to provide practical training in the estimation of physical parameters like band gap, ultrasound velocity, liquid compressibility, thin wire thickness, Young's modulus, and knowledge of the operation of the photoelectric effect and Michelson interferometer as well as to provide project-based skills development.

PHYSICS LABORATORY: (Any seven experiments to be conducted)

1. Torsional pendulum – Determination of rigidity modulus of wire and moment of inertia of disc.
2. Uniform bending (or) Non-uniform Bending– Determination of young's modulus.
3. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids.
4. Air wedge – Determination of thickness of a thin sheet/wire.
5. Determination of Band gap of a semiconductor.
6. Simple harmonic oscillations of cantilever.
7. Acoustic grating- Determination of velocity of ultrasonic waves in liquids.
8. Photoelectric effect
9. Michelson Interferometer.
10. Melde's string experiment
11. Experiment with lattice dynamics kit.

Chemistry Laboratory**Preamble:**

This course aims to provide the students, a basic practical knowledge in chemistry. The objective of this course is to develop intellectual and psychomotor skills of the students by providing hands on experience in quantitative, electrochemical and photo-chemical analysis.

CHEMISTRY LABORATORY: (Any seven experiments to be conducted)

1. Estimation of HCl using Na_2CO_3 as primary standard and Determination of alkalinity in water sample.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler's method.
4. Determination of chloride content of water sample by argentometric method.
5. Estimation of copper content of the given solution by Iodometry.
6. Determination of strength of given hydrochloric acid using pH meter.
7. Determination of strength of acids in a mixture of acids using conductivity meter.
8. Estimation of iron content of the given solution using potentiometer.
9. Estimation of iron content of the water sample using spectrophotometer.
10. Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.
11. Pseudo first order kinetics-ester hydrolysis.
12. Corrosion experiment-weight loss method.
13. Phase change in a solid.
14. Conductometric titration of strong acid vs strong base.

Reference Books:

Vogel's Textbook of Quantitative Chemical Analysis (8th edition, 2014).

TOTAL: 60 Periods

III - Course Outcomes**Physics Laboratory**

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	Apprehend the concepts of interference, diffraction of light and recognize the resonance concept of waves.	Understand (K2)
C02	Apply the principles of operations of semiconductor using simple circuits and interaction of electromagnetic waves and crystalline solids.	Apply (K3)
C03	Measure the elastic moduli and moment of inertia of given materials with the help of suggested procedures.	Apply (K3)
C04	Experiment the relationship between the light and matter & properties of liquids.	Analyze (K4)
C05	Estimate the velocity of sound and compressibility of liquid.	Understand (K2)

Chemistry Laboratory

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	Analyze the quality of water samples with respect to their acidity, alkalinity, hardness and DO.	Analyze (K4)
C02	Determine the amount of metal ions through volumetric and spectroscopic techniques.	Apply (K3)
C03	Analyze and determine the composition of alloys.	Analyze (K4)
C04	Learn simple method of synthesis of nanoparticles	Understand (K2)
C05	Quantitatively analyze the impurities in solution by electro analytical methods.	Analyze (K4)

IV - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C01	3	1	-	-	-	-	-	1	3	2	-	-	-	-
C02	3	1	-	-	-	-	-	1	2	1	-	-	-	-
C03	3	3	-	-	-	-	-	2	2	1	-	-	-	-
C04	3	2	-	-	-	-	-	1	3	2	-	-	-	-
C05	3	2	-	-	-	-	-	2	1	2	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23GE112 English Laboratory -I

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E./B.TECH. Common to all Branches	I	EEC	0	0	2	1

II - Course Objectives

1.	To improve the communicative competence of learners
2.	To help learners use language effectively in academic/work contexts
3.	To develop various listening strategies to comprehend various types of audio materials like lectures, discussions, videos etc.
4.	To build on students' English language skills by engaging them in listening, speaking and grammar learning activities that are relevant to authentic contexts.
5.	To use language efficiently in expressing their opinions via various media.

III - Course Content

Preamble: This course is designed to equip students with the necessary skills to listen and speak so as to develop their linguistic and communicative competencies.		
Unit - I	Introduction to Fundamentals of Communication	6 Periods
Listening for general information-specific details- conversation: Introduction to classmates - Audio /video (formal & informal); Telephone conversation; Listening to voicemail & messages; Listening and filling a form. Speaking-making telephone calls- Self Introduction; Introducing a friend;-politeness strategies- making polite requests, making polite offers, replying to polite requests and offers-understanding basic instructions (filling out a bank application for example).		
Unit - II	Narration and Summation	6 Periods
Listening-Listening to pod casts, anecdotes/stories/event narration; documentaries and interviews with celebrities- Note Taking. Speaking - Narrating personal experiences / events-Talking about current and temporary situations & permanent and regular situations - describing experiences and feelings-engaging in small talk-describing requirements and abilities.		
Unit - III	Description of a Process/Product	6 Periods
Listening - Listen to product and process descriptions; a classroom lecture; and advertisements about products. Speaking-Picture description-describing locations in work places-Giving instruction to use the product- explaining uses and purposes- Presenting a product- describing shapes and sizes and weights-talking about quantities (large & small)-talking about precautions.		
Unit - IV	Classification and Recommendations	9 Periods
Listening-Listening to TED Talks; Listening to lectures-and educational videos. Speaking-Small Talk; discussing and making plans-talking about tasks-talking about progress-talking about positions and directions of movement-talking about travel preparations-talking about transportation.		
Unit - V	Expression	6 Periods
Listening-Listening to debates/discussions; different viewpoints on an issue; and panel discussions. Speaking-making predictions-talking about a given topic-giving opinions-understanding a website-describing processes.		

TOTAL: 30 Periods

Recommended Software:	[1] Globarena Software
	[2] Open-Source Software and YouTube Videos in Career Lab.
Manual	[1] English Laboratory Manual, Department of English, NPR College of Engineering & Technology College, Dindigul.
MOOC/Web Platforms:	https://www.digitalteacher.in/english-language-lab

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	To listen to and comprehend general as well as complex academic information.	Understand (K2)
C02	To listen to and understand different points of view in a discussion.	Understand (K2)
C03	To speak fluently and accurately in formal and informal communicative contexts.	Apply (K3)
C04	To describe products and processes and explain their uses and purposes clearly and accurately.	Create (K6)
C05	To express their opinions effectively in both formal and informal discussions.	Create (K6)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C01	-	-	-	-	-	-	-	-	3	3	-	2	-	-
C02	-	-	-	-	-	-	-	-	3	3	-	2	-	-
C03	-	-	-	-	-	-	-	-	3	3	-	2	-	-
C04	-	-	-	-	-	-	-	-	3	3	-	2	-	-
C05	-	-	-	-	-	-	-	-	3	3	-	2	-	-

Mapping: 1-Low, 2-Medium, 3-High

Semester - II

SEMESTER - II**I - Course Name: 23HS201 Professional English - II**

Prerequisite	Programme Name	Sem	Category	L	T	P	C
23HS101-Professional English - I	B.E./B.TECH. Common to all Branches	II	HSMC	2	0	0	2

II - Course Objectives

1.	To engage learners in meaningful language activities to improve their reading and writing skills.
2.	To learn various reading strategies and apply in comprehending documents in professional context.
3.	To help learners understand the purpose, audience, contexts of different types of writing.
4.	To develop analytical thinking skills for problem solving in communicative contexts.
5.	To demonstrate an understanding of job applications and interviews for internship and placements.

III - Course Content**Preamble:**

This course is designed to impart required levels of Communication Skills in Reading and Writing and Proficiency in English language in writing necessary for different professional contexts.

Unit - I	Making Comparisons	6 Periods
Reading - Reading advertisements, user manuals, brochures; - Discourse markers (connectives & sequence words), Writing --Compare and Contrast Essay; Grammar-Active & Passive Voice-Impersonal Passive Voice.		
Unit - II	Expressing Causal Relations	6 Periods
Reading - Reading longer technical texts- Cause and Effect Essays, and Formal Letters/emails of complaint, Writing-Writing responses to complaints - Jumbled sentences. Grammar - Infinitive and Gerunds.		
Unit - III	Critical Thinking and Problem Solving	6 Periods
Reading- Case Studies, excerpts from literary texts, news reports etc. Writing -Letter to the Editor, Checklists, Drafting of Circulars, Agenda & Minutes of the meeting, Problem solution essay/Argumentative Essay. Grammar - Error correction; If conditional sentences.		
Unit - IV	Reporting of events	6 Periods
Reading -Newspaper articles; Writing - Accident Report with Recommendations, Survey Report; Grammar-Reported Speech, Modals -Conjunctions- Sentence pattern		
Unit - V	Cohesive Writing	6 Periods
Reading - Company profiles, Statement of Purpose, (SOP), an excerpt of interview with professionals; Writing-Job/Internship application-Cover letter & Resume; Grammar-Numerical adjectives, Relative Clauses.		

TOTAL: 30 Periods

Text Books:	[1] English for Engineers & Technologists (2020 edition) Orient Blackswan Private Ltd. Department of English, Anna University.
	[2] English for Science & Technology Cambridge University Press 2021.

	[3] Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN.Shoba, and Dr.Lourdes Joevani, Department of English, Anna University.
Reference Books:	[1] Ashraf Rizvi, "Effective Technical Communication", 2nd Edition, McGraw-Hill India, 2017.
	[2] Raman. Meenakshi, Sharma. Sangeeta (2019). Professional English. Oxford university press. New Delhi.
	[3] Improve Your Writing ed. V.N. Arora and Laxmi Chandra, Oxford Univ. Press, 2001, New Delhi.
	[4] Learning to Communicate –Dr. V.Chellammal. Allied Publishers, New Delhi, 2003.
	[5] Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata Mc Graw Hill & Co.Ltd.,2001,NewDelhi.
MOOC/Web Platforms:	https://onlinecourses.nptel.ac.in/noc23_hs115/preview

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	To compare and contrast products and ideas in technical texts and write analytical essays.	Apply (K2)
CO2	To identify and report cause and effects in events, industrial processes through technical texts and draft a report with suggestions.	Create (K6)
CO3	To analyze problems in order to arrive at feasible solutions and communicate them in the written format.	Analyze (K4)
CO4	To present their ideas and opinions in a planned and logical manner in industrial nature.	Create (K6)
CO5	To draft effective resumes in the context of job application.	Create (K6)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	-	-	-	-	-	-	-	-	3	3	-	2	-	-
CO2	-	-	-	-	-	-	-	-	3	3	-	2	-	-
CO3	-	-	-	-	-	-	-	-	3	3	-	2	-	-
CO4	-	-	-	-	-	-	-	-	3	3	-	2	-	-
CO5	-	-	-	-	-	-	-	-	3	3	-	2	-	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23MA203 Partial Differential Equations and Transforms

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E. ECE	II	BSC	3	1	0	4

II - Course Objectives

1.	To study the formation and solve the Partial Differential Equations.
2.	To understand the concepts of Dirichlet's conditions and Fourier series.
3.	To Study the application of transform techniques using Fourier Transforms.
4.	To understand the concept of Laplace transforms can be used for efficiently solving the problems that occur in various branches of engineering disciplines.
5.	To provide the basic concepts of Z-Transform and solve the difference equations.

III - Course Content

Preamble: Fourier analysis allows modelling periodic phenomena which appears frequently in engineering, alternating electric currents or the motion of planets. The idea of Fourier analysis is to represent complicated functions in terms of simple periodic functions, namely cosines and sines.		
Unit - I	Partial Differential Equations	12 Periods
Formation of partial differential equations - Elimination of arbitrary constants and functions - Solutions of five standard types of first order partial differential equations - Lagrange's linear equation - Homogenous type of Second order Linear differential equations with constant coefficients.		
Unit - II	Fourier Series	12 Periods
Dirichlet's conditions - General Fourier series - Half range sine and cosine series - Parseval's identity - Harmonic analysis.		
Unit - III	Fourier Transforms	12 Periods
Fourier transform pair - Fourier sine and cosine transforms - Properties - Transforms of simple functions - Convolution theorem (excluding Proof) - Parseval's identity.		
Unit - IV	Laplace Transforms	12 Periods
Existence conditions - Transforms of elementary functions - Transform of unit step function and unit impulse function - Basic properties - Shifting theorems - Transforms of derivatives and integrals - Initial and final value theorems - Inverse transforms - Convolution theorem (excluding Proof) - Transform of periodic functions - Application to solution of linear second order ordinary differential equations with constant coefficients.		
Unit - V	Z - Transforms and Difference Equations	12 Periods
Z-transforms - Elementary properties - Inverse Z-transform (using partial fraction and residues) - Convolution theorem - Formation of difference equations - Solution of difference equations using Z - transform.		

TOTAL: 60 Periods

Text Books:	[1] Veerarajan T, "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt.Ltd., New Delhi, Second reprint, 2012. [2] Grewal B.S., "Higher Engineering Mathematics", 42 nd Edition, Khanna Publishers, Delhi, 2012.
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Reference Books:	[1] Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 7 th Edition, Laxmi Publications Pvt Ltd, 2007. [2] Glyn James, "Advanced Modern Engineering Mathematics", 3 rd Edition, Pearson Education, 2007. [3] Erwin Kreyszig, "Advanced Engineering Mathematics", 8 th Edition, Wiley India, 2007. [4] Ray Wylie C and Barrett.L.C, "Advanced Engineering Mathematics" Tata McGraw Hill Education Pvt Ltd, Sixth Edition, New Delhi, 2012. [5] Datta K.B., "Mathematical Methods of Science and Engineering", Cengage Learning India Pvt Ltd, Delhi, 2013.
MOOC/Web Platforms:	https://archive.nptel.ac.in/courses/111/103/111103021/ https://archive.nptel.ac.in/courses/111/106/111106139/

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	To apply Partial Differential Equation in real time Engineering problems.	Apply (K3)
CO2	To understand general periodic functions and apply in problems of Fourier series, which are sums of sines and cosines.	Understand (K2)
CO3	To use the Fourier transform as the tool to connect the time domain and frequency domain in signal processing.	Apply (K3)
CO4	To apply Laplace transform and inverse transform of simple functions, properties, various related theorems and application to differential equations with constant coefficients.	Apply (K3)
CO5	To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z - Transform techniques for discrete time systems.	Understand (K2)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	1	1	-	-	-	-	2	-	-	3	-	-
CO2	3	3	1	1	-	-	-	-	2	-	-	3	-	-
CO3	3	3	1	1	-	-	-	-	2	-	-	3	-	-
CO4	3	3	1	1	-	-	-	-	2	-	-	3	-	-
CO5	3	3	1	1	-	-	-	-	2	-	-	3	-	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23BE204 Electronic Devices

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E. ECE	II	ESC	3	0	0	3

II - Course Objectives

1.	To understand the basic concepts of semiconductor devices.
2.	To learn the characteristics of bipolar junctions.
3.	To inculcate the construction, characteristics of FET and MOSFET.
4.	To understand the special purpose semiconductor devices.
5.	To introduce the concepts of power devices and display devices.

III - Course Content

Preamble: Electronics industry plays a vital role in all aspects of our day life with the evolution in automation industry, IoT, Robotics and Artificial Intelligence. Every industry, in order to work with this growing technology, one should know the working principle, operation and characteristics, diodes, transistors, FET, MOSFET, Special purpose semiconductor diodes, display devices and power devices.		
Unit - I	Semiconductor Diode	9 Periods
PN junction diode, Current equations, Diffusion and drift current densities, forward and reverse bias characteristics, Transition and Diffusion Capacitances, rectifier circuits, Zener Diode and its characteristics, regulators		
Unit - II	Bipolar Junction Transistors	9 Periods
NPN -PNP -Junctions-Early Effect-Current equations – Input and Output characteristics of CE, CB CC-Hybrid π model, h-parameter model, Ebers Moll Model, Multi Emitter Transistor.		
Unit - III	Field Effect Transistors	9 Periods
JFETs – Drain and Transfer characteristics, -Current Equations-Pinch off voltage and its significance, MOSFET- Characteristics- Channel length modulation, D-MOSFET, E-MOSFET		
Unit - IV	Special Purpose Semiconductor Devices	9 Periods
Metal-Semiconductor Junction- MESFET, Schottky barrier diode--Varactor diode –Tunnel diode- Gallium Arsenide device, LASER diode, LDR, Photo diode, Photo transistor, Opto Coupler, Solar cell		
Unit - V	Power Devices and Display Devices	9 Periods
Uni Junction Transistor, Silicon Controlled Rectifier, Diac, Triac, Power BJT, Light Emitting Diode, Liquid Crystal Display, Charge Coupled Devices		
TOTAL: 45 Periods		
Text Books:	1. Robert Boylestad and Louis Nashelsky, "Electron Devices and Circuit Theory": Printice Hall Publications, 11th Edition , 2015 2. Donald A Neaman, "Semiconductor Physics and Devices", Fourth Edition, Tata Mc GrawHill Inc. 2012 3. David A. Bell, Electronic Devices & Circuits, 5th Edition, Oxford University Press, 2008.	

Reference Books:	1. Millman and Halkias, "Electronic devices and circuits", 2nd Edition, McGraw Hill Publication, 2007 2. Salivahanan. S, Suresh Kumar. N, Vallavaraj.A, —Electronic Devices and circuit, Third Edition, Tata McGraw- Hill, 2008. 3. Yang, "Fundamentals of Semiconductor devices", McGraw Hill International Edition, 1978.
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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	Design simple rectifiers and voltage regulators using diodes.	Apply (K3)
C02	Apply suitable biasing conditions to study the input and output characteristics of BJT.	Apply (K3)
C03	Explore the characteristics and operation of JFET and MOSFET.	Understand (K2)
C04	Compare the characteristics of special Semiconductor diodes.	Understand (K2)
C05	Articulate the applications of Power and Display devices.	Understand (K2)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C01	3	2	1	-	-	-	-	-	-	-	-	-	1	-
C02	3	2	1	-	-	-	-	-	-	-	-	-	1	-
C03	3	2	1	-	-	-	-	-	-	-	-	-	1	-
C04	3	2	1	-	-	-	-	-	-	-	-	-	1	-
C05	3	2	1	-	-	-	-	-	-	-	-	-	1	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23CS201 Python Programming

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E. ECE	II	ESC	3	0	0	3

II - Course Objectives

1.	To learn to solve problems using Python conditionals and loops.
2.	To define Python functions and use function calls to solve problems
3.	To use Python data structures - lists, tuples, dictionaries to represent complex data.
4.	To do input/output with files in Python
5.	To use python Exceptions and Libraries

III - Course Content

Preamble: -		
Unit - I	Computational Thinking and Problem Solving	9 Periods
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). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi		
Unit - II	Data Types, Expressions, Statements	9 Periods
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 programmes : exchange the values of two variables, circulate the values of n variables, distance between two points.		
Unit - III	Control Flow, Functions, Strings	9 Periods
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, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programmes : square root, gcd, exponentiation, sum an array of numbers, linear search, binary search		
Unit - IV	Lists, Tuples, Dictionaries	9 Periods
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 – list comprehension; Illustrative programmes : simple sorting, histogram, Students marks statement, Retail bill preparation.		
Unit - V	Files, Modules, Packages	9 Periods
Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programmes: word count, copy file, Voter's age validation, Marks range validation (0-100).		

TOTAL: 45 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.
Reference Books:	[1] Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1st Edition, 2021. [2] G Venkatesh and 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 Modeling and Understand Data", Third Edition, MIT Press [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, Mc-Graw Hill, 2018.
MOOC/Web Platforms:	https://www.python.org/

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Develop simple python programmes for applying the concepts of data types, expressions, and python statements	Apply (K3)
CO2	Develop Python programmes for solving real-time computational problems by using conditionals, looping, functions, and strings.	Apply (K3)
CO3	Understand the concepts of compound data using Python lists, tuples, and dictionaries	Understand (K2)
CO4	Develop python programmes for solving computational problems by using modules, files, and python packages	Apply (K3)
CO5	Develop python programmes for solving computational problems by using Exceptions and Libraries	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	-	-	-	-	-	-	-	2	-	-	2
CO2	3	3	3	2	2	-	-	-	-	-	2	3	-	2
CO3	3	3	3	2	2	-	-	-	-	-	2	3	-	2
CO4	3	2	2	-	-	-	-	-	-	-	2	-	-	2
CO5	3	3	3	2	3	-	-	-	-	-	2	3	-	2

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23EC201 Circuits Analysis

Prerequisite	Programme Name	Sem	Category	L	T	P	C
23MA101- Matrices and Calculus	B.E. ECE	II	PCC	3	0	2	4

II - Course Objectives

1.	To learn the basic concepts and behaviour of DC and AC circuits.
2.	To understand various methods of circuit/ network analysis using network theorems.
3.	To learn the concept of Resonance and coupled circuits.
4.	To understand the transient response of the circuits subjected to DC and AC excitations.
5.	To understand the methods to analyze the Two port networks.

III - Course Content**Preamble:**

- This course introduces the fundamental concepts and principles that are essential for comprehending circuit behavior, design, and troubleshooting.
- They are the building blocks of countless electronic systems, from simple flashlight circuits to complex integrated circuits powering computers and smart phones.

Unit - I	Basic Circuits Analysis of DC and AC Circuits	9 Periods
Ohm's Law - Kirchhoff's laws - The single Node - Pair Circuit, series and Parallel Connected Independent Sources, Resistors in Series and Parallel, voltage and current division, source transformation - Mesh current and node voltage method of analysis for D.C and A.C. circuits - Duality and dual networks.		
Unit - II	Network Theorems for DC and AC Circuits	9 Periods
Superposition theorem, Thevenin's theorem, Norton's theorem, Reciprocity theorem, Millman's theorem, and Maximum power transfer theorem, application of Network theorems-- star delta conversion.		
Unit - III	Resonance and Coupled Circuits	9 Periods
Resonance - Series resonance - Parallel resonance - Variation of impedance with frequency, Variation in current through and voltage across L and C with frequency, Bandwidth, Quality factor, Selectivity, Self-inductance- Mutual inductance - Dot rule -Coefficient of coupling - Series, Parallel connection of coupled inductors		
Unit - IV	Transient Analysis	9 Periods
Natural response-Forced response - Transient response of RC, RL and RLC circuits to excitation by Step Signal, Impulse Signal and exponential sources - Complete response of RC, RL and RLC Circuits to sinusoidal excitation.		
Unit - V	Two Port Networks	9 Periods
Two port networks, Z parameters, Y parameters, Transmission (ABCD) parameters, Hybrid (H) Parameters, Interconnection of two port networks, Symmetrical properties of T and π networks.		
TOTAL: 45 Periods		

List of Experiments:	30 Periods
1. Verifications of KVL & KCL. 2. Verifications of Thevenin & Norton theorem. 3. Verification of Superposition Theorem. 4. Verification of maximum power transfer Theorem 5. Implementation of Star-Delta Conversion 6. Determination of Resonance Frequency of Series and Parallel RLC Circuits 7. Transient analysis of RL and RC circuits to step signal excitation 8. Transient analysis of RL and RC circuits to sinusoidal excitation 9. Measurement of currents and voltages of a two-port network to calculate Z and Y parameters	
TOTAL: 75 Periods	

Text Books:	1. Hayt Jack Kemmerly, Steven Durbin, "Engineering Circuit Analysis", Mc Graw Hill education, 9th Edition, 2018. 2. Joseph Edminister and Mahmood Nahvi, —Electric Circuits, Schaum's Outline Series, Tata McGraw Hill Publishing Company, New Delhi, Fifth Edition Reprint 2016. 3. Charles K. Alexander & Mathew N.O.Sadiku, "Fundamentals of Electric Circuits", Mc GrawHill, 2nd Edition, 2003.
Reference Books:	1. Robert.L. Boylestead, "Introductory Circuit Analysis", Pearson Education India, 12th Edition, 2014. 2. Allan H.Robbins, Wilhelm C.Miller, "Circuit Analysis Theory and Practice", Cengage Learning, Fifth Edition, 1st Indian Reprint 2013 3. John O Mallay, Schaum's Outlines "Basic Circuit Analysis", The Mc Graw Hill companies, 2nd Edition, 2011
MOOC/Web Platforms:	https://youtu.be/7Nh7ISeqn6E https://youtu.be/zF12z_R6xZA https://www.youtube.com/live/X2y1LI9Tq3w?feature=share

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Apply the basic concepts of Kirchoff's laws, mesh current and node voltage method for analysis of DC and AC circuits	Apply (K3)
CO2	Apply suitable network theorems to analyze electric circuits	Apply (K3)
CO3	Analyze series, parallel resonance and coupled circuits	Analyze (K4)
CO4	Analyze the transient response for any RC, RL and RLC circuits	Analyze (K4)
CO5	Analyze the two port network parameters and properties	Analyze (K4)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	1	-	-	-	-	1	1	-	-	2	-
CO2	3	3	2	1	-	-	-	-	1	1	-	-	2	-
CO3	3	3	3	2	-	-	-	-	1	1	-	-	2	-
CO4	3	3	3	2	-	-	-	-	1	1	-	-	2	-
CO5	3	3	3	2	-	-	-	-	1	1	-	-	2	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23GE901 Environmental Sciences and Sustainability

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E. /B.TECH. Common for CSE, ECE, and IT	II	BSC	2	0	0	0

II - Course Objectives

1.	To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize the biodiversity of India and its conservation.
2.	To impart knowledge on the causes, effects and control or prevention measures of environmental pollution.
3.	To study the dynamic processes and understand the features of the earth's interior and surface.
4.	To facilitate the understanding of global and Indian scenario of renewable and nonrenewable resources, causes of their degradation and measures to preserve them.
5.	To inculcate and embrace sustainability practices and develop a broader understanding on green materials, energy cycles and analyze the role of sustainable urbanization.

III - Course Content

Preamble: The objective of this course is intended to make the students to understand the basic concepts of environment, ecology and pollution of the current environmental issues and to participate in various activities on conserving and protecting the environment.		
Unit - I	Environment and Biodiversity	9 Periods
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	9 Periods
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	Social Issues and the Environment	9 Periods
Water conservation, rain water harvesting, watershed management – Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies.		
Unit - IV	Renewable Sources of Energy	9 Periods
Energy management and conservation, new energy sources: need of new sources. Different types new energy sources. Applications of - hydrogen energy, ocean energy resources, tidal energy conversion. Concept, origin and power plants of geothermal energy.		
Unit - V	Sustainability Practices	9 Periods
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: 45 Periods

Text Books:	1. Anubha Kaushik and C. P. Kaushik's 'Perspectives in Environmental Studies', 6 th Edition, New Age International Publishers, 2018. 2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2017. 3. Gilbert M. Masters, 'Introduction to Environmental Engineering and Science', 2 nd edition, Pearson Education, 2004. 4. Allen, D. T. and Shonnard, D. R., 'Sustainability Engineering: Concepts, Design and Case Studies', Prentice Hall. 5. Bradley, A.S; Adebayo, A.O., Maria, P. 'Engineering applications in sustainable design and development', Cengage learning. 6. Environment Impact Assessment Guidelines, Notification of Government of India, 2006.
Reference Books:	1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media, 2010. 2. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, Third Edition, 2015. 3. Erach Bharucha 'Textbook of Environmental Studies for Under graduate Courses' Orient Blackswan Pvt. Ltd. 2021.
MOOC/Web Platforms:	https://onlinecourses.nptel.ac.in/

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	To recognize and understand the functions of environment, ecosystems and biodiversity and their conservation	Remember (K1)
CO2	To identify the causes, effects of environmental pollution and natural disasters and contribute to the preventive measures in the society.	Understand (K2)
CO3	To identify the causes, effects of natural disasters and contribute to the preventive measures in the society.	Apply (K3)
CO4	To identify and apply the understanding of renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations.	Understand (K2)
CO5	To demonstrate the knowledge of sustainability practices and identify green materials, energy cycles and the role of sustainable urbanization.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	1	-	-	-	2	3	-	1	-	-	2	-	-
CO2	3	2	-	-	-	3	3	-	1	-	-	2	-	-
CO3	3	1	1	-	-	2	2	-	-	-	-	2	-	-
CO4	3	1	1	1	-	2	2	-	1	-	-	2	-	-
CO5	3	2	1	-	-	2	2	-	1	-	-	1	-	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23GE201 தமிழரும் தொழில்நுட்பமும் / Tamils and Technology

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E./B.TECH. Common to all Branches	II	HSMC	1	0	0	1

II - Course Content

Unit - I	Weaving And Ceramic Technology	3 Periods
Weaving Industry during Sangam Age - Ceramic technology - Black and Red Ware Potteries (BRW) - Graffiti on Potteries.		
Unit - II	Design and Construction Technology	3 Periods
Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age - Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period		
Unit - III	Manufacturing Technology	3 Periods
Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and gold Coins as source of history - Minting of Coins - Beads making-industries Stone beads -Glass beads - Terracotta beads -Shell beads/ bone beads - Archeological evidences - Gem stone types described in Silappathikaram.		
Unit - IV	Agriculture and Irrigation Technology	3 Periods
Dam, Tank, ponds, Sluice, Significance of KumizhiThoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries - Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.		
Unit - V	Scientific Tamil & Tamil Computing	3 Periods
Development of Scientific Tamil - Tamil computing - Digitalization of Tamil Books - Development of Tamil Software - Tamil Virtual Academy - Tamil Digital Library - Online Tamil Dictionaries - Sorkuvai Project.		
TOTAL: 15 Periods		

Text Cum Books:	[1] தமிழக வரலாறு மக்களும் பண்பாடும் கே.கே. பிள்ளை (வெளியீடு-தமிழ்நாடுபாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்). [2] கணினித்தமிழ் முனைவர் இலசந்தரம் (விகடன்பிரசுரம்). [3] கீழடி-வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு) [4] பொருளை-ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு) [5] Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL - (in print) [6] Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
Reference Books:	[1] Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D.Thirunavukkarasu) (Published by: International Institute of Tamil Studies). [2] The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies) [3] Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu) [4] Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay)

	(Published by: The Author) [5] Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu) [6] Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) - Reference Book.
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I - Course Name: 23BE213 Electronic Devices Laboratory

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E. ECE	II	PCC	0	0	3	1.5

II - Course Objectives

1.	To learn the characteristics of basic electronic devices such as Diode, BJT, FET
2.	To learn the characteristics of power electronic devices such as UJT, SCR

III - Course Content

List of Experiments:
PART - A 1. Study of passive components- Resistor, Capacitor and Inductor 2. Characteristics of PN Junction Diode and Zener diode 3. Full Wave Rectifier 4. Series Regulator 5. Common Emitter input-output characteristics 6. Common Collector input-output characteristics 7. FET drain current and transfer Characteristics 8. UJT Characteristics 9. SCR Characteristics 10. Characteristics of LDR 11. Study of CRO, DSO, MSO 12. Study of elements of smart phone 13. Assembly and dismantle of LED TV 14. Assembly and dismantle of computer/ laptop PART - B: Simulation (EDWinXP, PSpice, MultiSim, Proteus, Circuit Lab or any equivalent tool) 15. Input and Output characteristics of BJT Common emitter configuration and evaluation of parameters 16. Transfer and drain characteristics of a JFET and MOSFET
TOTAL: 45 Periods

IV - Course Outcomes

	On completion of the course, the students will be able to	Bloom's Level Mapped
CO1	Analyze the characteristics of basic electronic devices	Analyze (K4)
CO2	Analyze the characteristics of power electronic devices	Analyze (K4)
CO3	Analyze the characteristics of electronic devices using simulation software	Analyze (K4)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	1	-	-	-	-	1	1	-	-	2	-
CO2	3	3	2	1	-	-	-	-	1	1	-	-	2	-
CO3	3	3	2	2	2	-	-	-	1	1	-	1	2	2

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23CS211 Python Programming Laboratory

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E. ELECTRONICS AND COMMUNICATION ENGINEERING	II	ESC	0	0	3	1.5

II - Course Objectives

1.	To learn the basic programming constructs in Python.
2.	To practice various computing strategies for Python-based solutions to real world problems.
3.	To use Python data structures - lists, tuples, dictionaries.
4.	To do input/output with files in Python
5.	To use python Exceptions and Libraries

III - Course Content

1.	Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).
2.	Scientific problems using Conditionals and Iterative loops. (Number series, Number Patterns, pyramid pattern)
3.	Implementing real-time/technical applications using Lists, Tuples. (Items present in a library/Components of a car/ Materials required for construction of a building –operations of list & tuples)
4.	Implementing real-time/technical applications using Sets, Dictionaries. (Language, components of an automobile, Elements of a civil structure, etc.- operations of Sets & Dictionaries)
5.	Implementing programmes using Functions. (Factorial, largest number in a list, area of shape)
6.	Implementing programmes using Strings. (reverse, palindrome, character count, replacing characters)
7.	Implementing programmes using written modules and Python Standard Libraries (pandas, numpy, Matplotlib, scipy)
8.	Implementing real-time/technical applications using File handling. (copy from one file to another, word count, longest word)
9.	Implementing real-time/technical applications using Exception handling. (divide by zero error, voter's age validity, student mark range validation)
10.	Exploring Pygame tool.
11.	Developing a game activity using Pygame like bouncing ball, car race etc.

Text Books:	[1] Allen B.Downey, "Think Python:How to Think like a Computer Scientist", 2 nd Edition, O'Reilly Publishers, 2016. [2] Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and Programming", 1 st Edition, BCS Learning & Development Limited, 2017.
Reference Books:	[1] Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1 st Edition, 2021. [2] G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1 st Edition, Notion Press, 2021. [3] John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understand Data", Third Edition, MIT Press, 2021. [4] Martin C.Brown, "Python: The Complete Reference", 4 th Edition, Mc-Graw Hill, 2018.
MOOC/Web Platforms:	https://www.python.org/

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	Develop simple python programmes for applying the concepts of datatypes, expressions, and python statements	Create (K6)
C02	Develop Python programmes using conditionals, looping, functions, and strings for solving real-time computational problems.	Create (K6)
C03	Understand the concepts of compound data using Python lists, tuples, and dictionaries	Understand (K2)
C04	Develop python programmes for solving problems by using modules, files, and python packages	Create (K6)
C05	Utilize Python packages for developing real-world software applications	Create (K6)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C01	3	2	2	-	2	-	-	2	-	3	2	2	-	2
C02	3	3	3	2	2	-	-	2	-	3	2	3	-	2
C03	3	2	1	2	-	-	-	2	-	3	2	3	-	2
C04	3	2	2	2	2	-	-	-	2	-	2	3	-	2
C05	3	3	3	2	2	-	-	-	2	-	2	3	-	2

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23GE212 English Laboratory -II

Prerequisite	Programme Name	Sem	Category	L	T	P	C
23GE112- English Laboratory - I	B.E./B.TECH. Common to all Branches	II	EEC	0	0	2	1

II - Course Objectives

1.	To identify varied group discussion skills and apply them to take part in effective discussions in a professional context.
2.	To analyze concepts and problems and make effective presentations explaining them clearly and precisely.
3.	To enhance the Employability and Career Skills of students and acquire professional skills required for workplace / higher education.
4.	To develop their confidence and help them to attend interviews successfully.
5.	To make them Employable Graduates and use English language skills effectively in various situations.

III - Course Content

Preamble: This course is designed to impart necessary skills to listen, speak, read and write in order to obtain better professional communication skills.		
Unit - I	Role Play	3 Periods
Speaking-Role Play Exercises Based on Workplace Contexts,-talking about competition-discussing progress toward goals-talking about experiences-talking about events in life-discussing past events.		
Unit - II	Travelogue	3 Periods
Speaking: Discussing news stories-talking about frequency-talking about travel problems-discussing travel procedures -talking about travel problems-making arrangements-describing arrangements-discussing plans and decisions- discussing purposes and reasons- understanding common technology terms.		
Unit - III	Professional Speaking	3 Periods
Speaking: Self-Introduction-organizing the material - Introducing oneself to the audience - introducing the topic - answering questions - Practicing individual presentation-- Presenting the visuals effectively (5-minute presentations).		
Unit - IV	Group Discussion	3 Periods
Introduction to Group Discussion— Participating in group discussions - understanding group dynamics - brainstorming the topic - questioning and clarifying -GD strategies - improving GD skills through activities.		
Unit - V	Interview	3 Periods
Interview etiquette - dress code - body language - Job interviews through telephone/skype -one to one interview & panel interview - FAQs related to job interviews.		

TOTAL: 15 Periods

Recommended Software:	[1] Globarena Software.
	[2] Open-Source Software and YouTube Videos in Career Lab.
Reference Books:	[1] E. Suresh Kumar et al. Communication for Professional Success. Orient Blackswan: Hyderabad, 2015.
	[2] Interact English Lab Manual for Undergraduate Students, OrientBlackSwan: Hyderabad, 2016
	[3] English For Technical Communication (With CD) By Aysha Viswamohan, Mcgraw Hill Education, ISBN :0070264244.
	[4] Effective Communication Skill, Kulbhusan Kumar, RSSalaria, Khanna Publishing House
	[5] Learning to Communicate- Dr.V.Chellammal, Allied Publishing House, New Delhi, 2003.
MOOC/Web Platforms:	https://www.digitalteacher.in/english-language-lab

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	Speak effectively in group discussions held in a formal/semi-formal contexts.	Create (K6)
C02	Discuss, analyze and present concepts and problems from various perspectives to arrive at suitable solutions.	Analyze (K4)
C03	Make effective presentations in an attractive way using appropriate vocabulary.	Apply (K3)
C04	Attend job interviews and be successful in them.	Create (K6)
C05	Develop adequate Soft Skills required for the workplace.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C01	-	-	-	-	-	-	-	-	3	3	-	3	-	-
C02	-	-	-	-	-	-	-	-	3	3	-	3	-	-
C03	-	-	-	-	-	-	-	-	3	3	-	3	-	-
C04	-	-	-	-	-	-	-	-	3	3	-	3	-	-
C05	-	-	-	-	-	-	-	-	3	3	-	3	-	-

Mapping: 1-Low, 2-Medium, 3-High

Semester - III

SEMESTER -III

I - Course Name: 23MA303 Random Processes and Linear Algebra

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E. - ECE	III	BSC	3	1	0	4

II - Course Objectives

1.	To apply the knowledge of random variables in probability distributions
2.	To introduce the basic concepts of two - dimensional random variables.
3.	To understand the basic concepts of random processes which are widely used in communication fields.
4.	To understand the concepts of vector space which is used in all the circuit branches.
5.	To understand the concepts of linear transformations, inner product spaces and orthogonalization.

III - Course Content

Preamble: This course introduces basic concept of random variables and random processes are used in signal processing also in modelling noise etc. Linear algebra is widely used in image processing and signal processing.		
Unit - I	Random Variables	12 Periods
Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions - Transformation of one random variable.		
Unit - II	Two - Dimensional Random Variables	12 Periods
Marginal and conditional distributions – Covariance – Correlation and Linear regression – Transformation of two random variables.		
Unit - III	Random Processes	12 Periods
Classification – Stationary process – Markov process - Poisson process – Random telegraph process.		
Unit - IV	Vector Spaces	12 Periods
Vector spaces – Subspaces – Linear combinations and linear system of equations – Linear independence and linear dependence – Bases and dimensions.		
Unit - V	Linear Transformation and Inner Product Spaces	12 Periods
Linear transformation – Null spaces and ranges – Dimension theorem – Matrix representation of a linear transformations – Inner product – Norms – Gram Schmidt orthogonalization process.		

TOTAL: 60 Periods

Text Books:	[1] Trivedi, K.S., "Probability and Statistics with Reliability, Queueing and Computer Science Applications", 2nd Edition, John Wiley and Sons, 2002. [2] Ibe, O.C., "Fundamentals of Applied Probability and Random Processes", Elsevier, 1st Indian Reprint, 2007. [3] Friedberg, A.H., Insel, A.J. and Spence, L., "Linear Algebra", Prentice Hall of India, New Delhi, 4th Edition, 2004.
Reference Books:	[1] Hsu, "Schaum's Outline of Theory and Problems of Probability, Random Variables and Random Processes", Tata McGraw Hill Edition, New Delhi, 2004. RPLA Notes. [2] Gross, D., Shortle, J.F, Thompson, J.M and Harris, C.M., "Fundamentals of Queueing Theory", Wiley Student 4th Edition, 2014. [3] Yates, R.D. and Goodman, D. J., "Probability and Stochastic Processes", 2 nd Edition, Wiley India Pvt. Ltd., Bangalore, 2012. [4] Kolman, B. Hill, D.R., "Introductory Linear Algebra", Pearson Education, New Delhi, First Reprint, 2009. [5] Kumaresan, S., "Linear Algebra – A Geometric Approach", Prentice – Hall of India, New Delhi, Reprint, 2010. [6] Strang, G., "Linear Algebra and its applications", Thomson (Brooks/Cole), New Delhi, 2005.
MOOC/Web Platforms:	https://onlinestatbook.com/2/probability/basic.html https://webspace.maths.qmul.ac.uk/b.bogacka/MS_NotesWeek4.pdf https://onlinecourses.nptel.ac.in/noc22_ee123/preview https://www.math.uh.edu/~jiwenhe/math2331/lectures/sec4_1.pdf

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the fundamental knowledge of the concepts of probability and have knowledge of standard distributions which can describe real life phenomenon.	Understand (K2)
CO2	Understand the basic concepts of two-dimensional random variables and apply in engineering applications.	Understand (K2)
CO3	Apply the concept random processes in engineering disciplines.	Apply (K3)
CO4	Understand the fundamental concepts of vector space and their role in modern mathematics and applied contexts.	Understand (K2)
CO5	Apply the concepts of inner product spaces in engineering field.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	-	-	-	-	-	-	2	-	-	2	-	-
CO2	3	3	-	-	-	-	-	-	2	-	-	2	-	-
CO3	3	3	-	-	-	-	-	-	3	-	-	2	-	-
CO4	3	3	-	-	-	-	-	-	3	-	-	2	-	-
CO5	3	3	-	-	-	-	-	-	3	-	-	2	-	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23AD306 Data Structures Using Python

Prerequisite	Programme Name	Sem	Category	L	T	P	C
23CS201 Python Programming	B.E. - ECE	III	ESC	3	0	0	3

II - Course Objectives

1.	To understand the principles underlying Abstract Data Types (ADTs)
2.	To create linear data structures encompassing lists, stacks, and queues.
3.	To comprehend algorithms for sorting, searching, and hashing.
4.	To utilize tree structures.
5.	To utilize graph structures.

III - Course Content**Preamble:**

The course of data structures design typically involves the fundamental building blocks of data organization, manipulation, and retrieval that form the backbone of intelligent systems. It outlines the fundamental concepts, goals, and principles that guide the creation and implementation of data structures. It sets the stage for understanding why data structures are important, what problems they aim to solve, and the considerations that go into designing them effectively.

Unit I	Abstract Data Types	9 Periods
Abstract Data Types (ADTs)-ADTs and classes-Introduction to OOP-Classes in Python - Inheritance-Namespaces-Shallow and deep copying -Introduction to analysis of algorithms - Asymptotic notations-Recursion-Analyzing recursive algorithms		
Unit II	Linear Structures	9 Periods
List ADT -Array based implementations -Linked list- Implementations- Singly linked lists Circularly linked lists - Doubly linked lists-Applications of lists- Stack ADT -Implementation of Stack - Applications - Queue ADT - Queue Implementation - Priority Queues - Double ended queues -Applications		
Unit III	Sorting and Searching	9 Periods
Bubble sort - Selection sort - Insertion Sort-Merge Sort-Quick Sort-Linear Search-BinarySearch-Hashing-Hash functions- Collision handling-Load factors, rehashing, and efficiency		
Unit IV	Tree Structures	9 Periods
Tree ADT-Binary Tree ADT -Tree traversals-Binary search trees-AVL trees-Heaps -Multiway search trees		
Unit V	Graph Structures	9 Periods
Graph ADT-Representations of graph-Graph traversals - DAG-topological ordering shortest paths-minimum spanning trees		
TOTAL: 45 Periods		

Text Books:	1. Michael T. Goodrich, Roberto Tamassia, and Michael H. Goldwasser, "Data Structures and Algorithms in Python" (An Indian Adaptation), Wiley, 2021 2. Lee, Kent D., Hubbard, Steve, "Data Structures and Algorithms with Python, Springer Edition 2015. 3. Narasimha Karumanchi, "Data Structures and Algorithmic Thinking with Python, Careermonk, 2015.
Reference Books:	1. Rance D. Nicaise, "Data Structures and Algorithms Using Python, John Wiley & Sons, 2011. 2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, "Introduction to Algorithms", Third Edition, PHI Learning, 2010. 3. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++, Fourth Edition, Pearson Education, 2014. 4. Aho, Hopcroft, and Ullman, "Data Structures and Algorithms, Pearson Education India, 2002.
MOOC/ Web Platforms:	https://www.coursera.org/specializations/datastructuresalgorithms https://www.edx.org/learn/datastructures/theuniversityofcaliforniasan-diego-data-structures-fundamentals

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understanding of Abstract Data Types (ADTs) and their practical implementations.	Understand (K2)
CO2	Apply the design and implementation of Lists, Stacks, and Queues to address real-world challenges	Apply (K3)
CO3	Apply in-depth understanding of Sorting, Searching, and Hashing Algorithms for effective Problem Solving	Apply (K3)
CO4	Apply profound understanding of Trees to effectively manage Hierarchical and Interconnected Data	Apply (K3)
CO5	Analyze, Synthesize, and Innovate with Graph Structures for Complex Interconnected Data and Network Solutions	Analyze (K4)

V -Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	2	1	-	-	-	-	-	1	1	1	-	-
CO2	2	2	1	2	1	-	-	-	-	1	1	1	-	-
CO3	2	2	2	1	1	-	-	-	-	1	1	2	-	-
CO4	2	2	2	1	1	-	-	-	-	1	1	2	-	-
CO5	2	3	3	1	1	-	-	-	-	1	1	2	-	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23EC301 Electronic Circuits

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E. - ECE	III	PCC	3	0	0	3

II - Course Objectives

1.	To understand the biasing of transistors.
2.	To design and analyze differential and multistage amplifier circuits.
3.	To study about feedback amplifiers and oscillators principles.
4.	To understand the analysis and design of wave shaping multi vibrator circuits.
5.	To understand the analysis and design of power amplifiers.

III - Course Content

Preamble: The study of Electronic Circuits forms the foundation for understanding the behavior and design of analog and digital systems. This course introduces students to the fundamental concepts of electronic devices and their applications in various circuit configurations. It emphasizes the analysis and design of amplifier circuits, feedback systems, and oscillators using semiconductor devices such as diodes, BJTs, and FETs. Through theoretical study and practical experimentation, students gain the ability to interpret circuit behavior, evaluate performance characteristics, and design basic electronic systems		
Unit - I	Biasing of Transistors	9 Periods
Overview of BJT - Selection of operating point for BJT- DC Load Line - BJT: Types of Biasing (Fixed, Emitter Feedback, Collector Feedback & Voltage Divider) - Bias Stabilization - Bias compensation - Small Signal Analysis of CE amplifier - FET: Types of Biasing (Gate, Self, Voltage Divider, Source & Current Source).		
Unit - II	Differential Amplifier and Multistage Amplifiers	9 Periods
Differential amplifier - Common mode and Difference mode analysis - Cascode amplifier- Tuned amplifiers - Types - Gain and frequency response - Neutralization methods.		
Unit - III	Feedback Amplifiers and Oscillators	9 Periods
Feedback amplifiers -Feedback topology -Voltage / Current, Series /Shunt feedback Amplifiers - Oscillators- Condition for oscillations, phase shift - Wien bridge, Hartley, Colpitts and Crystal oscillators.		
Unit - IV	Wave Shaping and Multivibrator Circuits	9 Periods
Pulse circuits - attenuators - RC integrator and differentiator circuits - diode clippers and clippers - Multivibrators - Schmitt Trigger- UJT Relaxation Oscillator.		
Unit - V	Power Amplifiers and DC/DC Converters	9 Periods
Power amplifiers- Class A-Class B-Class AB-Class C - Power MOSFET- Class AB Power amplifier using MOSFET -DC/DC convertors - Buck, Boost, Buck-Boost analysis and design.		
TOTAL:45 Periods		

Text Books:	1. David A. Bell, Electronic Devices and Circuits, Oxford Higher Education press, 5 th Edition, 2010. 2. Robert L. Boylestad and Louis Nasheresky, "Electronic Devices and Circuit Theory", 10 th , Edition, Pearson Education / PHI, 2008. 3. Adel .S. Sedra, Kenneth C. Smith, Micro Electronic Circuits, Oxford University Press, 7 th , Edition, 2014.
Reference Books:	1. Donald.A. Neamen, Electronic Circuit Analysis and Design, Tata McGraw Hill, 3 rd , Edition, 2010. 2. D.Schilling and C.Belove, Electronic Circuits, McGraw Hill, 3 rd Edition, 1989 3. Muhammad H.Rashid, Power Electronics, Pearson Education / PHI, 2004.
MOOC/Web Platforms:	https://www.geeksforgeeks.org/feedback-amplifiers/ https://www.geeksforgeeks.org/astable-monostable-and-bistable-multivibrator/ https://www.youtube.com/watch?v=LTsTl3db7Ko

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the biasing methods and small signal analysis of transistors.	Understand (K2)
CO2	Design and analyze differential and multistage amplifier circuits.	Analyze (K4)
CO3	Design and analyze feedback amplifiers and oscillators.	Analyze (K4)
CO4	Design and analyze wave shaping and multivibrator circuits.	Analyze (K4)
CO5	Design and analyze power amplifiers and supply circuits.	Analyze (K4)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	-	-	-	-	-	-	-	-	-	3	-
CO2	3	3	3	2	2	-	-	-	-	-	-	-	3	-
CO3	3	3	3	2	2	-	-	-	-	-	-	-	3	-
CO4	3	3	3	2	2	-	-	-	-	-	-	-	3	-
CO5	3	3	3	2	2	-	-	-	-	-	-	-	3	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23EC302 Digital System Design

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E. - ECE	III	PCC	3	0	2	4

II - Course Objectives

1.	To present the fundamentals of digital circuits and simplification methods.
2.	To practice the design of various combinational digital circuits using logic gates.
3.	To bring out the analysis and design procedures for synchronous sequential circuits.
4.	To bring out the analysis and design procedures for asynchronous sequential circuits.
5.	To introduce semiconductor memories and related technology.

III - Course Content

Preamble: Studying digital system design lays the foundation for understanding the intricate workings of modern digital technology. With the proliferation of digital systems in every aspect of our lives, from smartphones to sophisticated computer networks, grasping the fundamentals becomes essential. The preamble of this study involves delving into concepts such as logic gates, Boolean algebra, and sequential logic circuits. These form the building blocks upon which complex digital systems are constructed.		
Unit - I	Number Systems and Boolean Algebra	9 Periods
Number systems - Arithmetic operations- Boolean algebra – basic postulates and theorems - canonical forms- Standard representation of logic functions-K-maps and Quine McClusky method.		
Unit - II	Combinational Logic Circuits	9 Periods
Binary / BCD adders, carry look ahead adder, subtractors, code converters, multiplexers and demultiplexers, encoders and decoders – multiplier - magnitude comparator – Parity Generator/Checker.		
Unit - III	Synchronous Sequential Circuits	9 Periods
Latches, Flip flops – SR, JK, T, D, Master/Slave FF, Triggering of FF, Analysis and design of clocked sequential circuits, Design of Moore/Mealy models, Shift registers, universal shift register, Counters- Ripple Counters, Ring Counter.		
Unit - IV	Asynchronous Sequential Circuits	9 Periods
Stable and Unstable states, output specifications, cycles and races, state reduction, race free assignments, Hazards, Essential Hazards, Fundamental and Pulse mode sequential circuits, Design of Hazard free circuits.		
Unit - V	Programmable Logic Devices	9 Periods
Classification of memories, Read/write operations- Memory decoding and expansion, basic memory- Static RAM, ROM, PROM, EPROM, EEPROM, EAPROM. PLDs- Architecture and implementation (PAL and PLA).		
TOTAL: 45 Periods		

PRACTICAL EXERCISES:	30 Periods
1. Verification of logic gates. 2. Design and implementation of adders and subtractors. 3. Design and implementation of code converters. 4. Design and implementation of Multiplexers. 5. Design and implementation of Demultiplexers. 6. Design and implementation of Encoders. 7. Design and implementation of Decoders. 8. Design and implementation of Magnitude Comparators. 9. Verification of flip-flops. 10. Design and implementation of counters using flip-flops. 11. Design and implementation of shift registers. 12. Mini Project.	
TOTAL:75 Periods	

Text Books:	1. M. Morris Mano and Michael D. Ciletti, 'Digital Design', Pearson, 5th Edition, 2017.(Unit - I -V) 2. Floyd TL, Digital Fundamentals, Pearson, 2017.
Reference Books:	1. Charles H. Roth, Jr, 'Fundamentals of Logic Design', Jaico Books, 4th Edition, 2002. 2. William I. Fletcher, An Engineering Approach to Digital Design, Pearson Education India, 2015. 3. John. F. Wakerly, Digital Design Principles and Practices, Pearson Education, 4th Edition, 2007.
MOOC/Web Platforms:	https://www.tutorialspoint.com/adders-and-subtractors-in-digital-electronics https://he-coep.vlabs.ac.in/exp/decoders-encodersmultiplexer-demultiplexer/theory.html https://www.elprocus.com/what-is-a-shift-register-different-types-counters-and-applications/

IV - Course Outcomes

On completion of the course, the students will be able to			Bloom's Level Mapped
CO1	Use Boolean algebra and simplification procedures relevant to digital logic.		Understand (K2)
CO2	Design various combinational digital circuits using logic gates.		Analyze (K4)
CO3	Analyze and design synchronous sequential circuits.		Analyze (K4)
CO4	Analyze and design asynchronous sequential circuits.		Analyze (K4)
CO5	Build logic gates and use programmable devices.		Understand (K2)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	1	1	-	-	-	-	-	-	2	3	-
CO2	3	3	3	2	2	-	-	-	-	-	-	2	3	-
CO3	3	3	3	2	2	-	-	-	-	-	-	2	3	-
CO4	3	3	3	2	2	-	-	-	-	-	-	2	3	-
CO5	3	3	3	1	1	-	-	-	-	-	-	2	3	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23EC303 Signals and Systems

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E. - ECE	III	PCC	3	1	0	4

II - Course Objectives

1.	To understand the basic classification and properties of signals & systems.
2.	To analyze continuous time signals using Fourier and Laplace transform.
3.	To analyze linear time invariant continuous time systems using Fourier and Laplace transform.
4.	To analyze discrete time signals using Fourier and Z transform.
5.	To analyze linear time invariant discrete time systems using Fourier and Z transform.

III - Course Content

Preamble: Grasping the classification of signals and systems is essential for analyzing continuous and discrete time signals and systems, facilitating effective design and implementation in signal processing and control.		
Unit - I	Classification of Signals and Systems	12 Periods
Standard signals- Step, Ramp, Pulse, Impulse, Real and complex exponentials and Sinusoids, Classification of signals – Continuous time (CT) and Discrete Time (DT) signals, Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals - Classification of systems- CT systems and DT systems- – Linear & Nonlinear, Time-variant & Time-invariant, Causal & Non-causal, Stable & Unstable.		
Unit - II	Analysis of Continuous Time Signals	12 Periods
Fourier series for periodic signals – Conditions for even and odd symmetry, Continuous Time Fourier Transform – Inverse Fourier Transform- Properties, Laplace Transforms – Inverse Laplace Transform- Properties.		
Unit - III	Linear Time Invariant Continuous Time Systems	12 Periods
Impulse response - convolution integrals- Differential Equation- Fourier and Laplace transforms in Analysis of CT systems.		
Unit - IV	Analysis of Discrete Time Signals	12 Periods
Baseband signal Sampling-Fourier Transform of Discrete time signals (DTFT), IDTFT- Properties of DTFT - Z Transform & Inverse Z transform- Properties.		
Unit - V	Linear Time Invariant Discrete Time Systems	12 Periods
Impulse response-Difference equations-Convolution sum- Discrete Fourier Transform and Z Transform Analysis of Recursive & Non-Recursive systems-DT, Realization techniques - direct form I, direct form II, parallel and cascade		
TOTAL: 60 Periods		

Text Books:	1. Oppenheim, Willsky and Hamid, "Signals and Systems", 2nd Edition, Pearson Education, New Delhi, 2015.(Units I - V) 2. Simon Haykin, Barry Van Veen, "Signals and Systems", 2nd Edition, Wiley, 2002
Reference Books:	1. B. P. Lathi, "Principles of Linear Systems and Signals", 2nd Edition, Oxford, 2009. 2. M. J. Roberts, "Signals and Systems Analysis using Transform methods and MATLAB", McGraw- Hill Education, 2018. 3. John Alan Stuller, "An Introduction to Signals and Systems", Thomson, 2007
MOOC/Web Platforms:	https://www.tutorialspoint.com/signals-and-systems-periodic-and-aperiodic-signals https://www.youtube.com/watch?v=f1pPNtKRb7o https://en.wikipedia.org/wiki/Discrete-time_Fourier_transform

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Determine if a given system is linear/causal/stable.	Understand (K2)
CO2	Analyze continuous time signals using Fourier and Laplace transform.	Analyze (K4)
CO3	Analyze linear time invariant continuous time systems using Fourier and Laplace transform.	Analyze (K4)
CO4	Analyze discrete time signals using Fourier and Z transform.	Analyze (K4)
CO5	Analyze linear time invariant discrete time systems using Fourier and Z transform.	Analyze (K4)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	2	1	-	-	-	-	-	-	1	3	1
CO2	3	3	3	2	1	-	-	-	-	-	-	1	3	1
CO3	3	3	3	2	1	-	-	-	-	-	-	1	3	1
CO4	3	3	3	2	1	-	-	-	-	-	-	1	3	1
CO5	3	3	3	2	1	-	-	-	-	-	-	1	3	1

Mapping: 1-Low, 2-Medium, 3-High

I – Course Name: 23GE902 Human Values and Ethics

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E./B.TECH.–Common to all Branches	III	HSMC	2	0	0	2

II - Course Objectives

1.	To create awareness about values and ethics enshrined in the Constitution of India.
2.	To sensitize students about the democratic values to be upheld in the modern society.
3.	To inculcate respect for all people irrespective of their religion or other affiliations.
4.	To instill a scientific temper in the students' minds and develop their critical thinking and awareness of plagiarism.
5.	To promote a sense of responsibility and understanding of the duties of citizens.

III - Course Content

Preamble: This course aims to provide a broad understanding of the modern values and ethical principles that have evolved and are enshrined in the Constitution of India concerning the democratic, secular, and scientific aspects. The course is designed for undergraduate students so that they can study, understand, and apply these values in their day-to-day life.		
Unit – I	Democratic Values	6 Periods
Understanding Democratic values: Equality, Liberty, Fraternity, Freedom, Justice, Pluralism, Tolerance, Respect for All, Freedom of Expression, Citizen Participation in the Governance-Indian Freedom Movement.		
Unit – II	Secular Values	6 Periods
Understanding Secular values – Interpretation of secularism in the Indian context - Disassociation of state from religion – Acceptance of all faiths – Encouraging non-discriminatory practices.		
Unit – III	Scientific Values and Ethics	6 Periods
Scientific thinking and method: Inductive and Deductive thinking, Proposing and testing Hypothesis, Validating facts using an evidence based approach. Transparency and Fairness in scientific pursuits – Scientific inventions for the betterment of society - Unfair application of scientific inventions.		
Unit – IV	Social Ethics	6 Periods
Application of ethical reasoning to social problems – Gender bias and issues – Gender violence – Social discrimination – Constitutional protection and policies – Inclusive practices.		
Unit – V	Professional Ethics	6 Periods
Plagiarism - Dishonesty - Stealing - Respect for Authority – Collective Bargaining - Confidentiality – Conflicts of Interest – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination. Values, and standards that both employees and employers - Code of ethics in the workplace.		

TOTAL: 30 Periods

Text Books:	1. Reading Text: Excerpts from John Stuart Mills on Liberty. 2. Reading Text: Excerpt from Secularism in India: Concept and Practice by Ram Puniyani. 3. Reading Text: Excerpt from the Scientific Temper by Antony Michaelis R. 4. Reading Text: Excerpt from 21 Lessons for the 21st Century by Yuval Noah Harari.
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Reference Books:	1. The Nonreligious: Understanding Secular People and Societies, Luke W. Galen Oxford University Press, 2016. 2. Secularism: A Dictionary of Atheism, Bullivant, Stephen; Lee, Lois, Oxford University Press, 2016. 3. The Oxford Handbook of Secularism, John R. Shook, Oxford University Press, 2017. 4. The Civic Culture: Political Attitudes and Democracy in Five Nations by Gabriel A. Almond and Sidney Verba, Princeton University Press, 5. Research Methodology for Natural Sciences by Soumitro Banerjee, IISc Press, January 2022
MOOC/Web Platforms:	1. www.onlineethics.org 2. www.nspe.org 3. www.globalethics.org 4. www.ethics.org

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the importance of democratic values in the harmonious functioning of social life.	Understand (K2)
CO2	Build secular values in both their personal and professional life.	Apply (K3)
CO3	Build democratic and scientific value in both their personal and professional life.	Apply (K3)
CO4	Identify rational solutions to social problems and behave in an ethical manner in society.	Understand (K2)
CO5	Build the critical thinking and the pursuit of truth in modern society.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	-	-	-	-	-	2	2	3	2	2	-	2	-	-
CO2	-	-	-	-	-	2	2	3	2	2	-	2	-	-
CO3	-	-	-	-	-	2	2	3	2	3	-	2	-	-
CO4	-	-	-	-	-	3	3	3	2	3	-	3	-	-
CO5	-	-	-	-	-	3	3	3	2	3	-	3	-	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23AD313 Data Structures using Python Laboratory

Prerequisite	Programme Name	Sem	Category	L	T	P	C
23CS201 Python Programming	B.E. - ECE	III	ESC	0	0	3	1.5

II - Course Objectives

1.	To implement ADTs in Python
2.	To design and implement linear data structures -lists, stacks, and queues
3.	To implement sorting, searching and hashing algorithms
4.	To solve problems using graph structures
5.	To solve problems using tree structures

III - List of Experiments

Note: The lab instructor is expected to design problems based on the topics listed. The Examination shall not be restricted to the sample experiments designed.	
1. Implement simple ADTs as Python classes 2. Implement recursive algorithms in Python 3. Implement List ADT using Python arrays 4. Linked list implementations of List 5. Implementation of Stack and Queue ADTs 6. Applications of List, Stack and Queue ADTs 7. Implementation of sorting and searching algorithms 8. Implementation of Hash tables 9. Tree representation and traversal algorithms 10. Implementation of Binary Search Trees 11. Implementation of Heaps 12. Graph representation and Traversal algorithms 13. Implementation of single source shortest path algorithm 14. Implementation of minimum spanning tree algorithms	
TOTAL: 45 Periods	

Text Books:	1. Michael T. Goodrich, Roberto Tamassia, and Michael H. Goldwasser, "Data Structures and Algorithms in Python" (An Indian Adaptation), Wiley, 2021 2. Lee, Kent D., Hubbard, Steve, "Data Structures and Algorithms with Python, Springer Edition 2015. 3. Narasimha Karumanchi, "Data Structures and Algorithmic Thinking with Python, Careermonk, 2015.
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Reference Books:	1. Rance D. Necaie, "Data Structures and Algorithms Using Python, John Wiley & Sons, 2011. 2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, "Introduction to Algorithms", Third Edition, PHI Learning, 2010. 3. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++, Fourth Edition, Pearson Education, 2014. 4. Aho, Hopcroft, and Ullman, "Data Structures and Algorithms, Pearson Education India, 2002.
MOOC/ Web Platforms:	https://www.coursera.org/specializations/datastructuresalgorithms https://www.edx.org/learn/datastructures/theuniversityofcaliforniasan-diego-data-structures-fundamentals

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Analyzing and Applying Fundamental Data Structures and Recursive Algorithms in Python	Apply (K3)
CO2	Design, implement, and analyzes linear data structures, such as lists, queues, and stacks, according to the needs of different applications	Create (K6)
CO3	Design, implement, and analyzes efficient tree structures to meet requirements such as searching, indexing, and sorting	Create (K6)
CO4	Analyzing Graph Representation Methods and Mastering Traversal Algorithms	Analyze (K4)
CO5	Design, implement, and analyzes single source shortest path algorithm and minimum spanning tree algorithms	Create (K6)

V- Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	2	1	1	-	-	-	-	1	1	1	-	-
CO2	2	2	1	2	1	-	-	-	-	2	1	1	-	-
CO3	2	2	2	1	1	-	-	-	-	3	1	2	-	-
CO4	2	2	2	1	1	-	-	-	-	2	1	2	-	-
CO5	2	3	3	1	1	-	-	-	-	1	1	2	-	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23EC311 Circuits Design and Simulation Laboratory

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E. - ECE	III	PCC	0	0	3	1.5

II - Course Objectives

1.	To gain hands on experience in designing electronic circuits.
2.	To differentiate feedback amplifiers.
3.	To differentiate the operation of various oscillators.
4.	To differentiate the operation of multivibrators.
5.	To learn simulation software used in circuit design.

III - Course Content

PRACTICAL EXERCISES:	45 Periods
Using BJT, design and analyze 1. CE amplifier. 2. Differential amplifier. 3. Cascode amplifier. 4. Single tuned amplifier. 5. RC Phase shift oscillator. 6. Clipper and Clamper. Using PSpice, MultiSim, Proteus, Circuit Lab or any equivalent tool, simulate 1. Stagger Tuned amplifier 2. Voltage shunt Feedback amplifier. 3. Current Series Feedback amplifier. 4. Tuned Collector Oscillator. 5. Bistable Multivibrator. 6. Class A Power Amplifier.	
TOTAL:45 Periods	

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Design and analyze various types of amplifiers.	Analyze (K4)
CO2	Design and analyze oscillators and wave shaping circuits.	Analyze (K4)
CO3	Design and simulate tuned amplifiers using SPICE Tool.	Analyze (K4)
CO4	Design and simulate various types of feedback amplifiers using SPICE Tool.	Analyze (K4)
CO5	Design and simulate oscillators and multivibrators using SPICE Tool.	Analyze (K4)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	2	-	-	-	-	-	2	2	2	3	-
CO2	3	3	3	2	-	-	-	-	-	2	2	2	3	-
CO3	3	3	3	3	3	-	-	-	-	2	2	2	3	3
CO4	3	3	3	3	3	-	-	-	-	2	2	2	3	3
CO5	3	3	3	3	3	-	-	-	-	2	2	2	3	3

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23ECA02 PCB Design for IoT Applications (Value Added Course)

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E. - ELECTRONICS AND COMMUNICATION ENGINEERING	III	EEC	11	-	10	1

II - Course Content

• Live Demo, value finding, identification, working principle of electronic components and circuits & Drafting fundamentals - PCB Designing Software • PCB Designing Practical • Industrial Embedded C Robotic programming and simulation • Practical session for Industrial Embedded C Robotic programming and simulation • Circuit creation for industrial products- • Trouble shooting of PCB kits, products and components by multimeter
TOTAL: 21 Periods

III - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	Understand the different manufacturing techniques and materials used in PCB production.	Understand [K2]
C02	Use PCB design software essential for creating and modifying PCB designs.	Apply [K3]
C03	Acquire skills for diagnosing and fixing issues that may arise in PCB prototypes or final products.	Apply [K3]

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C01	3	3	3	2	2	-	-	-	-	-	2	2	2	1
C02	3	3	3	2	2	-	-	-	-	-	2	2	2	1
C03	3	3	3	2	2	-	-	-	-	-	2	2	2	1

Mapping: 1-Low, 2-Medium, 3-High

Semester - IV

SEMESTER - IV

I - Course Name: 23EC401 Electromagnetic Fields

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E- ECE	IV	PCC	3	0	0	3

II - Course Objectives

1.	To impart knowledge on the basics of static electric field and the associated laws.
2.	To impart knowledge on the basics of static magnetic field and the associated laws.
3.	To give insights into coupling between electric and magnetic fields through Faraday's law, displacement current and Maxwell's equations.
4.	To study the behaviour of the propagation of EM waves.
5.	To study the significance of time varying fields.

III - Course Content

Preamble: Electromagnetic Fields study provides the foundation for understanding electric and magnetic field interactions, wave propagation, and their applications in modern engineering. Mastery of EMF concepts enables advancements in communication, power systems, and emerging technologies like RADAR and optical fiber networks.

Unit - I	Fundamentals of Electromagnetics	9 Periods
Electromagnetic model, Units and constants, Review of vector algebra, Rectangular, cylindrical and spherical coordinate systems, Line, surface and volume integrals, Gradient of a scalar field, Divergence of a vector field, Divergence theorem, Curl of a vector field, Stoke's theorem, Null identities, Helmholtz's theorem.		
Unit - II	Electrostatics	9 Periods
Electric potential, Electric field intensity, Electric flux density, dielectric constant, Conductors, Dielectrics, Coulomb's law, Gauss's law and applications, Boundary conditions, Capacitance-Parallel, cylindrical and spherical capacitors, Electrostatic energy, Poisson's and Laplace's equations, Current density and Ohm's law, Electromotive force and Kirchhoff's voltage law, Equation of continuity and Kirchhoff's current law.		
Unit - III	Magnetostatics	9 Periods
Vector magnetic potential, Magnetic field intensity, Magnetic flux density, idea of relative permeability, Lorentz force equation, Ampere's law, Biot-Savart law and applications, Calculation of magnetic field intensity for various current distributions, Magnetic circuits, Behaviour of magnetic materials, Boundary conditions, Inductance and inductors, Magnetic energy, Magnetic forces and torque.		
Unit - IV	Time-Varying Fields	9 Periods
Faraday's law, Displacement current, Maxwell's equations, Potential Functions, Electromagnetic boundary conditions, Wave equations and solutions, Time-harmonic fields, Wave propagation with the aid of Maxwell's equations.		
Unit - V	Plane Electromagnetic Waves	9 Periods
Plane waves in lossless and lossy dielectrics, Skin effect, Phase velocity and Group velocity, Electromagnetic power flow and Poynting vector, Normal incidence at a plane conducting boundary and dielectric boundary, Application of wave equation for RADAR.		

TOTAL: 45 Periods

Text Books:	1. D.K. Cheng, Field and wave electromagnetics, 2 nd Edition, Pearson (India), 2023 2. M.N.O.Sadiku and S.V. Kulkarni, Principles of electromagnetics, 6 th Edition, Oxford (Asian Edition), 2015
Reference Books:	1. Edward C. Jordan & Keith G. Balmain, Electromagnetic waves and Radiating Systems, 2 nd Edition, Prentice-Hall Electrical Engineering Series, 2012. 2. W.H. Hayt and J.A. Buck, Engineering electromagnetics, 7 th Edition, McGraw-Hill (India), 2006 3. B.M. Notaros, Electromagnetics, Pearson: New Jersey, 2011 4. N.N. Rao, Fundamentals of Electromagnetic for Engineering, Pearson education, New Delhi.
MOOC/Web Platforms:	1. https://openstax.org/books/calculus-volume-3/pages/2-7-cylindrical-and-spherical-coordinates 2. https://em.geosci.xyz/content/maxwell1_fundamentals/formative_laws/coulomb.html 3. https://eng.libretexts.org/Bookshelves/Electrical_Engineering/Electro-Optics/Book%3A_Electromagnetics_I_(Ellingson)/02%3A_Electric_and_Magnetic_Fields/2.07%3A_Magnetic_Field_Intensity

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Relate the fundamentals of vector algebra, coordinate system to electromagnetic concepts.	Understand (K2)
CO2	Interpret the concepts of electric field in material space and solve the boundary conditions.	Understand (K2)
CO3	Explain the concepts and characteristics of Magneto Static field in material space and solve boundary conditions.	Apply (K3)
CO4	Understand and apply Maxwell's equations to analyze electromagnetic fields, wave propagation, and time-harmonic phenomena in various media.	Analyse (K4)
CO5	Analyze plane wave propagation, power flow, and boundary interactions in various media.	Analyse (K4)

V - Mapping Table Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	-	-	-	-	-	-	-	-	1	3	-
CO2	3	3	3	-	-	-	-	-	-	-	-	1	3	-
CO3	3	3	3	-	-	-	-	-	-	-	-	1	3	-
CO4	3	3	3	-	-	-	-	-	-	-	-	1	3	-
CO5	3	3	3	-	-	-	-	-	-	-	-	1	3	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23EC402 Linear Integrated Circuits

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E- ECE	IV	PCC	3	0	0	3

II - Course Objectives

1.	To understand the basic principles of operational amplifiers, including their fabrication, characteristics.
2.	To design op-amp circuits for both linear and nonlinear applications.
3.	To apply the concepts of Phase-Locked Loops (PLLs) for various applications.
4.	To interpret the principle of ADC and DAC conversion using op-amps.
5.	To design waveform generators and specialized circuits using different ICs.

III - Course Content

Preamble: Linear Integrated Circuits are essential in analog signal processing, offering precision, stability, and versatility. This syllabus covers the fundamentals of LICs, including operational amplifiers, voltage regulators, comparators, and filters, with a focus on design, analysis, and real-world applications. Understanding these circuits is crucial for applications in communication, automation, medical instrumentation, and power management. This course equips students with the knowledge to design and implement LIC-based solutions for modern electronic systems.

Unit - I	Introduction to Operational Amplifiers	9 Periods
Classification of ICs - IC Fabrication - Ideal Operational Amplifier - Open and closed loop configurations - General operational amplifier stages and internal circuit diagrams of IC 741, Basic applications - Inverting and Non- inverting amplifiers, Voltage Follower and differential amplifier, DC and AC performance characteristics.		
Unit - II	Applications of Operational Amplifiers	9 Periods
Adder, Subtractor, V-to-I and I-to-V converters, Instrumentation amplifier, Integrator, Differentiator, Precision rectifier, peak detector, clipper and clamper, Logarithmic amplifier, Antilogarithmic amplifier, Comparators, Schmitt trigger, Low-pass, high-pass and band-pass filters.		
Unit - III	PLL and Regulators	9 Periods
Operation of the basic PLL, Voltage controlled oscillator, Monolithic PLL IC 565, application of PLL for AM detection, FM detection, FSK modulation and demodulation and Frequency synthesizing and clock synchronization, IC Voltage regulators - Three terminal fixed and adjustable voltage regulators - IC 723 general purpose regulator.		
Unit - IV	Analog to Digital and Digital to Analog Converters	9 Periods
D/A converter - specifications - Binary weighted resistor type, R-2R Ladder types - Voltage Mode and Current-Mode, Switches for D/A converters, high speed sample-and-hold circuits, A/D Converters - specifications, Flash type, Successive Approximation type, Single Slope type, Dual Slope type.		
Unit - V	Waveform Generators and Special Function ICs	9 Periods
Sine wave generators - RC Phase shift and Wein bridge oscillators, Triangular wave generator, Saw-tooth wave generator, IC555 Timer, Functional diagram and applications, Frequency to		

Voltage and Voltage to Frequency converters, ICL 8038 function generator, Audio Amplifier, Optocouplers and fiber optic IC.

TOTAL: 45 Periods

Text Books:	1. D.Roy Choudhry, Shail Jain, "Linear Integrated Circuits", New Age International Pvt. Ltd., 2018, 5 th Edition. (Unit I – V) 2. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", 4 th Edition, Tata Mc Graw-Hill, 2016 (Unit I – V)
Reference Books:	1. Ramakant A. Gayakwad, "OP-AMP and Linear ICs", 4 th Edition, Prentice Hall / Pearson Education, 2015. 2. Robert F.Coughlin, Frederick F.Driscoll, "Operational Amplifiers and Linear Integrated Circuits", 6 th Edition, PHI, 2001. 3. S.Salivahanan and V.S. Kanchana Bhaskaran, "Linear Integrated Circuits", TMH, 2 nd Edition, 4th Reprint, 2016.
MOOC/Web Platforms:	1. https://www.electrical4u.com/ideal-op-amp/ 2. https://www.allaboutcircuits.com/textbook/semiconductors/chpt-8/the-instrumentation-amplifier/ 3. https://www.youtube.com/watch?v=yds2Nxxqk3A

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the basics, fabrication, and characteristics of op-amp ICs, and apply them in as inverting, non-inverting, and differential amplifiers.	Apply (K3)
CO2	Design the circuits using op-amp for linear and nonlinear applications.	Apply (K3)
CO3	Apply the concepts of PLL for various applications and to understand the working of regulators.	Apply (K3)
CO4	Interpret the principle of operation of ADC and DAC using op-amps.	Understand (K2)
CO5	Design various waveform generators and other circuits using different ICs.	Apply (K3)

V - Mapping Table Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	-	-	-	-	-	-	-	-	2	3	-
CO2	3	3	3	-	-	-	-	-	-	-	-	2	3	-
CO3	3	3	3	-	-	-	-	-	-	-	-	2	3	-
CO4	3	3	3	-	-	-	-	-	-	-	-	2	3	-
CO5	3	3	3	-	-	-	-	-	-	-	-	2	3	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23EC403 Digital Signal Processing

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E- ECE	IV	PCC	3	1	0	4

II - Course Objectives

1.	To learn discrete Fourier transform, properties of DFT and its application to linear filtering.
2.	To understand the characteristics of digital filters, design digital IIR and FIR filters and apply these filters to filter undesirable signals in various frequency bands.
3.	To understand the effects of finite precision representation on digital filters.
4.	To understand the fundamental concepts of multi rate signal processing and its applications.
5.	To introduce the concepts of adaptive filters and its application to communication

III - Course Content

Preamble: Digital Signal Processing involves the analysis and manipulation of signals using digital techniques for applications in audio, communication, and image processing. Mastery of DSP enables efficient signal filtering, compression, and real-time data processing in modern electronic systems.

Unit - I	Discrete Fourier Transform	9 Periods
Discrete Fourier transform (DFT) - deriving DFT from DTFT, properties of DFT, circular convolution, Linear filtering using DFT, Filtering long data sequences - overlap save and overlap add methods, Radix-2 Fast Fourier transform (FFT)- Decimation-in-Time (DIT), Decimation-in-Frequency (DIF), Linear filtering using FFT.		
Unit - II	Infinite Impulse Response Filters	9 Periods
Design of analog filters - Butterworth filters, Chebyshev filters, Design of IIR filters from analog filters (LPF, HPF) - Approximation of derivatives, Impulse invariance method, Bilinear transformation, Frequency transformation in the analog domain.		
Unit - III	Finite Impulse Response Filters	9 Periods
Design of FIR filters - symmetric and Anti-symmetric FIR filters, design of linear phase FIR filters - Fourier series method, windowing techniques (Rectangular, Hamming and Hanning window), Frequency sampling method, FIR filter structures - linear phase structure, direct form realizations.		
Unit - IV	Finite Word Length Effects	9 Periods
Fixed point and floating-point number representation, ADC, quantization - truncation and rounding, quantization noise, quantization errors- input/output, coefficient, product, overflow error, limit cycle oscillations due to product quantization and summation, scaling to prevent overflow.		
Unit - V	Digital Signal Processors and Applications	9 Periods

Digital Signal Processors TMS320C5x and TMS320C54x- Architecture, Addressing modes, programming.

Applications: Speech Processing and Video Processing, Audio signal processing- Decimation, Interpolation, Sampling rate conversion by a rational factor, Adaptive Filters in communication systems.

TOTAL: 45 Periods

Text Books:	1. John G. Proakis & Dimitris G. Manolakis, —Digital Signal Processing – Principles, Algorithms & Applications, 4 th Edition, Pearson Education / Prentice Hall, 2007.
Reference Books:	1. Emmanuel C. Ifeachor & Barrie. W. Jervis, —Digital Signal Processing, 2 nd Edition, Pearson Education / Prentice Hall, 2002. 2. Oppenheim, R.W. Schaffer and J.R. Buck, —Discrete-Time Signal Processing, 8 th Indian Reprint, Pearson, 2004. 3. Sanjit K. Mitra, —Digital Signal Processing – A Computer Based Approach, Tata Mc Graw Hill, 2007. 4. Andreas Antoniou, —Digital Signal Processing, Tata Mc Graw Hill, 2006.
MOOC/Web Platforms:	1. https://home.engineering.iastate.edu/~julied/classes/ee524/LectureNotes/l5.pdf 2. https://www.youtube.com/watch?v=sMSrveHED0s 3. https://www.allaboutcircuits.com/technical-articles/design-of-fir-filters-using-frequency-sampling-method/

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Analyse discrete time signals using DFT.	Analyse(K4)
CO2	Implement the digital Infinite Impulse Response filters.	Apply (K3)
CO3	Develop the linear phase Finite Impulse Response filters using windowing and frequency sampling techniques.	Apply (K3)
CO4	Examine the finite word length effects in digital signal processing.	Analyse(K4)
CO5	Understand the architecture, addressing modes and instruction sets of Digital Signal Processors.	Understand (K2)

V - Mapping Table Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	-	-	-	-	-	-	-	-	2	3	-
CO2	3	3	3	-	-	-	-	-	-	-	-	2	3	-
CO3	3	3	3	-	-	-	-	-	-	-	-	2	3	-
CO4	3	3	3	-	-	-	-	-	-	-	-	2	3	-
CO5	3	3	3	-	-	-	-	-	-	-	-	2	3	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23EC404 Embedded Systems

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E- ECE	IV	PCC	3	0	2	4

II - Course Objectives

1.	To learn the architecture and features of 8051.
2.	To learn the architecture and features of ARM Processor.
3.	To learn the architecture and features of MSP430 Microcontroller.
4.	To understand the processes and operating systems in an embedded system.
5.	To familiarize with embedded real time applications.

III - Course Content

Preamble: Embedded Systems focus on the design and implementation of dedicated computing systems within devices for real-time control and automation. A strong understanding of embedded systems enables the development of smart applications in automotive, healthcare, IoT, and consumer electronics.

Unit - I	Introduction to Embedded Systems and Microcontroller	9 Periods
Introduction to Embedded Systems –Structural units in Embedded processor - selection of processor – Overview of 8085/8086 Microprocessors – Microcontroller for an Embedded System- 8051 Microcontroller – Architecture, Addressing Modes, Instruction Set- Programme and Data Memory – Stacks – Interrupts –Timers/Counters – Serial Ports – Programming.		
Unit - II	ARM Processor	9 Periods
ARM Processor – Instruction Set Preliminaries – CPU – Programming Input and Output – Supervisor Mode – Exceptions and Trap – Models for programmes – Assembly, Linking and Loading – Compilation Techniques – Programme Level Performance Analysis.		
Unit - III	MSP430 Microcontroller	9 Periods
Functional Block diagram of MSP-EXP430F5529LP - Memory Mapped CPU, Exceptions, Architecture of MSP430 - Addressing Modes - Instruction Set, Interrupts, Digital in - outs, Timer, Communication interfaces.		
Unit - IV	Processes and Operating Systems	9 Periods
Structure of a real time system, Task Assignment and Scheduling, Multiple Tasks and Multiple Processes, Multirate Systems, Pre-emptive real time Operating systems, Priority based scheduling, Interprocess Communication Mechanisms, Distributed Embedded Systems, MPSoCs and shared memory multiprocessors.		
Unit - V	Embedded System Applications	9 Periods
Embedded System Design Process – Model train controller, Chocolate Vending Machine, Digital camera, ATM machine and simple USB back channel.		

TOTAL: 45 Periods

Practical Experiments**30 Periods****Experiments using 8051**

1. Programming Arithmetic and Logical Operations in 8051.
2. Programming using On – Chip ports in 8051.
3. Programming using Serial Ports in 8051.
4. Design of Digital Clock using Timers/Counters in 8051.

Experiments using ARM

5. Interfacing ADC and DAC
6. Interfacing of LEDs and LCD
7. Interfacing keyboard
8. Interfacing Stepper Motor

Experiments using MSP430

9. Interfacing of LED
10. Interfacing of PWM

Text Books:	1. The 8051 Microcontroller: Architecture, Programming, and Applications, Kenneth Ayala, West Publishing Company, 2007 (Unit – I) 2. Marilyn Wolf, Computers as Components – Principles of Embedded Computing System Design, 3rd Edition, Morgan Kaufmann, 2012. (Unit – II, IV, V) 3. John H Davies, MSP430 Microcontroller Basics, Elsevier, 2008. Unit – III, V)
Reference Books:	1. Raj Kamal, 'Embedded System-Architecture, Programming, Design', Mc Graw Hill, 2013. 2. Lyla B.Das, Embedded Systems: An Integrated Approach, Pearson Education, 2013. 3. Jane.W.S .Liu, Real – Time Systems, Pearson Education, 2003
MOOC/Web Platforms:	1. https://www.youtube.com/watch?v=_SkpnG571z8 2. https://www.ti.com/document-viewer/lit/html/slau533 3. https://www.youtube.com/watch?v=Q4wkyEkXUMs 4. https://www.youtube.com/watch?v=dJuYKfR8vec

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	Explain the architecture and features of 8051.	Understand (K2)
C02	Apply ARM processor architecture and programming concepts.	Apply (K3)
C03	Design a model with MSP430 microcontrollers.	Apply (K3)
C04	Understand the principles of real-time operating systems.	Understand (K2)
C05	Apply embedded systems programming, design, and development skills.	Apply (K3)

V - Mapping Table Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C01	3	3	3	2	2	-	-	-	-	-	-	2	3	3
C02	3	3	3	2	2	-	-	-	-	-	-	2	3	3
C03	3	3	3	2	2	-	-	-	-	-	-	2	3	3
C04	3	3	3	2	2	-	-	-	-	-	-	2	3	3
C05	3	3	3	2	2	-	-	-	-	-	-	2	3	3

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23EC405 Control Systems

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E- ECE	IV	PCC	3	0	0	3

II - Course Objectives

1.	To introduce the components and their representation of control systems.
2.	To learn various methods for analyzing the time response, frequency response and stability of the systems.
3.	To learn the various applications of control systems.

III - Course Content

Preamble: Control Systems focus on the analysis and design of systems to regulate and optimize dynamic behavior in engineering applications. A solid grasp of control principles enables the development of stable and efficient automation in robotics, aerospace, industrial processes, and electrical systems.

Unit – I	System Components and their Representation	9 Periods
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Control System: Terminology and Basic Structure, Feed forward and Feedback control theory, Electrical and Mechanical Transfer Function Models, Block diagram Models, Signal flow graphs models.

Unit – II	Time Response Analysis	9 Periods
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Transient response, Steady state response, Measures of performance of the standard First order, Second order system, Effect on an additional zero and an additional pole, Steady state error constant, PID control-Analytical design for PD, PI, PID control systems.

Unit - III	Frequency Response Analysis	9 Periods
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Closed loop frequency response, Performance specification in frequency domain, Frequency response of standard second order system, Bode Plot, Polar Plot, Design of compensators using Bode plots- Cascade lead compensation, Cascade lag compensation, Cascade lag-lead compensation.

Unit - IV	Concepts of Stability Analysis and State Space Analysis	9 Periods
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Concept of stability, Bounded-Input Bounded-Output stability, Routh stability criterion, Relative stability, Root locus concept, Guidelines for sketching Root locus, Concept of State, state variables and state model, Conversion of state variable models to transfer functions, Concepts of Controllability and Observability.

Unit – V	Applications of Control Systems	9 Periods
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Implementation of digital controllers- digital temperature control system, digital position control system, Robotic Arm movement - Pick and Place, aerospace and medical imaging applications.

TOTAL : 45 Periods

Text Books:	1. M.Gopal, "Control System – Principles and Design", Tata McGraw Hill, 4th Edition, 2012. 2. William S. Levine, "Control System Applications", Taylor & Francis Group, 2018.
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Reference Books:	1.J.Nagrath and M.Gopal, "Control System Engineering", New Age International Publishers, 5 th Edition, 2007. 2. K.Ogata, "Modern Control Engineering", PHI, 5 th Edition, 2012. 3. S.K.Bhattacharya, "Control System Engineering", Pearson, 3 rd Edition, 2013. 4.Benjamin.C.Kuo, "Automatic Control Systems", Prentice Hall of India, 7 th Edition, 1995.
MOOC/Web Platforms:	1. https://www.youtube.com/watch?v=8kEVAHIFuJ4 2. https://www.youtube.com/watch?v=eLwT555K0Y 3. https://www.javatpoint.com/control-system-routh-hurwitz-stability-criterion

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Compute the transfer function of different physical systems.	Apply (K3)
CO2	Analyse the time domain specifications and calculate the steady state error.	Analyse (K4)
CO3	Illustrate the frequency response characteristics of open loop and closed loop system response.	Analyse (K4)
CO4	Analyse the stability using Routh-Hurwitz, root locus and state space methods.	Analyse (K4)
CO5	Select suitable control system components for various applications.	Analyse (K4)

V - Mapping Table Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	-	-	-	-	-	-	-	-	2	2	-
CO2	3	3	3	-	-	-	-	-	-	-	-	2	2	-
CO3	3	3	3	-	-	-	-	-	-	-	-	2	2	-
CO4	3	3	3	-	-	-	-	-	-	-	-	2	2	-
CO5	3	3	3	-	-	-	-	-	-	-	-	2	2	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23CS401 Artificial Intelligence and Machine Learning

Prerequisite	Programme Name	Sem	Category	L	T	P	C
23AD306 - Data Structures using Python	B.E- Common to ECE, CSE and IT	IV	ESC	3	0	2	4

II - Course Objectives

1.	To study about uninformed and Heuristic search techniques
2.	To learn techniques for reasoning under uncertainty
3.	To introduce Machine Learning and supervised learning algorithms
4.	To study about ensembling and unsupervised learning algorithms
5.	To learn the basics of deep learning using neural networks

III - Course Content

Preamble: AIML is a specialized markup language used for creating chatbots and virtual assistants. In this course, we will explore how AIML enables us to design and develop conversational agents that can interact with users in a human-like manner.

Unit – I **Problem Solving** **9 Periods**

Introduction to AI - AI Applications - Problem solving agents – search algorithms – uninformed search strategies – Heuristic search strategies – Local search and optimization problems – Rule based systems-Prolog

Unit – II **Probabilistic Reasoning** **9 Periods**

Acting under uncertainty – Bayesian inference – naïve bayes models– Bayesian networks – Inference in Bayesian Network -Probabilistic reasoning in recommender systems

Unit – III **Supervised Learning** **9 Periods**

Introduction to machine learning – Linear Regression Models: Least squares, single & multiple variables, gradient descent, Linear Classification Models: Discriminant function - Logistic regression, Naive Bayes, – Support vector machine- Decision Tree, Random forests

Unit – IV **Ensemble Techniques and Unsupervised Learning** **9 Periods**

Combining multiple learners: Model combination schemes, Voting, Ensemble Learning - bagging, boosting, Unsupervised learning: K-means, Instance Based Learning: KNN.

Unit – V **Neural Networks** **9 Periods**

Perceptron - Multilayer perceptron, activation functions, – gradient descent optimization – stochastic gradient descent -error back propagation, –hyperparameter tuning, regularization, dropout, Convolutional Neural Networks (CNNs) -Case study: TensorFlow, Keros

TOTAL : 45 Periods

Text Books:	1. Stuart Russell and Peter Norvig, "Artificial Intelligence – A Modern Approach", Fourth Edition, Pearson Education, 2021. 2. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Fourth Edition, 2020.
Reference Books:	1. Dan W. Patterson, "Introduction to Artificial Intelligence and Expert Systems", Pearson Education, 2007 2. Kevin Night, Elaine Rich, and Nair B., "Artificial Intelligence", McGraw Hill, 2008 3. Patrick H. Winston, "Artificial Intelligence", Third Edition, Pearson Education, 2006

	4. Deepak Khemani, "Artificial Intelligence", Tata McGraw Hill Education, 2013 (http://nptel.ac.in/) 5. Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006. 6. Tom Mitchell, "Machine Learning", McGraw Hill, 3rd Edition, 1997. 7. Charu C. Aggarwal, "Data Classification Algorithms and Applications", CRC Press, 2014 8. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, "Foundations of Machine Learning", MIT Press, 2012. 9. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016
MOOC/Web Platforms:	https://www.geeksforgeeks.org/ https://www.javatpoint.com/

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Demonstrate the concepts of AI problems and use appropriate search algorithms for problem solving	Apply (K3)
CO2	Apply reasoning under uncertainty and predicate logic methods for knowledge representation.	Apply (K3)
CO3	Implement supervised learning models for different Artificial Intelligence approaches to resolving a problem.	Apply (K3)
CO4	Demonstrate ensembling and unsupervised models to AI techniques in machine learning.	Apply (K3)
CO5	Illustrate the evaluation of the various algorithms and build deep learning neural network models.	Understand (K2)

Practical Exercises:

1. Implementation of Uninformed search algorithms (BFS, DFS)
2. Implementation of Informed search algorithms (A*, memory-bounded A*)
3. Implement naïve Bayes models
4. Implement Bayesian Networks
5. Build Regression models
6. Build decision trees and random forests
7. Build SVM models
8. Implement ensembling techniques
9. Implement clustering algorithms
10. Implement EM for Bayesian networks
11. Build simple NN models
12. Build deep learning NN models

TOTAL: 30 Periods**Total Periods: 45+30 =75 Periods**

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C01	3	3	3	-	-	-	-	-	-	-	-	2	-	-
C02	3	3	3	-	-	-	-	-	-	-	-	2	-	-
C03	3	3	3	-	-	-	-	-	-	-	-	2	-	-
C04	3	3	3	-	-	-	-	-	-	-	-	2	-	-
C05	3	3	3	-	-	-	-	-	-	-	-	2	-	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23EC411 Linear Integrated Circuits Laboratory

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E- ECE	IV	PCC	0	0	3	1.5

II - Course Objectives

1.	To design basic op-amp circuits, such as integrators and differentiators.
2.	To design and implement filters using op-amps, and perform experiments to analyze their frequency response.
3.	To design and simulate RC oscillators and D/A converters using the IC741 op-amp.
4.	To design multivibrators using the IC 555.
5.	To analyze and simulate the performance of various circuits such as instrumentation amplifiers, filters, Wien bridge oscillators, Schmitt triggers, and power supplies using simulation tools.

III - Practical Exercises:**PART-A****Design and Testing of the following circuits:****Using IC741:**

1. Inverting, non-inverting amplifiers and Voltage follower
2. Differential amplifier
3. Instrumentation amplifier
4. Integrator and Differentiator
5. Active low pass and high pass filters
6. RC Phase shift oscillator
7. R-2R ladder type D-A converter

Using IC555:

8. Astable multivibrator
9. Monostable multivibrator

Application:

10. Study of Audio Amplifier: Provide loud and clear sound for large spaces

PART-B**Simulation:**

1. Instrumentation amplifier
2. Band Pass Filter
3. Wien Bridge Oscillator
4. Schmitt Trigger
5. DC Power Supply using LM317

TOTAL: 45 Periods

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	Design basic op-amp circuits, integrator and differentiator.	Apply(K3)
C02	Design filters and oscillators using op-amp.	Apply(K3)
C03	Design D/A converter using op-amp.	Apply(K3)
C04	Design multivibrators using IC555.	Apply(K3)
C05	Simulate and analyze the performance of instrumentation amplifier, BPF, Wien bridge oscillator, Schmitt trigger and power supply circuits.	Apply(K3)

V - Mapping Table Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C01	3	3	3	2	2	-	-	-	2	2	2	2	3	2
C02	3	3	3	2	2	-	-	-	2	2	2	2	3	2
C03	3	3	3	2	2	-	-	-	2	2	2	2	3	2
C04	3	3	3	2	2	-	-	-	2	2	2	2	3	2
C05	3	3	3	2	2	-	-	-	2	2	2	2	3	2

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23EC412 Digital Signal Processing Laboratory

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E - ECE	IV	PCC	0	0	3	1.5

II - Course Objectives

1.	To perform basic signal processing operations in MATLAB.
2.	To implement FIR and IIR filters in MATLAB.
3.	To study the architecture of DSP processor.
4.	To implement FIR and IIR filters using DSP processor.
5.	To design a DSP system to demonstrate the Multi-rate and Adaptive signal processing concepts.

III - Practical Exercises:**Part A – Simulation using MATLAB**

1. Generation of basic elementary signals
2. Computation of Linear and Circular convolution
3. Computation of Auto correlation and cross correlation
4. Computation of DFT and IDFT
5. Determination of Power Spectrum
6. Design of IIR filters
7. Design of FIR filters
8. Generation of DTMF signals
9. Implementation of Interpolation and Decimation process

Part B – Implementation using DSP Processor (TMS320C5x/TMS320C54x)

1. Implementation of above experiments 1,4,6,7,8 & 9
2. Performance analysis of noise: Add noise above 3kHz and then remove, Interference Suppression using 400Hz Tone.

TOTAL : 45 Periods**IV - Course Outcomes**

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	Carryout basic signal processing operations.	Apply (K3)
C02	Demonstrate their abilities towards MATLAB based implementation of various DSP systems.	Apply (K3)
C03	Design and Implement the FIR and IIR Filters using MATLAB for performing filtering operation over real-time signals.	Apply (K3)
C04	Design and Implement the FIR and IIR Filters in DSP Processor for performing filtering operation over real-time signals.	Apply (K3)
C05	Design a DSP system for various applications of DSP.	Apply (K3)

V - Mapping Table Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	2	2	-	-	-	2	2	-	2	3	3
CO2	3	3	3	2	2	-	-	-	2	2	-	2	3	3
CO3	3	3	3	2	2	-	-	-	2	2	-	2	3	3
CO4	3	3	3	2	2	-	-	-	2	2	-	2	3	3
CO5	3	3	3	2	2	-	-	-	2	2	-	2	3	3

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23ECA01 Embedded Systems with Arduino

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E - ECE	IV	EEC	15	0	20	1

II - Course Objectives

1.	To learn fundamentals of embedded systems
2.	To study sensors, switches and LEDs.
3.	To be familiarized with IoT applications.

III - Course Content

Module - I	Introduction to Embedded Systems and NodeMCU	7 Periods
- Embedded Systems Overview, Definition, importance, and applications. Real-world examples and discussion on industry use cases. Understanding NodeMCU Features, architecture, and technical specifications. - Hands-on: NodeMCU Setup, Installing drivers and IDE (Arduino IDE or similar). Configuring the NodeMCU board for basic development. Basic Programme Uploading a simple programme (e.g., blinking an LED).		
Module - II	IoT Architecture and Basics	7 Periods
- Components: Devices, gateways, cloud, and user interfaces. Role of NodeMCU in IoT systems. Input/Output Operations, Interfacing LEDs, switches, and basic I/O operations. - Hands-on: Basic Project, Build a simple project using LEDs and a button. - Demonstrate how inputs control outputs. Debugging Tips, Common issues and solutions in I/O setups.		
Module - III	Sensor Integration	7 Periods
- Introduction to Sensors, Overview of sensors: Temperature, humidity, motion, and light. Explanation of sensor communication protocols (analog, digital). - Hands-on: Interfacing Sensors, Connect and read data from: DHT11/DHT22 (Temperature & Humidity). PIR Motion Sensor. LDR (Light-Dependent Resistor). Display real-time sensor data on a serial monitor.		
Module - IV	No-Code App Development and Cloud Integration	7 Periods
- No-Code App Development, Introduction to MIT App Inventor. Designing a mobile app interface for IoT control and monitoring. Adding UI components like buttons, labels, and data displays. - Connecting to the Cloud, Overview of cloud platforms (Firebase, ThingSpeak, or Blynk). Steps to send data from NodeMCU to the cloud. Hands-on: Cloud Connectivity, Send sensor data to the cloud. Display data on the mobile app.		

Module - V	IoT Project	7 Periods
- Interfacing Zigbee Module and GSM Module with NodeMCU, Using Arduino with Raspberry Pi, Combine NodeMCU, sensors, cloud, and mobile app into a cohesive project. - Building an IoT System, Example projects: Smart Home (light/fan control, room temperature monitoring). Environmental Monitor (temperature, humidity, and light levels).		

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	To understand the fundamentals of embedded systems and the NodeMCU platform, including its features and applications.	Understand (K3)
C02	To apply basic IoT concepts and perform input/output operations with NodeMCU, integrating sensors and devices.	Apply (K3)
C03	To interface and read data from various sensors (e.g., DHT11, PIR, LDR) and display it through real-time monitoring.	Apply (K3)
C04	To design no-code mobile applications for IoT control and successfully integrate them with cloud platforms for data storage and display.	Apply (K3)
C05	To develop and implement an end-to-end IoT project combining NodeMCU, sensors, cloud connectivity, and mobile applications.	Apply (K3)

V - Mapping Table Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C01	3	3	3	-	-	-	-	-	2	2	2	2	3	3
C02	3	3	3	-	-	-	-	-	2	2	2	2	3	3
C03	3	3	3	-	-	-	-	-	2	2	2	2	3	3
C04	3	3	3	-	-	-	-	-	2	2	2	2	3	3
C05	3	3	3	-	-	-	-	-	2	2	2	2	3	3

Mapping: 1-Low, 2-Medium, 3-High

Semester - V

SEMESTER -V**I - Course Name: 23EC501 Networks and Security**

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E- ECE	V	PCC	3	0	2	4

II - Course Objectives

1.	To understand network architectures, protocol models, and data link layer protocols including Ethernet, WLAN, and HDLC.
2.	To explore network layer addressing, protocols, routing techniques, and the transition from IPv4 to IPv6.
3.	To study transport and application layer protocols, congestion control mechanisms, and internet-based services.
4.	To examine network security fundamentals including encryption techniques, cryptosystems, and security services.
5.	To introduce hardware security concepts including hardware Trojans, side-channel attacks, and secure design in IoT and SDN.

III - Course Content

Preamble: Core Topics: Network fundamentals, security protocols, encryption, vulnerability assessment, incident response. Practical Focus: Hands-on labs and real-world simulations. Security Emphasis: Understanding, mitigating, and responding to emerging threats in a digital networked environment. Professional Relevance: Prepares students for careers in network administration, security operations, ethical hacking, and more.		
Unit – I	Network Models and Datalink Layer	9 Periods
Overview of Networks and its Attributes – Network Models – OSI, TCP/IP, Protocol stack, SMTP, Introduction to Datalink Layer – Error Detection and Correction – Ethernet (802.3)- Wireless LAN – IEEE 802.11, Bluetooth – Flow and Error Control Protocols – HDLC – PPP.		
Unit – II	Network Layer Protocols	9 Periods
Network Layer – IPv4 Addressing – Network Layer Protocols (IP, ICMP and Mobile IP) Unicast and Multicast Routing – Intradomain and Interdomain Routing Protocols – IPv6 Addresses – IPv6 – Datagram Format - Transition from IPv4 to IPv6.		
Unit – III	Transport and Application Layers	9 Periods
Transport Layer Protocols – UDP and TCP Connection and State Transition Diagram - Congestion Control and Avoidance (DEC bit, RED)- QoS - Application Layer, Domain Name System – World Wide Web, HTTP, Electronic Mail.		
Unit – IV	Network Security	9 Periods
Network security threats, OSI Security Architecture – Attacks – Security Services and Mechanisms – Encryption –Advanced Encryption Standard – Public Key, Cryptography, Cryptosystems.		
Unit – V	Hardware Security	9 Periods
Introduction to hardware security, Hardware Trojans, Side – Channel Attacks – Physical Attacks and Countermeasures – Design for Security. IoT Network Security, Software Defined Networking (SDN)		

TOTAL: 45 Periods

List of Experiments – 30 Periods

1. Study of OSI and TCP/IP Reference Models Using Packet Tracer.

Experiments using C

2. Implement the Data Link Layer framing methods - i) Bit stuffing, (ii) Character stuffing

2. Implementation of Error Detection / Correction Techniques

i) LRC, (ii) CRC, (iii) Hamming code

3. Implementation of Stop and Wait, and Sliding Window Protocols

4. Implementation of Go back-N and Selective Repeat Protocols.

5. Implementation of Distance Vector Routing algorithm (Routing Information Protocol) (Bellman-Ford).

6. Implementation of Link State Routing algorithm (Open Shortest Path First) with 5 nodes (Dijkstra's).

7. Implementation of Data encryption and decryption using Data Encryption Standard algorithm.

8. Implementation of Data encryption and decryption using RSA (Rivest, Shamir and Adleman) algorithm.

Experiments using Tool Command Language

1. Implement and realize the Network Topology - Star, Bus and Ring using NS2.

2. Implement and perform the operation of CSMA/CD and CSMA/CA using NS2.

TOTAL: 75 Periods

Text Books:	1.Behrouz.A.Forouzan, Data Communication and Networking, Fifth Edition, TMH, 2017. (Unit I,II,III) 2.William Stallings, Cryptography and Network Security, Seventh Edition, Pearson Education, 2017 (Unit- IV)
Reference Books:	1.Bhunia Swarup, Hardware Security –A Hands on Approach, Morgan Kaufmann, First edition, 2018. (Unit – V). 2.James.F.Kurose and Keith.W.Ross, Computer Networking – A Top – Down Approach, Sixth Edition, Pearson, 2017. 3.Doughlas. E.Comer, Computer Networks and Internets with Internet Applications, Fourth Edition, Pearson Education, 2008.

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the Network Models, data link layers and Ethernet.	Understand (K2)
CO2	Categorize and classify the routing protocols.	Apply (K3)
CO3	List the functions of the transport and application layer.	Understand (K2)
CO4	Evaluate and choose the network security mechanisms and cryptography.	Analyze (K4)
CO5	Apply the hardware security attacks and countermeasures.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	2	2	-	-	-	-	-	-	3	3	3
CO2	3	3	2	2	2	-	-	-	-	-	-	2	3	3
CO3	3	3	3	2	2	-	-	-	-	-	-	2	3	3
CO4	3	3	2	2	2	-	-	-	-	-	-	3	3	3
CO5	3	3	3	3	2	-	-	-	-	-	-	2	3	3

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23EC502 Communication Systems

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E- ECE	V	PCC	3	0	0	3

II - Course Objectives

1.	To introduce the concepts of various analog modulations and their spectral characteristics.
2.	To know the concepts of sampling and pulse modulation schemes.
3.	To study the various digital modulation schemes and their spectral characteristics.
4.	To introduce the noise characterization of various modulation schemes
5.	To learn the various spread spectrum methods and multiple access techniques.

III - Course Content**Preamble:**

Core Topics: Analog and digital communication, modulation techniques, error correction, transmission media.

Emerging Technologies: 5G networks, satellite communication, fiber optics.

Practical Focus: Hands-on learning in signal analysis, system design, and troubleshooting.

Interdisciplinary Impact: Communication systems are central to industries like telecom, healthcare, entertainment, and cyber security.

Unit – I	AM, FM and PM	9 Periods
Need for Modulation, Principles of Amplitude Modulation Systems – DSB, SSB and VSB modulations – SSB Generation – Filter and Phase Shift Methods – VSB Generation – Filter Method, Pre-envelope & Complex-envelope AM techniques, Angle Modulation, Representation of FM and PM signals, Generation and Detection of FM – Transmitters and Receivers.		
Unit – II	Pulse Modulation	9 Periods
Low pass sampling – Aliasing – Signal Reconstruction – Quantization – Uniform & Non-Uniform Quantization - Quantization Noise – Nyquist criterion – Logarithmic Companding – PAM, PPM, PWM – TDM and FDM – Pulse Code Modulation – DPCM – Delta Modulation.		
Unit – III	Digital Modulation Schemes	9 Periods
Geometric Representation of Signals – Generation, Detection, IQ representation, PSD & BER of Coherent BPSK, BFSK and QPSK – QAM – Carrier Synchronization – DPSK – DEPSK – M-ary PSK – Comparison of Digital Modulation Techniques.		
Unit – IV	Noise Characterization	9 Periods
Noise Sources – Noise Figure, Noise Temperature and Noise Bandwidth – Noise in Cascaded Systems – Representation of Narrow Band Noise – Noise performance analysis in AM & FM systems – Threshold Effect, Pre-Emphasis and De-Emphasis for FM.		
Unit – V	Spread Spectrum and Multiple Access Techniques	9 Periods
Model of Spread Spectrum Digital Communication System – Generation of PN Sequences – Direct Sequence Spread Spectrum Signals – Frequency Hop Spread Spectrum Signals – Comparison of Spread Spectrum Methods – Applications – Multiple Access Techniques – Wireless Communication Systems – Multiple Access Techniques for Wireless Communication.		

TOTAL: 45 Periods

Text Books:	1. Simon Haykins, "Communication Systems", Wiley, 5th Edition, 2009.(Unit I - V) 2. B.P.Lathi, "Modern Digital and Analog Communication Systems", 4th Edition, Oxford University Press, 2011
Reference Books:	1. Wayner Tomasi, Electronic Communication System, 5th Edition, Pearson Education, 2008. 2. D.Roody, J.Coolen, Electronic Communications, 4th edition PHI 2006 3. B.Sklar, "Digital Communications Fundamentals and Applications", 2nd Edition Pearson Education 2007 4. H P Hsu, Schaum Outline Series - "Analog and Digital Communications" TMH 2006 5. L.Couch., "Modern Communication Systems", Pearson, 2001 6. Taub & Schilling, "Principles of Communication Systems", 4 th Edition, McGraw Hill, 2020.
MOOC/Web Platforms:	https://www.youtube.com/watch?v=0TQUaZcBynA&list=PLb2wGSuEdRG8lKGO4q7NXE6QDWISAsBkZ https://www.youtube.com/watch?v=f1YuSD9iOPE&list=PLXOYj6DUOGrr0UQsJD2apF2y1E3QufERH

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Gain knowledge in various analog modulation techniques.	Understand (K2)
CO2	Understand the concepts of pulse modulation.	Understand (K2)
CO3	Gain knowledge in digital modulation techniques.	Understand (K2)
CO4	Apply the knowledge of noise characterization to obtain the various parameters of the communication systems.	Apply (K3)
CO5	Learn the basics of spread spectrum methods and multiple access techniques.	Understand (K2)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	2	-	-	-	-	-	-	2	3	3
CO2	3	3	2	2	2	-	-	-	-	-	-	2	3	3
CO3	3	3	2	2	2	-	-	-	-	-	-	2	3	3
CO4	3	2	2	2	2	-	-	-	-	-	-	2	3	3
CO5	3	2	2	2	2	-	-	-	-	-	-	2	3	3

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23EC503 Transmission Lines and RF Systems

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E- ECE	V	PCC	3	1	0	4

II - Course Objectives

1.	To understand the fundamental parameters and behavior of transmission lines, including wave propagation, distortion, and loading techniques.
2.	To analyze high-frequency transmission lines through SWR, input impedance, and reflection phenomena, and to learn measurement techniques.
3.	To study impedance matching techniques using transformers, stubs, and Smith charts for efficient transmission line design.
4.	To examine electromagnetic wave propagation in parallel plane and waveguide structures with emphasis on TE, TM, and TEM modes.
5.	To introduce key active RF components and design principles including amplifiers, filters, and semiconductor devices for RF applications.

III - Course Content**Preamble:**

In modern communication and high-speed electronic systems, the efficient transmission of signals with minimal distortion and loss is of paramount importance. The study of Transmission Lines and RF Systems provides the foundational knowledge required to understand how electromagnetic waves propagate through guided structures and how radio frequency (RF) circuits function in practical applications.

Unit – I	Transmission Line Theory	12 Periods
Types of transmission Lines-General solution-Primary and Secondary constants-Infinite Line concepts-waveform distortion-condition for Distortion less line-Cambells Equation-Loading-Types of Loading-Input impedance: Open and short-circuited line-Calculation of voltage, current, power-Impedance and Efficiency of Transmission-Reflection Loss.		
Unit – II	High-Frequency Transmission Lines	12 Periods
Line of Zero Dissipation - Standing Waves – Nodes – Antinodes - Standing Wave Ratio - Input Impedance - Open and Short - circuited Lines - Power Measurement - Reflection Loss on unmatched line.		
Unit – III	Impedance Matching	12 Periods
Impedance Matching: $\lambda/4$, $\lambda/2$, $\lambda/8$ Lines-Smith Chart-Determination of Load Impedance, Input Impedance, Reflection Coefficient, VSWR, V_{min} and V_{max} using Smith Chart- Stub Matching: Single Stub Matching and Double Stub Matching using Smith Chart.		
Unit – IV	Electromagnetic Waveguides	12 Periods
Transverse Magnetic (TM) waves-Transverse Electric (TE) waves-Transverse Electromagnetic (TEM) waves between parallel plates-TM and TE waves in rectangular waveguides-Impossibility of TEM in rectangular waveguides-Bessel's differential equation and Bessel function-TM and TE waves in circular waveguides.		

Unit – V	Introduction to RF Systems	12 Periods
Review of Low Frequency Parameters: Impedance, Admittance, Hybrid and ABCD parameters, High Frequency Parameters-Formulation of S-parameters-Properties of S-parameters - Reciprocal and Lossless Networks, Basic concepts of RF design: Filters, couplers, power dividers.		

TOTAL: 60 Periods

Text Books:	1. John D Ryder — Networks, Lines and Fields, 2 nd Edition, Prentice Hall India, 2015. (For UNIT I-IV). 2. Mathew M. Radmanesh — Radio Frequency and Microwave Electronics, Pearson Education Asia, 2 nd Edition, 2002. (For UNIT V)
Reference Books:	1. Reinhold Ludwig and Powel Bretchko, RF Circuit Design – Theory and Applications, Pearson Education Asia, 1st Edition, 2001. 2. D. K. Misra, Radio Frequency and Microwave Communication Circuits – Analysis and Design, John Wiley and Sons, 2004. 3. E. C. Jordan and K. G. Balmain, Electromagnetic Waves and Radiating Systems, Prentice Hall of India, 2006. 4. G. S. N. Raju, Electromagnetic Field Theory and Transmission Lines, Pearson Education, 1st Edition, 2005. 5. Richard Chi-Hsi Li -, “RF Circuit Design” – A John Wiley & Sons, Inc, Publications. 6. W. Alan Davis, Krishna Agarwal, “Radio Frequency Circuit Design”, John Wiley & Sons, 2001.

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Develop a transmission line model.	Understand (K2)
CO2	Analyze the performance of transmission lines.	Analyze (K4)
CO3	Analyze impedance matching by stubs using Smith Charts.	Analyze (K4)
CO4	Characterize the wave propagation in parallel plates and waveguides.	Understand (K2)
CO5	Design a RF transceiver system for wireless communication.	Analyze (K4)

V - Mapping Table Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	2	1	-	-	-	-	-	2	3	2
CO2	3	2	2	3	2	1	-	-	-	-	-	2	3	2
CO3	3	3	3	2	1	2	-	-	-	-	-	2	3	2
CO4	3	3	2	3	2	1	-	-	-	-	-	2	3	2
CO5	3	2	3	2	2	1	-	-	-	-	-	1	3	2

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23EC504 VLSI Design

Prerequisite	Programme Name	Sem	Category	L	T	P	C
23EC302 Digital Systems Design	B.E- ECE	V	PCC	3	0	0	3

II - Course Objectives

1.	To understand the principles, characteristics, and scaling effects of MOS transistors and CMOS logic families.
2.	To familiarize with design of combinational and sequential logic circuits.
3.	To explore interconnect modeling, memory architectures, and arithmetic circuit implementations using programmable devices.
4.	To gain knowledge of ASIC design flow, testing methodologies, fault models, and test bench development.
5.	To familiarize with Verilog and System Verilog programming.

III - Course Content**Preamble:**

The study of VLSI Design equips students with the fundamental understanding and practical skills required to design, analyze, and implement integrated circuits at the transistor, logic, and system levels. It encompasses topics such as MOS transistor theory, combinational and sequential logic design, CMOS circuit techniques, timing analysis, layout design, and fabrication processes.

Unit - I	MOS Transistor Principle	9 Periods
MOS logic families (NMOS and CMOS), Ideal and Non-Ideal IV Characteristics, Capacitance - Voltage Characteristics, CMOS Inverter: DC Transfer, Technology Scaling, Propagation Delays, Stick diagram, Layout diagrams, Elmore's constant.		
Unit - II	Combinational and Sequential Logic Circuits	9 Periods
Static Logic Gates, Dynamic Logic Gates, Pass Transistor Logic, Power Dissipation, Low Power Design principles, Static Latches and Registers, Dynamic Latches and Registers, Pipelines, Non-bistable Sequential Circuits, Timing classification of Digital Systems, Synchronous Design.		
Unit - III	Memory and Arithmetic Circuits	9 Periods
Interconnect Parameters, Logic Implementation using Programmable Devices (ROM, PLA, FPGA), Memory Architecture and Building Blocks, Memory Core and Memory Peripherals Circuitry, adders, multipliers, comparators.		
Unit - IV	ASIC Design and Testing	9 Periods
Introduction to wafer to chip fabrication process flow. Microchip design process & issues in test and verification of complex chips, embedded cores and SoCs, Introduction to ASICs, ASIC Design Flow, Design for Testability: Fault models, Stuck at Faults, Automatic test pattern generation, Scan design: Test interface and boundary scan.		
Unit - V	Verilog and System Verilog	9 Periods
Introduction to Verilog, Combinational Logic Design: Adder, Multiplier, Carry Look ahead adder, Sequential Design: Flip-flops, Counters, Shift Register, Introduction to test benches, Writing test		

benches in Verilog HDL, System Verilog Language Concepts, System Verilog Data types, System Verilog Randomization, System Verilog Functional Coverage.

TOTAL: 45 Periods

Text Books:	1. Jan D Rabaey, Anantha Chandrakasan, "Digital Integrated Circuits: A Design Perspective", PHI, 2016. (Units II, III and IV). 2. Neil H E Weste, Kamran Eshraghian, "Principles of CMOS VLSI Design: A System Perspective," Addison Wesley, 2009. (Units – I, IV). 3. Michael J Smith, "Application Specific Integrated Circuits", Addison Wesley, (Unit – V) 4. Samir Palnitkar, "Verilog HDL: A guide to Digital Design and Synthesis", Second Edition, Pearson Education, 2003. (Unit – V) 5. Parag K.Lala, "Digital Circuit Testing and Testability", Academic Press, 1997, (Unit – V) 6. Chris Spears, System Verilog for Verification, 2nd Edition, Springer, 2008.
Reference Books:	1. D.A. Hodges and H.G. Jackson, Analysis and Design of Digital Integrated Circuits, International Student Edition, McGraw Hill 1983 2. P. Rashinkar, Paterson and L. Singh, "System-on-a-Chip Verification-Methodology and Techniques", Kluwer Academic Publishers, 2001 3. Samiha Mourad and Yervant Zorian, "Principles of Testing Electronic Systems", Wiley 2000 4. M. Bushnell and V. D. Agarwal, "Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits", Kluwer Academic Publishers, 2000.

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Gain in depth knowledge of MOS technology.	Understand (K2)
CO2	Apply Combinational and Sequential logic circuits design principles.	Apply (K3)
CO3	Gain knowledge on memory architecture and arithmetic building blocks.	Understand (K2)
CO4	Apply the ASIC Design Process and Testing.	Apply (K3)
CO5	Develop digital circuits using verilog and system verilog programming.	Create (K6)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	2	2	-	-	-	-	3	2	3	3	2
CO2	3	3	3	2	2	-	-	-	-	3	2	3	3	2
CO3	3	3	3	2	2	-	-	-	-	3	2	3	3	2
CO4	3	3	3	2	2	-	-	-	-	3	2	3	2	2
CO5	3	3	3	2	3	-	-	-	-	3	2	3	2	3

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23EC511 Communication Systems Laboratory

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E- ECE	V	PCC	0	0	3	1.5

II - Course Objectives

1.	To understand the principles and implementation of amplitude and frequency modulation and demodulation techniques.
2.	To gain practical knowledge of signal sampling methods and time division multiplexing (TDM).
3.	To learn the generation and demodulation of various pulse modulation techniques including PCM, PAM, PPM, and PWM.
4.	To study and simulate digital modulation schemes such as ASK, PSK, FSK, and BPSK for effective digital communication.
5.	To explore error control coding techniques through simulation of linear block codes and cyclic codes for reliable data transmission.

III - Course Content**LIST OF EXPERIMENTS**

1. AM- Modulator and Demodulator
2. FM - Modulator and Demodulator
3. Signal sampling and TDM:
4. Pulse Code Modulation and Demodulation.
5. Pulse Amplitude Modulation and Demodulation.
6. Pulse Position Modulation and Demodulation
7. Pulse Width Modulation and Demodulation.
8. Delta Modulation and Demodulation.
9. BER Performance of BPSK over AWGN Channel
10. Digital Modulation – ASK, PSK
11. Simulation of ASK, FSK, and BPSK Generation and Detection Schemes.
12. Simulation of Linear Block
13. Simulation of Cyclic Error Control Coding Schemes.

TOTAL: 45 Periods

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	Apply the principles of analog modulation and demodulation techniques such as AM and FM.	Apply (K3)
C02	Implement sampling and Time Division Multiplexing (TDM) techniques in communication systems.	Analyze (K4)
C03	Investigate the signal transmission quality in communication systems.	Analyze (K4)
C04	Assess the performance of various digital modulation schemes including ASK, FSK, and PSK through simulation.	Analyze (K4)
C05	Design and simulate error control coding schemes using linear block and cyclic codes for reliable data communication.	Analyze (K4)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	2	-	-	2	3	3	-	3	3	2
CO2	3	3	2	2	2	-	-	2	3	3	-	3	3	2
CO3	3	3	2	2	2	-	-	2	3	3	-	3	3	2
CO4	3	2	2	2	2	-	-	2	3	3	-	3	3	2
CO5	3	2	2	2	2	-	-	2	3	3	-	3	3	2

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23EC512 VLSI Design Lab

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E- ECE	V	PCC	0	0	3	1.5

II - Course Objectives

1.	To design and simulate basic combinational and sequential digital circuits using HDL.
2.	To implement digital designs on FPGA platforms such as Xilinx and Altera.
3.	To develop and analyze arithmetic units and counters using hardware description languages.
4.	To design and simulate CMOS digital circuits including logic gates and flip-flops with layout generation.
5.	To evaluate the performance of CMOS amplifiers through DC and transient analysis.

III - Course Content

1. Design of basic combinational (Adders, Subtractors, Mux, De-Mux, Encoder, Decoder and comparator) circuits using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA.
2. Design of basic sequential (SR, D, T and JK Flip-flops) circuits using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA.
3. Design an Adder; Multiplier (Min 8 Bit) using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA.
4. Design and implement Universal Shift Register and Memories using HDL. Simulate it using Xilinx/Altera Software.
5. Design Finite State Machine (Moore/Mealy) using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA.
6. Design 3-bit synchronous up/down counter using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA.
7. Design 4-bit Asynchronous up/down counter using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA.
8. Design and simulate a CMOS Basic Gates & Flip-Flops. Generate Manual/Automatic Layout.
9. Design and simulate a 4-bit synchronous counter using a Flip-Flops. Generate Manual/Automatic Layout.
10. Design and simulate a CMOS Inverting Amplifier. Analyze the DC and transient characteristics and switching times, estimation of Transconductance.
11. Design and Simulate basic Common Source, Common Gate and Common Drain Amplifiers.
12. Design and simulate simple 5 transistor differential amplifier. Analyze the DC and transient characteristics and switching times, Estimation the resistance.

TOTAL: 45 Periods

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Write HDL code for basic as well as advanced digital integrated circuit.	Apply (K3)
CO2	Import the logic modules into FPGA Boards.	Apply (K3)
CO3	Synthesize Place and Route the digital IPs.	Analyze (K4)
CO4	Design, Simulate and Extract the layouts of Digital & Analog IC Blocks using EDA tools.	Analyze (K4)
CO5	Test and Verification of IC design.	Analyze (K4)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	3	-	-	2	3	3	-	3	3	3
CO2	3	3	2	2	3	-	-	2	3	3	-	3	3	3
CO3	3	3	2	2	3	-	-	2	3	3	-	3	3	3
CO4	3	2	2	2	3	-	-	2	3	3	-	3	3	3
CO5	3	2	2	2	3	-	-	2	3	3	-	3	3	3

Mapping: 1-Low, 2-Medium, 3-High

Mandatory Courses

Mandatory Courses

I - Course Name: 23MC901 English for Communication

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All B.E/B.Tech Programmes	-	MC	3	0	0	0

II - Course Objectives

1.	To improve the four essential skills of mastering the English language: Listening, Speaking, Reading, and Writing (LSRW)
2.	To enhance students' confidence and fluency in communicating effectively in academic and professional contexts.
3.	To develop vocabulary, pronunciation, and grammatical accuracy.

III - Course Content

Preamble:		
The course <i>English for Communication</i> is designed to equip students with essential language skills required for effective communication in academic, professional, and social contexts. Emphasizing practical usage, the course focuses on developing proficiency in speaking, listening, reading, and writing.		
Unit - I	Effective Listening	9 Periods
Active Listening: Techniques and Importance-Reasons for Poor Listening-Traits of a Good Listener-Listening Modes and Types-Barriers to Listening-Listening Practice: General vs. Specific Listening		
Unit - II	Effective Speaking	9 Periods
Basics of English Speech Sounds-Word and Sentence Stress-Intonation Patterns-Introducing Self and Others		
Unit - III	Effective Communication	9 Periods
Building Confidence and Fluency-Vocal Cues: Tone, Pitch, Rate of Speech-Telephone Etiquette and Real-life Conversations-Dialogue Writing		
Unit - IV	Effective Reading	9 Periods
Reading for Gist and Specific Information-Techniques: Skimming, Scanning, Predicting-SQ3R Reading Method-Study Skills for Comprehension		
Unit - V	Effective Reading	9 Periods
Vocabulary Building: Prefixes, Suffixes, Synonyms, Antonyms, One-word Substitutes-Writing Sentences and Paragraphs-Writing for Digital Platforms-Précis Writing: Rules and Examples		
TOTAL: 45 Periods		

Reference Books:	• M.V. Rodrigues, "English for Effective Communication", Oxford University Press • Simon Sweeney, "English for Business Communication", Cambridge University Press • Krishna Mohan & Meera Banerji, "Developing Communication Skills", Macmillan India • Sanjay Kumar & Pushpa Lata, "Communication Skills", Oxford University Press
MOOC/Web Platforms:	https://www.coursera.org/?utm_source=chatgpt.com https://www.edx.org/?utm_source=chatgpt.com

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Demonstrate effective listening skills in academic and general contexts.	Apply (K3)
CO2	Communicate fluently and clearly using correct pronunciation, stress, and intonation.	Apply (K3)
CO3	Participate in conversations and telephonic communications with appropriate etiquette.	Apply (K3)
CO4	Comprehend and interpret various types of texts using reading strategies.	Analyse (K4)
CO5	Produce clear, well-structured written content with appropriate vocabulary and grammar.	Create (K6)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	-	-	-	-	-	-	-	2	3	-	2	-	-	-
CO2	-	-	-	-	-	-	-	2	3	-	2	-	-	-
CO3	-	-	-	-	-	-	-	2	3	-	2	-	-	-
CO4	-	-	-	-	-	-	-	2	3	-	2	-	-	-
CO5	-	-	-	-	-	-	-	2	3	-	2	-	-	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23MC902 Introduction to Women and Gender Studies

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All B.E/B.Tech Programmes	-	MC	3	0	0	0

II. Course Objectives

1.	To familiarize students with basic gender-related concepts like sex, gender, patriarchy, and hegemony.
2.	To critically examine different feminist theories and their contribution to gender discourse.
3.	To trace the historical and socio-political development of women's movements globally and in India.
4.	To analyze how language and media shape and reflect gender identities and representations.
5.	To encourage critical thinking and resistance strategies against gender discrimination.

III. Course Content

Preamble This course explores key gender concepts, feminist theories, and movements, focusing on the intersections of power, identity, and representation. It examines gender roles, media, and the impact of language in shaping societal norms.		
UNIT-I	Concepts	9 Periods
Sex vs. Gender, masculinity, femineity, socialization, patriarchy, public/private, essentialism, binarism, power, hegemony, hierarchy, stereotype, gender roles, gender relation, deconstruction, resistance, sexual division labor.		
UNIT-II	Feminist Theory	9 Periods
Liberal, Marxist, Socialist, Radical, Psychoanalytic, postmodernist, Ecofeminist, Gender Identity.		
UNIT-III	Women's Movements: Global, National and Local	9 Periods
Rise of Feminism in Europe and America. Women's Movement in India.		
UNIT-IV	Gender and Language	9 Periods
Linguistic Form and Gender, Gender and narratives		
UNIT-V	Gender and Representation	9 Periods
Advertising and popular visual media. Gender and Representation in Alternative Media. Gender and social media.		

TOTAL: 45 Periods

Text Books	1. Connell, R.W. (1995). Gender. Cambridge: Polity Press.
	2. Agarwal, B. (1988). Structures of Patriarchy: State, Community and Household in Modern South Asia. New Delhi: Kali for Women.
	3. Vandana Shiva (1989). Staying Alive: Women, Ecology and Development. New Delhi: Kali for Women.
Reference Books	1. Krishnaraj, Maithreyi (Ed.). (1985). Evolving New Methodologies in Research on Women's Studies. SNDT Women's University, Bombay.
	2. Harding, Sandra (1987). Feminism and Methodology. Indiana University Press.
	3. Rosemarie Tong (2009). Feminist Thought: A More Comprehensive Introduction. Westview Press.
	4. Judith Butler (1990). Gender Trouble: Feminism and the Subversion of Identity. Routledge.
	5. Radha Kumar (1993). The History of Doing: An Illustrated Account of Movements for Women's Rights and Feminism in India, 1800-1990. Kali for Women.
Web Source	https://archive.nptel.ac.in/courses/109/107/109107191/?utm_source=chatgpt.com

IV. Course Outcomes

On the completion of this course, students will be able to:		Bloom's Level Mapped
CO1:	Understand foundational gender concepts and their application in real-world contexts.	Understand (K2)
CO2:	Apply feminist theoretical approaches to critique social norms and institutions.	Apply (K3)
CO3:	Evaluate the role of social movements in shaping gender equality.	Evaluate (K5)
CO4:	Examine gendered language patterns and narrative constructions.	Analyze (K4)
CO5:	Analyze the portrayal and representation of gender in traditional and new media.	Analyze (K4)

V. Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	-	-	-	-	-	-	-	-	2	3	-	2	-	-
CO2	-	-	-	-	-	-	-	-	2	3	-	2	-	-
CO3	-	-	-	-	-	-	-	-	2	3	-	2	-	-
CO4	-	-	-	-	-	-	-	-	2	3	-	2	-	-
CO5	-	-	-	-	-	-	-	-	2	3	-	2	-	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23MC903 Disaster Risk Reduction and Management

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All B.E/B.Tech Programmes	-	MC	3	0	0	0

II - Course Objectives

1.	To understand fundamental disaster concepts and different types of disasters.
2.	To learn Disaster Risk Reduction (DRR) principles and the phases of the disaster cycle.
3.	To Grasp India's disaster management laws, policies, and institutional structures.
4.	To identify and use key tools and technologies for disaster preparedness and response.
5.	To analyze real-world disaster scenarios and develop practical response planning skills.

III - Course Content

Preamble: This course addresses the critical need to manage increasing disaster risks in our interconnected world. It focuses on reducing risks, building resilience, and fostering safety rather than just reacting to disasters.		
Unit - I	Hazards, Vulnerability and Disaster Risks	9 Periods
Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Types of Disasters: Natural, Human induced, Climate change induced –Earthquake, Landslide, Flood, Drought, Fire etc – Technological disasters- Structural collapse, Industrial accidents, oil spills -Causes, Impacts including social, Economic, political, environmental, health, psychosocial, etc.- Disaster vulnerability profile of India and Tamil Nadu - Global trends in disasters: urban disasters, pandemics, Complex emergencies, - - Inter relations between Disasters and Sustainable development Goals.		
Unit - II	Disaster Risk Reduction (DRR)	9 Periods
Sendai Framework for Disaster Risk Reduction, Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community Based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayat Raj Institutions / Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Early Warning System – Advisories from Appropriate Agencies- Relevance of indigenous Knowledge, appropriate technology and Local resources.		
Unit - III	Disaster Management	9 Periods
Components of Disaster Management – Preparedness of rescue and relief, mitigation, rehabilitation and reconstruction- Disaster Risk Management and post disaster management – Compensation and Insurance- Disaster Management Act (2005) and Policy - Other related policies, plans, programmers and legislation - Institutional Processes and Framework at State and Central Level- (NDMA –SDMA-DDMA-NRDF- Civic Volunteers).		

Unit - IV	Tools and Technology for Disaster Management	9 Periods
Early warning systems -Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment. - Elements of Climate Resilient Development –Standard operation Procedure for disaster response – Financial planning for disaster Management.		
Unit - V	Disaster Management: Case Studies	9 Periods
Discussion on selected case studies to analyse the potential impacts and actions in the contest of disasters-Landslide Hazard Zonation: Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.- Field work-Mock drill.		

TOTAL: 45 Periods

Text Books:	1. Taimpo (2016), Disaster Management and Preparedness, CRC Publications 2. Singh R (2017), Disaster Management Guidelines for earthquakes, Landslides, Avalanches and tsunami, Horizon Press Publications 3. Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN- 13: 978-9380386423 4. Tushar Bhattacharya, Disaster Science and Management, McGraw Hill India Education Pvt. Ltd., 2012. ISBN-10: 1259007367, ISBN-13: 978-1259007361]
Reference Books:	1. Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005. 2. Government of India, National Disaster Management Policy, 2009. 3. Shaw R (2016), Community based Disaster risk reduction, Oxford University Press.
MOOC/Web Platforms:	https://onlinecourses.swayam2.ac.in/ini25_hs32/preview https://onlinecourses.swayam2.ac.in/cec25_hs135/preview https://onlinecourses.swayam2.ac.in/ntr25_ed61/preview

IV - Course Outcomes

	On completion of the course, the students will be able to	Bloom's Level Mapped
C01	To impart knowledge on the concepts of Disaster, Vulnerability and Disaster Risk reduction (DRR).	Apply (K3)
C02	To enhance understanding on Hazards, Vulnerability and Disaster Risk Assessment prevention and risk reduction.	Apply (K3)
C03	To develop disaster response skills by adopting relevant tools and technology.	Apply (K3)
C04	Enhance awareness of institutional processes for Disaster response in the country.	Understand (K2)
C05	Develop rudimentary ability to respond to their surroundings with	Apply

potential Disaster response in areas where they live, with due sensitivity.	(K3)
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V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	-	-	2	2	-	-	2	-	-	-
CO2	3	3	3	3	-	-	2	1	-	-	2	-	-	-
CO3	3	3	3	3	-	-	2	2	-	-	-	-	-	-
CO4	3	3	3	3	-	-	2	1	-	-	2	-	-	-
CO5	3	3	3	3	-	-	2	2	-	-	2	-	-	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23MC904 History of Science and Technology in India

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All B.E/B.Tech Programmes	-	MC	3	0	0	0

II - Course Objectives

1.	To learn sources of history of Science, Technology and Medicine in Early India
2.	To understand the development of Science and Technology in Medieval India.
3.	To study the different scientific surveys and debates in British India.
4.	To analyse the developments of Science, Technology and Medicine in Independent India.
5.	To analyse the developments of Agriculture Technology and Harvesting in Independent India.

III - Course Content

Preamble: Students will be able to: Understand the premises informing the twin themes of science and Technology, development of science, and origin of Agriculture in perspective.

Unit - I	Concepts and Perspectives	9 Periods
Meaning of History Objectivity, Determinism, Relativism, Causation, Generalization in History; Moral judgment in history Extent of subjectivity, contrast with physical sciences, interpretation and speculation, causation verses evidence, concept of historical inevitability, Historical Positivism. Science and Technology-Meaning, Scope and Importance, Interaction of science, technology & society, Sources of history on science and technology in India.		
Unit - II	Historiography of Science and Technology in India	9 Periods
Introduction to the works of D.D. Kosambi, Dharmpal, Debiprasad Chattopadhyay, Rehman, S. Irfan Habib, Deepak Kumar, Dhruv Raina, and others.		
Unit - III	Science and Technology in Ancient India	9 Periods
Technology in pre-historic period Beginning of agriculture and its impact on technology Science and Technology during Vedic and Later Vedic times Science and technology from 1st century AD to C-1200.		
Unit - IV	Science and Technology in Medieval India	9 Periods
Legacy of Technology in Medieval India, Interactions with Arabs Development in medical knowledge, interaction between Unani and Ayurveda and alchemy Astronomy and Mathematics: interaction with Arabic Sciences Science and Technology on the eve of British conquest		

Unit – V	Agrarian Technology: History of Agriculture and Hydrology	9 Periods
Plant science in ancient India – Knowledge of plants and agricultural practices - Agricultural tools and technology Water harvesting technology – Harappan, Mauryan, Gupta and Post Gupta eras		

TOTAL: 45 Periods

Books for study & Reference:	1. Arnold, David, 1999. Science, Technology and Medicine in Colonial India, The New Cambridge History of India Series, Cambridge, Oxford University Press. 2. Bose, D. N., 1989. A Concise History of Science in India, New Delhi, Indian National Science Academy. 3. Dharmapal, 1971. Indian Science and Technology in the Eighteenth Century, Delhi. Gopal, S. and Kumar Ravindra, Colonial Development, Education and Social Awareness up to 2000, PHISPC, Delhi, Oxford University Press. 4. Jaggi, O. P., 1977. Medicines in Medieval India, Delhi, Atma Ram & Sons, Delhi. 5. Jaggi, O. P., Dawn of Indian Technology (Pre & Proto Historic Period – Vol. I) (Vedic & Upnishadic Period – Vol. II) Indian System of Medicine Vo. IV, Indian Astronomy & Mathematics Vol. VI, Science & technology in Medieval – India Vol. VII, S. Delhi, Atma Ram & Sons.
MOOC/Web Platforms:	Web source 1. https://dst.gov.in/ 2. https://www.india.gov.in/topics/science-technology

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the meaning, scope, and importance of science and technology and their interaction with society through historical perspectives.	Apply (K3)
CO2	Evaluate the impact of these historiographical works on the understanding of indigenous knowledge systems and colonial influence on science and technology.	Apply (K3)
CO3	Trace the evolution of science and technology in India from the 1st century AD to around 1200 AD.	Apply (K3)
CO4	Examine developments in medical knowledge, particularly the interplay between Unani, Ayurveda, and alchemy.	Analyze (K4)
CO5	Analyze the evolution of water harvesting and irrigation technologies during the Harappan, Mauryan, Gupta, and Post-Gupta periods	Analyze (K4)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C01	2	1	-	-	-	-	-	-	-	-	-	-	-	-
C02	2	1	-	-	-	-	-	-	-	-	-	-	-	-
C03	2	1	-	-	-	-	-	-	-	-	-	-	-	-
C04	2	1	-	-	-	-	-	-	-	-	-	-	-	-
C05	2	1	-	-	-	-	-	-	-	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23MC905 Political and Economic Thought for a Human Society

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All B.E/B.Tech Programmes	-	MC	3	0	0	0

II - Course Objectives

1.	The course will start by exploring human needs and desires, and how various political and economic systems attempt to address them
2.	The course will culminate in a critical assessment of the systems discussed, examining their past execution and exploring future prospects.

III - Course Content

Preamble: This course explores political and economic ideas that shape just and equitable societies, emphasizing human dignity, inclusivity, and ethical responsibility.		
Unit - I	Foundations of a Human Society	9 Periods
Considerations for human society, holistic thought, human being's desires, harmony in self, harmony in relationships, society, and nature, societal systems.		
Unit - II	Political and Economic Systems in the Modern World	9 Periods
Capitalism – Free markets, demand-supply, perfect competition, laissez-faire, monopolies, imperialism. Liberal democracy, Fascism and totalitarianism. World War I and II.		
Unit - III	Foundations and Models of Communism	9 Periods
Communism – Mode of production, theory of labour, surplus value, class struggle, dialectical materialism, historical materialism, Russian and Chinese models.		
Unit - IV	The Welfare State and Human-Centered Development	9 Periods
Welfare state. Relation with human desires. Empowered human beings, satisfaction, Gandhian thought. Swaraj, Decentralized economy & polity, Community. Control over one's lives.		
Unit - V	Indian Civilization and the Shaping Forces of Society	9 Periods
Relationship with nature, Essential elements of Indian civilization, Technology as driver of society, Role of education in shaping of society. Future directions		

Text Books:	1. R. Nagaraj, "The Flaming Feet and other Essays: The Dalit Movement in India, "Seagull Books London Ltd. 2. J. C. Kumarappa and Gandhi's Struggle for Economic Justice", Venu Madhav Govindu and Deepak Malghan, Oxford University Press; Illustrated edition (August 2016). 3. "The Theory of Moral Sentiments", Adam Smith, Penguin Classics; Anniversary edition (May 2010). 4. "The Principles of Political Economy", John Stuart Mill, Create Space Independent Pub (September 2016).
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Reference Books:	1. Challengers to capitalism: Marx, Lenin, and Mao", John G. Gurley, San Francisco Book Co (January 1976) 2. "Small is Beautiful: Economics as if People Mattered", E. F. Schumacher, Harper Perennial; Reprint edition (October 2010) 3. "The History and Culture of the Indian People: Volume 9: British Paramountcy and Indian Renaissance Part I", R.C. Majumdar, Bhartiya Vidya Bhavan (January 2002)
MOOC/ Web Platforms:	https://www.sistk.org/downloads/MATERIALS/23HS0814-UHV.pdf?utm_source=chatgpt.com https://www.investopedia.com/articles/investing/102914/main-characteristics-capitalist-economies.asp https://uhv.org.in/UHV-II%20Course%20Material%202024/L%2022%20Sum%20Up%20and%20Program%20v5.pdf?utm_source=chatgpt.com

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Relationship with nature, Essential elements of Indian civilization, Technology as driver of society, Role of education in shaping of society. Future directions	Understand (K2)
CO2	Demonstrate the ability to analyze and resolve ethical dilemmas using principles of universal human values and ethical reasoning.	Understand (K2)
CO3	Develop an appreciation for cultural diversity and demonstrate behaviours that reflect sensitivity and respect for different cultural perspectives and practices.	Apply (K3)
CO4	Identify and engage in actions that reflect human values, contributing positively to their communities and promoting social harmony	Apply (K3)
CO5	Regularly reflect on their personal development in terms of values and ethics, and articulate ways in which they can continue to grow and apply these in their lives.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1	3	-	3	3	-	3	-	3	3	3	-	-	-
CO2	1	3	-	2	3	-	3	2	2	3	3	1	-	-
CO3	1	3	-	3	3	-	2	2	2	2	3	-	-	-
CO4	1	3	-	2	2	-	2	3	2	3	1	-	-	-
CO5	1	3	-	2	3	-	3	3	3	3	2	1	-	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23MC906 Well-Being with Traditional Practices-Yoga, Ayurveda, and Siddha

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All B.E/B.Tech Programmes	-	MC	3	0	0	0

II - Course Objectives

1.	To Understand the essential components of health and their importance.
2.	To Develop confidence to maintain a healthy lifestyle.
3.	To Learn effective techniques to prevent lifestyle-related disorders.
4.	To Recognize the role of balanced diet and physical activity in health maintenance.
5.	To Explore traditional systems like Ayurveda and Siddha for holistic well-being and disease prevention.

III - Course Content

Preamble:

This course explores holistic health and wellness, emphasizing the importance of prevention over treatment. It delves into various dimensions of health—physical, mental, emotional, social, spiritual, and environmental—while highlighting the role of diet, traditional medicine, and lifestyle in disease prevention. With insights from modern science and ancient Indian systems like Ayurveda and Siddha, learners gain practical tools for maintaining well-being. The course also reflects on the relationship between civilization, nature, and technology in shaping future health and societal outcomes.

Unit - I	Health and its Importance	9 Periods
Present health status -Definition -Importance of maintaining health – More importance on prevention than treatment. Ten types of health one has to maintain – Physical health – Mental health – Social health – Financial health – Emotional health – Spiritual health – Intellectual health – Relationship health – Environmental health – Occupational/Professional health Types of diseases and disorders-The life expectancy-present status – mortality rate – dreadful diseases non-communicable diseases (NCDs) the leading cause of death – 60% – heart disease – cancer – diabetes – chronic pulmonary diseases – risk factors – tobacco – alcohol – unhealthy diet – lack of physical activities. Types of diseases and disorders – Lifestyle disorders – Obesity – Diabetes – cardiovascular diseases – Cancer – Strokes – COPD – Arthritis – Mental health issues Causes of the above diseases/disorders – Importance of prevention of illness – Takes care of health – Improves quality of life – Reduces absenteeism – Increase satisfaction – Saves time Simple lifestyle modifications to maintain health – Healthy Eating habits (Balanced diet according to age) Physical Activities (Stretching exercise, aerobics, resisting exercise) – Maintaining BMI		
Unit - II	Diet	9 Periods

Role of diet in maintaining health – energy one needs to keep active throughout the day – nutrients one needs for growth and repair – helps one to stay strong and healthy – helps to prevent diet-related illness, such as some cancers – keeps active and – helps one to maintain a healthy weight – helps to reduce risk of developing lifestyle disorders like diabetes – arthritis – hypertension – PCOD – infertility – ADHD – sleeplessness -helps to reduce the risk of heart diseases – keeps the teeth and bones strong.

Balanced Diet and its 7 Components – Carbohydrates – Proteins – Fats – Vitamins – Minerals Fibre and Water.

Food additives and their merits & demerits – Effects of food additives – Types of food additives Food additives and processed foods – Food additives and their reactions

Definition of BMI and maintaining it with diet

Importance – Consequences of not maintaining BMI – different steps to maintain optimal BMI

Nutrigenomics: How Food Influences Gene Expression. Anti-inflammatory and Immunomodulatory

Diets in Traditional Medicine

Common cooking mistakes - Different cooking methods, merits and demerits of each method

Unit – III	Role of Ayurveda & Siddha Systems in Maintaining Health	9 Periods
AYUSH systems and their role in maintaining health – preventive aspect of AYUSH – AYUSH as a soft therapy. Secrets of traditional healthy living – Traditional Diet and Nutrition – Regimen of Personal and Social Hygiene – Daily routine (Dinacharya) – Seasonal regimens (Ritucharya) – basic sanitation and healthy living environment – Sadvritta (good conduct) – for conducive social life. Principles of Siddha & Ayurveda systems – Macrocosm and Microcosm theory – Panchcheekarana Theory / (Five Element Theory) 96 fundamental Principles – Uyir Thathukkal (Tri-Dosha Theory) – Udal Thathukkal Tridosha Theory and Its Modern Biomedical Correlates. Rasayana and Kayakalpa: Traditional Rejuvenation Therapies. Role of Siddha Varma and Marma Therapies in Neurological and		
Unit – IV	Mental Wellness	9 Periods
Emotional health – Definition and types – Three key elements: the subjective experience – the physiological response – the behavioral response – Importance of maintaining emotional health Role of emotions in daily life -Short term and long-term effects of emotional disturbances – Leading a healthy life with emotions – Practices for emotional health – Recognize how thoughts influence emotions – Cultivate positive thoughts – Practice self-compassion – Expressing a full range of emotions. Stress management – Stress definition – Stress in daily life – How stress affects one's life – Identifying the cause of stress – Symptoms of stress – Managing stress (habits, tools, training, professional help) – Complications of stress mismanagement. Sleep – Sleep and its importance for mental wellness – Sleep and digestion. Immunity – Types and importance – Ways to develop immunity		
Unit – V	Civilization, Nature, and the Role of Technology	9 Periods
Relationship with nature, Essential elements of Indian civilization, Technology as driver of society, Role of education in shaping of society. Future directions		

TOTAL: 45 Periods

Reference Books:	1. WHAT WE KNOW ABOUT EMOTIONAL INTELLIGENCE How It Affects Learning, Work, Relationships, and Our Mental Health, by Moshe Zeidner, Gerald Matthews, and Richard D. Roberts
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	2. A Bradford Book, The MIT Press, Cambridge, Massachusetts, London, England 3. The Mindful Self-Compassion Workbook, Kristin Neff, Ph.D Christopher Germer, Ph.D, Published by The Guilford Press A Division of Guilford Publications, Inc. 370 Seventh Avenue, Suite 1200, New York, NY 10001
MOOC/ Web Platforms:	• https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4799645/Simple lifestyle modifications to maintain health • https://www.niddk.nih.gov/health-information/diet-nutrition/changing-habits-betterhealth#:~:text=Make%20your%20new%20healthy%20habit,t%20have%20time%20to%20cook

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	Learn the importance of different components of health.	Understand (K2)
C02	Gain confidence to lead healthy life.	Apply (K3)
C03	Learn new techniques to prevent lifestyle health disorders.	Apply (K3)
C04	Understand the importance of diet and workouts in maintaining health.	Understand (K2)
C05	Explore traditional health systems for holistic well-being and disease prevention.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C01	-	-	-	-	-	-	-	-	2	3	-	2	-	-
C02	-	-	-	-	-	-	-	-	2	3	-	2	-	-
C03	-	-	-	-	-	-	-	-	2	3	-	2	-	-
C04	-	-	-	-	-	-	-	-	2	3	-	2	-	-
C05	-	-	-	-	-	-	-	-	2	3	-	2	-	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23MC907 State, Nation Building and Politics in India

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All B.E/B.Tech Programmes	-	MC	3	0	0	0

II - Course Objectives

1.	To understand how the state operates through its main branches: the executive, legislature, and judiciary.
2.	To familiarize the student with the foundational ideas of politics and sovereignty, and how they're changing in our interconnected world.
3.	To familiarize the students with the historical journey of India's national movement and the evolution of its Constitution.
4.	To make the students understand why India adopted a parliamentary-federal system and the core principles behind its Constitution.
5.	To acquaint the student with the dynamic nature of India's political landscape, including current challenges in national integration and nation-building.

III - Course Content

Preamble: From this course, understanding the political landscape, the functioning of the state, and the ongoing process of nation-building is crucial for truly impactful contributions. This course will equip the students with a nuanced perspective on how India, a vibrant and complex democracy, operates.		
Unit – I	State, Sovereignty, and Political Dynamics	8 Periods
Understanding the need and role of State and politics. Development of Nation-State, sovereignty, sovereignty in a globalized world.		
Unit – II	Structure and Functioning of the State	8 Periods
Organs of State – Executive, Legislature, Judiciary. Separation of powers, forms of government- unitary-federal, Presidential-Parliamentary, The idea of India.		
Unit – III	The Revolt of 1857 and the National Awakening	7 Periods
1857 and the national awakening.		
Unit – IV	Indian National Movement and Constitution Making	7 Periods
1885 Indian National Congress and development of national movement – its legacies. Constitution making and the Constitution of India.		
Unit – V	Foundations of Federalism and Nation-Building	7 Periods
Goals, objective and philosophy. Why a federal system? National integration and nation-building.		
Unit – VI	Contemporary Challenges and Future of Indian Politics	8 Periods
Challenges of nation-building – State against democracy (Kothari) New social movements. The changing nature of Indian Political System, the future scenario. What can we do?		

TOTAL: 45 Periods

Text Books:	1. Sunil Khilnani, The Idea of India. Penguin India Ltd., New Delhi. 2. Madhav Khosla, The Indian Constitution, Oxford University Press. New Delhi, 2012. 3. Brij Kishore Sharma, Introduction to the Indian Constitution, PHI, New Delhi, latest edition. 4. Sumantra Bose, Transforming India: Challenges to the World's Largest Democracy, Picador India, 2013. 5. Atul Kohli, Democracy and Discontent: India's Growing Crisis of Governability, Cambridge University Press, Cambridge, U. K., 1991. 6. M. P. Singh and Rekha Saxena, Indian Politics: Contemporary Issues and Concerns, PHI, New Delhi, 2008, latest edition. 7. Rajni Kothari, Rethinking Democracy, Orient Longman, New Delhi, 2005.
Reference Books:	1. D. D. Basu, Introduction to the Constitution of India. LexisNexis/PHI Learning. 2. Granville Austin, The Indian Constitution: Cornerstone of a Nation. Oxford University Press. 3. Ramachandra Guha, India After Gandhi: The History of the World's Largest Democracy. Picador India. 4. Christophe Jaffrelot, The Hindu Nationalist Movement and Indian Politics. Penguin India.
MOOC/Web Platforms:	https://onlinecourses.nptel.ac.in/noc25_lw05/preview https://onlinecourses.nptel.ac.in/noc25_lw19/preview

IV - Course Outcomes

	On completion of the course, the students will be able to	Bloom's Level Mapped
C01	Grasp the theoretical aspect of the state, its various organs, and how they function.	Apply (K3)
C02	Understand the historical context and philosophical basis of India's current political system.	Apply (K3)
C03	Identify the major challenges and ongoing efforts related to national integration and nation-building in India.	Apply (K3)
C04	Develop a clear and accurate understanding of India's political system and processes.	Understand (K2)
C05	Critically analyze to improve civic participation and contribute to better governance and public service delivery.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C01	3	3	1	1	-	3	-	2	2	-	1	3	-	-
C02	3	3	1	1	-	3	-	2	2	-	1	3	-	-
C03	3	3	1	1	-	3	-	2	2	-	1	3	-	-
C04	3	3	1	1	-	3	-	2	2	-	1	3	-	-
C05	3	3	-	-	-	3	-	2	2	-	-	2	-	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23MC908 Industrial Safety

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All B.E/B.Tech Programmes	-	MC	3	0	0	0

II - Course Objectives

1.	To impart knowledge on different facets and aspects of engineering systems
2.	To understand the Focusing on Tools, and the techniques.
3.	To study the Methodologies needed for prevention of Occurrence.
4.	To analyze the accidents under different industrial settings.
5.	To analyze the Environmental condition to avoid noise pollution.

III - Course Content

Preamble: Students will be able to: Understand the premises informing the twin themes of Industrial Safety techniques to avoid the accidents.		
Unit – I	Safety Terminologies	9 Periods
Hazard-Types of Hazard- Risk-Hierarchy of Hazards Control Measures-Lead indicators- lag Indicators-Flammability- Toxicity Time-weighted Average (TWA) – Threshold Limit Value (TLV) – Short Term Exposure Limit (STEL)- Immediately dangerous to life or health (IDLH)- acute and chronic effects- Routes of Chemical Entry-Personnel Protective Equipment- Health and Safety Policy-Material Safety Data Sheet MSDS		
Unit – II	Standards and Regulations	9 Periods
Indian Factories Act-1948- Health- Safety- Hazardous materials and Welfare- ISO 45001:2018 occupational health and safety (OH&S) – Occupational Safety and Health Audit IS14489:1998- Hazard Identification and Risk Analysis- code of practice IS 15656:2006		
Unit – III	Safety Activities	9 Periods
Toolbox Talk- Role of safety Committee- Responsibilities of Safety Officers and Safety Representatives- Safety Training and Safety Incentives- Mock Drills- On-site Emergency Action Plan- Off-site Emergency Action Plan- Safety poster and Display- Human Error Assessment		
Unit – IV	Workplace Health and Safety	9 Periods
Noise hazard- Particulate matter- musculoskeletal disorder improper sitting poster and lifting Ergonomics RULE & REBA- Unsafe act & Unsafe Condition- Electrical Hazards- Crane Safety-Toxic gas Release		

Unit - V	Environmental Control	9 Periods
Industrial Health Hazards – Environmental Control – Industrial Noise – Noise measuring instruments, Control of Noise, Vibration – Personal Protection.		

TOTAL: 45 Periods

Reference Books:	1. R.K. Jain and Prof. Sunil S. Rao Industrial Safety, Health and Environment Management Systems, Khanna Publisher. 2. L. M. Deshmukh Industrial Safety Management: Hazard Identification and Risk Control McGraw-Hill Education 3. Frank Lees (2012) 'Lees' Loss Prevention in Process Industries, Butterworth-Heinemann publications, UK, 4th Edition. 4. John Ridley & John Channing (2008) Safety at Work: Routledge, 7th Edition. 5. Dan Petersen (2003) Techniques of Safety Management: A System Approach. 6. Alan Waring (1996), Safety management system: Chapman & Hall, England Society of Safety Engineers, USA
MOOC/Web Platforms:	1. https://archive.nptel.ac.in/courses/110/105/110105094/ 2. https://www.shiksha.com/online-courses/industrial-safety-courses-certification-training-by-nptel-st575-tg1307

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	Understand the concepts of flammability, toxicity, and various exposure limits.	Apply (K3)
C02	Explain the key provisions of the Indian Factories Act and apply the principles of ISO 45001:2018	Apply (K3)
C03	Identify the responsibilities and duties of Safety Officers and Safety Representatives in ensuring compliance with safety protocols and regulations.	Apply (K3)
C04	Identify and assess common workplace hazards such as noise, particulate matter, and toxic gas release, and evaluate their impact on worker health.	Analyze (K4)
C05	Describe the sources and effects of industrial noise and use noise measuring instruments to assess workplace noise levels.	Analyze (K4)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C01	2	1	-	-	-	-	-	-	-	-	-	-	-	-
C02	2	1	-	-	-	-	-	-	-	-	-	-	-	-
C03	2	1	-	-	-	-	-	-	-	-	-	-	-	-
C04	2	1	-	-	-	-	-	-	-	-	-	-	-	-
C05	2	1	-	-	-	-	-	-	-	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23MC909 Indian Constitution

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All B.E/B.Tech Programmes	-	MC	3	0	0	0

II - Course Objectives

1.	Understand the basics of Constitution of India – meaning, nature, fundamental right and duties.
2.	Explain the parliamentary system of the government and the relationship between the governments.
3.	Detail the powers and functions of Central government.
4.	Detail the powers and functions of State government.

III - Course Content**Preamble:**

Students will be able to: Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.

To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional

- Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism. To address the role of socialism in India after the commencement of the Bolshevik

- Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Unit – I	History of Making of The Indian Constitution	9 Periods
History, Drafting Committee, (Composition & Working)		
Unit – II	Philosophy of The Indian Constitution	9 Periods
Preamble, Salient Features		
Unit – III	Contours of Constitutional Rights and Duties	9 Periods
Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.		
Unit – IV	Organs of Governance	9 Periods
Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.		
Unit – V	Indian Society	9 Periods
Nature, Meaning and definition; Indian Social Structure; Caste, Religion, Language in India; Constitutional Remedies for citizens – Political Parties and Pressure Groups; Right of Women, Children and Scheduled Castes and Scheduled Tribes and other Weaker Sections.		

TOTAL:45 Periods

Reference Books:	1.The Constitution of India,1950(Bare Act), Government Publication 2.Dr.S.N.Busi, Dr.B. R.Ambedkar framing of Indian Constitution,1st Edition, 2015. 3.M.P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis,2014. 4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015
MOOC/Web Platforms:	https://onlinecourses.nptel.ac.in/noc20_lw02/preview

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Describe the historical background and events that led to the framing of the Indian Constitution.	Apply (BL 3)
CO2	Identify and analyze the salient features of the Indian Constitution, including federalism, parliamentary democracy, secularism, and the rule of law.	Apply (BL 3)
CO3	Explain the significance and scope of Fundamental Rights enshrined in the Indian Constitution and their role in ensuring individual liberty and equality	Apply (BL 3)
CO4	Describe the qualifications and disqualifications of Members of Parliament and assess their significance in maintaining democratic integrity	Analyze (BL 4)
CO5	Analyze the structure of Indian society, including the role and interrelationship of caste, religion, and language.	Analyze (BL 4)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO3	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO4	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO5	2	1	-	-	-	-	-	-	-	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23MC910 Elements of Literature

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All B.E/B.Tech Programmes	-	MC	3	0	0	0

II - Course Objectives

1.	To identify and define the fundamental elements of literature, including plot, character, setting, theme, point of view, tone, and style.
2.	To analyze literary works across various genres such as fiction, poetry, and drama using appropriate literary terminology.
3.	To interpret how literary devices and techniques contribute to the meaning and impact of a text.

III - Course Content**Preamble:**

The course *Elements of Literature* is designed to introduce students to the foundational components of literary works and to cultivate an appreciation for the art of storytelling. Through the study of various genres, styles, and cultural contexts, students will develop critical reading, analytical, and interpretive skills.

Unit – I	Introduction to Literature	9 Periods
Nature, purpose, and scope of literature - Functions of literature: Emotional, social, moral, aesthetic - Literature as a reflection of life and a tool for transformation – Enhancing reading, writing, critical thinking, and discussion through literature - Understanding catharsis and human empathy through texts.		
Unit – II	Elements of Fiction	9 Periods
Fiction, fact, and literary truth-Narrative techniques and perspectives - Plot structure: exposition, conflict, climax, resolution -Characterization: dynamic vs static, round vs flat - Setting, theme, tone, and atmosphere.		
Unit – III	Elements of Poetry	9 Periods
Emotions, imagination, and subjective experience – Figurative language: simile, metaphor, conceit, symbol, pun, irony - Devices of sound: alliteration, assonance, rhyme, rhythm - Poetic forms: sonnet, ballad, haiku, free verse - Personification, animation, rhetorical trends.		
Unit – IV	Elements of Drama	9 Periods
Drama as a performative and representational art - Dramatic modes and structural components: act, scene, dialogue - Theatrical performance and stage directions - Drama as narration, mediation, and persuasion - Features of tragedy, comedy, satire.		
Unit – V	Introduction to Literary Criticism	9 Periods
What is literary theory? - Brief overview of major schools: Formalism, Marxism, Psychoanalysis, Feminism - Applying critical perspectives to text interpretation - Writing literary analysis: structure, thesis, evidence, citation - Interdisciplinary connections: literature and society, history, psychology.		

TOTAL:45 Periods

Reference Books:	1. Literature: An Introduction to Fiction, Poetry, Drama, and Writing by X.J. Kennedy & Dana Gioia 2. How to Read Literature Like a Professor by Thomas C. Foster 3. Beginning Theory: An Introduction to Literary and Cultural Theory by Peter Barry
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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Recall the fundamental elements of literature such as plot, character, setting, theme, and point of view.	Understand (K2)
CO2	Apply literary terms and concepts to analyze a variety of genres, including fiction, poetry, and drama.	Apply (K3)
CO3	Analyze how cultural, historical, and social contexts influence literary works and their interpretations.	Analyze (K4)
CO4	Create well-organized written and oral analyses that demonstrate critical thinking and insight into literary texts.	Create (K6)
CO5	Compare and contrast different literary works and traditions to identify unique and shared features.	Analyze (K4)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	-	-	-	-	-	-	-	-	2	3	-	2	-	-
CO2	-	-	-	-	-	-	-	-	2	3	-	2	-	-
CO3	-	-	-	-	-	-	-	-	2	3	-	2	-	-
CO4	-	-	-	-	-	-	-	-	2	3	-	2	-	-
CO5	-	-	-	-	-	-	-	-	2	3	-	2	-	-

Mapping: 1-Low, 2-Medium, 3-High

Professional Elective Courses



Vertical 1

Semiconductor Technologies

I - Course Name: 23PEC01 Display Systems

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E- ECE	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

1.	To understand the foundational concepts, visual perception principles, and electronics involved in modern display systems.
2.	To explore the working principles, technologies, and driving mechanisms of LCD and other transmissive and reflective displays.
3.	To study the operation, types, and applications of emissive displays and various projection technologies.
4.	To analyze the optics, technology, and design of near-eye displays including smart and holographic systems.
5.	To examine 3D display technologies including autostereoscopic, volumetric, and light field display systems

III - Course Content**Preamble:**

Display systems are integral components in the interface between humans and electronic devices, enabling the visualization of information in various formats such as text, graphics, images, and video. These systems convert electronic signals into visual representations that users can perceive and interpret, making them essential in computers, televisions, smartphones, digital signage, and virtual reality devices.

Unit - I	Display Basics	9 Periods
Introduction to Displays, Requirements of Displays, The Human Visual System, Colorimetry, Depth Perception, Motion Pictures, Fundamental Measures of Displays, Colour, and Intensity Production, Electronics of Displays, Various Display Assembly Technologies		
Unit - II	Transmissive Displays	9 Periods
Introduction to transmissive Displays, Liquid Crystal Display (LCD), Types of LCD, LED Backlighting in LCDs, Reflective Displays, Electronic Paper (E-Ink), Digital Micromirror Device (DMD), Electrowetting and Electrofluidic Displays, Practical applications of Transmissive and Reflective Displays.		
Unit - III	Emissive and Projection Displays	9 Periods
Emissive Displays: CRT, OLED, AMOLED, QLED, Field Emission Displays, Projection Displays: Projector Optics, Projection Lenses and Lamps, OLED Projectors, LCD Projectors, DLP and GLV Projectors, Holographic Projectors		
Unit - IV	Near Eye Displays Display	9 Periods
Near-Eye Displays (NED), Head-Mounted Displays (HMD), Combiner Mirrors and Basic Optical Principles, On-Axis and Off-Axis Near-Eye Displays, Smart NEDs and Augmented Reality, Light Field Displays and Holographic NEDs, Contact Lens Displays, Adaptive Displays, Eye Tracking.		
Unit - V	3-D Displays	9 Periods
Introduction to 3D Displays and their Significance, Spatial and Spectroscopic Displays, Autostereoscopic Displays, Parallax Barrier Displays, Volumetric Displays, Light Field Display, Computer-Generated Holograms (CGH), HDTV and LED Displays, Touch Screen Displays.		

TOTAL: 45 Periods

Reference Books:	1. R G Gupta, Television Engineering and Video Systems, McGraw Hill, India, 2011 (Second Edition). 2. A Veeralakshmi and R Srivel, "Television and Video Engineering", Ane Books, 2013. 3. E.H. Stupp, M. S. Brennessoltz, "Projection Displays", Wiley, 2008 (Second Edition). 4. Joseph A. Castellano, "Handbook of Display Technology", Elsevier, 1992.
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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the principles of display technologies and the role of the human visual system in display design.	Understand (K2)
CO2	Differentiate between transmissive, reflective, and emissive display technologies and describe their working principles	Apply (K3)
CO3	Analyze near-eye display technologies and understand their optical design and applications	Apply (K3)
CO4	Illustrate the various projection display techniques including holographic and laser-based projectors	Apply (K3)
CO5	Describe the basic concepts of 3D displays including autostereoscopic, volumetric, and holographic displays	Understand (K2)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	-	-	-	-	-	-	-	-	1	2	-
CO2	3	3	3	-	-	-	-	-	-	-	-	1	2	-
CO3	3	3	3	-	-	-	-	-	-	-	-	1	2	-
CO4	3	3	3	-	-	-	-	-	-	-	-	1	2	-
CO5	3	3	3	-	-	-	-	-	-	-	-	1	2	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23PEC02 Wide Band Gap Devices

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E- ECE	V/VI/VII	PEC	2	0	2	3

II - Course Objectives

1.	To understand the operation, characteristics, advantages, and challenges of SiC and GaN devices in real-world applications.
2.	To analyze the switching characteristics and loss mechanisms of WBG devices using standard evaluation methods like double pulse testing.
3.	To explore the design and performance of gate driver circuits tailored for wide bandgap power devices.
4.	To examine high-frequency design challenges and optimize PCB layouts for minimizing parasitics and EMI in WBG systems.
5.	To investigate the application of WBG devices across domains such as consumer electronics, EVs, wireless power, and renewable energy systems

III - Course Content

Unit – I	WBG Devices and their applications in Real World	6 Periods
Review of semiconductor basics, Operation and characteristics of the SiC Schottky Barrier Diode, SiC DMOSFET and GaN HEMT, Review of Wide bandgap semiconductor technology - Advantages and disadvantages Thermal Management and Reliability of WBG Devices.		
Unit – II	Switching Characterization of WBG	6 Periods
Turn-on and Turn-off characteristics of the device, Hard switching loss analysis, Double pulse test set-up , Switching loss mechanisms.		
Unit – III	Drivers for Wide Band Gap Devices	6 Periods
Gate driver, Impact of gate resistance, Gate drivers for wide band gap power devices, Transient immunity integrated gate drivers.		
Unit – IV	High Frequency Design Complexity and PCB Designing	6 Periods
Effects of parasitic inductance, Effects of parasitic capacitance, EMI filter design for high frequency power converters High frequency PCB design, Conventional power loop design, High frequency power loop optimization, Separation of power from signal PCB.		
Unit – V	Applications of Wide Band Gap Devices	6 Periods
Consumer electronics applications, Wireless power transfer applications, Electric vehicle applications and Renewable energy sources applications.		

TOTAL: 30 Periods**List of Experiments – 30 Periods:**

1. Conduct switching loss and Magnetic loss on Low side
2. Conduct Double pulse test (DPT) and learn IEC 60747 -8/9 standards
3. Conduct experiments for Diode reverse recovery on High side
4. Conduct Power analysis and harmonic measurement

5. Measure Turn on /off delay. Calculate recovery softness factor, measure reverse recovery energy

TOTAL: 60 Periods

Reference Books:	1. F. Wang, Z. Zhang and E. A. Jones, Characterization of Wide Bandgap Power Semiconductor Devices, IET, ISBN-13: 978-1785614910 (2018). 2. B.J.Baliga, "Gallium Nitride and Silicon Carbide Power Devices," World Scientific Publishing Company (3 Feb. 2017). 3. L. Corradini, D. Maksimovic, P. Mattavelli, R. Zane, "Digital Control of HighFrequency Switched-Mode Power Converters", Wiley, ISBN-13: 978-1118935101 (9th June, 2015)
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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Design principles of power devices.	Apply (K3)
CO2	Explain reliability issues and testing methods.	Understand (K2)
CO3	Design and conduct experiments, as well as to analyze and interpret data.	Apply (K3)
CO4	Implement the experience for practical applications of WBG.	Apply (K3)
CO5	Explain the practical usage of this technology.	Understand (K2)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO2	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO3	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO4	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO5	3	3	3	3	3	-	-	1	2	2	-	1	3	3

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23PEC03 IC Technology and Validation

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E- ECE	V/VI/VII	PEC	2	0	2	3

II - Course Objectives

1.	To understand the fundamentals of IC technologies and VLSI fabrication processes including oxidation, lithography, and doping techniques.
2.	To analyze MOS device theory, short-channel effects, and the design and characteristics of NMOS, CMOS, and BiCMOS inverters.
3.	To evaluate CMOS circuit parameters such as resistance, capacitance, delay, power dissipation, and transistor sizing for performance estimation.
4.	To study silicon validation and fault modeling techniques essential for effective VLSI testing and diagnosis at different design levels.
5.	To explore design-for-testability strategies including scan chains, BIST architectures, memory testing, and test pattern generation.

III - Course Content

Unit – I	IC Technology Introduction	6 Periods
Introduction to IC Technology – MOS, PMOS, NMOS, CMOS & BiCMOS Technologies. VLSI Fabrication, Oxidation, Lithography, Diffusion, Ion Implantation, Metallization, Integrated Resistors and Capacitors.		
Unit – II	MOS Theory Analysis-I	6 Periods
Basic Electrical Properties of MOS Circuits, Figure of Merit ω_0 , Short Channel and Narrow Channel Width Effects.		
Unit – III	MOS Theory Analysis- II	6 Periods
Pass Transistor, Transmission Gate, NMOS Inverter, Various Pull-ups, CMOS Inverter Analysis and Design, Bi-CMOS Inverters, Latch up in CMOS Circuits		
Unit – IV	CMOS Circuit Characterization and Performance Estimation	6 Periods
Sheet Resistance R_S , conductivity and its Concept to MOS, Area Capacitance Units, Calculations - Delays, Driving Large Capacitive Loads, Delay Estimation, Logical Effort and Transistor Sizing, Power Dissipation, Reliability		
Unit – V	Basics of Silicon Validation	6 Periods
Need for Testing, Testing at Various Levels, Objectives of Testing - VLSI Test process and Test Equipment - Types of Testing: Functionality Tests, Silicon Debug, Manufacturing Tests, Defect during manufacturing - Fault Modelling, Observability and Controllability, Fault Coverage, Fault Sampling - ATE, Test economics.		

TOTAL: 30 Periods

List of Experiments – 30 Periods

1. MOS TESTING for I_{ds} - V_{ds} Relationships
2. MOSFET testing for threshold voltage like V_{th} , gate breakdown voltage.
3. Sheet resistivity measurement.
4. Conductivity measurement.
5. Inverter testing
6. Designing of CMOS inverter/ logic gate and testing of delay estimation.

TOTAL: 60 Periods

Reference Books:	1. Kamran Ehraghian, Douglas A. Pucknell and Sholeh Eshraghian, "Essentials of VLSI Circuits and Systems" – PHI, EEE, 2005 Edition.
	2. Neil H. E. Weste and David. Harris Ayan Banerjee, "CMOS VLSI Design" - Pearson Education, 1999.
	3. M.L. Bushnell and V.D. Agrawal, "Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits", Kluwer Academic Publishers, 2004
	4. N.K. Jha and S.G. Gupta, "Testing of Digital Systems", Cambridge University Press, 2003
	5. Etienne Sicard, Sonia Delmas Bendhia, "Basics of CMOS Cell Design", TMH, EEE, 2005
	6. N. Jha and S.D. Gupta, "Testing of Digital Systems", Cambridge, 2003

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the CMOS fabrication process.	Understand (K2)
CO2	Apply the fundamental concept of MOS FET and testing.	Apply (K3)
CO3	Apply the concept of MOS theory and analysis.	Apply (K3)
CO4	Understand the basics of Testing and Fault Modeling.	Understand (K2)
CO5	Explain the design for testability methods for CMOS circuits.	Understand (K2)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO2	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO3	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO4	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO5	3	3	3	3	3	-	-	1	2	2	-	1	3	3

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23PEC04 Low Power IC Design

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E- ECE	V/VI/VII	PEC	2	0	2	3

II - Course Objectives

1.	To understand the need for low power circuit design and analyze various sources of power dissipation and leakage control in modern devices.
2.	To explore voltage scaling, pipelining, parallel processing, and capacitance minimization techniques for low power circuit design.
3.	To study different adder architectures and low-voltage, low-power design strategies for arithmetic circuits with a focus on adders.
4.	To examine various multiplier architectures and design techniques suitable for low-voltage, low-power applications.
5.	To analyze memory architectures and technologies with emphasis on designing low-power ROM, SRAM, and DRAM systems.

III - Course Content

Preamble: Designing low power ICs involves techniques applied at various levels, including technology selection, circuit architecture, logic design, and physical implementation. Key strategies include dynamic and static power reduction, voltage scaling, power gating, clock gating, and the use of energy-efficient components.		
Unit – I	Fundamentals of Low Power Circuits	6 Periods
Need for Low Power Circuit Design, Sources of Power Dissipation – Switching Power Dissipation, Short Circuit Power Dissipation, Leakage Power Dissipation, Glitching Power Dissipation, Short Channel Effects, New Device Technologies for Reducing Leakage Current.		
Unit – II	Low-Power Design Approaches	6 Periods
Low-Power Design through Voltage Scaling: VTCMOS circuits, MTCMOS circuits, Architectural Level Approach –Pipelining and Parallel Processing Approaches. Switched Capacitance Minimization Approaches: System Level Measures, Circuit Level Measures, Mask level Measures.		
Unit – III	Low-Voltage Low-Power Adders	6 Periods
Introduction, Standard Adder Cells, CMOS Adder's Architectures – Ripple Carry Adders, Carry Look-Ahead Adders, Carry Select Adders, Carry Save Adders, Low Voltage Low Power Design Techniques –Trends of Technology and Power Supply Voltage, Low-Voltage Low-Power Logic Styles, CAD Tools for Low Power Synthesis - Case Study.		
Unit – IV	Low-Voltage Low-Power Multipliers	6 Periods
Introduction, Overview of Multiplication, Types of Multiplier Architectures, Braun Multiplier, Baugh-Wooley Multiplier, Booth Multiplier, Introduction to Wallace Tree Multiplier.		

Unit – V	Low-Voltage Low-Power Memories	6 Periods
Basics of ROM, Low-Power ROM Technology, Future Trend and Development of ROMs, Basics of SRAM, SRAM architecture, Low Power SRAM Technologies, CMOS memory circuits Basics of DRAM, Self-Refresh Circuit, Future Trend and Development of DRAM.		

TOTAL: 30 Periods**List of Experiments – 30 Periods**

1. Modeling and sources of power consumption.
2. Power estimation at different design levels (mainly circuit, transistor, and gate)
3. Power optimization for combinational circuits.
4. Power optimization for sequential circuits.
5. Power optimization for RT and algorithmic levels.

TOTAL: 60 Periods

Reference Books:	1. Sung-Mo Kang, Yusuf Leblebici, "CMOS Digital Integrated Circuits – Analysis and Design", TMH, 2011. 2. Kiat-Seng Yeo, Kaushik Roy, "Low-Voltage, Low-Power VLSI Subsystems", TMH Professional Engineering, 2004. 3. Ming-BO Lin, "Introduction to VLSI Systems: A Logic, Circuit and System Perspective", CRC Press, 2012. 4. Anantha Chandrakasan, "Low Power CMOS Design", IEEE Press, /Wiley International, 1998 5. Kaushik Roy, Sharat C. Prasad, "Low Power CMOS VLSI Circuit Design", John Wiley, & Sons, 2000. 6. Gary K. Yeap, "Practical Low Power Digital VLSI Design", Kluwer Academic Press, 2002 7. Bellamour, M. I. Elamasri, "Low Power CMOS VLSI Circuit Design", A Kluwer Academic Press, 1995. 8. Siva G. Narendran, Anatha Chandrakasan, "Leakage in Nanometer CMOS Technologies", Springer, 2005
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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	Understand the fundamentals of Low power IC design.	Understand (K2)
C02	Apply the knowledge of architectural approaches.	Apply (K3)
C03	Analyze and design Low Voltage Low Power combinational circuits.	Analyze (K4)
C04	Design the Low Voltage Low Power Circuits.	Apply (K3)
C05	Explain the use of Low-Voltage Low-Power Memories.	Understand (K2)


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V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C01	3	3	3	3	3	-	-	1	2	2	-	1	3	3
C02	3	3	3	3	3	-	-	1	2	2	-	1	3	3
C03	3	3	3	3	3	-	-	1	2	2	-	1	3	3
C04	3	3	3	3	3	-	-	1	2	2	-	1	3	3
C05	3	3	3	3	3	-	-	1	2	2	-	1	3	3

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23PEC05 VLSI Testing and Design for Testability

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E- ECE	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

1.	To introduce the fundamentals of digital circuit testing and fault modeling, including fault types, simulation methods, and delay models.
2.	To develop test generation techniques for combinational and sequential circuits and design circuits with enhanced testability
3.	To explore various design-for-testability (DFT) strategies including ad-hoc and scan-based design approaches.
4.	To understand built-in self-test (BIST) concepts, architectures, and test algorithms for memory and embedded systems.
5.	To study fault diagnosis techniques at the logic and system levels, including self-checking and reduction-based methods.

III - Course Content**Preamble:**

Design for Testability (DFT) is a critical methodology incorporated during the design phase to facilitate efficient and effective testing of VLSI circuits. By embedding specific test features and structures within the chip, DFT techniques simplify the generation of test patterns, reduce test time, and improve fault coverage, thus enhancing the overall quality and yield of semiconductor devices.

Unit - I	Test Requirements and Metrics	9 Periods
Validation platforms- SOC design methodology, IP components, Integration, Clocking, I/Os and interfaces, Device modes, Logic, memories, analog, I/Os, power management; Test requirements, Test handoffs, Testers Where DUT and DFT fit into design / framework; Test-ATPG, DFT, BIST, COF, TTR; Test cost metrics and test economics; Logic fault models- SAF, TDF, PDF, IDDQ, StBDG, Dy-BDG, SDD; Basics of test generation and fault simulation- Combinational circuits, Sequential; Specific algorithmic approaches, CAD framework, Optimizations		
Unit - II	Scan Design And BIST	9 Periods
Scan Design- Scan design requirements, Types of scan and control mechanisms, Test pattern construction for scan, Managing scan in IPs and SOC, Scan design optimizations, Partitioning, Clocking requirements for scan and delay fault testing, Speed of operation; BIST – Framework, Controller configurations, FSMs, LFSRs, STUMPS architecture, Scan compression and bounds, Test per cycle, Test per scan, Self-testing and self-checking circuits, Online test		
Unit - III	Memory Test and Test Interfaces	9 Periods
Memory Test -Memory fault models, Functional architecture as applicable to test, Test of memories, Test of logic around memories, BIST controller configuration, Test of logic around memories, DFT and architecture enhancements, Algorithmic optimizations; Test Interfaces-Test control requirements, Test interfaces - 1500, JTAG, Hierarchical, serial control, Module / IP test, SOC test, Board test, System test, Boundary scan.		

Unit – IV	Design Considerations and Power Management during Test	9 Periods
Design Considerations- Design considerations, Physical design congestion, Partitioning, Clocks, Test modes, Pins, Test scheduling, Embedded test, Architecture improvements, Test in the presence of security; Power management during test- Methods for low power test, ATPG methods, DFT methods, Scan methods, Low power compression, Test of power management, Implications of power excursions, Optimizations		
Unit – V	Analog Test	9 Periods
Test requirements. DFT methods. BIST methods. Test versus measurement. Defect tests versus performance tests. Tests for specific modules - PLL, I/Os, ADC, DAC, SerDes, etc. RF test requirements.		

TOTAL: 45 Periods

Reference Books:	1. M. Abramovici, M.A. Breuer and A.D. Friedman, "Digital Systems Testing & Testable Design", Jaico Publishing House. 2. M.L. Bushnell and V.D. Agrawal, "Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits", Kluwer Academic Publishers. 3. P.K. Lala, "Digital Circuit Testing and Testability", Academic Press, 2002. 4. A.L. Crouch, "Design Test for Digital IC's and Embedded Core Systems", Prentice Hall International.
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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the fundamentals of digital circuit testing.	Understand (K2)
CO2	Apply test generation techniques for both combinational and sequential circuits.	Apply (K3)
CO3	Design testable circuits using Design for Testability methodologies.	Apply (K3)
CO4	Implement Built-In Self-Test (BIST) and memory testing strategies.	Analyze (K4)
CO5	Perform diagnosis and fault localization in digital systems.	Apply (K3)

V - Mapping Table Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	3	-	-	-	-	-	-	1	3	3
CO2	3	3	3	3	3	-	-	-	-	-	-	1	3	3
CO3	3	3	3	3	3	-	-	-	-	-	-	1	3	3
CO4	3	3	3	3	3	-	-	-	-	-	-	1	3	3
CO5	3	3	3	3	3	-	-	-	-	-	-	1	3	3

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23PEC06 Analog IC Design

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E- ECE	V/VI/VII	PEC	2	0	2	3

II - Course Objectives

1.	To understand the operation and analysis of single-stage MOS amplifiers including CS, CG, source follower, and advanced configurations like cascode.
2.	To evaluate the high-frequency response and noise characteristics of various amplifier stages for analog IC design.
3.	To study negative feedback principles and design single-stage and two-stage operational amplifiers with enhanced performance features.
4.	To analyze stability and frequency compensation techniques for multi-stage amplifiers to ensure robust analog circuit behavior
5.	To explore fault detection in logic circuits and learn advanced analog circuit design techniques including band gap references and analog layout practices.

III - Course Content**Preamble:**

Analog Integrated Circuit (IC) design is a fundamental area of electronics engineering focused on the creation of circuits that process continuous-time signals. Unlike digital circuits, which operate on discrete logic levels, analog ICs deal with real-world signals such as voltage, current, frequency, and amplitude, enabling applications in audio, radio frequency (RF), sensors, power management, and instrumentation.

Unit – I	Single Stage Amplifiers	6 Periods
Overview of analog vs. digital ICs, Basic MOS physics and equivalent circuits and models, CS, CG and Source Follower, differential amplifier with active load, Cascode and Folded Cascode configurations with active load		
Unit – II	High Frequency and Noise Characteristics of Amplifiers	6 Periods
Miller effect, association of poles with nodes, frequency response of CS, CG and Source Follower, Cascode and Differential Amplifier stages, statistical characteristics of noise, noise in Single Stage amplifiers, noise in Differential amplifiers.		
Unit – III	Feedback and Single Stage Operational Amplifiers	6 Periods
Properties and types of negative feedback circuits, effect of loading in feedback networks, Operational amplifier performance parameters, single stage Op-Amps, two-stage Op-Amps, Gain boosting and common-mode feedback.		
Unit – IV	Stability and Frequency Compensation	6 Periods
Multipole Systems, Phase Margin, Frequency Compensation, Compensation of Two Stage Op-Amps, Slewing In Two Stage Op-Amps, Other Compensation Techniques.		
Unit – V	Logic Circuit Testing and Advanced Analog Circuits	6 Periods
Faults in Logic Circuits- Basic Concepts of Fault Detection- Design for Testability, Bandgap reference circuits, Analog layout techniques		

TOTAL: 30 Periods

List of Experiments – 30 Periods

1. DC and AC analysis of NMOS and PMOS devices
2. Design and simulation of Common Source and Source Follower amplifiers
3. Design and simulation of differential amplifier
4. Frequency response analysis of single-stage operational amplifiers
5. Slew rate evaluation of Op-Amp.
6. Design and Simulation of Wilson Current mirror circuit.

TOTAL: 60 Periods

Reference Books:	1. Behzad Razavi, "Design of Analog Cmos Integrated Circuits", Tata Mcgraw Hill, 2001 2. Parag K.Lala, "An Introduction to Logic Circuit Testing", Morgan & Claypool Publishers, 2009. 3. Willey M.C. Sansen, "Analog Design Essentials", Springer, 2006. 4. Grebene, "Bipolar and MOS Analog Integrated Circuit Design", John Wiley & Sons, Inc., 2003. 5. Phillip E.Allen, Douglas R.Holberg, "CMOS Analog Circuit Design", Oxford University Press, 2nd Edition, 2002 6. Jacob Baker "CMOS: Circuit Design, Layout, and Simulation, Wiley IEEE Press, 3rd Edition, 2010
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IV - Course Outcomes

	On completion of the course, the students will be able to	Bloom's Level Mapped
CO1	Understand the fundamentals and modeling of MOSFET devices and analog IC design.	Understand (K2)
CO2	Analyze the frequency and noise characteristics of amplifiers.	Analyze (K4)
CO3	Analyze and design single-stage amplifiers for specified performance parameters	Analyze (K4)
CO4	Analyze stability of op-amp.	Analyze (K4)
CO5	Analyze advanced analog circuits and testing.	Analyze (K4)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO2	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO3	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO4	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO5	3	3	3	3	3	-	-	1	2	2	-	1	3	3

Mapping: 1-Low, 2-Medium, 3-High

Vertical 2

Signal Processing Technologies

I - Course Name: 23PEC07 Advanced Digital Signal Processing

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E- ECE	V/VI/VII	PEC	2	0	2	3

II - Course Objectives

1.	To introduce the concepts of discrete time random signal processing.
2.	To know about multirate signal processing and its applications.
3.	To understand the spectrum estimation techniques.
4.	To learn the concept of prediction theory and filtering.

III - Course Content

Preamble: This course/module delves into advanced topics including multirate systems, filter banks, adaptive filtering, spectral estimation, time-frequency analysis, and optimal signal representation. It emphasizes both the mathematical rigor and algorithmic strategies required to process digital signals efficiently and accurately.		
Unit - I	Multirate Signal Processing	6 Periods
Review of Convolution, DFT and ZT, Multirate Signal Processing - Decimation, Interpolation, Sampling Rate Conversion by a rational factor – digital filter banks, sub band coding, Quadrature Mirror Filter.		
Unit - II	Discrete Time Random Processes	6 Periods
Stationary random processes, Autocorrelation, Rational Power Spectra, Filters for generating random Processes from white noise and inverse filter – AR, MA and ARMA processes – relationship between autocorrelation and the filter parameters.		
Unit - III	Linear Prediction and Filtering	6 Periods
Linear Prediction – Forward and Backward - Wiener filters for filtering and prediction – FIR Wiener Filter – IIR Wiener Filter – Kalman Filter.		
Unit - IV	Adaptive Filtering	6 Periods
FIR adaptive filters – adaptive filters based on steepest descent method – LMS algorithm – Variants of LMS algorithm – adaptive echo cancellation – adaptive channel equalization – RLS Algorithm.		
Unit - V	Spectrum Estimation	6 Periods
Estimation of power spectra from finite duration observations of signals – Non parametric methods of spectrum estimation – the Bartlett and the Welch method – Parametric spectrum estimation – AR, MA and ARMA.		

TOTAL: 30 Periods

List of Experiments – 30 Periods

1. Study of autocorrelation and Cross Correlation of random signals
2. Design and Implementation of Multirate Systems.
3. Design and Implementation of Wiener Filter
4. Design and Implementation of FIR Linear Predictor.
5. Design of adaptive filters using LMS algorithm.
6. Spectrum Estimation using Bartlett and Welch Methods

TOTAL: 60 Periods

Reference Books:	1. John G. Proakis & Dimitris G. Manolakis, –Digital Signal Processing – Principles, Algorithms & Applications, Fourth Edition, Pearson Education / Prentice Hall, 2007. 2. P. Vaidyanathan, "Multirate systems and filter banks", Prentice Hall Inc. 1993.
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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Comprehend multirate signal processing and demonstrate its applications.	Understand (K2)
CO2	Demonstrate an understanding of the power spectral density and apply to discrete random signals and systems.	Analyze (K4)
CO3	Apply linear prediction and filtering techniques to discrete random signals for signal detection and estimation.	Apply (K3)
CO4	Analyze adaptive filtering problems and demonstrate its application.	Analyze (K4)
CO5	Apply power spectrum estimation techniques to random signals.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO2	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO3	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO4	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO5	3	3	3	3	3	-	-	1	2	2	-	1	3	3

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23PEC08 Image Processing

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E- ECE	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

1.	To become familiar with digital image fundamentals
2.	To get exposed to simple image enhancement techniques in Spatial and Frequency domain.
3.	To learn concepts of degradation function and restoration techniques.
4.	To study the image segmentation and representation techniques.
5.	To become familiar with image compression and recognition methods

III - Course Content**Preamble:**

This course introduces the fundamental principles and methodologies used to process and interpret digital images. Topics include image acquisition, sampling and quantization, enhancement techniques in spatial and frequency domains, filtering, restoration, segmentation, morphological operations, and color image processing.

Unit - I	Digital Image Fundamentals	9 Periods
Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels – Color image fundamentals – RGB, HSI models, Two-dimensional mathematical preliminaries, 2D transforms – DFT, DCT.		
Unit - II	Image Enhancement	9 Periods
Spatial Domain: Gray 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 – Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement.		
Unit - III	Image Restoration	9 Periods
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	9 Periods
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	9 Periods
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.

TOTAL: 45 Periods

Reference Books:	1. Kenneth R. Castleman, 'Digital Image Processing', Pearson, 2006. 2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, 'Digital Image Processing using MATLAB', Pearson Education, Inc., 2011. 3. D.E. Dudgeon and R.M. Mersereau, 'Multidimensional Digital Signal Processing', Prentice Hall Professional Technical Reference, 1990. 4. William K. Pratt, 'Digital Image Processing', John Wiley, New York, 2002 5. Milan Sonka et al 'Image processing, analysis and machine vision', Brookes/Cole, Vikas Publishing House, 2nd edition, 1999.
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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the basics and fundamentals of digital image processing.	Understand (K2)
CO2	Operate on images using the techniques of smoothing, sharpening and enhancement.	Apply (K3)
CO3	Understand the restoration concepts and filtering techniques.	Understand (K2)
CO4	Learn the basics of segmentation, features extraction, compression and recognition methods for color models.	Understand (K2)
CO5	Comprehend image compression concepts.	Understand (K2)

V - Mapping Table Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	3	-	-	-	-	-	-	1	3	3
CO2	3	3	3	3	3	-	-	-	-	-	-	1	3	3
CO3	3	3	3	3	3	-	-	-	-	-	-	1	3	3
CO4	3	3	3	3	3	-	-	-	-	-	-	1	3	3
CO5	3	3	3	3	3	-	-	-	-	-	-	1	3	3

Mapping: 1-Low, 2-Medium, 3-High



I - Course Name: 23PEC09 Speech Processing

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E- ECE	V/VI/VII	PEC	2	0	2	3

II - Course Objectives

1.	To understand the fundamentals of human speech production, perception, phonetics, and spectrographic analysis of speech signals.
2.	To study the extraction and significance of speech features and evaluate various distortion measures used in speech applications.
3.	To explore different speech coding techniques including waveform, parametric, hybrid, and transform domain coding methods.
4.	To analyze various speech enhancement algorithms and filtering techniques for noise reduction and speech quality improvement.
5.	To examine text-to-speech synthesis techniques and investigate modern applications like speech transformation, watermarking, and emotion recognition.

III - Course Content**Preamble:**

This course/module provides a comprehensive introduction to the principles and techniques used in the analysis, modeling, and synthesis of speech signals. It covers core concepts such as speech production and perception, time and frequency domain analysis, short-time Fourier transforms, linear predictive coding (LPC), cepstral analysis, and speech feature extraction (e.g., MFCCs).

Unit - I	Fundamentals of Speech	6 Periods
The Human speech production mechanism, Discrete-Time model of speech production, Speech perception - human auditory system, Phonetics - articulatory phonetics, acoustic phonetics, and auditory phonetics, Categorization of speech sounds, Spectrographic analysis of speech sounds, Pitch frequency, Pitch period measurement using spectral and cepstral domain, Formants, Evaluation of Formants for voiced and unvoiced speech.		
Unit - II	Speech Features and Distortion Measures	6 Periods
Significance of speech features in speech-based applications, Speech Features - Cepstral Coefficients, Mel Frequency Cepstral Coefficients (MFCCs), Perceptual Linear Prediction (PLP), Log Frequency Power Coefficients (LFPCs), Speech distortion measures-Simplified distance measure, LPC-based distance measure, Spectral distortion measure, Perceptual distortion measure		
Unit - III	Speech Coding	6 Periods
Need for speech coding, Waveform coding of speech - PCM, Adaptive PCM, DPCM, ADPCM, Delta Modulation, Adaptive Delta Modulation, G.726 Standard for ADPCM, Parametric Speech Coding - Channel Vcoders, Linear Prediction Based Vcoders, Code Excited Linear Prediction (CELP) based Vcoders, Sinusoidal speech coding techniques, Hybrid coder, Transform domain coding of speech		
Unit - IV	Speech Enhancement	6 Periods
Classes of Speech Enhancement Algorithms, Spectral-Subtractive Algorithms - Multiband Spectral Subtraction, MMSE Spectral Subtraction Algorithm, Spectral Subtraction Based on Perceptual Properties, Wiener Filtering - Wiener Filters in the Time Domain, Wiener Filters in the Frequency Domain, Wiener Filters for Noise Reduction, Maximum-Likelihood Estimators, Bayesian Estimators, MMSE and Log-MMSE Estimator, Subspace Algorithms.		

Unit - V	Speech Synthesis and Application	6 Periods
A Text-to-Speech systems (TTS), Synthesizers technologies – Concatenative synthesis, Use of Formants for concatenative synthesis, Use of LPC for concatenative synthesis, HMM-based synthesis, Sinewave synthesis, Speech transformations, Watermarking for authentication of a speech, Emotion recognition from speech.		

TOTAL: 30 Periods**List of Experiments – 30 Periods**

1. Write a MATLAB Program to classify voiced and unvoiced segment of speech using various time domain measures
2. Write a MATLAB Program to calculate the MFCC for a speech signal
3. Implement ITU-T G.722 Speech encoder in MATLAB
4. Write a MATLAB Program to implement Wiener Filters for Noise Reduction
5. Design a speech emotion recognition system using DCT and WPT in MATLAB

TOTAL: 60 Periods

Reference Books:	1. Rabiner L. R. and Juang B. H, Fundamentals of speech recognition, Pearson Education, 2003 2. Thomas F. Quatieri, Discrete-time speech signal processing - Principles and practice, Pearson, 2012
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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the fundamentals of speech.	Understand (K2)
CO2	Extract various speech features for speech related applications.	Apply (K3)
CO3	Choose an appropriate speech coder for a given application.	Analyze (K4)
CO4	Build a speech enhancement system.	Analyze (K4)
CO5	Build a text-to-speech synthesis system for various applications.	Analyze (K4)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO2	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO3	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO4	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO5	3	3	3	3	3	-	-	1	2	2	-	1	3	3

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23PEC10 Software Defined Radio

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E- ECE	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

1.	To introduce the fundamentals, characteristics, and architectural principles of software-defined radio systems.
2.	To understand RF front-end components, receiver topologies, and their impact on SDR performance and flexibility.
3.	To explore digital signal generation techniques, including direct digital synthesis and DAC performance considerations.
4.	To examine smart antenna technologies, beamforming structures, and associated algorithms and hardware implementations.
5.	To analyze hardware and software platforms for SDR, including DSPs, FPGAs, ASICs, and development tools like GNU Radio and USRP.

III - Course Content

Preamble: This course introduces the fundamental concepts, architectures, and design principles of SDR systems. It explores topics such as signal modulation/demodulation, digital up/down conversion, channel estimation, dynamic spectrum access, and cognitive radio frameworks. Emphasis is placed on the shift from fixed-function hardware to programmable radio platforms that support multiple standards and waveforms.		
Unit - I	Introduction to Software Radio	9 Periods
Basics of Software defined Radio. Principles Characteristics and Benefits of a Software Radio. Architecture of Software Radio.		
Unit - II	RF Implementation	9 Periods
Components of RF front - end, Dynamic range, RF receiver front - end topologies, Enhanced flexibility of the RF chain with software radios, Importance of the components to overall performance, Transmitter architectures and their issues.		
Unit - III	Digital Generation of Signals	9 Periods
Comparison of direct digital synthesis with analog signal synthesis, Approaches to direct digital synthesis, Digital-to-Analog Conversion (DAC), Analysis of spurious signals		
Unit - IV	Smart Antennas	9 Periods
Introduction, Types of smart antennas, Structures for beam forming systems, Smart antenna algorithms, Hardware implementation of smart antennas, Digital Hardware Choices-Key hardware elements.		
Unit - V	Hardware and Software for SDR	9 Periods
DSP Processors, FPGA, ASICs. Trade-offs, Object oriented programming, Object Brokers, GNU Radio-USRP.		

TOTAL: 45 Periods

Reference Books:	1. Jeffrey Hugh Reed, "Software Radio: A Modern Approach to Radio Engineering," Prentice Hall Professional, 2002. 2. Tony J Roupheal, "RF and DSP for SDR," Elsevier Newnes Press, 2008. 3. P. Kenington, "RF and Baseband Techniques for Software Defined Radio," Artech House, 2005. 4. Paul Burns, "Software Defined Radio for 3G," Artech House, 2002. 5. Behrouz. F. Bourjney "Signal Processing for Software defined Radios", Lulu 2008.
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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	Demonstrate an understanding in the evolving paradigm of Software defined radio and technologies for its implementation.	Understand (K2)
C02	Analyze Radio frequency implementation issues.	Analyze (K4)
C03	Implement Smart antenna techniques for software defined radio.	Analyze (K4)
C04	Compare various digital synthesis procedures.	Understand (K2)
C05	Comprehend various hardware and software requirements for software defined radios.	Understand (K2)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C01	3	3	3	3	3	-	-	-	-	-	-	1	2	-
C02	3	3	3	3	3	-	-	-	-	-	-	1	2	1
C03	3	3	3	3	3	-	-	-	-	-	-	1	2	1
C04	3	3	3	3	3	-	-	-	-	-	-	1	2	-
C05	3	3	3	3	3	-	-	-	-	-	-	1	2	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23PEC11 DSP Architecture and Programming

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E- ECE	V/VI/VII	PEC	2	0	2	3

II - Course Objectives

1.	Study the architecture of programmable DSP processors.
2.	Learn to implement various standard DSP algorithms in DSP Processors.
3.	Use the Programmable DSP Processors to build real-time DSP systems.

III - Course Content

Preamble: This course/module focuses on the architectural features, instruction sets, and programming models of specialized DSP processors. It covers topics such as parallelism, pipelining, Harvard and modified Harvard architectures, memory hierarchies, and hardware accelerators used to optimize signal processing tasks.		
Unit - I	Architectures for Programmable DSP Processors	6 Periods
Basic Architectural features, DSP Computational building blocks, Bus architecture and memory, Data addressing capabilities, Address generation Unit, Programmability and program execution, Speed issues, Features for external interfacing		
Unit - II	TMS320C5X Programmable DSP Processor	6 Periods
Architecture of TMS320C54xx DSP processors, Addressing modes – Assembly language Instructions -Memory space, interrupts, and pipeline operation of TMS320C54xx DSP Processor, On-Chip peripherals, Block Diagram of TMS320C54xx		
Unit - III	TMS320C6X Programmable DSP Processor	6 Periods
Commercial TI DSP processors, Architecture of TMS320C6x DSP Processor, Linear and Circular addressing modes, TMS320C6x Instruction Set, Assembler directives, Linear Assembly, Interrupts, Multichannel buffered serial ports, Block diagram of TMS320C67xx DSP Starter Kit and Support Tools		
Unit - IV	Implementation of DSP Algorithms	6 Periods
DSP Development system, On-chip, and On-board peripherals of C54xx and C67xx DSP development boards, Code Composer Studio (CCS) and support files, Implementation of Conventional FIR, IIR, and Adaptive filters in TMS320C54xx/TMS320C67xx DSP processors for real-time DSP applications, Implementation of FFT algorithm for frequency analysis in real-time.		
Unit - V	Applications of DSP Processors	6 Periods
Voice scrambling using filtering and modulation, Voice detection and reverse playback, Audio effects, Graphic Equalizer, Adaptive noise cancellation, DTMF signal detection, Speech thesis using LPC, Automatic speaker recognition		

TOTAL: 30 Periods

List of Experiments – 30 Periods

1. Real-Time Sine Wave Generation
2. Programming examples using C, Assembly and linear assembly
3. Implementation of moving average filter
4. FIR implementation with a Pseudorandom noise sequence as input to a filter.
5. Fixed point implementation of IIR filter
6. FFT of Real-Time input signal

HARDWARE & SOFTWARE SUPPORT TOOLS:

- TMS320C54xx /TMS320C67xx DSP Development board
- Code Composer Studio (CCS)
- Function Generator and Digital Storage Oscilloscope
- Microphone and speaker

TOTAL: 60 Periods

Reference Books:	1. Avtar Singh and S. Srinivasan, Digital Signal Processing – Implementations using DSP Microprocessors with Examples from TMS320C54xx, Cengage Learning India Private Limited, Delhi 2012 2. Rulph Chassaing and Donald Reay, Digital Signal Processing and Applications with the TMS320C6713 and TMS320C6416 DSK, Second Edition, Wiley India (P) Ltd, New Delhi, 2008
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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the architectural features of DSP Processors.	Understand (K2)
CO2	Comprehend the organization of TMS320C54xx DSP processors.	Understand (K2)
CO3	Build solutions using TMS320C6x DSP Processor.	Analyze (K4)
CO4	Implement DSP Algorithms.	Analyze (K4)
CO5	Study the applications of DSP Processors.	Understand (K2)

V - Mapping Table Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO2	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO3	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO4	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO5	3	3	3	3	3	-	-	1	2	2	-	1	3	3

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23PEC12 Multimedia Compression and Communication

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E- ECE	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

1.	To study the fundamentals of audio compression techniques such as PCM, ADPCM, delta modulation, and predictive coding methods.
2.	To understand various image and video compression formats and algorithms including JPEG, MPEG, and motion estimation techniques.
3.	To explore the principles and methods used in text compression including Huffman, arithmetic, and Lempel-Ziv based coding schemes.
4.	To analyze guaranteed service models in networking, focusing on QoS metrics, scheduling, routing, and resource reservation protocols.
5.	To examine multimedia communication networks, emphasizing streaming, synchronization, jitter handling, and communication protocols like RTP and SIP.

III - Course Content

Preamble: This course/module introduces the principles and techniques used to compress and transmit multimedia data effectively. Topics include lossy and lossless compression, entropy coding, transform coding (DCT, wavelets), video compression standards (JPEG, MPEG, H.264/AVC, H.265/HEVC), audio compression (MP3, AAC), and scalable media coding.		
Unit - I	Audio Compression	9 Periods
Multimedia components - Sampling and Quantization of Speech (PCM) - Adaptive differential PCM - Delta Modulation - Vector Quantization- Linear predictive coding (LPC), Code excited Linear predictive Coding (CELP)		
Unit - II	Image and Video Compression	9 Periods
Image Formats - Graphics Interchange format- Tagged image file format-Digitized documents-Digitized pictures JPEG-Video Encoding, Motion estimation -Overview of H.263 and MPEG-2		
Unit - III	Text Compression	9 Periods
Static and Dynamic Shannon Fano Coding, Huffman coding - Arithmetic coding -Lempel-Ziv coding - LZW coding - LZ78 algorithm		
Unit - IV	Guaranteed Service Model	9 Periods
Best Effort service model - Scheduling and Dropping policies - Network Performance Parameters - Quality of Service and metrics - WFQ and its variants - Random Early Detection - QoS aware Routing - Admission Control - Resource Reservation - RSVP		
Unit - V	Multimedia Communication Networks	9 Periods
Stream characteristics for Continuous media - Temporal Relationship - Object Stream Interactions, Media Levity, Media Synchronization - Models for Temporal Specifications -		

Streaming of Audio and Video – Jitter – Fixed playout and Adaptive playout – Recovering from packet loss – RTSP – Multimedia Communication Standards – RTP/RTCP – SIP and H.263

TOTAL: 45 Periods

Reference Books:	1. Tay Vaughan, –Multimedia Making it work, McGraw-Hill Osborne Media, 2006. 2. Kurose and W. Ross, Computer Networking: A Top-Down Approach, Pearson education, 7 th edition, 2017. 3. KR. Rao, Z S Bojkovic, D A Milovanovic, Multimedia Communication Systems: Techniques, Standards, and Networks, Pearson Education 2007 4. R. Steimnetz, K. Nahrstedt, Multimedia Computing, Communications and Applications, Pearson Education, 1 st edition, 1995 5. Nalin K Sharda, Multimedia Information Networking, Prentice Hall of India, 1999 6. Aura Ganz, Zvi Ganz and Kittu Wongthawaravat, Multimedia Wireless Networks: Technologies, Standards and QoS, Prentice Hall, 2003. 7. Ellen Kayata Wesel, Wireless Multimedia Communications: Networking Video, Voice and Data, Addison Wesley, 1998
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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Apply suitable audio compression techniques.	Apply (K3)
CO2	Apply suitable image and video compression techniques.	Apply (K3)
CO3	Apply suitable text compression techniques.	Apply (K3)
CO4	Select suitable service model for specific application.	Apply (K3)
CO5	Explain the multimedia communication network.	Understand (K2)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	3	-	-	-	-	-	-	1	2	-
CO2	3	3	3	3	3	-	-	-	-	-	-	1	2	-
CO3	3	3	3	3	3	-	-	-	-	-	-	1	2	-
CO4	3	3	3	3	3	-	-	-	-	-	-	1	2	-
CO5	3	3	3	3	3	-	-	-	-	-	-	1	2	-

Mapping: 1-Low, 2-Medium, 3-High

Vertical 3

RF Technologies



I - Course Name: 23PEC13 Antenna Design

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E- ECE	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

1.	To introduce the basic concepts of antenna arrays for smart antenna design.
2.	To discuss the random variables and processes for angle of arrival (AOA) estimation.
3.	To describe different algorithms used for AOA estimation.
4.	To introduce the concepts of fixed weight beamforming.
5.	To introduce the concept of adaptive beamforming.

III - Course Content**Preamble:**

This course/module offers a comprehensive study of antenna fundamentals, theory, and modern design methodologies. Topics include radiation principles, antenna parameters, wire antennas, aperture antennas, microstrip patch antennas, array design, and broadband/multiband antennas. Emphasis is also placed on emerging areas such as reconfigurable antennas, wearable antennas, and antennas for 5G and IoT applications.

Unit - I	Array Antenna	9 Periods
Linear arrays: Two element and Uniform N element array – Array weighting: Beam steered and weighted arrays – Circular arrays – Rectangular planar arrays – Fixed beam arrays – Butler Matrices – Fixed sidelobe cancelling – Retrodirective arrays: Passive and active retrodirective arrays.		
Unit - II	Principles of Random Variables and Processes	9 Periods
Definition of Random Variables - Probability Density Functions - Expectation and Moment - Common Probability Density Functions - Stationarity and Ergodicity - Autocorrelation and Power Spectral.		
Unit - III	Angle of Arrival Estimation	9 Periods
Fundamentals of Matrix Algebra: Vector basics - Matrix basics - Array Correlation Matrix – AOA Estimation Methods: Bartlett AOA estimate, Capon AOA estimate, Linear prediction AOA estimate, Maximum entropy AOA estimate, Pisarenko harmonic decomposition AOA estimate, Min-norm AOA estimate, MUSIC AOA estimate, Root-MUSIC AOA estimate, ESPRIT AOA estimate.		
Unit - IV	Smart Antennas: Fixed Weight Beamforming	9 Periods
Introduction - Historical Development of Smart Antennas - Fixed Weight Beamforming Basics: Maximum signal-to-interference ratio, Minimum mean-square error, Maximum likelihood, Minimum variance.		
Unit - V	Smart Antennas: Adaptive Beamforming	9 Periods
Adaptive Beamforming: Least mean squares, Sample matrix inversion, Recursive least squares, Constant modulus, Least squares constant modulus, Conjugate gradient method, Spreading sequence array weights, Description of the new SDMA receiver.		

TOTAL: 45 Periods

Reference Books:	1. Frank Gross, Smart antennas for wireless communications, McGra-Hill, 2006. 2. S. Chandran, Adaptive antenna arrays, trends and applications, Springer, 2009. 3. T. S. Rappaport, Smart antennas: Adaptive arrays, algorithms and wireless position location, IEEE Press, 1998. 4. Robert A. Monzingo, Randy L. Haupt and Thomas W. Miller, Introduction to Adaptive arrays, 2nd Edition, IET, 2011. 5. Thomas Kaiser, Smart Antennas: State of the Art, Hindawi, 2005
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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Describe the basics of phased array antennas.	Understand (K2)
CO2	Understand random process and its application in Smart antennas.	Understand (K2)
CO3	Estimate the weights of the antenna array based on the angle of arrival.	Apply (K3)
CO4	Analyze the fixed weight beamforming in smart antennas.	Analyze (K4)
CO5	Analyze adaptive beamforming in smart antennas.	Analyze (K4)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	3	-	-	-	-	-	-	1	2	-
CO2	3	3	3	3	3	-	-	-	-	-	-	1	2	-
CO3	3	3	3	3	3	-	-	-	-	-	-	1	2	-
CO4	3	3	3	3	3	-	-	-	-	-	-	1	2	-
CO5	3	3	3	3	3	-	-	-	-	-	-	1	2	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23PEC14 Microwave Integrated Circuits

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E- ECE	V/VI/VII	PEC	2	0	2	3

II - Course Objectives

1.	To understand the fundamentals of transmission lines and analyze planar structures like microstrip, stripline, and coplanar waveguides along with launching techniques.
2.	To study the behavior and modeling of lumped components and analyze common transmission line discontinuities
3.	To design and implement various microwave filters using periodic structures and standard filter synthesis methods.
4.	To analyze coupled-line structures and design microwave couplers using even- and odd-mode analysis
5.	To explore the operation and design of microwave mixers and control circuits including phase shifters and PIN diode-based attenuators.

III - Course Content

Preamble: This course/module introduces the principles, design methodologies, and fabrication techniques of MICs. Core topics include transmission lines (microstrip, stripline, CPW), S-parameters, impedance matching, passive components (couplers, filters, resonators), active components (amplifiers, mixers, oscillators), and noise analysis. Emphasis is placed on high-frequency circuit behavior, electromagnetic simulation, and system integration challenges.		
Unit – I	Planar Transmission Lines and Launching Techniques	6 Periods
Fundamentals of transmission lines Foundations of microstrip lines, striplines, slotlines, coplanar waveguides, coplanar strips Launching techniques and transitions		
Unit – II	Lumped Components and Discontinuities	6 Periods
Lumped components: capacitors, inductors, and resistors Discontinuities: open-circuit end correction, corners, symmetrical steps, T-junctions, series gaps, and bends		
Unit – III	Periodic Structures and Filter Design	6 Periods
Periodic structures. Filter design by the image parameter and insertion loss method. Filter transformations and implementation. Design of various types of low-pass, high-pass, band-stop, and band-pass filters		
Unit – IV	Couplers and Mode Analysis	6 Periods
Even- and odd-mode analysis. Branch-line couplers. Hybrid-ring couplers. Coupled lines and directional couplers.		
Unit – V	Mixers and Control Circuits	6 Periods
Mixer Types – Conversion Loss – SSB and DSB Mixers – Design of Mixers: Single Ended Mixers – Single Balanced Mixers – Sub Harmonic Diode Mixers, Microwave Diodes, Phase Shifters – PIN Diode Attenuators		

TOTAL: 30 Periods

List of Experiments – 30 Periods

1. Study of transmission line parameters – Impedance analysis
2. Design of impedance matching networks
3. Design of low pass and high pass filter
4. Design of band-pass and band-stop filters
5. Design of branch line couplers
6. Design of phase shifters
7. Design of Mixers

TOTAL: 60 Periods

Reference Books:	1. Jia Sheng Hong, M. J. Lancaster, "Microstrip Filters for RF/Microwave Applications", John Wiley & Sons, 2001 2. Reinhold Ludwig and Powel Bretchko, RF Circuit Design – Theory and Applications", 23 Pearson Education Asia, First Edition, 2001 3. Thomas H. Lee, "Planar Microwave Engineering", Cambridge University Press, 2004 4. Matthew M. Radmanesh, "Radio Frequency and Microwave Electronics", Pearson Education, 2002 5. David M. Pozar, "Microwave Engineering", John Wiley & Sons, 4th edition 2012
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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the concepts of planar transmission line.	Understand (K2)
CO2	Explain the purpose of Lumped Components and Discontinuities.	Understand (K2)
CO3	Design the Periodic Structures and Filter.	Apply (K3)
CO4	Analyze the performance of couplers.	Analyze (K4)
CO5	Design the Mixers for various requirements.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO2	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO3	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO4	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO5	3	3	3	3	3	-	-	1	2	2	-	1	3	3

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23PEC15 RF Transceivers

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E- ECE	V/VI/VII	PEC	2	0	2	3

II - Course Objectives

1.	To understand the fundamentals of RF system design
2.	To acquaint with the various components of RF system for wireless communications
3.	To know the basic techniques needed for analysis of RF systems
4.	To enable the students to verify the basic principles and design aspects involved in RF systems components
5.	To conduct experiments to analyze and interpret data to produce meaningful conclusion and match with theoretical concepts

III - Course Content**Preamble:**

This course/module explores the architecture, design principles, and performance evaluation of RF transceivers. It covers key concepts such as RF front-end components (mixers, amplifiers, filters, oscillators), heterodyne and direct-conversion architectures, frequency synthesis, modulation techniques, noise and linearity considerations, and system-level integration challenges.

Unit - I	Transceiver Specifications and Architectures	6 Periods
CMOS: Introduction to MOSFET Physics - Noise: Thermal, shot, flicker, popcorn noise - Transceiver Specifications: Two port Noise theory, Noise Figure, THD, IP2, IP3, Sensitivity, SFDR - Phase noise - Transceiver Architectures: Receiver: Homodyne, Heterodyne, Image reject, Low-IF.		
Unit - II	Impedance Matching Networks and Amplifiers	6 Periods
Fundamental of S-parameters and Smith chart - Passive IC components - Impedance matching networks - Amplifiers: Common Gate, Common Source Amplifiers - OC Time constants in bandwidth estimation and enhancement - High frequency amplifier design - Low Noise Amplifiers: Power match and Noise match, single-ended and differential LNAs		
Unit - III	Feedback Systems and Power Amplifiers	6 Periods
Feedback Systems: Stability of feedback systems, Gain and phase margin, Root-locus techniques, Time and Frequency domain considerations, Compensation - Power Amplifiers: General model - Class A, AB, B, C power amplifiers - Linearization Techniques - Efficiency boosting techniques - ACPR metric		
Unit - IV	Filters, Oscillators and Mixers	6 Periods
Overview - basic resonator and filter configuration, special filter realizations, filter implementation - Basic oscillator model, high-frequency oscillator configuration, Colpitt's oscillator - basic characteristics of mixers, single and double-balanced mixers, image reject mixers, FET/ MOSFET mixers		
Unit - V	PLL and Frequency Synthesizers	6 Periods
PLL: Linearized Model, Noise properties, Phase detectors, Loop filters and Charge pumps - Frequency Synthesizers: Integer-N frequency synthesizers - Direct Digital Frequency Synthesizers, PLL design examples		

TOTAL: 30 Periods

List of Experiments – 30 Periods

1. Measurement of S-parameters for impedance matching circuits, and RF filters using network analyzer
2. Design of RF inductor and capacitor
3. Design and characterization of LNA
4. Design of impedance matching network
5. Design of low-pass and band-pass filter at RF
6. Design and characterization of mixer

TOTAL: 60 Periods

Reference Books:	1. Lee T, Design of CMOS RF Integrated Circuits, Cambridge, Second Edition, 2004 2. Razavi B, RF Microelectronics, Pearson Education, Second Edition, 2012 3. Ludwig R, and Bretchko P, RF Circuit Design Theory and Applications, Prentice Hall, 2000 2. Razavi B, Design of Analog CMOS Integrated Circuits, McGraw Hill, Second Edition, 2017 4. Kyung-WhanYeom, Microwave Circuit Design - A Practical Approach using ADS, Pearson Education, 2015 Note: Green – New, Red - Removed
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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the characteristics of transmission lines and its losses.	Understand (K2)
CO2	Calculate the standing wave ratio and input impedance in high frequency transmission lines.	Apply (K3)
CO3	Analyze impedance matching by stubs using Smith Charts.	Analyze (K4)
CO4	Comprehend the characteristics of TE and TM waves.	Understand (K2)
CO5	Design a RF transceiver system for wireless communication.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO2	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO3	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO4	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO5	3	3	3	3	3	-	-	1	2	2	-	1	3	3

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23PEC16 Signal Integrity

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E- ECE	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

1.	Understand characteristic impedance of transmission line and impedance matching Techniques.
2.	Understand plain signal reflection and cross talk noise in the transmission line, and also explain the mathematical analysis method.
3.	Understand Eye diagram and related measurement to test quality of Signal.
4.	Learn Jitter analysis and jitter decomposition.
5.	Work with high frequency differential signal and its applications.

III - Course Content**Preamble:**

This course/module provides a comprehensive understanding of the principles and analysis techniques used to evaluate and improve signal quality in high-speed electronic systems. Topics include transmission line theory, impedance matching, reflection and ringing, crosstalk, jitter, eye diagrams, and power distribution network (PDN) integrity.

Unit - I	Signal Reflection and Impedance Matching Technique	9 Periods
Phenomenon of signal reflection. Signal reflection at transmitting end, Signal reflection at branch point. Multiple reflection in transmission line, Prevention of signal reflection by using impedance matching technique.		
Unit - II	Crosstalk Noise	9 Periods
Crosstalk definition and classification, Crosstalk mechanism, Analysis of crosstalk noise in transmission line, Main factor of causing crosstalk noise.		
Unit - III	Differential Signal Transmission Circuit	9 Periods
Pros and cons of using differential signaling compared with that of single-ended signaling, High-speed differential interfaces. Theory of differential signaling, Differential signal termination techniques.		
Unit - IV	Frequency Response	9 Periods
Frequency response of transmission line and circuit, Inter-symbol interference (ISI) and eye-pattern, Deterioration of a signal waveform due to ISI, Circuit techniques to prevent the deterioration, Linear time-invariant systems, Frequency response of pulse.		
Unit - V	Eye Diagram and Jitter	9 Periods
Jitter Definition and Types of Jitter, Jitter decomposition, Eye diagram analysis and related measurement		

TOTAL: 45 Periods

Reference Books:	1. Eric Bogatin, "Signal and Power integrity Simplified", Pearson, 3 rd Edition 2. Howard Johnson and Martin Graham, "High Speed Digital Design", Prentice Hall, 1 st Edition. 3. Howard Johnson, "High Speed Signal Propagation", Prentice Hall, 1 st Edition
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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	Familiarity with high-speed design and related issues.	Understand (K2)
C02	Understanding on critical design aspect.	Understand (K2)
C03	Know about Jitter and related measurements which is critical for design.	Understand (K2)
C04	Practical application of high-speed differential signals.	Understand (K2)
C05	Measurement expertise up to industry expectations.	Understand (K2)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C01	3	3	3	3	3	-	-	-	-	-	-	1	2	-
C02	3	3	3	3	3	-	-	-	-	-	-	1	2	-
C03	3	3	3	3	3	-	-	-	-	-	-	1	2	-
C04	3	3	3	3	3	-	-	-	-	-	-	1	2	-
C05	3	3	3	3	3	-	-	-	-	-	-	1	2	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23PEC17 EMI/EMC Pre Compliance Testing

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E- ECE	V/VI/VII	PEC	2	0	2	3

II - Course Objectives

1.	To understand the nature, origin, and significance of EMI/EMC in electronic systems, along with applicable standards and design needs.
2.	To analyze different types of EMI coupling mechanisms including conducted, radiated, inductive, and capacitive coupling.
3.	To explore EMI measurement techniques and devices, including direct connections, inductive probes, and specialized EMC antennas.
4.	To study EMI receivers, spectrum analyzers, and other test equipment used for immunity and transient testing in compliance with EMC standards.
5.	To learn EMC-compliant PCB design practices, focusing on signal integrity, power distribution, decoupling, trace routing, and minimizing EMI sources.

III - Course Content**Preamble:**

This course/module focuses on EMI/EMC pre-compliance testing—a crucial stage in the product development lifecycle that helps identify and mitigate electromagnetic issues before full compliance testing. It covers the fundamental principles of EMI and EMC, regulatory standards (CISPR, FCC, IEC, MIL-STD), test environments, measurement techniques, and diagnostic tools.

Unit – I	Nature and origins of Electromagnetic Compatibility	6 Periods
Introduction to EMI and EMC- Various EMC requirements and standards-Need for EMC and its importance in electronic product design -Visualizing the EMI problem-Source of EMI, EMI coupling to victim equipment, Intersystem and Intrasystem EMI, EMC standards and specifications		
Unit – II	Types of EMI Coupling	6 Periods
Conducted, radiated and transient coupling; Common ground impedance coupling; Common mode and ground loop coupling; Differential mode coupling, Inductive coupling - Capacitive coupling - Radiative coupling, Near field cable to cable coupling; Field to cable coupling, Power mains and Power supply coupling; Transient EMI		
Unit – III	Measurement Devices for EMI	6 Periods
Introduction – Measurement by direct connection, Inductively coupled devices, EMC antennas – Basic antenna parameters, Antennas for radiated emission testing, Wideband antennas - Magnetic field antennas, Type of antennas used in susceptibility testing		
Unit – IV	Receivers, Analyzers and Measurement Equipment	6 Periods
EMI receiver, Spectrum Analyzers, RF power meter Frequency meters. Standards requiring immunity tests, Automatic EMC tests, Electromagnetic transient testing, Transient types, Continuous and transient signal, ESD-electrostatic discharge		

Unit - V	EMC Design of PCBs	6 Periods
RF Sources in PCB - SMD / through hole components, Pins, Basic loops, Differential vs Common mode - Board layout: Ground plane and Power plane, ground bounce, Power distribution for two-layer boards, Power supply decoupling, Board zoning, Signal traces, Cross talk, Trace routing - Cables and connectors		

TOTAL: 30 Periods**List of Experiments - 30 Periods**

1. Basic spectrum measurement and power measurement with markers.
2. Perform environment scan and detect various signals available.
3. DPX, Spectrogram and transient capture with mask test and act on violation.
4. EMI spurious detection and measurement against EMI limit lines.
5. Use of LISN and measurement concept of Conducted emission.

TOTAL: 60 Periods

Reference Books:	1. David Morgan, "A Handbook for EMC Testing and Measurement", IET Electrical Measurement, 2012 2. Tim Williams, "EMC for Product Designers", 5th Edition, Newnes Elsevier, 2017 3. I.V.P.Kodali, "Engineering EMC Principles, Measurements and Technologies", IEEE Press, Newyork, 1996 4. Paul, C.R., "Introduction to Electromagnetic Compatibility", 2nd ed., Wiley (2010) 5. David K. Cheng, "Field and Wave Electromagnetics", 2nd ed. Pearson Education, 2009
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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	Perceive the various types and mechanisms of Electromagnetic Interference.	Understand (K2)
C02	Propose a suitable EMI mitigation technique.	Apply (K3)
C03	Evaluate EMI coupling & control principles.	Apply (K3)
C04	Explain the importance receivers and analyzer.	Understand (K2)
C05	Design PCBs which are electromagnetically compatible.	Apply (K3)

V - Mapping Table Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO2	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO3	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO4	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO5	3	3	3	3	3	-	-	1	2	2	-	1	3	3

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23PEC18 RFID System Design and Testing

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E- ECE	V/VI/VII	PEC	2	0	2	3

II - Course Objectives

1.	To understand the fundamental principles of RFID systems, including near-field and far-field operation, modulation methods, and frequency classifications.
2.	To study the global RFID standards, protocols, and anti-collision mechanisms used in proximity and vicinity card systems.
3.	To explore the operating principles of RFID tags, readers, middleware, and the fundamentals of RFID communication.
4.	To analyze data integrity techniques, multiaccess procedures, and cryptographic methods for enhancing RFID system security
5.	To investigate RFID-enabled sensors, design challenges in antennas and ICs, and applications involving printable and integrated RFID systems.

III - Course Content

Preamble: This course/module provides a comprehensive introduction to RFID systems, covering the design of RFID tags and readers, frequency bands (LF, HF, UHF, and microwave), communication protocols (ISO/IEC standards, EPCglobal), antenna design, coupling mechanisms, and power management for passive and active RFID devices.		
Unit - I	Introduction to RFID	6 Periods
RFID Principles: Near-field based RFID – Properties of Magnetic field – Far-field based RFID – Properties of Backscatter RF Systems – Modulation techniques – Types of RFID Systems: LF, HF, UHF, Active, Passive		
Unit - II	RFID Standards and Protocols	6 Periods
Industry standards: EPC global – ISO/IEC Standards - ISO15693 Vicinity cards and RFID – ISO14443 Proximity cards and RFID – Anti-Collision Protocols-The NFC forum – Reading collocated RFID tags: Query Tree protocol – Query Slot protocol		
Unit - III	Operating Principles	6 Periods
RFID Tag components: RFID tag types – the 1-Bit Transponder and Chipless Tags – RFID readers and middleware component – Communication fundamentals: Coupling, Data encoding, multi-path effect – Tag, Reader and sensor communication.		
Unit - IV	Data Integrity and Security	6 Periods
The checksum procedure – Multiaccess procedures – Attacks on RFID Systems – Protection by Cryptographic measures		
Unit - V	RFID Enabled Sensors and Applications	6 Periods
RFID enabled Sensors: Antenna design challenges – IC design – Integration of sensors and RFID - Power consumption and Link budget –Printable RFID		

TOTAL: 30 Periods

List of Experiments – 30 Periods

1. Design of a passive RFID Tag Antenna.
2. Interfacing RFID Reader with Arduino for ID Authentication.
3. Determination of read range of the RFID tag at UHF and Microwave frequencies.
4. Determination of RFID tag performance for different standards.
5. Real-time Inventory System using RFID.

TOTAL: 60 Periods

Reference Books:	1.Klaus Finkenzeller, "RFID Handbook: Fundamentals and Applications in Contactless Smart Cards and Identification", Wiley, 2010. 2.Daniel M. Dobkin, "The RF in RFID", Elsevier, 2012. 3.Stevan Preradovic, "RFID Systems: Research Trends and Challenges", InTech, 2011 4.Patrick J. Sweeney, "RFID for Dummies", Wiley, 2005. 5.Himanshu Bhatt and Bill Glover, "RFID Essentials", O'Reilly Media, 2006
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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the fundamentals of RFID technologies and system components.	Understand (K2)
CO2	Explore RFID protocols and standards used in various industries.	Apply (K3)
CO3	Illustrate the operation of various components of RFID systems.	Apply (K3)
CO4	Describe the privacy and security issues in RFID Systems.	Understand (K2)
CO5	Develop skills for designing and testing RFID systems for real-world applications.	Apply (K3)

V - Mapping Table Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO2	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO3	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO4	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO5	3	3	3	3	3	-	-	1	2	2	-	1	3	3

Mapping: 1-Low, 2-Medium, 3-High

Vertical 4

Bio Medical Technologies

I - Course Name: 23PEC19 Wearable Devices

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E- ECE	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

1.	Understand the design, components, and applications of wearable systems and sensors.
2.	Explore signal processing techniques and energy harvesting methods for wearable devices.
3.	Learn wireless health system architectures and challenges in body area networks (BAN).
4.	Study smart textile technologies and their integration with wearable sensors.
5.	Analyze diverse applications of wearable systems in healthcare, fitness, safety, and environmental monitoring.

III - Course Content**Preamble:**

This course provides a comprehensive introduction to wearable technologies, covering sensor integration, signal processing, low-power electronics, wireless communication, user interface design, and system-level challenges. It also explores current trends such as flexible electronics, energy harvesting, IoT connectivity, and data security in wearables.

Unit - I	Introduction to Wearable Systems and Sensors	9 Periods
Wearable Systems- Introduction, Need for Wearable Systems, Drawbacks of Conventional Systems for Wearable Monitoring, Applications of Wearable Systems, Types of Wearable Systems, Components of wearable Systems. Sensors for wearable systems-Inertia movement sensors, Respiration activity sensor, Inductive plethysmography, Impedance plethysmography, pneumography, Wearable ground reaction force sensor.		
Unit - II	Signal Processing and Energy Harvesting for Wearable Devices	9 Periods
Wearability issues -physical shape and placement of sensor, Technical challenges - sensor design, signal acquisition, sampling frequency for reduced energy consumption, Rejection of irrelevant information. Power Requirements- Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles.		
Unit - III	Wireless Health Systems	9 Periods
Need for wireless monitoring, Definition of Body area network, BAN and Healthcare, Technical Challenges- System security and reliability, BAN Architecture - Introduction, Wireless communication Techniques.		
Unit - IV	Smart Textile	9 Periods
Introduction to smart textile- Passive smart textile, active smart textile. Fabrication Techniques Conductive Fibres, Treated Conductive Fibres, Conductive Fabrics, Conductive Inks. Case study smart fabric for monitoring biological parameters - ECG, respiration.		
Unit - V	Applications	9 Periods
Healthcare monitoring, Chronic disease management, Fitness and sports, Industrial safety, Military and defense, Environmental monitoring, Navigation and tracking		

TOTAL: 45 Periods

Reference Books:	1. Sandeep K.S, Gupta, Tridib Mukherjee and Krishna Kumar Venkatasubramanian, Body Area Networks Safety, Security, and Sustainability, Cambridge University Press, 2013. 2. Guang-Zhong Yang, Body Sensor Networks, Springer, 2006.
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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	Describe the concepts of wearable system.	Understand (K2)
C02	Explain the energy harvestings in wearable device.	Apply (K3)
C03	Use the concepts of BAN in health care.	Understand (K2)
C04	Illustrate the concept of smart textile.	Understand (K2)
C05	Compare the various wearable devices in healthcare system.	Understand (K2)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C01	3	3	3	-	-	-	-	-	-	-	-	1	3	-
C02	3	3	3	-	-	-	-	-	-	-	-	1	3	-
C03	3	3	3	-	-	-	-	-	-	-	-	1	3	-
C04	3	3	3	-	-	-	-	-	-	-	-	1	3	-
C05	3	3	3	-	-	-	-	-	-	-	-	1	3	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23PEC20 Human Assist Devices

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E- ECE	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

1.	To understand the conditions required for heart/lung systems, the types of oxygenators and pumps, their functioning, and artificial heart systems, including their mock test setups.
2.	To explore cardiac assist devices like intra-aortic balloon pumping, veno-arterial pumping, and prosthetic cardio valves, as well as the characteristics of biomaterials for implantable devices.
3.	To learn the principles of hemodialysis, the role of different types of hemodialyzers, wearable artificial kidneys, and the associated monitoring systems.
4.	To study spinal orthotics, externally powered limb prostheses, and various orthotic devices for lower and upper limbs, including materials and functional electrical stimulation for enhancing mobility.
5.	To examine the operation and types of ventilators, breathing apparatus, audiometric devices, and hearing aids.

III - Course Content**Preamble:**

This course introduces students to the principles, design, and applications of human assistive technologies. It covers biomechanical foundations, sensor integration, actuation mechanisms, control strategies, ergonomics, and user-centered design. Emphasis is also placed on regulatory standards, clinical validation, and ethical considerations in assistive technology development.

Unit - I	Heart Lung Machine and Artificial Heart	9 Periods
Condition to be satisfied by the H/L System. Different types of Oxygenators, Pumps, Pulsatile and Continuous Types, Monitoring Process, Shunting, The Indication for Cardiac Transplant, Driving Mechanism, Blood Handling System, Functioning and different types of Artificial Heart, Mock test setup for assessing its functions.		
Unit - II	Cardiac Assist Devices	9 Periods
Synchronous Counter pulsation, assisted through Respiration Right Ventricular Bypass Pump, Left Ventricular Bypass Pump, Open Chest and closed Chest type, Intra-Aortic Balloon Pumping Veno Arterial Pumping, Prosthetic Cardio Valves, Principle and problem, Biomaterials for implantable purposes, its characteristics and testing.		
Unit - III	Artificial Kidney	9 Periods
Indication and Principle of Hemodialysis, Membrane, Dialysate, Different types of hemodialyzers, Monitoring Systems, Wearable Artificial Kidney, Implanting Type		
Unit - IV	Prosthetic and Orthotic Devices	9 Periods
Spinal orthotics and Prosthesis, Splint - Static and Dynamic. Hand and Arm Replacement - Different Types of Models Externally Powered Limb Prosthesis, Lower Limb and Upper limb orthotic devices, Functional Electrical Stimulation, Sensory Assist Devices, Materials for Prosthetic and orthotic devices, Haptic Devices		

Unit – V	Respiratory and Hearing Aids	9 Periods
Ventilator and its Types-Intermittent positive pressure, Breathing Apparatus Operating Sequence, Electronic IPPB unit with monitoring for all respiratory parameters. Types of Deafness, Basic Audiometer- Pure tone audiometer-Bekesy audiometer system, hearing aids - types, tonometer, Hearing Aids, Construction and Functional Characteristics.		

TOTAL: 45 Periods

Reference Books:	1. Kolff W.J., "Artificial Organs", John Wiley and Sons, New York, 1979. 2. Andreas.F. Von racum, "Hand book of Biomaterial Evaluation", Mc-Millan publishers, 1980. 3. Albert M. Cook and Webster J.G., "Therapeutic Medical Devices", Prentice Hall Inc., New Jersey, 2020 4. Gray E Wnek, Gray L Browlin, "Encyclopedia of Biomaterials and biomedical Engineering" Marcel Dekker Inc New York 2004. 5. Gerr M. Craddock, "Assistive Technology-Shaping the future", IOS Press, 1st edition, 2003. 6. Tracy, K, Willem Kolff and the Invention of the Dialysis Machine. Mitchell Lane Pub, 2003. 7. Yadin David, Wolf W. von Malt Zahn, Michael R. Neumann, Joseph, Bronzing, "Clinical Engineering," CRC Press, 1st edition, 2010
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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the importance of Heart lung machine and artificial Heart.	Understand (K2)
CO2	Identify the importance of different types of assist devices and related issues.	Apply (K3)
CO3	Understand about the implantation of artificial kidney.	Apply (K3)
CO4	Explore the different types of models for Prosthetic and orthotic purpose.	Apply (K3)
CO5	Perceive the knowledge in different types of respiratory and hearing aids.	Understand (K2)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	-	-	-	-	-	-	-	-	1	3	-
CO2	3	3	3	-	-	-	-	-	-	-	-	1	3	-
CO3	3	3	3	-	-	-	-	-	-	-	-	1	3	-
CO4	3	3	3	-	-	-	-	-	-	-	-	1	3	-
CO5	3	3	3	-	-	-	-	-	-	-	-	1	3	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23PEC21 Therapeutic Equipment

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E- ECE	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

1.	To understand the working principles, types, and applications of cardiac pacemakers, defibrillators, and cardiac ablation catheters.
2.	To explore the principles, types, and operational mechanisms of ventilators, heart-lung machines, and related respiratory therapeutic equipment.
3.	To learn the functionality of therapeutic equipment like electrotherapy, muscle stimulators, and traction devices used for biomechanical rehabilitation.
4.	To analyze various body care equipment including skin treatments, fitness machines, and therapeutic devices for body slimming, rejuvenation, and pain relief.
5.	To study the design, working principles, and applications of dental care equipment including chairs, handpieces, radiography machines, and related decontamination systems.

III - Course Content**Preamble:**

This course provides a comprehensive overview of therapeutic medical devices, focusing on their principles of operation, clinical applications, safety standards, and regulatory compliance. Students will explore the integration of electronics, mechanics, and biomedical principles in device design, along with emerging trends such as smart therapy systems, remote monitoring, and AI-assisted interventions.

Unit - I	Introduction	9 Periods
Coronary Care Equipments - Cardiac Pacemaker: Internal and External Pacemaker-Programmable pacemakers. Cardiac Defibrillators: AC and DC Defibrillator- Internal and External Defibrillators - Protection Circuit, Defibrillator analyzers. Cardiac ablation catheter. Types of Ventilators - Pressure, Volume, and Time controlled. Basic principles of electromechanical, pneumatic and electronic ventilators, Patient Cycle Ventilators, Ventilator testing, Humidifiers, Nebulizers, Inhalators. Heart lung machine (HLM) - Functional details of oxygenators - types of oxygenators.		
Unit - II	Biomechanical Therapeutic Equipment	9 Periods
Electrodiagnosis, Therapeutic radiation, Electrotherapy, Electrodes, Stimulators for Nerve and Muscle, Functional Electrical Stimulation. peripheral nerve stimulator, ultrasonic stimulators, Stimulators for pain and relief - Inferential Therapy Unit, TENS. GAIT Assessment and Therapy. Continuous Passive Motion unit, Cervical / Lumber Traction Machine -Traction Table.		
Unit - III	Body Care Equipment	9 Periods
Skin Treatment: Ultrasonic spot remove, vacuum therapy unit, Skin tightening, Wrinkle Reduction, Facial and Rejuvenation. Laser hair therapy machine. Body Slimmer/Shaper - Deep Heat Therapy, Massager, Fitness - Treadmill, Bike.		
Unit - IV	Dental Care Equipment	9 Periods
Dental Chair - Dental Hand pieces and Accessories: Evolution of rotary equipment, Low-speed handpiece, High-speed handpiece, Hand piece maintenance. Vacuum and Pneumatic techniques: Vacuum techniques, Oral evacuation systems, Vacuum pump, Pneumatic		

techniques, Dental compressor, Decontamination Unit and constant fumigation unit. Dental Radiography: Dental X-ray Machine.

Unit - V	Heat and Photon Therapy Equipment	9 Periods
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High frequency heat therapy, Principle, Short wave diathermy, Microwave diathermy, Ultrasonic therapy, Lithotripsy. Therapeutic UV and IR Lamps, Basic principles of Biomedical LASERS: Applications of lasers in medicine, CO₂laser, He-Ne laser, Nd-YAG and Ruby laser.

TOTAL: 45 Periods

Reference Books:	1.Khandpur. R.S., "Handbook of Biomedical Instrumentation". Second Edition. Tata McGraw Hill Pub. Co., Ltd. 2003. 2. John.G.Webster. "Medical Instrumentation, Application and Design". Fourth Edition, Wiley, NewYork, 2009. 3.Leslie Cromwell, Fred. J. Weibell & Erich. A. Pfeiffer. "Biomedical Instrumentation and Measurements", Second Edition. Prentice Hall Inc.2000. 4. John Low & Ann Reed. "Electrotherapy Explained, Principles and Practice". Second Edition, Butterworth Heinemann Ltd. 2000. 5. Joseph. J. Carr, John Michael Brown, "Introduction to Biomedical Equipment Technology", Prentice Hall and Technology, 2008.
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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Suggest suitable therapeutic devices for ailments related to cardiology, pulmonology, neurology, etc.	Apply (K3)
CO2	Comprehend the principles of bodycare equipment.	Understand (K2)
CO3	Understand the operation of dental care equipment.	Understand (K2)
CO4	Analyze the different types of therapies for suitable applications.	Analyze (K4)
CO5	Appreciate the application of lasers in biomedical applications.	Understand (K2)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	-	-	-	-	-	-	-	-	1	3	-
CO2	3	3	3	-	-	-	-	-	-	-	-	1	3	-
CO3	3	3	3	-	-	-	-	-	-	-	-	1	3	-
CO4	3	3	3	-	-	-	-	-	-	-	-	1	3	-
CO5	3	3	3	-	-	-	-	-	-	-	-	1	3	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23PEC22 Medical Imaging Systems

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E- ECE	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

1.	Understand the fundamental principles of various medical imaging modalities like X-ray, CT, MRI, and nuclear imaging.
2.	Explore the design and functioning of imaging equipment and associated electronics.
3.	Analyze image formation techniques and data acquisition methods across different imaging systems.
4.	Learn the clinical applications and safety protocols in diagnostic and therapeutic radiology.
5.	Develop knowledge on advanced imaging technologies and recent trends in medical imaging and radiation therapy.

III - Course Content

Preamble: This course introduces the fundamental principles, operational mechanisms, and clinical applications of various medical imaging modalities. It covers topics including image acquisition, signal processing, system components, image reconstruction, contrast agents, and safety considerations. Students will also explore recent advancements such as AI-assisted imaging, 3D and functional imaging, and image-guided interventions.		
Unit - I	Nature of X-Rays	9 Periods
- X-Ray absorption - Tissue contrast. X- Ray Equipment (Block Diagram) - X-Ray Tube, the collimator, Bucky Grid, power supply, Digital Radiography - discrete digital detectors, storage phosphor and film scanning, X-ray Image Intensifier tubes - Fluoroscopy - Digital Fluoroscopy. Angiography, cine Angiography. Mammography.		
Unit - II	Computed Tomography	9 Periods
Principles of tomography, CT Generations, X- Ray sources- collimation- X- Ray detectors - Viewing systems - spiral CT scanning - Ultra fast CT scanners. Image reconstruction techniques - back projection and iterative method.		
Unit - III	Magnetic Resonance Imaging	9 Periods
Fundamentals of magnetic resonance. Interaction of Nuclei with static magnetic field and Radio frequency wave- rotation and precession - Induction of magnetic resonance signals - bulk magnetization - Relaxation processes T1 and T2. Block Diagram approach of MRI system - system magnet (Permanent, Electromagnet and Superconductors), generations of gradient magnetic fields, Radio Frequency coils (sending and receiving), shim coils, Electronic components.		
Unit - IV	Nuclear Imaging	9 Periods
Radioisotopes- alpha, beta, and gamma radiations. Radio Pharmaceuticals. Radiation detectors - gas filled, ionization chambers, proportional counter, GM counter and scintillation Detectors, Gamma camera - Principle of operation, collimator, X-Y positioning circuit, pulse height analyzer. Principles of SPECT and PET		

Unit – V	Radiation Therapy and Radiation Safety	9 Periods
Radiation therapy – linear accelerator, Telegamma Machine. Recent Techniques in radiation therapy – 3D CRT – IMRT – IGRT and Cyber knife – radiation measuring instruments Dosimeter, film badges, Thermo Luminescent dosimeters – electronic dosimeter – Radiation protection in medicine – radiation protection principles		

TOTAL: 45 Periods

Text Books:	1. Isaac Bankman, I. N. Bankman , Handbook of Medical Imaging: Processing and Analysis (Biomedical Engineering), Academic Press,2000 2. Jacob Beutel (Editor), M. Sonka (Editor), Handbook of Medical Imaging, Volume 2. Medical Image Processing and Analysis, SPIE Press 2000 3. Khin Wee Lai, Dyah Ekashanti Octorina Dewi “Medical Imaging Technology”, Springer Singapore, 2015
Reference Books:	1. Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw – Hill, New Delhi, 2003. 2. Dougherty, Geoff (Ed.), “Medical Image Processing-Techniques and Applications “, Springer-Verlag New York, 2011

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Describe the working principle and applications of X-ray machines.	Understand (K2)
CO2	Explain the principles and procedures of computed tomography.	Understand (K2)
CO3	Interpret MRI techniques used for visualizing various body sections.	Apply (K3)
CO4	Demonstrate the applications of radionuclide imaging in medical diagnostics.	Apply (K3)
CO5	Assess different imaging techniques to select appropriate equipment for accurate diagnosis and implement radiation safety measures.	Analyze (K4)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	-	-	-	-	-	-	-	-	1	3	-
CO2	3	3	3	-	-	-	-	-	-	-	-	1	3	-
CO3	3	3	3	-	-	-	-	-	-	-	-	1	3	-
CO4	3	3	3	-	-	-	-	-	-	-	-	1	3	-
CO5	3	3	3	-	-	-	-	-	-	-	-	1	3	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23PEC23 Brain Computer Interface and Applications

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E- ECE	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

1.	To understand the fundamentals, structure, and classification of Brain-Computer Interface (BCI) systems, including EEG signal acquisition and preprocessing for artifact removal.
2.	To explore various electrophysiological sources like sensorimotor activity, mu rhythm, movement-related potentials, and other neural activities associated with BCI.
3.	To study feature extraction techniques such as Fourier Transform, wavelets, and parametric models like AR, MA, ARMA, and PCA, for effective BCI signal analysis.
4.	To learn about different feature translation methods, including Linear Discriminant Analysis, Support Vector Machines, Neural Networks, and other machine learning techniques used in BCI systems.
5.	To apply BCI technology in real-world scenarios, such as functional restoration with neuroprostheses, brain-actuated mobile robot control, and visual feedback for external device control.

III - Course Content

Preamble: This course provides a comprehensive introduction to the principles, signal acquisition techniques, signal processing methods, and classification algorithms used in BCI systems. It covers the physiological basis of brain signals (EEG, ECoG, etc.), system design challenges, safety considerations, and ethical implications.		
Unit – I	Introduction to BCI	9 Periods
Fundamentals of BCI – Structure of BCI system – Classification of BCI – Invasive, Non-invasive and Partially invasive BCI – EEG signal acquisition - Signal Preprocessing – Artifacts removal.		
Unit – II	Electrophysiological Sources	9 Periods
Sensorimotor activity – Mu rhythm, Movement Related Potentials – Slow Cortical Potentials- P300 - Visual Evoked Potential - Activity of Neural Cells – Multiple Neuromechanisms.		
Unit – III	Feature Extraction Methods	9 Periods
Time/Space Methods – Fourier Transform, PSD – Wavelets – Parametric Methods – AR, MA, ARMA models – PCA – Linear and Non-Linear Features.		
Unit – IV	Feature Translation Methods	9 Periods
Linear Discriminant Analysis – Support Vector Machines - Regression – Vector Quantization– Gaussian Mixture Modeling – Hidden Markov Modeling – Neural Networks.		
Unit – V	Applications of BCI	9 Periods
Functional restoration using Neuroprosthesis - Functional Electrical Stimulation, Visual Feedback and control - External device control, Case study: Brain actuated control of mobile Robot.		

TOTAL: 45 Periods

Reference Books:	1. Bernhard Graimann, Brendan Allison, Gert Pfurtscheller, "Brain-Computer Interfaces: Revolutionizing Human-Computer Interaction", Springer, 2010. 2. R. Spehlmann, "EEG Primer", Elsevier Biomedical Press, 1981. 3. Arnon Kohen, "Biomedical Signal Processing", Vol I and II, CRC Press Inc, Boca Rato, Florida, 1986. 4. Bishop C.M., "Neural Networks for Pattern Recognition", Oxford, Clarendon Press, 1995.
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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Describe BCI system and its potential applications.	Understand (K2)
CO2	Analyze event related potentials and sensory motor rhythms.	Analyze (K4)
CO3	Compute features suitable for BCI.	Apply (K3)
CO4	Design classifier for a BCI system.	Apply (K3)
CO5	Implement BCI for various applications.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	-	-	-	-	-	-	-	-	1	3	-
CO2	3	3	3	-	-	-	-	-	-	-	-	1	3	-
CO3	3	3	3	-	-	-	-	-	-	-	-	1	3	-
CO4	3	3	3	-	-	-	-	-	-	-	-	1	3	-
CO5	3	3	3	-	-	-	-	-	-	-	-	1	3	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23PEC24 Body Area Networks

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E- ECE	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

1.	To understand the fundamentals and applications of Body Area Networks (BAN) in healthcare, addressing key technical challenges such as sensor design and system reliability.
2.	To explore the hardware components and technologies used in BAN, including low-power processors, memory, antennas, power sources, and communication interfaces.
3.	To examine the principles of RF communication and wireless standards, with a focus on BAN-specific communication protocols and network topologies.
4.	To identify and address coexistence issues in BAN, including interference, regulatory concerns, and security measures for safe and reliable operation.
5.	To analyze the practical applications of BAN in healthcare for monitoring chronic diseases, cardiac conditions, and supporting smart wearable devices.

III - Course Content**Preamble:**

This course explores the architecture, communication protocols, sensing technologies, and design challenges associated with BANs. Topics include low-power sensor integration, wireless standards (Bluetooth, ZigBee, UWB), signal processing for physiological data, security and privacy in healthcare data, and interoperability with external systems such as smartphones and cloud platforms.

Unit - I	Introduction	9 Periods
Definition of BAN, BAN in Healthcare, Pervasive Patient Monitoring using BAN, Technical Challenges: Sensor design, Biocompatibility, Energy Supply, Optimal node placement, Number of nodes, System security and reliability, BAN Architecture.		
Unit - II	Hardware For BAN	9 Periods
Processor: Low Power MCUs, Mobile Computing MCUs, Integrated Processor with Radio Transceiver, Memory, Antenna: PCB, Wire, Ceramic, External, Matching Network, Sensor Interface, Power Sources: Batteries and Fuel Cells, Material Selection for Wearable Integration, Wireless Communication Technologies for Wearable Systems.		
Unit - III	Wireless Communication and Network	9 Periods
RF Communication in Body, Antenna Design and Testing, Propagation, Base Station, Network Topology: Stand-Alone BAN, Wireless Personal Area Network Technologies: IEEE 802.15.1, IEEE P802.15.13, IEEE 802.15.14, Zigbee, Healthcare System Standards.		
Unit - IV	Coexistence Issues with BAN	9 Periods
Interferences: Intrinsic & Extrinsic, Effect on Transmission, Countermeasures: Physical Layer and Data Link Layer; Regulatory Issues: Medical Device Regulation in USA and Asia, Security and Self-Protection: Bacterial Attacks, Virus Infection, Secured Protocols, Self-Protection.		
Unit - V	Applications of BAN	9 Periods
Monitoring Chronic Diseases, Hospital and Elderly Patients, Cardiac Arrhythmias Monitoring, Multi-patient Monitoring Systems, Multichannel Neural Recording, Gait Analysis, Sports Medicine, Electronic Pill, Smart Garments.		

TOTAL: 45 Periods

Reference Books:	1. Zhang, Yuan-Ting, "Wearable Medical Sensors and Systems", Springer, 2013. 2. Guang-Zhong Yang (Ed.), "Body Sensor Networks", Springer, 2006. 3. Annalisa Bonfiglio, Danilo De Rossi, "Wearable Monitoring Systems", Springer, 2011.
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IV - Course Outcomes

	On completion of the course, the students will be able to	Bloom's Level Mapped
CO1	Comprehend and appreciate the significance and role of this course in the present contemporary world.	Understand (K2)
CO2	Design a BAN for appropriate application in medicine.	Apply (K3)
CO3	Assess the efficiency of communication and the security parameters.	Apply (K3)
CO4	Understand the need for medical device regulation and regulations followed in various regions.	Understand (K2)
CO5	Extend the concepts of BAN for medical applications.	Understand (K2)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	-	-	-	-	-	-	-	-	1	3	-
CO2	3	3	3	-	-	-	-	-	-	-	-	1	3	-
CO3	3	3	3	-	-	-	-	-	-	-	-	1	3	-
CO4	3	3	3	-	-	-	-	-	-	-	-	1	3	-
CO5	3	3	3	-	-	-	-	-	-	-	-	1	3	-

Mapping: 1-Low, 2-Medium, 3-High

Vertical 5

Sensor Technologies and IoT

I - Course Name: 23PEC25 IoT Processors

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E- ECE	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

1.	Understand the evolution, architecture, and instruction set of ARM processors, focusing on Cortex-M3 fundamentals.
2.	Learn about Cortex-M3 registers, operation modes, exception handling, and interrupt management using the NVIC.
3.	Gain practical skills in interfacing peripherals with STM32F401 microcontroller development boards.
4.	Develop programming expertise for Cortex-M3/M4 using C and assembly, including interrupt-driven programming and exception handling.
5.	Explore advanced Cortex-M3 features such as memory protection, power management, and multi-processor configurations.

III - Course Content**Preamble:**

This course introduces students to the architecture, features, and design considerations of processors used in IoT systems. It covers microcontrollers, system-on-chips (SoCs), low-power processing cores, real-time operating systems (RTOS), and communication interfaces such as UART, SPI, I2C, and wireless protocols.

Unit – I	Overview of ARM and Cortex-M3	9 Periods
ARM Architecture – Versions, Instruction Set Development, Thumb 2 and Instruction Set Architecture, Cortex M3 Basics: Registers, Stack Pointer, Link Register, Program Counter, Special Registers, Operation Mode, Exceptions and Interrupts, Vector Tables, Stack Memory Operations, Reset Sequence, CORTEX M3 Instruction Sets: Assembly Basics, Instruction List, Instruction Descriptions, CORTEX M3 – Implementation Overview: Pipeline, Block Diagram. Bus Interfaces, I – Code Bus, D – Code Bus, System Bus- External PPB and DAP Bus.		
Unit – II	Cortex Exception Handling and Interrupts	9 Periods
Exception Types, Priority, Vector Tables, Interrupt Inputs and Pending behaviour, Fault Exceptions, Supervisor Call and Pendable Service Call, NVIC: Nested Vector Interrupt Controller, Overview, Basic Interrupts, SYSTICK Time, Interrupt Behavior, Interrupt/Exception Sequences, Exception Exits, Nested Interrupts, Tail – Chaining Interrupts, Late Arrivals and Interrupt Latency.		
Unit – III	Cortex M3/M4 Programming	9 Periods
Cortex M3/M4 Programming: Overview, Typical Development Flow, Using C, CMSIS Using Assembly, Exception Programming Using Interrupts, Exception/Interrupt Handlers, Software Interrupts, Vector Table Relocation, Memory Protection Unit and other CORTEX M3 Features, MPU Registers, Setting up the MPU, Power Management, Multiprocessor Configuration.		
Unit – IV	Microcontroller Development Boards	9 Periods
About STM32F401 Nucleo board, PWM and the Interrupt on STM32F401, Embedded C Programming Environment.		

Unit - V	Interfacing of Microcontroller Development Boards	9 Periods
Interfacing of STM32F401 Board, Interfacing LED and LCD, Serial port terminal application, Interfacing of temperature sensor, Interfacing of LDR light sensor, Speaker interfacing, Microphone interfacing, Speed control of DC motor using STM32, Bluetooth interfacing, Interfacing of gas sensor with STM32.		

TOTAL: 45 Periods

Reference Books:	1. Joseph Yiu, The Definitive Guide to the ARM CORTEX M3/M4, Second Edition, Elsevier, 2010. 2. Andrew N Sloss, Dominic Symes, Chris Wright, ARM System Developers Guide Designing and Optimising System Software, Elsevier, 2006. 3. Michael J Flynn and Wayne Luk, Computer System Design, System On Chip, Wiley India 2011. 4. Steve Furber, ARM System - on - Chip Architecture, 2nd Edition, Pearson, 2015. 5. CORTEX M Series ARM Reference Manual 6. CORTEX M3 Technical Reference Manual 7. STM32L152XX ARM CORTEX M3 Microcontroller Reference Manual 5/97. 8. https://www.st.com/resource/en/datasheet/stm32l433cc.pdf 9. NPTEL course entitled "Embedded system Design with ARM" by Indranil Sengupta & Kamalika Datta
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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Describe the basics ARM and Cortex M3 processor.	Understand (K2)
CO2	Develop assembly language/ embedded C- language code for a given problem.	Apply (K3)
CO3	Use ARM development boards and its exception and interrupt handling functionality	Apply (K3)
CO4	Evaluate the various unsupervised Learning algorithms using appropriate Dataset	Understand (K2)
CO5	Interface microcontroller development board with various sensors and display devices for given application/problem	Understand (K2)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO2	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO3	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO4	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO5	3	3	3	3	3	-	-	1	2	2	-	1	3	3

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23PEC26 IoT based System Design

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E- ECE	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

1.	Understand ARM Cortex-M3 architecture and instruction set relevant to IoT devices.
2.	Explore middleware platforms and architectures supporting IoT ecosystems and resource management.
3.	Learn key IoT communication protocols, including IEEE 802.15.4, Zigbee, CoAP, MQTT, and modern databases.
4.	Study IoT networking concepts, including low-power wireless technologies, IP optimization, and security considerations.
5.	Analyze real-world IoT applications and case studies across various domains such as smart cities, agriculture, and healthcare.

III - Course Content**Preamble:**

The Internet of Things (IoT) is revolutionizing the way systems are designed and deployed across sectors such as healthcare, agriculture, manufacturing, smart cities, and transportation. Building robust and intelligent IoT systems requires an interdisciplinary approach that integrates embedded hardware, sensor technologies, real-time communication, cloud platforms, and data analytics.

Unit - I	Introduction to Internet of Things	9 Periods
– Versions, Instruction Set Development, Thumb 2 and Instruction Set Architecture, Cortex M3 Basics: Registers, Stack Pointer, Link Register, Program Counter, Special Registers, Operation Mode, Exceptions and Interrupts, Vector Tables, Stack Memory Operations, Reset Sequence, CORTEX M3 Instruction Sets: Assembly Basics, Instruction List, Instruction Descriptions, CORTEX M3 – Implementation Overview: Pipeline, Block Diagram. Bus Interfaces, I – Code Bus, D – Code Bus, System Bus- External PPB and DAP Bus.		
Unit - II	IoT Middleware Platform	9 Periods
Middleware technologies for IoT system (IoT Ecosystem Overview – Horizontal Architecture Approach for IoT Systems – SOA based IoT Middleware) Middleware architecture of RFID, WSN, SCADA, M2M, are Approach Toward 5G (COMPaaS Middleware) – Resource management in IoT.		
Unit - III	IoT Protocols and IoT Access Technologies	9 Periods
IEEE 802.15.4, 802.15.4e, Zigbee protocol, IP versions, CoAP and MQTT. Modern databases: No SQL, New SQL, MongoDB.		
Unit - IV	Communication and Networking	9 Periods
IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN – Network Layer: IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks – Application Transport Methods: Supervisory Control and Data Acquisition –Application Layer Protocols: CoAP and MQTT- Data aggregation & dissemination		

Unit – V	Applications and Case Studies	9 Periods
Home automations - Smart cities – Environment – Energy – Retail – Logistics – Agriculture – Industry - Health and life style – Case study.		

TOTAL: 45 Periods

Reference Books:	1.Honbo Zhou, "Internet of Things in the cloud: A middleware perspective", CRC press, 2012. 2.Vijay Madiseti and Arshdeep Bahga, "Internet of Things (A Hands-on Approach)", VPT, 1st Edition, 2014. 3.Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press, 2017. 4.Constandinos X. Mavromoustakis, George Mastorakis, Jordi Mongay Batalla, "Internet of Things (IoT) in 5G Mobile Technologies" Springer International Publishing Switzerland, 2016
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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Articulate the main concepts, key technologies, strength and limitations of IoT.	Understand (K2)
CO2	Identify the architecture, infrastructure models of IoT.	Apply (K3)
CO3	Analyze the networking and how the sensors are communicated in IoT.	Analyze (K4)
CO4	Analyze and design different models for IoT implementation.	Analyze (K4)
CO5	Identify and design the new models for market strategic interaction.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	3	-	-	-	-	-	-	1	3	-
CO2	3	3	3	3	3	-	-	-	-	-	-	1	3	-
CO3	3	3	3	3	3	-	-	-	-	-	-	1	3	-
CO4	3	3	3	3	3	-	-	-	-	-	-	1	3	-
CO5	3	3	3	3	3	-	-	-	-	-	-	1	3	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23PEC27 Wireless Sensor Network Design

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E- ECE	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

1.	Understand the architecture, standards, and design principles of Wireless Sensor Networks (WSNs).
2.	Analyze MAC and routing protocols tailored for low-power and efficient wireless communication.
3.	Explore the integration of 6LoWPAN with IPv6 and related mobility support mechanisms.
4.	Examine QoS and energy management strategies critical for WSN performance and sustainability.
5.	Gain proficiency in simulation tools and programming frameworks like TinyOS and Contiki OS for WSN development.

III - Course Content**Preamble:**

Wireless Sensor Networks (WSNs) have emerged as a key enabling technology in modern applications such as environmental monitoring, smart cities, industrial automation, precision agriculture, and defense systems. These networks consist of spatially distributed sensor nodes that cooperatively sense, process, and communicate data wirelessly, often in resource-constrained and dynamic environments.

Unit - I	Introduction to Wireless Sensor Networks	9 Periods
Introduction to Wireless Sensor Networks – Motivation, Applications, and Challenges, Comparison with Ad Hoc Networks, Node Architecture – Sensor Node Components, Network Architecture – Types of Topologies, Design Principles, Service Interfaces, and Gateway Concepts, Short Range Wireless Communication Standards: IEEE 802.15.4, Zigbee, Bluetooth, Physical Layer and Transceiver Design Considerations.		
Unit - II	MAC and Routing Protocols	9 Periods
MAC Protocols – Fundamentals, Low Duty Cycle Protocols, Wakeup Concepts Contention and Schedule-Based Protocols – SMAC, BMAC, TRAMA Routing Protocols – Design Requirements, Classification SPIN, Directed Diffusion, LEACH, PEGASIS Routing Metrics and Performance Trade-offs.		
Unit - III	6LoWPAN and IPv6 Integration	9 Periods
6LoWPAN Architecture – Protocol Stack and Adaptation Layer Link Layer Addressing and Routing (Mesh-Under, Route-Over) Header Compression – Stateless & Context-Based Fragmentation and Reassembly Mobility Support: Mobile IPv6, Proxy Mobile IPv6, Proxy Home Agent Routing for Low Power and Lossy Networks – ROLL, Border Routing, MANET Integration.		
Unit - IV	Applications and QoS/Energy Management	9 Periods
Application Design Issues – End-to-End, Real-Time Streaming, Publish/Subscribe Web Services and Middleware Protocol Paradigms Common Protocols – MQTT-S, ZigBee CAP, SNMP, Real-time Transport QoS Requirements – Delay, Reliability, Throughput Energy Management – Power-aware MAC and Routing, Battery and Transmission Management Trade-offs Between QoS and Energy Efficiency		

Unit – V	Simulation Tools and Programming Frameworks	9 Periods
TinyOS – Introduction to NesC, Modules, Interfaces, Configuration Programming in TinyOS, TOSSIM Simulator Contiki OS – Structure, Communication Stack Programming and Simulation in Cooja Environment Comparative Overview of WSN Development Tools		

TOTAL: 45 Periods

Reference Books:	1. Holger Karl , Andreas willig, “Protocol and Architecture for Wireless Sensor Networks”, John Wiley Publication, 2006. 2. Anna Forster, “Introduction to Wireless Sensor Networks”, Wiley, 2017. 3. Zach Shelby Sensinode and Carsten Bormann, “ 6LoWPAN: The Wireless Embedded Internet” John Wiley and Sons, Ltd, Publication, 2009. 4. Philip Levis, “TinyOS Programming”, 2006 –www.tinyos.net. 5. The Contiki Operating System. http://www.sics.se/contiki .
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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Design solutions for WSNs applications.	Apply (K3)
CO2	Develop efficient MAC and Routing Protocols.	Apply (K3)
CO3	Design solutions for 6LOWPAN applications.	Apply (K3)
CO4	Develop efficient layered protocols in 6LOWPAN.	Apply (K3)
CO5	Use Tiny OS and Contiki OS in WSNs and 6LOWPAN applications.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	3	-	-	-	-	-	-	1	3	-
CO2	3	3	3	3	3	-	-	-	-	-	-	1	3	-
CO3	3	3	3	3	3	-	-	-	-	-	-	1	3	-
CO4	3	3	3	3	3	-	-	-	-	-	-	1	3	-
CO5	3	3	3	3	3	-	-	-	-	-	-	1	3	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23PEC28 Industry 4.0 and Industrial IoT

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E- ECE	V/VI/VII	PEC	2	0	2	3

II - Course Objectives

1.	Understand the key components and technologies driving Industry 4.0, including cyber-physical systems and smart factories.
2.	Explore Industrial IoT application domains such as healthcare, power plants, and inventory management.
3.	Learn the architecture and layers of Industrial IoT, focusing on sensing, processing, communication, and networking.
4.	Analyze IoT analytics techniques including big data, machine learning, and fog computing for industrial applications.
5.	Evaluate cyber security challenges and solutions within Industry 4.0 environments.

III - Course Content**Preamble:**

The convergence of the Internet of Things (IoT) with industrial systems marks the foundation of Industry 4.0, a transformative movement that is reshaping global manufacturing and production ecosystems. Industrial IoT (IIoT) enables intelligent, connected operations through real-time data acquisition, edge computing, predictive maintenance, and autonomous decision-making—fostering efficiency, flexibility, and innovation in modern industries.

Unit - I	Industry 4.0	6 Periods
Globalization and Emerging Issues, The Fourth Revolution, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories, Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artificial Intelligence, Big Data and Advanced Analysis, Cybersecurity in Industry 4.0.		
Unit - II	Industrial IoT	6 Periods
Basics, Industrial Processes, Industrial Sensing and Actuation, Industrial Internet Systems, Business Model and Reference Architecture.		
Unit - III	Industrial IoT-Layers	6 Periods
Sensing layer - Sensors and Actuators, Network layer - Wired/Wireless, Gateways and Edge Connectivity, Processing layer - Middleware, Local Storage and Analytics, Application layer.		
Unit - IV	IIoT Analytics	6 Periods
Big Data Analytics and Software Defined Networks, Machine Learning and Data Science: R and Julia Programming, Data Management with Hadoop, Security and Fog Computing.		
Unit - V	Application Domains	6 Periods
Healthcare, Power Plants, Inventory Management and Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management.		

TOTAL: 30 Periods

List of Experiments - 30 Periods

1. Study and Program different Sensors for IoT applications
2. LDR sensor, IR sensor, Temperature Sensor, Ultrasound Sensor, Gas sensor
3. Write a program using IR sensor for working morning alarm and night lamp.
4. Write a program using Temperature sensor for detecting heat / fire.
5. Write a program using Gas sensor for detecting LPG gas leak.
6. Write a program using Ultrasound sensor for range detection.
7. Write a program using sensors for carparking assist
8. Write a program using sensors for water level indicator and overflow detection
9. Designing and debugging complex mixed signal devices (analog, digital, and RF)
10. Write a program to interface Bluetooth and implement DC Motor.
11. Write a program to control DC motor using Google Assistance.
12. Write a program to control Stepper motor using Google Assistance.

TOTAL:60 Periods

Reference Books:	1."Industry 4.0: The Industrial Internet of Things", by Alasdair Gilchrist (Apress) 2."Industrial Internet of Things: Cyber manufacturing Systems" by Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat (Springer)
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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Comprehend the Core Principles and Technologies of Industry 4.0.	Understand (K2)
CO2	Design and Analyze Industrial IoT Architectures.	Apply (K3)
CO3	Apply Data Analytics and Machine Learning for Industrial Intelligence.	Apply (K3)
CO4	Assess and Implement Industrial Cybersecurity and Fog Computing Solutions.	Analyze (K4)
CO5	Evaluate and Develop IIoT Solutions for Domain-Specific Applications.	Analyze (K4)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO2	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO3	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO4	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO5	3	3	3	3	3	-	-	1	2	2	-	1	3	3

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23PEC29 MEMS Design

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E- ECE	V/VI/VII	PEC	2	0	2	3

II - Course Objectives

1.	Understand fundamental electric and mechanical properties relevant to sensors and actuators.
2.	Analyze electrostatic sensing and actuation principles including capacitive sensors and actuators.
3.	Explore thermal sensing and actuation mechanisms and their applications in various sensors.
4.	Describe piezoelectric effects and their applications in sensing and actuation devices.
5.	Examine magnetic sensing and actuation concepts along with fabrication techniques of micro magnetic components.

III - Course Content**Preamble:**

Micro-Electro-Mechanical Systems (MEMS) represent a fusion of microscale mechanical and electronic components on a single chip, enabling the development of compact, efficient, and highly sensitive devices. MEMS technology is pivotal in a wide range of applications, including sensors, actuators, biomedical implants, automotive systems, communication devices, and industrial automation.

Unit - I	Essential Electric and Mechanical Concepts	6 Periods
Conductivity of semiconductors, Crystal planes and orientations, stress and strain, flexural beam bending analysis under simple loading conditions, Dynamic system, resonant frequency and quality factor		
Unit - II	Sensing and Actuation	6 Periods
Parallel plate capacitor, Applications of parallel plate capacitors- inertial sensor, pressure sensor, flow sensor, tactile sensor, parallel plate actuators, interdigitated finger capacitors, applications of comb drive devices.		
Unit - III	Thermal Sensing and Actuation	6 Periods
Fundamentals of thermal transfer, Sensors and actuators based on thermal expansion, Thermal couples, Thermal resistors, Applications- Infrared sensors, flow sensors, Inertial sensors, other sensors		
Unit - IV	Piezoelectric Sensing and Actuation	6 Periods
Mathematical description of piezoelectric effects, Cantilever piezoelectric actuator model, properties of piezoelectric materials –Quartz, PZT,PVDF, ZnO, Applications – Acoustic sensors, Tactile sensors		
Unit - V	Magnetic Sensing and Actuation	6 Periods
Concepts and principles- magnetization and nomenclatures, principles of micro magnetic actuators, fabrication of micro magnetic components- deposition, design and fabrication of magnetic coil, MEMS magnetic actuators		

TOTAL: 30 Periods

List of Experiments - 30 Periods

1. Design and simulation of piezoelectric cantilever
2. Design and simulation of thermo couples
3. Design and simulation of comb drive actuators

TOTAL: 60 Periods

Reference Books:	1. Murty B.S, Shankar P, Raj B, Rath, B.B, Murday J, Textbook of Nanoscience and Nanotechnology, Springer publishing, 2013. 2. Sergey Edward Lyshevski, "MEMS and NEMS: Systems, Devices, and Structures", CRC Press, 2002 3. Tai Ran Hsu, MEMS and Microsystems Design and Manufacture, Tata Mcgraw Hill, 2002 4. Vinod Kumar Khanna Nanosensors: Physical, Chemical, and Biological, CRC press, 2012.
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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the basics of MEMS design aspects.	Understand (K2)
CO2	Apply the knowledge in the development of electro static sensors and actuators	Apply (K3)
CO3	Apply the knowledge in the development of thermal sensors and actuators.	Apply (K3)
CO4	Apply the knowledge in the development of piezoelectric sensors and actuators	Apply (K3)
CO5	Apply the knowledge in the development of magnetic sensors and actuators	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO2	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO3	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO4	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO5	3	3	3	3	3	-	-	1	2	2	-	1	3	3

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23PEC30 Fundamentals of Nano Electronics

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E- ECE	V/VI/VII	PEC	2	0	2	3

II - Course Objectives

1.	To understand the principles of nano-scale electronic materials and devices.
2.	To study synthesis methods of nanomaterials using top-down and bottom-up approaches.
3.	To explore advanced characterization techniques for analyzing nanomaterials.
4.	To examine the properties and applications of carbon-based nanostructures.
5.	To analyze real-world applications of nanoelectronics in various domains like healthcare, energy, and sensing.

III - Course Content

Preamble: Nanoelectronics is at the forefront of technological advancement, enabling the development of ultra-compact, high-performance, and energy-efficient electronic devices. As traditional CMOS scaling approaches physical limits, nanoelectronic devices and architectures offer new paradigms through quantum effects, novel materials, and nanoscale fabrication techniques.		
Unit - I	Introduction to Nano Electronics	6 Periods
Nano electronics in recent scenario - Crystal Structure –Semiconductors- Band theory– Donors - Acceptors and Deep traps, Mobility – Excitons, Electron confinement - Quantum dots, wires and well, 1D, 2D and 3D Nano structured materials, metal Oxides- Physical, Chemical and Optical properties		
Unit - II	Synthesis of Nano materials	6 Periods
Bottom-up Approaches-Sol-gel, Self-assembled monolayer, Physical and Chemical vapour deposition, thin films, epitaxy-Lithography Top-down Approaches-Grinding, high energy ball milling, Injection molding		
Unit - III	Nano materials Characterization	6 Periods
X-ray diffraction, Powder diffraction, Structural analysis, Scanning Electron Microscopy, FESEM, AFM, Transmission Electron Microscope, Spectroscopic techniques: UV-Visible, Infra-red Spectroscopy, rotational, vibrational photo luminescence (PL)		
Unit - IV	Carbon Nanostructures	6 Periods
Introduction, Carbon Molecules – Nature of the Carbon Bond, New Carbon Structures, Carbon Clusters – Small Carbon Clusters, Alkali-Doped C60 – Superconductivity in C60 – Larger and Smaller Fullerenes – Other Buckyballs, Carbon Nanotubes – Fabrication – Structure –Graphene, Nanotube for memory applications-Nano structures and nano structured device		
Unit - V	Applications of Nano Electronics	6 Periods
Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS), Spintronics- Nano Crystals devices- Graphene based Liquid Crystal devices, Nano electronics in Energy- Nano sensors for biomedical applications - Nano biometrics – Nanobots - Smart dust sensor for the future, Nano medicine		

TOTAL: 30 Periods

List of Experiments - 30 Periods

T-CAD/ Any other relevant software-based Simulations

1. Quantum Devices
2. XRD, SEM, AFM
3. Carbon nanotubes

TOTAL: 60 Periods

Reference Books:	1. Hanson, Fundamentals of Nanoelectronics, Pearson education, 2009 2. Mircea Dragoman and Daniela Dragoman, Nanoelectronics: Principles and Devices, Artech House, 2009 3. Vladimir V. Mitin, Viatcheslav A. Kochelap, Michael A. Stroscio, —Introduction to Nano electronics: Science, Nanotechnology, Engineering, and Applications, Cambridge University Press, Revised edition, 2012 4. Robert Puers, Livio Baldi, Marcel Van de Voorde and Sebastiaan E. Van Nooten, Nanoelectronics: Materials, Devices, Applications, Wiley, 2017 5. Brajesh Kumar Kaushik, Nanoelectronics: Devices, Circuits and Systems, Elsevier science, 2018
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IV - Course Outcomes

	On completion of the course, the students will be able to	Bloom's Level Mapped
CO1	Understand the basics of nano electronics including quantum wires, dots and wells.	Understand (K2)
CO2	Explain the bottom-up and top-down approaches to synthesize the nano materials.	Understand (K2)
CO3	Identify the nano material characterization method.	Apply (K3)
CO4	Apply the knowledge in the development of nanostructure devices.	Apply (K3)
CO5	Select the suitable nano devices for various applications.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO2	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO3	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO4	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO5	3	3	3	3	3	-	-	1	2	2	-	1	3	3

Mapping: 1-Low, 2-Medium, 3-High

Vertical 6

High Speed Communication Technologies

I - Course Name: 23PEC31 Wireless Communication

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E- ECE	V/VI/VII	PEC	2	0	2	3

II - Course Objectives

1.	Understand the cellular system design principles including frequency reuse and handoff strategies.
2.	Analyze mobile radio propagation and fading effects in wireless channels.
3.	Apply modulation, equalization, and diversity techniques to improve wireless communication.
4.	Compare multiple access methods and their impact on cellular capacity.
5.	Explore the evolution and architecture of wireless networks up to 5G and beyond.

III - Course Content**Preamble:**

Wireless communication forms the backbone of modern connectivity, enabling seamless data transmission across devices, people, and systems without the constraints of physical infrastructure. It powers everything from mobile phones and satellite systems to Wi-Fi, Bluetooth, and next-generation networks like 5G and beyond.

Unit – I	Cellular Concept-System Design Fundamentals	6 Periods
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Introduction-Frequency Reuse-Channel Assignment Strategies-Handoff Strategies: Prioritizing Handoffs, Practical Handoff Considerations. Interference And System Capacity: Co-Channel Interference and System Capacity-Channel Planning for Wireless Systems, Adjacent Channel Interference, Power Control for Reducing Interference, Trunking and Grade of Service. Improving Coverage and Capacity in Cellular Systems: Cell Splitting, Sectoring. Call Setup and Cellular Signaling Procedures

Unit – II	Mobile Radio Propagation	6 Periods
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Large Scale Path Loss: Introduction to Radio Wave Propagation - Free Space Propagation Model – Three Basic Propagation Mechanism: Reflection – Brewster Angle- Diffraction, Scattering. Small Scale Fading and Multipath: Small Scale Multipath Propagation, Factors Influencing Small-Scale Fading, Doppler Shift, Coherence Bandwidth, Doppler Spread and Coherence Time. Types Of Small- Scale Fading: Fading Effects Due To Multipath Time Delay Spread, Jakes Model, Doppler Spread, and Doppler Spectrum

Unit – III	Modulation Techniques, Equalization and Diversity	6 Periods
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Digital Modulation – An Overview: Factors That Influence the Choice of Digital Modulation, Spread Spectrum Modulation Techniques: Pseudo- Noise (PN) Sequences, Direct Sequence Spread Spectrum (DS-SS)- Modulation Performance in Fading and Multipath Channels-Equalization, Diversity and Channel Coding: Introduction-Fundamentals of Equalization-Diversity Techniques: Practical Space Diversity Considerations, Polarization Diversity, Frequency Diversity, Time Diversity. Beam forming and Smart Antennas

Unit – IV	Multiple Access Techniques	6 Periods
Introduction: Introduction To Multiple Access- Frequency Division Multiple Access (FDMA) - Time Division Multiple Access (TDMA) - Spread Spectrum Multiple Access-Code Division Multiple Access (CDMA) - Space Division Multiple Access (SDMA) - Capacity of Cellular Systems: Capacity of Cellular CDMA, Capacity of CDMA With Multiple Cells. Capacity Enhancement with MIMO		
Unit – V	Wireless Networking	6 Periods
Introduction: Difference Between Wireless And Fixed Telephone Networks, Development Of Wireless Networks: First Generation Wireless Networks, Second Generation Wireless Networks, Third Generation Wireless Networks, Fixed Network Transmission Hierarchy, Traffic Routing In Wireless Networks: Circuit Switching, Packet Switching- Personal Communication Services/ Networks(PCS/PCNs):Packet Vs Circuit Switching For PCN, Cellular Packet- Switched Architecture- Packet Reservation Multiple Access(PRMA)- Network Databases: Distributed Database For Mobility Management- Universal Mobile Telecommunication Systems(UMTS). Trends Beyond 5G: Massive MIMO, mmWave, Ultra-Reliable Low Latency Communication (URLLC)		

TOTAL: 30 Periods**List of Experiments – 30 Periods**

1. Modeling of wireless communication systems using Matlab (Two ray channel and Okumura –Hata model)
2. Modeling and simulation of Multipath fading channel
3. Design, analyze and test Wireless standards and evaluate the performance measurements such as BER, PER, BLER, throughput, capacity, ACLR, EVM for 4G and 5G using Matlab
4. Modulation: Spread Spectrum – DSSS Modulation & Demodulation
5. Wireless Channel equalization: Zero-Forcing Equalizer (ZFE), MMSE Equalizer (MMSEE), Adaptive Equalizer (ADE), Decision Feedback Equalizer (DFE)
6. Modeling and simulation of TDMA, FDMA and CDMA for wireless communication

TOTAL: 60 Periods

Reference Books:	1. Communication –Andrea Goldsmith, Cambridge University Press, 2011 2. Van Nee, R. and Ramji Prasad, –OFDM for wireless multimedia communications, Artech House, 2000 3. David Tse and Pramod Viswanath, –Fundamentals of Wireless Communication, Cambridge University Press, 2005. 4. Upena Dalal, –Wireless Communication”, Oxford University Press, 2009. 5. Andreas.F. Molisch, –Wireless Communications”, John Wiley – India, 2006. 6. Wireless Communication and Networks –William Stallings, Pearson Education, Second Edition 2002
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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the Concept and Design of a Cellular System.	Understand (K2)
CO2	Understand Mobile Radio Propagation and Various Digital Modulation Techniques.	Apply (K3)
CO3	Identify suitable Multiple Access Techniques for Wireless Networks.	Apply (K3)
CO4	Characterize a wireless channel and evolve the system design specifications.	Analyze (K4)
CO5	Design a cellular system based on resource availability and traffic demands.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO2	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO3	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO4	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO5	3	3	3	3	3	-	-	1	2	2	-	1	3	3

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23PEC32 4G/5G Communication Networks

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E- ECE	V/VI/VII	PEC	2	0	2	3

II - Course Objectives

1.	Understand the evolution of wireless networks from 2G to 5G and the fundamental differences between 4G and 5G technologies.
2.	Analyze the architecture, components, and protocols of 5G networks including Next Generation Core and 5G New Radio.
3.	Explore advanced 5G concepts such as network slicing, multi-access edge computing (MEC), and dynamic spectrum management.
4.	Study the application of millimeter wave technology, cognitive radio, and software-defined radio in 5G environments.
5.	Examine security challenges and solutions in 5G networks, focusing on network domain, user domain, and slicing security.

III - Course Content**Preamble:**

The evolution from 4G to 5G communication networks marks a major leap in wireless technology, enabling ultra-reliable, high-speed, low-latency, and massively connected systems. These technologies support diverse applications such as enhanced mobile broadband, autonomous vehicles, smart cities, industrial automation, and immersive multimedia experiences.

Unit - I	Evolution of Wireless Networks	6 Periods
Networks evolution: 2G, 3G, 4G, 5G and beyond, Evolution of radio access networks, Need for 5G. 4G versus 5G, Next Generation core (NG-core),		
Unit - II	5G Concepts and Challenges	6 Periods
Fundamentals of 5G technologies, overview of 5G core network architecture, 5G new radio and cloud technologies, EPC for 5G, Massive MIMO		
Unit - III	Network Architecture and the Processes	6 Periods
5G architecture and core, network slicing, multi access edge computing (MEC), Visualization of 5G components, end-to-end system architecture, 5G protocols: 5G NAS, NGAP, GTP-U and RACH		
Unit - IV	Dynamic Spectrum Management and MM-Waves	6 Periods
Mobility management, Command and control, spectrum sharing and spectrum trading, cognitive radio based on 5G, Software Defined Radio, millimeter waves.		
Unit - V	Security in 5G Networks	6 Periods
Security features in 5G networks, network domain security, user domain security, mitigating the threats in 5G & Network Slicing Security.		

TOTAL: 30 Periods

List of Experiments – 30 Periods**SIMULATION USING MATLAB**

1. 5G-Compliant waveform generation and testing
2. Modeling of 5G Synchronization signal blocks and bursts
3. Channel modeling in 5G networks
4. Multiband OFDM demodulation
5. Perfect Channel estimation
6. Development of 5G New Radio Polar Coding

TOTAL: 60 Periods

Reference Books:	1. 5G Core networks: Powering Digitalization, Stephen Rommer, Academic Press, 2019 2. An Introduction to 5G Wireless Networks: Technology, Concepts and Use cases, Saro Velrajan, First Edition, 2020 3. 5G Simplified: ABCs of Advanced Mobile Communications Jyrki. T.J. Penttinen, Copyrighted Material. 4. 5G system Design: An end to end Perspective, Wan Lee Anthony, Springer Publications, 2019. Antoniou, Digital Filters: Analysis, Design and Applications. Tata McGraw-Hill, New Delhi, 2003.
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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the evolution of wireless networks.	Understand (K2)
CO2	Learn the concepts of 5G networks.	Understand (K2)
CO3	Analyse the 5G architecture and protocols.	Analyze (K4)
CO4	Estimate the dynamic spectrum management.	Analyze (K4)
CO5	Learn the security aspects in 5G networks.	Understand (K2)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO2	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO3	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO4	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO5	3	3	3	3	3	-	-	1	2	2	-	1	3	3

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23PEC33 Satellite Communication

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E- ECE	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

1.	Understand fundamental satellite orbital mechanics including Kepler's laws, orbital parameters, and the characteristics of geostationary and non-geostationary orbits.
2.	Analyze the components and technologies of the space segment such as spacecraft structure, power systems, attitude control, thermal management, and communication payloads.
3.	Apply principles of satellite link design including uplink/downlink calculations, free space loss, atmospheric effects, and noise temperature considerations.
4.	Explore satellite access methods, modulation and multiplexing techniques, and coding schemes for efficient transmission of voice, data, and video signals.
5.	Study various satellite communication applications including direct broadcast services, mobile satellite systems, navigational systems like GPS, and emerging satellite networks.

III - Course Content**Preamble:**

Satellite communication plays a pivotal role in global connectivity by enabling long-distance, high-capacity, and reliable data transmission across diverse terrains and remote areas. It forms the foundation for applications such as television broadcasting, GPS navigation, weather forecasting, disaster management, and global internet services.

Unit - I	Satellite Orbits	9 Periods
Kepler's Laws, Newton's law, orbital parameters, orbital perturbations, station keeping, geo stationary and non-geo stationary orbits - Look Angle Determination- Limits of visibility - eclipse -Sub satellite point -Sun transit outage-Launching Procedures - launch vehicles and propulsion Effects of a non-spherical earth, Atmospheric drag		
Unit - II	Space Segment	9 Periods
Spacecraft Technology- Structure, Primary power, Attitude and Orbit control, Thermal control and propulsion, communication payload and supporting subsystems, Telemetry, Tracking and command-Transponders Antenna Subsystem		
Unit - III	Satellite Link Design	9 Periods
Basic link analysis, Uplink and Downlink Design equation, Free space loss-Atmospheric effects, Ionospheric scintillation, Rain induced attenuation and interference, system noise temperature, Link Design with and without frequency reuse.		
Unit - IV	Satellite Access and Coding Techniques	9 Periods
Modulation and Multiplexing: Voice, Data, Video, Analog - digital transmission system, Digital video Broadcast, Multiple Access: FDMA, TDMA, CDMA, PAMA and DAMA Assignment Methods, Compression - encryption, Coding Schemes.		
Unit - V	Satellite Applications	9 Periods
Direct Broadcast Satellite Television and Radio: C-Band and Ku-Band Home Satellite TV, Digital DBS TV, INTELSAT Series, INSAT, VSAT, Mobile satellite services: GSM, GPS, LEO, MEO, Satellite Navigational System, GPS-Position Location Principles, Differential GPS, Orbcomm, Iridium		

TOTAL: 45 Periods

Reference Books:	1. Dennis Roddy, Satellite Communication, 4th Edition, Mc Graw Hill International, 2017 2. Tri T. Ha, Digital Satellite Communications, 2nd edition, Mc Graw Hill education, 2017 3. Wilbur L. Pritchard, Hendri G. Suyderhoud, Robert A. Nelson, Satellite Communications Systems Engineering, 2nd edition, Prentice Hall/Pearson, 2013 4. Bruce R. Elbert, The Satellite Communication Applications, Hand Book, Artech House Boston London, 2003
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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Identify the satellite orbits.	Apply (K3)
CO2	Analyze the satellite subsystems.	Analyze (K4)
CO3	Evaluate the satellite link power budget.	Analyze (K4)
CO4	Identify access technology for satellite.	Apply (K3)
CO5	Design various satellite applications.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	3	-	-	-	-	-	-	1	3	-
CO2	3	3	3	3	3	-	-	-	-	-	-	1	3	-
CO3	3	3	3	3	3	-	-	-	-	-	-	1	3	-
CO4	3	3	3	3	3	-	-	-	-	-	-	1	3	-
CO5	3	3	3	3	3	-	-	-	-	-	-	1	3	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23PEC34 Radar Technologies

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E- ECE	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

1.	To understand fundamental radar principles, radar equation, detection metrics, and radar system classifications.
2.	To explore the operational principles and applications of CW, FM, Doppler, and MTI radar systems.
3.	To study various radar tracking techniques including monopulse, conical scan, and Track While Scan (TWS) methods.
4.	To examine signal processing techniques in radar, including detection in noise/clutter and adaptive CFAR strategies.
5.	To learn the components and working of radar transmitters, receivers, antennas, and display systems.

III - Course Content**Preamble:**

Radar (Radio Detection and Ranging) is a critical technology used across civilian and defense sectors for detecting, tracking, and imaging objects at various ranges and conditions. From air traffic control and weather monitoring to military surveillance and autonomous navigation, radar systems play a vital role in modern sensing and situational awareness.

Unit - I	Introduction to Radar	9 Periods
Radar principles - Basic block diagram, detection, range, velocity, Radar Equation - simple form, Pulsed Radar equation, Detection of Signals in Noise- Receiver Noise, Signal-to-Noise Ratio, Probabilities of Detection and False Alarm, Integration of Radar Pulses, Radar classifications based on Frequencies, Wave form and application		
Unit - II	Types of Radar	9 Periods
CW and Frequency Modulated Radar, Doppler and MTI Radar- Delay Line Cancellers, Staggered Pulse Repetition Frequencies, Doppler Filter Banks, MTI from a Moving Platform (AMIT), Pulse Doppler Radar.		
Unit - III	Tracking Radar	9 Periods
Tracking with Radar, Monopulse Tracking, Conical Scan, Sequential Lobing, Limitations to Tracking Accuracy, Low-Angle Tracking - Comparison of Trackers, Track while Scan (TWS) Radar- Target prediction, state estimation		
Unit - IV	Radar Signal Processing	9 Periods
Radar Signal Processing Fundamentals, Detection strategies, Constant False Alarm rate detectors, Adaptive CFAR, Detection of radar signals in Noise and clutter, detection of non-fluctuating target in noise, Doppler spectrum of fluctuating targets, Range Doppler spectrum of stationary and moving radar.		
Unit - V	Radar Transmitters and Receivers	9 Periods
Radar Transmitter - Linear Beam Power Tubes, Solid State RF Power Sources, Magnetron, Crossed Field Amplifiers, Radar Receiver - Receiver noise power, Super heterodyne Receiver, Duplexers and Receiver Protectors - Radar Displays, Radar Antenna - Reflector Antennas, Electronically Steered Phased Array Antennas, Phase Shifters		

TOTAL: 45 Periods

Reference Books:	1. M.I. Skolnik, "Introduction to Radar Systems", Tata McGraw Hill 2006 2. P.Z. Peebles, "Radar Principles", Wiley, 1998. 3. Habibur Rahman, "Fundamental Principles of Radar", CRC press, Taylor and Francis, 2019. 4. M. R. Richards, J. A. Scheer, W. A. Holm, Editors, "Principles of Modern Radar, Basic Principles", SciTech Publishing, 2012 5. Nathansan, "Radar design principles-Signal processing and environment", PHI, 2 nd Edition, 2007
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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Identify the Radar parameters.	Understand (K2)
CO2	Differentiate various radar types.	Apply (K3)
CO3	Evaluate different tracking and filtering schemes.	Analyze (K4)
CO4	Apply signal processing in target detection.	Apply (K3)
CO5	Select suitable Radar transmitter and receiver blocks.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	3	-	-	-	-	-	-	1	3	-
CO2	3	3	3	3	3	-	-	-	-	-	-	1	3	-
CO3	3	3	3	3	3	-	-	-	-	-	-	1	3	-
CO4	3	3	3	3	3	-	-	-	-	-	-	1	3	-
CO5	3	3	3	3	3	-	-	-	-	-	-	1	3	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23PEC35 Massive MIMO Networks

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E- ECE	V/VI/VII	PEC	2	0	2	3

II - Course Objectives

1.	Understand the fundamentals and system models of Massive MIMO for uplink and downlink communication.
2.	Analyze propagation channels, including correlated Rayleigh fading and favorable propagation conditions.
3.	Apply channel estimation and linear processing techniques in single-cell Massive MIMO systems.
4.	Evaluate uplink and downlink data transmission methods in multi-cell Massive MIMO environments.
5.	Examine practical case studies of Massive MIMO deployment in rural and urban scenarios.

III - Course Content**Preamble:**

Massive Multiple Input Multiple Output (Massive MIMO) technology is a cornerstone of 5G and future wireless networks, enabling dramatically increased spectral efficiency, capacity, and energy efficiency through the use of large-scale antenna arrays. By simultaneously serving multiple users on the same time-frequency resources, Massive MIMO systems are transforming wireless communication performance and scalability.

Unit - I	Massive MIMO Networks	6 Periods
Fundamentals of Massive MIMO, Correlated Rayleigh Fading, System Model for Uplink and Downlink, Basic Impact of Spatial Channel Correlation, Channel Hardening and Favourable Propagation,		
Unit - II	Massive MIMO Propagation Channel	6 Periods
MIMO channels Favorable Propagation and Deterministic Channels-Capacity Linear Processing-Singular Values and Favorable Propagation, Favorable Propagation and Random Channels-Independent Rayleigh Fading-Uniformly Random Line-of-Sight (UR-LoS)-Independent Rayleigh Fading versus UR-LoS - Finite-Dimensional Channels		
Unit - III	Single-Cell Systems	6 Periods
Uplink Pilots and Channel Estimation - Orthogonal Pilots- De-Spreading of the Received Pilot Signal-MMSE Channel Estimation, Uplink Data Transmission - Zero-Forcing -Maximum-Ratio, Downlink Data Transmission-Linear Precoding-Zero-Forcing-Maximum-Ratio, Discussion Interpretation of the Effective SINR.		
Unit - IV	Multi-Cell Systems	6 Periods
Uplink Pilots and Channel Estimation, Uplink Data Transmission - Zero-Forcing -Maximum-Ratio, Downlink Data Transmission -Zero-Forcing - Maximum-Ratio, Discussion -Asymptotic Limits with Infinite Numbers of Base Station Antennas - The Effects of Pilot Contamination - Non-Synchronous Pilot Interference		
Unit - V	Case Studies	6 Periods
Single-Cell Deployment Example: Fixed Broadband Access in Rural Area, Multi-Cell Deployment: Preliminaries and Algorithms, Multi-Cell Deployment Examples: Mobile Access -		

Dense Urban Scenario 172- Suburban Scenario - Minimum Per-Terminal Throughput Performance -Additional Observations - Comparison of Power Control Policies

TOTAL: 30 Periods

List of Experiments – 30 Periods

1. Massive MIMO hybrid beamforming
2. Single cell massive MIMO downlink communications
3. Multicell massive MIMO downlink communications.
4. Precoding in massive MIMO single cell and multicell downlink communications
5. Channel estimation in massive MIMO system

TOTAL: 60 Periods

Reference Books:	1. Erik G. Larsson, Hong Yang, Hien Quoc Ngo, "Fundamentals of Massive MIMO", Cambridge University Press 2016. (UNITS II-V) 2. Emil Björnson, Jakob Hoydis and Luca Sanguinetti (2017), "Massive MIMO Networks: Spectral, Energy, and Hardware Efficiency", Foundations and Trends, Now, 2017. (UNIT I) 3. Long Zhao, Hui Zhao, Kan Zheng, "Wei Xiang Massive MIMO in 5G Networks: Selected Applications", Springer 2018. 4. Leibo Liu, Guiqiang Peng, Shaojun Wei, "Massive MIMO Detection Algorithm and VLSI Architecture", Springer 2019. 5. Shahid Mumtaz, Jonathan Rodriguez, Linglong Dai, "mmWave Massive MIMO: A Paradigm for 5G"
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IV - Course Outcomes

	On completion of the course, the students will be able to	Bloom's Level Mapped
CO1	Understand and explain massive MIMO networks.	Understand (K2)
CO2	Analyze massive MIMO propagation channels and their capacity bounds.	Analyze (K4)
CO3	Examine channel estimation techniques for single cell system.	Analyze (K4)
CO4	Analyze channel estimation techniques for multi cell system.	Analyze (K4)
CO5	Explain the concepts underlining the deployment of single and multicell massive	Understand (K2)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO2	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO3	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO4	3	3	3	3	3	-	-	1	2	2	-	1	3	3
CO5	3	3	3	3	3	-	-	1	2	2	-	1	3	3

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23PEC36 Advanced Wireless Communication Techniques

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	B.E- ECE	V/VI/VII	PEC	3	0	0	3

II - Course Objectives

1.	Understand network architectures and research challenges in cooperative cellular wireless networks.
2.	Analyze cooperative communication techniques in OFDM and MIMO relay networks for improved efficiency.
3.	Explore relay-based cooperative strategies including space-time coding and resource optimization.
4.	Examine green radio concepts focusing on energy-efficient base station power management and cooperative processing.
5.	Investigate access techniques and adaptive scheduling for energy-saving in green cellular radio networks.

III - Course Content**Preamble:**

As wireless systems evolve toward high-capacity, low-latency, and ultra-reliable communication, advanced techniques have become essential for meeting the demands of next-generation networks such as 5G, 6G, and beyond. These methods address challenges in spectrum efficiency, interference management, and mobility across diverse application domains like IoT, vehicular networks, and broadband mobile access.

Unit - I	Cooperative Communications and Green Concepts	9 Periods
Network architectures and research issues in cooperative cellular wireless networks; Cooperative communications in OFDM and MIMO cellular relay networks: issues and approaches; Fundamental trade-offs on the design of green radio networks, green modulation and coding schemes		
Unit - II	Cooperative Techniques	9 Periods
Cooperative techniques for energy efficiency, Cooperative base station techniques for cellular wireless networks; Turbo base stations; Antenna architectures for cooperation; Cooperative communications in 3GPP LTE-Advanced, Partial information relaying and coordinated multi-point transmission in LTE-Advanced		
Unit - III	Relay-Based Cooperative Cellular Networks	9 Periods
Distributed space-time block codes; Collaborative relaying in downlink cellular systems; Radio resource optimization; Adaptive resource allocation; Cross-layer scheduling design for cooperative wireless two-way relay networks; Network coding in relay-based networks.		
Unit - IV	Green Radio Networks	9 Periods
Base Station Power-Management Techniques- Opportunistic spectrum and load management, Energy-saving techniques in cellular wireless base stations, Power-management for base stations in smart grid environment, Cooperative multi cell processing techniques for energy-efficient cellular wireless communications		

Unit – V	Access Techniques for Green Radio Networks	9 Periods
Cross-layer design of adaptive packet scheduling for green radio networks; Energy-efficient relaying for cooperative cellular wireless networks; Energy performance in TDD-CDMA multichip cellular networks; Resource allocation for green communication in relay-based cellular networks; Green Radio Test-Beds and Standardization Activities.		

TOTAL: 45 Periods

Reference Books:	1. F. Richard Yu, Yu, Zhang and Victor C. M. Leung “Green Communications and Networking”, CRC press, 2012. 2. Ramjee Prasad and Shingo Ohmori, Dina Simunic, “Towards Green ICT”, River Publishers, 2010. 3. Jinsong Wu, Sundeep Rangan and Honggang Zhang, “Green Communications: Theoretical Fundamentals, Algorithms and Applications”, CRC Press, 2012
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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Identify the necessity and the design aspects of cooperative communication.	Apply (K3)
CO2	Identify the necessity and the design aspects of green wireless communication.	Apply (K3)
CO3	Evolve new techniques in wireless communication.	Apply (K3)
CO4	Demonstrate the feasibility of using mathematical models using simulation tools.	Analyze (K4)
CO5	Demonstrate the impact of the green engineering solutions in a global, economic, environmental and societal context.	Analyze (K4)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	3	-	-	-	-	-	-	1	3	-
CO2	3	3	3	3	3	-	-	-	-	-	-	1	3	-
CO3	3	3	3	3	3	-	-	-	-	-	-	1	3	-
CO4	3	3	3	3	3	-	-	-	-	-	-	1	3	-
CO5	3	3	3	3	3	-	-	-	-	-	-	1	3	-

Mapping: 1-Low, 2-Medium, 3-High

Open Elective Courses

I - Course Name: 230CS01 Artificial Intelligence and Machine Learning Fundamentals

Prerequisite	Programme Name	Semester	Category	L	T	P	C
Python /Programming	B.E – Common to ECE, EEE, Mech, Civil	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To understand the fundamental concepts, history, and problem-solving strategies of Artificial Intelligence and Machine Learning, along with their real-world applications.
2.	To learn knowledge representation, logical inference, and probabilistic reasoning techniques for <u>handling</u> uncertainty in intelligent systems.
3.	To explore and apply various supervised machine learning algorithms for predictive modeling and data classification.
4.	To analyze and implement unsupervised learning techniques for clustering, dimensionality reduction, and anomaly detection.
5.	To examine real-world applications of AI and ML across domains and understand ethical, explainable, and operational aspects of intelligent systems.

III - Course Content

Unit – I	Introduction to AI and ML	10 Periods
Introduction to AI and ML – History and foundations of AI – Intelligent agents – Problem solving – Search strategies – Uninformed and informed search – Heuristic functions-Introduction to ML types (Supervised, Unsupervised, Reinforcement), Applications of AI in real-world domains.		
Unit – II	Probabilistic Reasoning	8 Periods
Knowledge representation and reasoning – Logic and inference – Propositional and predicate logic – Uncertainty – Bayes Theorem – Rule-based systems-Probabilistic graphical models (Bayesian networks), Fuzzy logic for reasoning.		
Unit – III	Supervised Learning	9 Periods
Machine Learning Algorithms – Linear regression, Logistic regression, KNN, Decision trees, Naive Bayes. Support Vector Machines, Ensemble methods (Bagging, Boosting)		
Unit – IV	Unsupervised Learning	9 Periods
Unsupervised Learning – Clustering techniques: K-means, Hierarchical, DBSCAN – Dimensionality reduction: PCA, LDA-Anomaly detection, Auto encoders.		
Unit – V	AI and ML Applications	9 Periods
AI and ML Applications – Natural Language Processing – Computer Vision – Robotics – Expert systems-AI ethics and governance, Explainable AI (XAI), ML Ops and deployment.		

TOTAL: 45 Periods

Text Books:	1. Stuart Russell and Peter Norvig, "Artificial Intelligence – A Modern Approach", Fourth Edition, Pearson Education, 2021. 2. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Fourth Edition, 2020.
Reference Books:	1. Tom M. Mitchell, Machine Learning, McGraw Hill, 2022 2. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly, 2023

	3. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2021 4. Michael Negnevitsky, AI: A Guide to Intelligent Systems, Pearson, 2020 5. Ankur Taly et al., Explainable AI: Interpreting, Explaining and Visualizing Deep Learning, Springer, 2023
M00C/Web Platforms:	https://nptel.ac.in/courses/106/106/106106126/

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the principles and history of Artificial Intelligence and Machine Learning.	Understand (K2)
CO2	Apply logic and probabilistic reasoning for knowledge representation.	Apply (K3)
CO3	Apply machine learning algorithms for classification and regression.	Apply (K3)
CO4	Analyze unsupervised learning methods and dimensionality reduction.	Analyze (K4)
CO5	Apply AI/ML techniques in real-world applications and understand responsible AI practices.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	2	1	1	-	-	-	-	-	-	1	-	1
CO2	2	2	2	1	1	-	-	-	-	-	-	1	-	1
CO3	2	2	2	1	1	-	-	-	-	-	-	1	-	1
CO4	2	2	2	1	1	-	-	-	-	-	-	1	-	1
CO5	2	2	2	1	1	-	-	-	-	-	-	1	-	1

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23OCS02 Fundamentals of Augmented Reality/Virtual Reality

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Python	B.E – Common to ECE, EEE, Mech, Civil	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To introduce the fundamental principles of Augmented Reality (AR) and Virtual Reality (VR).
2.	To understand the components, devices, and working mechanisms of immersive technologies.
3.	To gain basic knowledge of 3D visualization, modeling, and simulation concepts.
4.	To explore common toolkits, applications, and interaction techniques used in AR/VR.
5.	To study various applications, challenges, and future trends in AR/VR across engineering fields.

III - Course Content

Unit – I	Introduction to AR and VR Technologies	9 Periods
Overview of Virtual Reality (VR) and Augmented Reality (AR)-Concept of Immersion, Interaction, and Imagination-Difference between VR and 3D Computer Graphics-Benefits and Components of a VR System-Introduction to Immersive Technologies: AR, VR, MR, and XR-Basic Display Systems: Graphics Displays, 3D Trackers, and Sound Displays-Applications of AR/VR in Various Fields		
Unit – II	Basics of 3D Visualization and Modeling	9 Periods
Fundamentals of 3D Object Modeling-Transformation and Kinematics Basics-Overview of 3D Graphics and Game Engines-Object Hierarchies and Viewing the 3D World-Introduction to Physical Modeling and Collision Detection-Force Computation and Interaction Basics		
Unit – III	AR/VR Tools and Interaction Methods	9 Periods
Introduction to VR Programming and Toolkits-WorldToolKit and Java 3D Overview-Basics of Augmented Reality and Computer Vision Concepts-Interaction and Navigation in AR/VR Environments-Gesture Interfaces and Wearable Devices		
Unit – IV	Case Studies and Emerging Trends	9 Periods
Analysis of successful AR/VR applications in gaming, education, healthcare, and retail-Discussion on ethical considerations and challenges in AR/VR-Future directions and research opportunities in AR/VR		
Unit – V	Applications and Future Scope	9 Periods
Human Factors in VR – Methodology and Terminology – VR Health and Safety Issues – VR and Society-Medical Applications of VR – Education, Arts and Entertainment – Military VR Applications – Emerging Applications of VR – VR Applications in Manufacturing – Applications of VR in Robotics – Information Visualization – VR in Business – VR in Entertainment – VR in Education.		

TOTAL: 45 Periods

Text Books:	1. Grigore C. Burdea & Philippe Coiffet, <i>Virtual Reality Technology</i> , Wiley-IEEE Press, 2nd Edition, 2003. 2. Alan B. Craig, <i>Understanding Augmented Reality: Concepts and Applications</i> , Morgan Kaufmann, 2013
Reference Books:	1. Steven M. LaValle, <i>Virtual Reality</i> , Cambridge University Press, 2017. 2. Dieter Schmalstieg and Tobias Hollerer, <i>Augmented Reality: Principles and Practice</i> , Addison-Wesley, 2016. 3. Jason Jerald, <i>The VR Book: Human-Centered Design for Virtual Reality</i> , ACM Books, 2016
MOOC/Web Platforms:	https://nptel.ac.in/courses/106/106/106106138 https://onlinecourses.nptel.ac.in/noc25_cs87

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	Understand the fundamental concepts, principles, and scope of AR and VR technologies.	Understand (K2)
C02	Identify and describe the key components, devices, and working mechanisms of AR/VR systems.	Apply (K3)
C03	Explain the basics of 3D visualization, transformation, and object modeling in virtual environments.	Understand (K2)
C04	Utilize AR/VR toolkits and interaction methods to explore immersive technologies and user interfaces.	Apply (K3)
C05	Analyze real-world applications, ethical issues, and emerging trends of AR/VR across different engineering domains.	Analyze (K4)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C01	3	2	-	-	3	-	-	-	-	-	-	-	-	1
C02	3	3	2	-	3	-	-	-	-	-	-	-	-	1
C03	3	2	2	2	3	-	-	-	-	-	-	-	-	1
C04	3	2	3	2	3	-	-	-	-	-	-	-	-	1
C05	3	3	3	2	3	2	-	-	2	2	-	2	-	1

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23OCS03 Data Science Fundamentals

Prerequisite	Programme Name	Semester	Category	L	T	P	C
Basics of Databases	B.E – Common to ECE, EEE, Mech, Civil	V/VI/VII	OEC	3	0	0	3

II – Course Objectives

1.	Apply core Python and data manipulation libraries to clean, preprocess, and transform data.
2.	Analyze and visualize data using statistical and graphical methods to derive insights.
3.	Develop machine learning models for classification, regression, and clustering tasks.
4.	Handle large-scale datasets efficiently using distributed tools like PySpark and cloud platforms.
5.	Present analytical findings through dashboards, reports, and interactive visualizations

III – Course Content

Unit – I	Introduction	9 Periods
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	Data Manipulation	9 Periods
Python Shell – Jupyter Notebook – NumPy Arrays – Universal Functions – Aggregations – Computation on Arrays – Fancy Indexing – Sorting arrays – Structured data – Data manipulation with Pandas – Data Indexing and Selection – Handling missing data – Hierarchical indexing – Combining datasets – Aggregation and Grouping – String operations – Working with time series – Data cleaning pipelines – Introduction to Polars.		
Unit – III	Machine Learning	9 Periods
The modeling process – Types of machine learning – Supervised learning – Unsupervised learning – Semi-supervised learning – Classification – Regression – Clustering – Outliers and Outlier Analysis – Feature engineering and selection – Model evaluation metrics.		
Unit – IV	Data Visualization	9 Periods
Importing Matplotlib – Simple line plots – Scatter plots – Density and contour plots – Histograms – Legends – Colors – Subplots – Text and annotation – Customization – Three-dimensional plotting – Geographic visualization with Plotly – Visualization with Seaborn – Interactive dashboards with Plotly and Streamlit.		
Unit – V	Handling Large Data	9 Periods
Problems with large data – Techniques for handling large datasets – Programming tips for large data – Predicting malicious URLs (case study) – Recommender system (case study) – Tools and techniques needed – Research question – Data preparation – Model building – Model monitoring and automation – Scalable ML using PySpark – Working with cloud-based data platforms (e.g., AWS, BigQuery).		

TOTAL: 45 Periods

Text Books:	1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, "Introducing Data Science", Manning Publications, 2016. (Unit I)
Reference Books:	1. Robert S. Witte and John S. Witte, "Statistics", Eleventh Edition, Wiley Publications, 2017. (Units II and III) 69 2. Jake VanderPlas, "Python Data Science Handbook", O'Reilly, 2016. (Units IV and V)
MOOC/Web Platforms:	https://nptel.ac.in/courses/106/106/106106179/

IV – Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	Apply core Python and data manipulation libraries to clean, preprocess, and transform data.	Apply (K3)
C02	Analyze and visualize data using statistical and graphical methods to derive insights.	Analyze (K4)
C03	Apply machine learning models for classification, regression, and clustering tasks.	Apply (K3)
C04	Handle large-scale datasets efficiently using distributed tools like PySpark and cloud platforms.	Apply (K3)
C05	Present analytical findings through dashboards, reports, and interactive visualizations	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C01	2	2	2	1	1	-	-	-	-	-	-	1	-	1
C02	2	2	2	1	1	-	-	-	-	-	-	1	-	1
C03	2	2	2	1	1	-	-	-	-	-	-	1	-	1
C04	2	2	2	1	1	-	-	-	-	-	-	1	-	1
C05	2	2	2	1	1	-	-	-	-	-	-	1	-	1

Mapping: 1-Low, 2-Medium, 3-High

I – Course Name: 23OCS04 Introduction to Data Structures using Python

Prerequisite	Programme Name	Semester	Category	L	T	P	C
Basics of Python	B.E – Common to ECE, EEE, Mech, Civil	V/VI/VII	OEC	3	0	0	3

II – Course Objectives

1.	Apply core Python and data manipulation libraries to clean, preprocess, and transform data.
2.	Analyze and visualize data using statistical and graphical methods to derive insights.
3.	Develop machine learning models for classification, regression, and clustering tasks.
4.	Handle large-scale datasets efficiently using distributed tools like PySpark and cloud platforms.
5.	Present analytical findings through dashboards, reports, and interactive visualizations

III – Course Content

Unit – I	Abstract Data Types	9 Periods
Data Abstraction: Data Representation – Types of Data Structures – Abstract Data Type ADTs and classes – introduction to OOP – classes in Python – inheritance – namespaces – shallow and deep copying Introduction to analysis of algorithms – asymptotic notations-The Big-O, Omega and Theta notation- Optimizing for optimistic scenarios – Trade- offs between Time and Space		
Unit – II	Linear Structures	9 Periods
Linear ADTs: List – Stack – Queue – Circular Queue – Linked List – Singly Linked List, Doubly Linked List, Circular Linked List -Applications- Expression evaluation, Scheduling Algorithms, Polynomial Evaluation, Josephus Problem		
Unit – III	Sorting and Searching	9 Periods
Bubble sort – selection sort – insertion sort – merge sort – quick sort- Radix sort, Bitonic sort, Cocktail sort, Medians and Order Statistics- Minimum and maximum, Selection in expected linear time, Selection in worst-case linear time, linear search, Interpolation search, Exponential search.		
Unit – IV	Tree Structures	9 Periods
Binary trees- Properties of Binary trees, B-tree, B-Tree definition- Operations on B-Tree: Searching a B-tree, Creating, Splitting, Inserting and Deleting, B+-tree. Threaded binary trees, Leftist trees, Tournament trees, 2-3 tree, Splay tree, Red-black trees, Range trees. Heaps as priority queues, Binary heaps, binomial and Fibonacci heaps, Heaps in Huffman coding, Extendible hashing.		
Unit – V	Graph Structures	9 Periods
Representation of graphs, Topological sorting, Shortest path algorithms- Dijkstra's algorithm, Floyd-Warshall algorithm, Minimum spanning trees – Reverse delete algorithm, Boruvka's algorithm.		

TOTAL: 45 Periods

Text Books:	1. Michael T. Goodrich, Roberto Tamassia, and Michael H. Goldwasser, "Data Structures & Algorithms in Python", An Indian Adaptation, John Wiley & Sons Inc., 2021
Reference Books:	1. Lee, Kent D., Hubbard, Steve, "Data Structures and Algorithms with Python" Springer Edition 2015 2. Rance D. Necaise, "Data Structures and Algorithms Using Python", John Wiley & Sons, 2011 3. Aho, Hopcroft, and Ullman, "Data Structures and Algorithms", Pearson Education, 1983. 4. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, "Introduction to Algorithms", Second Edition, McGraw Hill, 2002.
MOOC/Web Platforms:	https://nptel.ac.in/courses/106106145/

IV – Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Apply core Python and data manipulation libraries to clean, preprocess, and transform data.	Apply (K3)
CO2	Analyze and visualize data using statistical and graphical methods to derive insights.	Analyze (K4)
CO3	Apply machine learning models for classification, regression, and clustering tasks.	Apply (K3)
CO4	Handle large-scale datasets efficiently using distributed tools like PySpark and cloud platforms.	Apply (K3)
CO5	Present analytical findings through dashboards, reports, and interactive visualizations	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	2	1	1	-	-	-	-	-	-	1	-	1
CO2	2	2	2	1	1	-	-	-	-	-	-	1	-	1
CO3	2	2	2	1	1	-	-	-	-	-	-	1	-	1
CO4	2	2	2	1	1	-	-	-	-	-	-	1	-	1
CO5	2	2	2	1	1	-	-	-	-	-	-	1	-	1

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23OCS05 IoT Concepts and Applications

Prerequisite	Programme Name	Semester	Category	L	T	P	C
Basic Electronics Knowledge	B.E – Common to ECE, EEE, Mech, Civil	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	Understand IoT fundamentals, ecosystem, and evolution.
2.	Understand IoT communication protocols, standards, and middleware.
3.	Learn about IoT network topologies, communication technologies, and cloud integration.
4.	Explore data analytics and AI in IoT applications.
5.	Understand security, ethics, and real-world IoT applications.

III - Course Content

Unit – I	Foundations of IoT History and Evolution of IoT	10 Periods
IoT Ecosystem & Layers: Perception, Network, Middleware, Application - IoT Design Goals, Challenges, and Future Directions - Architectures: oneM2M, IoT World Forum (IoTWF), Fog & Edge Computing - Functional Blocks of IoT Systems - Smart Objects: Sensors, Actuators, Embedded Systems Mini Project Idea: Build a "Thing" using basic sensors and Arduino to demonstrate environmental data collection.		
Unit – II	Protocols, Standards and Middleware	8 Periods
Need for Middleware in IoT - RFID, WSN, SCADA, M2M Middleware Architectures - IoT Access Technologies: IEEE 802.15.4, LoRaWAN, NB-IoT - Communication Protocols: MQTT, CoAP, HTTP vs CoAP - Protocol Stack Overview: 6LoWPAN, RPL, 6TiSCH - Interoperability and Resource Management		
Unit – III	Communication and Networking for IoT	9 Periods
IoT Network Topologies: Star, Mesh, Cluster - LPWAN vs WPAN: LoRa, Sigfox, Zigbee, BLE - IPv6, 6LoWPAN, and addressing in Constrained Devices - Routing in IoT: RPL, Mobility Support - Application Layer Communication: Data Aggregation, Dissemination - Cloud Platforms: AWS IoT Core, ThingSpeak Hackathon Task: Design a networked system for smart traffic control using simulated nodes.		
Unit – IV	Data Analytics and AI in IoT	9 Periods
Data Lifecycle in IoT: Collection to Visualization - Real-time Analytics and Edge AI - Data Cleaning, Storage (Cloud vs Edge), and Processing - Machine Learning in IoT: Supervised vs Unsupervised - AI Tools: TensorFlow Lite, TinyML - Big Data Tools: Apache Kafka, Spark Streaming Lab Task: Train a TinyML model on microcontroller to detect gestures or anomalies in sensor data.		
Unit – V	Security, Ethics and Applications	9 Periods
Cybersecurity Challenges in IoT - Secure Communication, Authentication, and Data Privacy - Legal, Ethical, and Environmental Concerns - Real-World Applications: - Smart Cities & Grids - Precision Agriculture - Healthcare Monitoring - Industrial IoT- Smart Retail		

TOTAL: 45 Periods

Text Books:	1. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017 2. Samuel Greengard, The Internet of Things, The MIT Press, 2015
Reference Books:	1. Pethuru Raj, "The Internet of Things: Enabling Technologies" 2. Arshdeep Bahga, Vijay Madisetti, "IoT: A Hands-on Approach"
MOOC/Web Platforms:	Online tools: Blynk, Node-RED, Firebase, Azure IoT Hub Hardware: ESP32, NodeMCU, Raspberry Pi, DHT11, PIR sensors

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand IoT fundamentals, ecosystem, and evolution.	Understand (K2)
CO2	Understand IoT communication protocols, standards, and middleware.	Understand (K2)
CO3	Apply IoT network topologies, communication technologies, and cloud integration.	Apply (K3)
CO4	Explore data analytics and AI in IoT applications.	Analyze (K4)
CO5	Understand security, ethics, and real-world IoT applications.	Understand (K2)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	2	1	1	-	-	-	-	-	-	1	-	1
CO2	2	2	2	1	1	-	-	-	-	-	-	1	-	1
CO3	2	2	2	1	1	-	-	-	-	-	-	1	-	1
CO4	2	2	2	1	1	-	-	-	-	-	-	1	-	1
CO5	2	2	2	1	1	-	-	-	-	-	-	1	-	1

Mapping: 1-Low, 2-Medium, 3-High

I – Course Name: 230CE01 Cartography and GIS

Prerequisite	Programme Name	Semester	Category	L	T	P	C
Nil	All programmes except B.E - Civil Engineering	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To understand the fundamental elements of cartography including types of maps, map projections, coordinate systems, and their applications.
2.	To learn the principles of map design, symbolization, color usage, lettering, and the processes involved in map production and reproduction.
3.	To introduce the basic concepts, components, and data models of Geographic Information Systems (GIS), including spatial and attribute data structures.
4.	To explore the methods of spatial data input, georeferencing, coordinate transformations, and understand topological relationships in GIS.
5.	To assess data quality parameters, understand GIS standards and metadata, and learn about spatial data output through maps and graphical representations.

III - Course Content

Unit – I	Elements of Cartography	9 Periods
Definition of Cartography – Maps – Functions – Uses and Types of Maps – Map Scales and Contents – Map Projections – Shape, Distance, Area and Direction Properties – Perspective and mathematical Projections – Indian Maps and Projections – Map Co-ordinate System – UTM and UPS References.		
Unit – II	Map Design and Production	9 Periods
Map and Mapping concepts -Map Design Fundamentals – Symbols and Conventional Signs – Graded and Ungraded Symbols – Color Theory – Colours and Patterns in Symbolization – Map Lettering – Map Production – Map Printing – Colours and Visualization – Map Reproduction – Map Generalization – Geometric Transformations – Bilinear and Affine Transformations.		
Unit – III	Basics of GIS	9 Periods
Introduction to GIS – Definitions – History of GIS – Components of a GIS – Hardware, Software, Data, People, Methods – Introduction to data quality – Types of data – Spatial, Attribute data – types of attributes – scales/levels of measurements – spatial data models – Raster Data Structures – Raster Data Compression – Vector Data Structures – Raster Vs Vector Models – TIN and GRID data models.		
Unit – IV	Data Input and Topology	9 Periods
Scanner – Raster Data Input – Raster Data File Formats – Georeferencing– Vector Data Input – Digitizer– Datum Projection and Reprojection – Coordinate Transformation – Topology – Adjacency, Connectivity and containment – Topological Consistency – Non topological file formats – Attribute Data Linking – Linking External Databases – GPS Data Integration – Raster to Vector and Vector to Raster Conversion.		

Unit - V	Data Quality and Output	9 Periods
Assessment of Data Quality - Basic Aspects - Completeness, Logical Consistency, Positional Accuracy, Temporal Accuracy, Thematic Accuracy and Lineage – Metadata – GIS Standards – Interoperability – OGC - Spatial Data Infrastructure – Data Output – Map Compilation – Chart / Graphs.		

TOTAL: 45 Periods

Text Books:	1. Arthur H. Robinson et al, "Elements of Cartography", 7th Edition, Wiley, 2002. 2. Kang - Tsung Chang, "Introduction to Geographic Information Systems", McGraw Hill Publishing, Fourth Edition, 2017. 3. Ian Heywood, Sarah Cornelius, Steve Carver, Srinivasa Raju, "An Introduction to Geographical Information Systems, Pearson Education, Fourth Edition, 2011.
Reference Books:	1. John Campbell, "Introductory Cartography", Wm. C.Brown Publishers, 3rd Edition, 2004 2. Chor Pang LO, Albert K. W. Yeung, "Concepts and Techniques of Geographic Information Systems", Pearson Education, 2nd Edition, November 2016. ISBN: 9789332581883
MOOC/Web Platforms:	https://www.my-mooc.com/en/categorie/gis https://www.my-mooc.com/en/mooc/fundamentals-of-gis

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	Understand map types, scales, projections, and coordinate systems used in cartography.	Understand (K2)
C02	Apply map design principles, symbolization, and transformation techniques for map production.	Apply (K3)
C03	Explain GIS components, data types, and spatial data models.	Understand (K2)
C04	Perform data input, georeferencing, and establish topology in GIS.	Apply (K3)
C05	Assess GIS data quality and generate spatial outputs using standards and metadata.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C01	3	1	-	-	3	-	-	-	-	2	-	1	-	-
C02	3	1	-	-	3	-	-	-	-	2	-	1	-	-
C03	3	1	-	-	3	-	-	-	-	2	-	1	-	-
C04	3	1	-	-	3	-	-	-	-	2	-	1	-	-
C05	3	1	-	-	3	-	-	-	-	2	-	1	-	-

Mapping: 1-Low, 2-Medium, 3-High

I- Course Name: 23OCE02 Environment, Health and Safety

Prerequisite	Programme Name	Semester	Category	L	T	P	C
Nil	All programmes except B.E - Civil Engineering	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

6.	To understand the need for EHS systems in workplaces and interpret international and national EHS regulations, policies, and ergonomics principles
7.	To learn occupational health hazards, exposure pathways, and apply appropriate control measures including personal protective equipment.
8.	To understand safety features in workplace design and implement safety systems for physical, chemical, and construction-related hazards.
9.	To be familiarize with workplace hazards, conduct job safety analyses, and develop effective risk management and emergency response plans.
10.	To understand and apply the components of an EHS management system based on national and international standards like BIS and ISO 45001.

III - Course Content

Unit – I	Introduction	9 Periods
Need for developing Environment, Health and Safety systems in work places- International initiatives, National Policy and Legislations on EHS in India - Regulations and Codes of Practice - Role of trade union safety representatives - Ergonomics.		
Unit – II	Occupational Health and Hygiene	9 Periods
Definition of occupational health and hygiene - Categories of health hazards – Exposure pathways and human responses–Exposure Assessment-occupational exposure limits - Hierarchy of control measures - Role of personal protective equipment and the selection criteria.		
Unit – III	Workplace Safety and Safety Systems	9 Periods
Features of Satisfactory and Safe design of work premises – good housekeeping - Training methods and strategies -types of training. Evaluation and review of training -lighting and color, Ventilation and Heat Control, Noise, Chemical and Radiation Safety – Electrical Safety – Fire Safety – Safety at Construction sites, ETP – Machine guarding – Process Safety, Working at different levels.		
Unit – IV	Hazards and Risk Management	9 Periods
Safety appraisal – Job Safety Analysis-Control techniques – plant safety inspection – Accident investigation - Analysis and Reporting – Hazard and Risk Management Techniques –Onsite and Offsite emergency Plans. Employee Participation- Education and Training- Case Studies.		
Unit – V	Environmental Health and Safety Management	9 Periods
Concept of Environmental Health and Safety Management – Elements of Environmental Health and Safety Management Policy and implementation and review – Bureau of Indian standards on safety and health 14489 - 1998 and 15001 - ISO 45001-Strucure and Clauses-Case Studies.		

TOTAL: 45 Periods

Text Books:	1. Industrial Health and Safety Acts and Amendments, by Ministry of Labour and Employment, Government of India 2. Fundamentals of Industrial Safety and Health by Dr.K.U.Mistry, Siddharth Prakashan, 2012
Reference Books:	1. The Facility Manager's Guide to Environmental Health and Safety by Brian Gallant, Government Inst Publ., 2007. 2. Effective Environmental, Health, and Safety Management Using the Team Approach by Bill Taylor, Culinary and Hospitality Industry Publications Services, 2005. 3. Environmental and Health and Safety Management by Nicholas P.Chermisinoff and Madelyn L. Graffia, William Andrew Inc. NY, 1995
MOOC/Web Platforms:	https://www.coursera.org/courses?query=environmental%20health https://moocs.anuonline.ac.in/quality-health-safety-environment.html

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	Understand the need for EHS in industries and related Indian regulations.	Understand (K2)
C02	Identify workplace health hazards and apply assessment and control methods.	Understand (K2)
C03	Analyze safety systems used in industrial environments.	Apply (K3)
C04	Prepare emergency plans and conduct accident investigations.	Apply (K3)
C05	Understand EHS Management System and its key elements.	Understand (K2)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C01	3	-	-	-	1	2	3	-	-	-	-	-	-	-
C02	3	-	-	-	1	2	3	-	-	-	-	-	-	-
C03	3	-	-	-	1	2	3	-	-	-	-	-	-	-
C04	3	-	-	-	1	2	3	-	-	-	-	-	-	-
C05	3	-	-	-	1	2	3	-	-	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High

I – Course Name: 23OCE03 Environmental Impact Assessment

Prerequisite	Programme Name	Semester	Category	L	T	P	C
Nil	All programmes except B.E - Civil Engineering	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To introduce the fundamentals, historical development, and legal aspects of Environmental Impact Assessment (EIA).
2.	To apply methodologies and analytical tools for environmental impact prediction and evaluation.
3.	To assess socio-economic impacts of developmental projects on individuals, families, and communities.
4.	To analyze and propose mitigation measures for impacts on natural, cultural, and economic environments.
5.	To gain practical insights into EIA through real-world industrial and infrastructure case studies.

III - Course Content

Unit – I	Introduction	9 Periods
Historical development of Environmental Impact Assessment (EIA). Environmental Clearance- EIA in project cycle. legal and regulatory aspects in India – types and Methods of categorization of industries for EIA limitations of EIA –EIA process screening – scoping - terms of reference in EIA- setting – analysis – mitigation – public hearing in EIA- EIA consultant accreditation.		
Unit – II	Components and Quality Analysis	9 Periods
Matrices networks – checklists – cost benefit analysis – analysis of alternatives – expert systems in EIA. prediction tools for EIA – mathematical modelling for impact prediction – assessment of impacts – air – water – soil – noise – biological -- cumulative impact assessment.		
Unit – III	Socio-Economic Impact Assessment	9 Periods
Socio-economic impact assessment - relationship between social impacts and change in community and institutional arrangements. factors and methodologies- individual and family level impacts community's transition.		
Unit – IV	Prediction, Assessment and Mitigation	9 Periods
Methods for Prediction and assessment of impacts on Air, Water, Soil and Noise - Biological, Cultural, Social and Economic environments - Standards and guidelines for evaluation - Options for mitigation of impacts - Policies for decision making.		
Unit – V	Case Studies	9 Periods
Mining, power plants, cement plants, highways, petroleum refining industry, storage & handling of hazardous chemicals, common hazardous waste facilities, CETPs, CMSWMF, building and construction projects.		

TOTAL: 45 Periods

Text Books:	1. Morris, P. and Therivel, R., Environmental Impact Assessment: Theory and Practice, 2nd Edition, Routledge, London, 2021. 2. Glasson, J., Therivel, R. and Chadwick, A., Introduction to Environmental Impact Assessment, 5th Edition, Routledge, London, 2019. 3. Fonseca, A. (Ed.), Handbook of Environmental Impact Assessment, Edward Elgar Publishing, Cheltenham, 2022. 4. Morris, P. and Therivel, R., Methods of Environmental Impact Assessment, 4th Edition, Routledge, London, 2020. 5. Gilpin, A. (Ed.), Environmental Impact Assessment: Cutting Edge for the 21st Century, Revised Reprint, Routledge, London, 2020.
Reference Books:	1. Canter, L.W., Environmental Impact Assessment, 2nd Edition, McGraw-Hill, New York, 1996. 2. Lawrence, D.P., Impact Assessment – Practical Solutions to Recurrent Problems and Contemporary Challenges, 2nd Edition, Wiley, New Jersey, 2014. 3. Kolluru, R., Bartell, S., Pitblado, R. and Stricoff, R., Risk Assessment and Management Handbook, McGraw-Hill Inc., New York, 1996.
MOOC/Web Platforms:	1. https://onlinecourses.nptel.ac.in/noc22_ar07/preview 2. https://www.futurelearn.com/courses/environmental-impact-assessment 3. https://cursos.iadb.org/en/topics/management-social-and-environmental-risk/principles-reviewing-environmental-impact-assessments

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the principles, process, and regulatory framework of Environmental Impact Assessment.	Understand (K2)
CO2	Apply analytical methods and prediction tools for assessing environmental impacts.	Apply (K3)
CO3	Evaluate socio-economic consequences of developmental projects on communities.	Apply (K3)
CO4	Recommend suitable mitigation measures and policies for sustainable project development.	Apply (K3)
CO5	Analyze real-world case studies to integrate theory with practical EIA applications.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	-	-	-	-	2	2	-	-	2	-	-	-	-
CO2	3	2	3	3	2	-	-	-	-	-	-	2	-	-
CO3	-	2	-	-	-	3	2	2	-	2	-	-	-	-
CO4	-	-	3	-	-	3	3	3	-	3	2	-	-	-
CO5	3	-	3	2	-	2	3	-	2	3	-	2	-	-

Mapping: 1-Low, 2-Medium, 3-High

I- Course Name: 23OCE04 Industrial Waste Water Management

Prerequisite	Programme Name	Semester	Category	L	T	P	C
Nil	All programmes except B.E - Civil Engineering	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To introduce the sources, characteristics, and environmental impacts of industrial wastewater.
2.	To provide knowledge on regulatory requirements and the importance of pollution prevention and waste minimization in industries.
3.	To familiarize students with various physical, chemical, and biological treatment methods used in industrial wastewater management.
4.	To develop understanding on reuse strategies, residuals management, and zero discharge concepts.
5.	To enable students to analyze real-life case studies and recommend suitable wastewater treatment and pollution control strategies for specific industries.

III - Course Content

Unit – I	Industrial Wastewater Treatment Introduction	8 Periods
Industrial scenario in India– Industrial activity and Environment - Uses of Water by industry – Sources and types of industrial wastewater – Nature and Origin of Pollutants - Industrial wastewater and environmental impacts – Regulatory requirements for treatment of industrial		
Unit – II	Industrial Pollution Prevention & Waste Minimization	8 Periods
Prevention vis a vis Control of Industrial Pollution – Benefits and Barriers – Waste management Hierarchy - Source reduction techniques – Periodic Waste Minimization. Methods and materials changes – Waste minimization strategies – Zero discharge concept.		
Unit – III	Industrial Wastewater Treatment	10 Periods
Flow and Load Equalization – Solids Separation – Removal of Fats, Oil & Grease- Neutralisation- Removal of Inorganic Constituents – Precipitation, Heavy metal removal, Nitrogen & Phosphorous removal, Ion exchange, Adsorption, Membrane Filtration, Difficulties and Remedial Measures, Rotating Biological Contactors. Suspended Growth Processes		
Unit – IV	Wastewater Reuse and Residual Management	9 Periods
Individual and Common Effluent Treatment Plants – Joint treatment of industrial and domestic wastewater - Zero effluent discharge systems - Quality requirements for Wastewater reuse Industrial reuse, Present status and issues. Residuals of industrial wastewater treatments – Individual and common effluent treatment plants.		
Unit – V	Case Studies	10 Periods
Industrial manufacturing process description, wastewater characteristics, source reduction options and waste treatment flow sheet for Textiles – Tanneries – Pulp and paper – metal finishing – Sugar and Distilleries		

TOTAL: 45 Periods

Text Books:	1. Wastewater Treatment – Concepts and Design Approach, by G L Karia and R A Christian, Prentice Hall of India, 2006 2. Environmental Engineering by Gerard Kiely, McGraw Hill Education (India) Pvt Ltd, 2013 3. Environmental Engineering – A Design Approach by A. P. Sincero and G A Sincero, Prentice Hall of India, 2014
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Reference Books:	1. "Industrial wastewater management, Treatment & disposal, Water Environment" Federation Alexandria Virginia, Third Edition, 2008. 2. Lawrance K. Wang, Yung Tse Hung, Howard H. Lo and Constantine Yapijakis "Handbook of Industrial and Hazardous waste Treatment", Second Edition, 2004. 3. Metcalf & Eddy, Inc., George Tchobanoglous, Franklin L. Burton and H. David Stensel, Wastewater engineering, treatment and reuse, Fourth Edition, McGraw-Hill, 2017 4. Nelson Leonard Nemerow, "industrial waste Treatment", Elsevier, 2007. 5. Wesley Eckenfelder W., "Industrial Water Pollution Control", Second Edition, Mc Graw Hill, 2000. 6. Paul L. Bishop, Pollution Prevention: -Fundamentals and Practice", Mc-Graw Hill International, Boston, 2000. 7. Waste water Treatment for pollution control and reuse by Soli. J. Arceivala, Shyam. R. Asolekar, Tata McGraw Hill, 2007
MOOC/Web Platforms:	https://onlinecourses.nptel.ac.in/noc24_ce53/preview https://nptel.ac.in/courses/105105350 https://onlinecourses.nptel.ac.in/noc25_ce116/preview

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the source and types of industrial wastewater and their environmental impacts and choose the regulatory laws pertaining to environmental protection	Understand (K2)
CO2	Apply industrial wastewater pollution and implement pollution prevention, waste minimization in industries	Apply (K3)
CO3	Apply knowledge and skills to design industrial wastewater treatment schemes	Apply (K3)
CO4	Analyze environmental performance of industries to internal, external client, regulatory bodies and design water reuse management techniques	Analyze (K4)
CO5	Apply research to develop effective management systems for industrial wastewater that are technically sound, economically feasible and socially acceptable	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	-	-	-	3	2	2	-	-	-	2	-	-
CO2	3	2	3	2	2	2	2	-	-	-	-	2	-	-
CO3	3	3	3	3	2	3	-	-	-	-	-	3	-	-
CO4	3	2	3	3	3	3	2	-	-	-	-	3	-	-
CO5	3	3	3	3	3	3	2	-	-	-	-	3	-	-

Mapping: 1-Low, 2-Medium, 3-High

I-Course Name: 23OCE05 Remote Sensing Concepts

Prerequisite	Programme Name	Semester	Category	L	T	P	C
Nil	All programmes except B.E - Civil Engineering	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To help students understand the basic concepts and components of remote sensing, including the principles of radiation.
2.	To understand how electromagnetic radiation interacts with the Earth's surface and atmosphere.
3.	To learn about different satellite orbits, types of platforms, and the applications of nano-satellites.
4.	To understand how various remote sensors work and their characteristics.
5.	To learn how to use satellite data, interpret images, and apply cloud-based tools like Google Earth Engine for analysis.

III - Course Content

Unit - I	Remote Sensing and Electromagnetic Radiation	9 Periods
Definition – components of Remote Sensing – History of Remote Sensing – Merits and demerits of data collation between conventional and remote sensing methods – Electromagnetic Spectrum – Radiation principles – Wave theory, Planck's law, Wien's Displacement Law, Stefan's Boltzmann law, Kirchoff's law – Radiation sources: active & passive – Radiation Quantities		
Unit - II	EMR Interaction with Atmosphere and Earth Material	9 Periods
Standard atmospheric profile – Main atmospheric regions and their characteristics – Interaction of radiation with atmosphere – Scattering, absorption and refraction – Atmospheric windows – Energy balance equation – Specular and diffuse reflectors – Spectral reflectance & emittance – Spectroradiometer – Spectral Signature concepts – Typical spectral reflectance curves for vegetation, soil, and water – Solid surface scattering in microwave region – Introduction to drone-based hyperspectral remote sensing and thermal mapping		
Unit - III	Orbits and Platforms	9 Periods
Motions of planets and satellites – Newton's law of gravitation – Gravitational field and potential – Escape velocity – Kepler's laws of planetary motion – Orbit elements and types – Orbital perturbations and maneuvers – Types of remote sensing platforms – Ground-based, airborne, and spaceborne platforms – Classification of satellites – Sun-synchronous and geosynchronous satellites – Lagrange orbit – Latest nano-satellite applications		
Unit - IV	Sensing Techniques	9 Periods
Classification of remote sensors – Resolution concept: spatial, spectral, radiometric and temporal resolutions - Scanners - Along and across track scanners – Optical-infrared sensors – Thermal sensors – microwave sensors – Calibration of sensors - High Resolution Sensors - LIDAR, UAV – Orbital and sensor characteristics of live Indian earth observation satellites		
Unit - V	Data Products and Interpretation	9 Periods
Photographic and digital products – Types, levels and open-source satellite data products – selection and procurement of data– Visual interpretation: basic elements and interpretation		

keys -Digital interpretation – Concepts of Image rectification, Image enhancement and Image classification - Cloud-based access (Google Earth Engine), and real-time analytics tools

TOTAL: 45 Periods

Text Books:	1. Thomas M.Lillesand, Ralph W. Kiefer and Jonathan W. Chipman, Remote Sensing and Image interpretation, John Wiley and Sons, Inc, New York, 2015. 2. George Joseph and C Jeganathan, Fundamentals of Remote Sensing, Third Edition Universities Press (India) Private limited, Hyderabad, 2018
Reference Books:	1. Janza, F.Z., Blue H.M. and Johnson, J.E. Manual of Remote Sensing. Vol.I, American Society of Photogrametry, Virginia, USA, 2002. 2. Verbyla, David, Satellite Remote Sensing of Natural Resources. CRC Press, 1995 3. Paul Curran P.J. Principles of Remote Sensing. Longman, RLBS, 1988. 4. Introduction to Physics and Techniques of Remote Sensing, Charles Elachi and Jacob Van Zyl, 2006 Edition II, Wiley Publication

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the basic concepts, components, and radiation principles of remote sensing.	Understand (K2)
CO2	Understand how electromagnetic radiation interacts with the atmosphere and Earth's surface materials.	Understand (K2)
CO3	Understand satellite orbits, different types of platforms, and nano-satellite applications.	Understand (K2)
CO4	Understand the working of different remote sensors and their characteristics.	Understand (K2)
CO5	Understand satellite data types, interpretation methods, and use of cloud tools like Google Earth Engine.	Understand (K2)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1	-	1	1	1	1	-	-	-	-	1	1	-
CO2	3	1	-	1	1	1	1	-	-	-	-	1	1	-
CO3	3	1	-	1	1	1	1	-	-	-	-	1	1	-
CO4	3	1	-	1	1	1	1	-	-	-	-	1	1	-
CO5	3	1	-	1	1	1	1	-	-	-	-	1	1	-

Mapping: 1-Low, 2-Medium, 3-High

I- Course Name: 23OEE01 AI with MATLAB

Prerequisite	Programme Name	Semester	Category	L	T	P	C
Nil	All programmes except B.E - EEE	V/VI/VII	OEC	3	0	0	3

II-Course Objectives

1.	To introduce the fundamentals of Artificial Intelligence and its real-world applications.
2.	To familiarize students with the MATLAB environment for AI development.
3.	To develop the ability to implement AI algorithms such as search methods, knowledge representation, and reasoning.
4.	To apply machine learning techniques using MATLAB toolboxes.
5.	To enable students to design and simulate AI-based systems using MATLAB.

III-Course Content

Unit-I	Introduction to AI and MATLAB	9 Periods
Basics of Artificial Intelligence – History, Applications, and Challenges- Overview of MATLAB – Environment, Scripts, Functions - Data handling and visualization in MATLAB - Introduction to MATLAB toolboxes for AI - Simple AI programs using MATLAB.		
Unit-II	Problem Solving and Search Techniques	9 Periods
Uninformed Search: BFS, DFS, Depth-Limited Search - Informed Search: A*, Best-First Search, Heuristic Functions - Constraint Satisfaction Problems - Implementation of search strategies in MATLAB - Case studies using AI search in MATLAB.		
Unit-III	Knowledge Representation and Reasoning	9 Periods
Propositional and Predicate Logic - Rule-Based Systems and Inference Mechanisms - Forward and Backward Chaining - Uncertainty and Probabilistic Reasoning - MATLAB implementation of logical reasoning systems.		
Unit-IV	Machine Learning with MATLAB	9 Periods
Supervised Learning: Regression, Classification - Unsupervised Learning: Clustering Techniques - Dimensionality Reduction and Data Preprocessing - Introduction to MATLAB Machine Learning Toolbox - Case studies: Fault detection, Image classification.		
Unit-V	Neural Networks and Fuzzy Logic Systems	9 Periods
Basics of Artificial Neural Networks (ANNs) - Designing and Training Neural Networks in MATLAB - Introduction to Fuzzy Logic and Fuzzy Inference Systems - Building Fuzzy systems using MATLAB Fuzzy Logic Toolbox - Applications in control systems, prediction, and decision-making.		

TOTAL: 45 Periods

Text Books:	1. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach, 4th US edition", Pearson Education, 2022. 2. Phil Kim, MATLAB Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence: A practical guide for AI and deep
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	learning with MATLAB, Apress, 2017.
MOOC/Web Platforms:	1. MATLAB Official Documentation (AI & ML Toolboxes) https://www.mathworks.com/products/artificial-intelligence.html 2. MATLAB Tutorials and Examples (MathWorks) https://www.mathworks.com/learn/tutorials/matlab-onramp.html 3. AI Projects in MATLAB – File Exchange https://www.mathworks.com/matlabcentral/fileexchange/ 4. Coursera – Introduction to AI with MATLAB https://www.coursera.org/learn/ai-for-everyone 5. MATLAB and Simulink Training – MathWorks https://www.mathworks.com/services/training.html

IV-Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand and explain key concepts of Artificial Intelligence and their applications.	Understand (K2)
CO2	Implement AI techniques including search algorithms and knowledge-based systems using MATLAB.	Apply (K3)
CO3	Apply machine learning models in MATLAB for classification, clustering, and regression tasks.	Apply (K3)
CO4	Develop intelligent systems using neural networks and fuzzy logic in MATLAB.	Apply (K3)
CO5	Simulate and analyze AI-driven solutions for practical engineering problems.	Apply (K3)

V-Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	1	1	-	-	-	-	1	-	-	1	1
CO2	3	3	3	2	1	-	-	-	-	1	-	-	1	1
CO3	3	3	3	2	1	-	-	-	-	1	-	-	1	1
CO4	3	3	2	2	2	-	-	-	-	1	-	-	1	1
CO5	3	3	2	2	2	-	-	-	-	1	-	-	1	1

Mapping:1-Low,2-Medium,3-High

I - Course Name: 23OEE02 Applied Soft Computing

Prerequisite	Programme Name	Semester	Category	L	T	P	C
Basic Programming	All programmes except B.E - EEE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To introduce the basic principles and scope of soft computing techniques such as fuzzy logic, neural networks, and genetic algorithms.
2.	To impart knowledge on fuzzy set theory and fuzzy logic controllers, including their application in electrical engineering.
3.	To explore the structure, learning methods, and practical applications of neural networks.
4.	To understand the functioning of genetic algorithms and how they are applied to electrical engineering problems.
5.	To train students in using MATLAB toolboxes for implementing fuzzy logic, neural networks, and genetic algorithms in real-world electrical problems.

III - Course Content

Unit – I	Introduction	9 Periods
Introduction to soft computing - Fuzzy logic, Neural Network and Genetic algorithm.		
Unit – II	Fuzzy Logic	9 Periods
Fuzzy sets, logic operations, and relations; Fuzzy decision-making; fuzzy inference systems; design steps in fuzzy logic controller; application of fuzzy logic controller in Electrical engineering.		
Unit – III	Neural Networks	9 Periods
Basic concepts and major classes of neural networks, supervised and unsupervised learning, Single-layer perceptron, multi-layer perceptron, Back Propagation Neural network, RBF networks. Application of neural network modelling / control problems in Electrical engineering.		
Unit – IV	Genetic Algorithms	9 Periods
Introduction - genetic algorithm steps-Selection, Crossover and Mutation; Application of GA to Electrical engineering problems.		
Unit – V	Application	9 Periods
Use of MATLAB Fuzzy logic, Neural network and GA toolboxes to solve electrical engineering problems.		

TOTAL: 45 Periods

Text Books:	1. S.N. Sivanandam & S.N. Deepa, Principles of Soft Computing, Wiley India Pvt. Ltd., 2nd Edition, 2011. 2. Timothy J. Ross, Fuzzy Logic with Engineering Applications, Wiley, 4th Edition, 2020.
Reference Books:	1. Simon Haykin, Neural Networks and Learning Machines, Pearson Education, 3rd Edition, 2008. 2. David E. Goldberg, Genetic Algorithms in Search, Optimization, and Machine Learning, Pearson Education, 1989. 3. Satish Kumar, Neural Networks: A Classroom Approach, McGraw-Hill Education, 2nd Edition, 2017. 4. J.S.R. Jang, C.T. Sun, and E. Mizutani, Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence, Pearson Education, 2004.
MOOC/Web Platforms:	https://onlinecourses.nptel.ac.in/noc22_cs54/preview

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the fundamental concepts and components of soft computing.	Understand (K2)
CO2	Design and apply fuzzy logic systems in electrical engineering contexts.	Apply (K3)
CO3	Construct and use neural network models for analysis and control tasks in electrical systems.	Analyze (K4)
CO4	Implement genetic algorithm procedures for solving electrical engineering optimization problems.	Apply (K3)
CO5	Apply MATLAB tools to model and solve real-time electrical engineering problems using soft computing techniques.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	1	1	-	-	-	-	1	-	-	-	1
CO2	3	3	3	2	1	-	-	-	-	1	-	-	-	1
CO3	3	3	3	2	1	-	-	-	-	1	-	-	-	1
CO4	3	3	2	2	2	-	-	-	-	1	-	-	-	1
CO5	3	3	2	2	2	-	-	-	-	1	-	-	-	1

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23OEE03 Electric Vehicle Technology

Prerequisite	Programme Name	Semester	Category	L	T	P	C
Basic Programming	All programmes except B.E - EEE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To understand the principles of electromechanical energy conversion and the characteristics of various electrical machines used in electric and hybrid electric vehicles.
2.	To analyze the operation and characteristics of different types of power electronic converters and their applications in motor drive systems.
3.	To study the control strategies for DC and AC motor drives including advanced techniques used in electric vehicle propulsion systems.
4.	To explore the architecture, powertrain components, and energy storage systems used in hybrid and electric vehicles.
5.	To apply the fundamentals of vehicle mechanics for analyzing drive cycles, powertrain sizing, and implementing control and energy management strategies in hybrid electric vehicles.

III - Course Content

Unit – I	Rotating Power Converters	9 Periods
Magnetic Circuits and Electromechanical Energy Conversion- DC Machines- AC Machines- Special Electrical Machines (BLDC, PMSM & SRM)- Power Electronic Converters for Motor Drives- Applications in Electric Vehicles and Renewable Energy Systems		
Unit – II	Static Power Converters	9 Periods
Working and Characteristics of Power Diodes, MOSFET and IGBT. Working of uncontrolled rectifiers, controlled rectifiers (Single phase and three phase), DC choppers, single and three phase inverters, Multilevel inverters, and Matrix Converters.		
Unit – III	Control of DC and AC Motor Drives	9 Periods
Fundamentals of Electric Drive Dynamics-DC Motor Drive Control (Chopper, four quadrant) - Induction Motor Drives (v/f, Inverter - fed) - Vector Control of AC Motors (IM, PMSM)-BLDC -SRM - Advanced Control and Implementation Techniques.		
Unit – IV	Hybrid Electric Vehicle Architecture and Power Train Components	9 Periods
Evolution and Classification of Electrified Vehicles – Comparison – Powertrain Components and Energy Storage – Mechanical Subsystems of Powertrain - Advanced Technologies and Trends.		
Unit – V	Mechanics of Hybrid Electric Vehicles and Control of Vehicles	9 Periods
Fundamentals of Vehicle Mechanics - Drive Cycle Analysis and Powertrain Sizing - Hybrid Electric Vehicle Architectures – supervisory Control and Energy Management – Advanced Control Strategies – Intelligent Vehicle Control and Integration		

TOTAL: 45 Periods

Text Books	1. Stephen D. Umans, "Fitzgerald & Kingsley's Electric Machinery", Tata McGraw Hill, 7th Edition, 2020. 2. Bogdan M. Wilamowski, J. David Irwin, The Industrial Electronics Handbook, Second Edition, Power Electronics and Motor Drives, CRC Press, 2011
Reference Books	1. Paul C. Krause, Oleg Wasynczuk, Scott D. Sudhoff, Steven D. Pekarek "Analysis of Electric Machinery and Drive Systems", 3rd Edition, Wiley-IEEE Press, 2013. 2. Rashid M.H., "Power Electronics Circuits, Devices and Applications ", Pearson, fourth Edition, 10th Impression 2021. 3. Iqbal Husain, 'Electric and Hybrid Electric Vehicles', CRC Press, 2021. 4. Wei Liu, 'Hybrid Electric Vehicle System Modeling and Control', Second Edition, WILEY, 2017 5. James Larminie and John Lowry, 'Electric Vehicle Technology Explained', Second Edition, Wiley, 2012

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the operating principles and characteristics special machines used in electric mobility.	Understand (K2)
CO2	Analyze the structure and functionality of power semiconductor devices in electric vehicle applications.	Analyze (K4)
CO3	Analyze the control strategies for DC and AC electric drives.	Analyze (K4)
CO4	Clarify the architecture of electric and hybrid electric vehicles and inverters.	Analyze (K4)
CO5	Apply the fundamentals of vehicle mechanics to evaluate energy requirements and hybrid electric vehicles.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	-	-	-	-	3	3	-	-	-	-	-	1	-
CO2	3	3	-	-	-	3	3	-	-	-	-	-	1	-
CO3	3	3	-	2	-	3	3	-	-	-	-	-	1	-
CO4	3	3	2	2	-	3	3	-	-	-	-	-	1	-
CO5	3	2	-	-	-	3	3	-	-	-	-	-	1	-

Mapping: 1-Low, 2-Medium, 3-High

I- Course Name: 23OEE04 Electrical Safety

Prerequisite	Programme Name	Semester	Category	L	T	P	C
Nil	All programmes except B.E - EEE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To introduce the fundamental concepts of electrical safety, including the nature of electrical shocks and preventive measures.
2.	To familiarize students with national and international electrical safety standards, codes, and statutory requirements.
3.	To provide knowledge on electrical protection methods, maintenance procedures, and first aid techniques for electrical hazards.
4.	To equip students with the skills to conduct energy audits for various electrical systems and recommend energy-saving techniques.
5.	To develop an understanding of safety management practices, policies, and motivation strategies to foster a safety-oriented workplace.

III - Course Content

Unit – I	Introduction to Electrical Safety, Shocks and their Prevention	9 Periods
Review of Electrical concept, Electrostatic – Electro magnetism – Electrical Hazards – Energy leakage – Clearance and insulation – Current surges – Electrical causes of fire and explosion – Human interface with electricity – Human resistance to electricity.		
Unit – II	Standards and Requirements	9 Periods
National electrical Safety code - Standards and statutory requirements – Indian electricity acts and rules – statutory requirements from Electrical inspectorate. Hazardous area classification and Classification of electrical equipment for hazardous areas (IS, NFPA, API and OSHA standards).		
Unit – III	Electrical Protection and Maintenance	9 Periods
Selection of Environment, Protection and Interlock – Discharge rods and earthing device – Safety in the use of portable tools - Preventive maintenance. First aid-Cardio Pulmonary Resuscitation (CPR).		
Unit – IV	Energy Audit of Electrical Systems	9 Periods
Instruments for energy audit - energy audit of heating, ventilation and air conditioning systems - energy audit of compressed air systems - energy audit of buildings - energy audit of electric drive utilities-energy efficient electrical systems- types and tips for improvement in industry.		
Unit – V	Safety Management of Electrical Systems	9 Periods
Principles of Safety Management, Management Safety Policy, Safety organization, safety auditing, Motivation to managers, supervisors, employees towards safety.		

TOTAL: 45 Periods

Text Books	1. John Codick, "Electrical safety handbook", 4th Edition, McGraw Hill Professional, 2012, New Delhi. 2. C.S. Raju, "A Practical Book on domestic safety", Sri Sai Publisher, Chennai - 2003. 3. Power Engg. Hand book, TNEB Engineers officers, Chennai-2002.
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Reference Books	1. Rao - R.C, Khanna, "Electrical safety, Fire safety engineering and safety management", 2nd Edition, Khanna Publisher, 2012, New Delhi. 2. Trivedi P.R., Jolka B.R., "Energy Management", Common Wealth Publishers, New Delhi, 1997. 3. Barney L. Capehart, Wayne C. Turner, and William J. Kennedy, Guide to Energy Management, Fifth Edition, The Fairmont Press, Inc., 2006
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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Identify various electrical hazards and explain methods for preventing electrical shocks and fire incidents.	Understand (K2)
CO2	Interpret and apply national and international electrical safety standards and statutory requirements in real-world scenarios.	Apply (K3)
CO3	Demonstrate appropriate electrical protection techniques and perform basic preventive maintenance and emergency first aid (CPR).	Apply (K3)
CO4	Conduct energy audits in electrical systems and recommend measures for improving energy efficiency in industrial and building applications.	Analyze (K4)
CO5	Implement principles of electrical safety management and develop safety policies, audit strategies, and motivation techniques in organizations.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	-	-	-	-	3	3	-	-	-	-	-	1	-
CO2	3	3	-	-	-	3	3	-	-	-	-	-	1	-
CO3	3	3	-	2	-	3	3	-	-	-	-	-	1	-
CO4	3	3	2	2	-	3	3	-	-	-	-	-	1	-
CO5	3	2	-	-	-	3	3	-	-	-	-	-	1	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23OEE05 E-waste Management

Prerequisite	Programme Name	Semester	Category	L	T	P	C
Nil	All programmes except B.E - EEE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	Gaining knowledge about the current state of e-waste generation, collection, and disposal, both globally and in specific regions.
2.	Learning about the potential risks associated with e-waste, including the release of hazardous materials and their impact on ecosystems and human health.
3.	Studying national and international laws and regulations governing e-waste management, such as the E-Waste (Management) Rules.
4.	Learning about the emerging technologies and green chemistry
5.	Exploring various methods for reducing, reusing, recycling, and responsibly disposing of e-waste, including techniques for material recovery and waste minimization.

III - Course Content

Unit – I	General Concepts to E Waste and E-Waste Management	9 Periods
Introduction and general concepts to e-waste and e-waste management; Principle and standards for the disposal; Life cycle and Performance assessment and understanding		
Unit – II	Health Effects of E-Waste Pollution	9 Periods
Health Effects of E-waste Pollution; Global Trends of E-waste Pollution and Its Impact on Environment		
Unit – III	Material Recycling and Processing Techniques	9 Periods
E-waste: Global Scenario, Constituents, and Biological Strategies for Remediation Materials Recycling Considerations Processing Techniques.		
Unit – IV	Green Chemistry	9 Periods
Emerging Technologies Bioremediation Approaches e-factor concept in green chemistry Case studies: implementation of e-waste recycling		
Unit – V	Recycling Process	9 Periods
Recycling Processes and Plastic in e-waste is an emerging problem for India: Implications for Future Prospect		

TOTAL: 45 Periods

Text Books	1. Hugo Marcelo Veit and Andréa Moura Bernardes, "Electronic Waste: Recycling Techniques" Springer 2015. 2. Johri R., E-waste: implications, regulations, and management in India and current global best practices, TERI Press, New Delhi
Reference Books	1. Hester R.E., and Harrison R.M, Electronic Waste Management. Science, 2009

	2. Muammer Kaya, "Electronic Waste and Printed Circuit Board Recycling Technologies", Springer 2019. 3. Muhammad Zaffar Hashmi and Ajit Varma, "Electronic Waste Pollution: Environmental Occurrence and Treatment Technologies", Springer 2019. 4. Lifeng Zhang and Gregory K. Krumdick, "Recycling of Electronic Waste II", Wiley 2011. 5. Fowler B, Electronic Waste – 1 st Edition (Toxicology and Public Health Issues), 2017Elsevier
MOOC/Web Platforms:	https://news.mit.edu/2013/ewaste-mit

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the environmental impacts of e-waste.	Understand (K2)
CO2	Apply concepts of e-waste management hierarchy.	Apply (K3)
CO3	Distinguish the role of various national and internal act and laws applicable for e-waste management and handling.	Analyze (K4)
CO4	Analyze the e – waste management measures proposed under national and global legislations.	Analyze (K4)
CO5	To assess the overall sustainability of e-waste, considering the three pillars: environmental, economic, and energy.	Understand (K2)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	-	-	-	-	3	3	-	-	-	1	-	-	-
CO2	3	3	-	-	-	3	3	-	-	-	1	-	-	-
CO3	3	3	-	2	-	3	3	-	-	-	1	-	-	-
CO4	3	3	2	2	-	3	3	-	-	-	1	-	-	-
CO5	3	2	-	-	-	3	3	-	-	-	1	-	-	-

Mapping:1-Low,2-Medium,3-High

I-Course Name: 23OEE06 Industrial Automation

Prerequisite	Programme Name	Semester	Category	L	T	P	C
Nil	All programmes except B.E - EEE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To introduce the fundamentals of industrial automation systems, including their architecture and essential communication protocols such as Modbus and Profibus.
2.	To familiarize students with key automation components like sensors, actuators, process control valves, and power electronic devices used in industrial systems.
3.	To impart knowledge on computer-aided measurement and control systems, including data acquisition, process interfaces, and industrial communication systems.
4.	To develop the ability to program, configure, and implement Programmable Logic Controllers (PLCs) in industrial process control and automation applications.
5.	To understand the structure and operation of Distributed Control Systems (DCS), including software configurations, communication protocols, and integration with other automation systems.

III - Course Content

Unit - I	Introduction	9 Periods
Basics of industrial automation, Requirement of automation systems, Architecture of Industrial Automation system, Introduction of PLC and supervisory control and data acquisition (SCADA)- Flexible manufacturing system (FMS) - Industrial bus systems: Modbus & Profibus.		
Unit - II	Automation Components	9 Periods
Measurement Systems Characteristics - Sensors for temperature, pressure, force, displacement, speed, flow, level, humidity and pH measurement. Actuators, process control valves, power electronics devices DIAC, TRIAC, power MOSFET and IGBT. Introduction of DC and AC servo drives for motion control.		
Unit - III	Computer Aided Measurement and Control Systems	9 Periods
Role of computers in measurement and control, Elements of computer aided measurement and control, man- machine interface, computer aided process control hardware, process related interfaces, Communication and networking, Industrial communication systems, Data transfer techniques, Computer aided process control software, Computer based data acquisition system, Advanced automation functions, Levels of automations, Automated flow lines and transfer mechanisms - Analysis of transfer lines without storage, Automated flow lines with storage buffers.		
Unit - IV	Programmable Logic Controllers	9 Periods
Programmable controllers, Programmable logic controllers, Analog digital input and output modules, PLC programming, Ladder diagram, Sequential flow chart, PLC Communication and networking, PLC selection, PLC Installation, Advantage of using PLC for Industrial automation, Application of PLC to process control industries		

Unit - V	Distributed Control System	9 Periods
introductions to computer based industrial automation – Direct Digital Control (DDC) – DCS software configuration, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers, Features of DCS, Advantages of DCS – Transport Automation		
TOTAL: 45 Periods		

Text Books	1. S.K.Singh, "Industrial Instrumentation", Tata McGraw Hill, 2nd edition companies, 2003. 2. C D Johnson, "Process Control Instrumentation Technology", Prentice Hall India, 8th Edition, 2006.
Reference Books	1. E.A.Parr, Newness, New Delhi, "Industrial Control Handbook", 3rd Edition, 2000.

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the signal conditioning circuits for a variety of industrial and automation applications	Understand (K2)
CO2	Establish an in-depth understanding of data acquisition systems, interfacing techniques, and Distributed Control Systems (DCS).	Apply (K3)
CO3	Clarify the fundamentals and significance of communication buses used in applied automation engineering	Analyze (K4)
CO4	Understand the ladder logic and function block programs for PLCs using timers, counters, arithmetic, and logic instructions.	Analyze (K4)
CO5	Analyze the advanced PLC logic solutions for real- world industrial automation problems	Analyze (K4)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	-	-	-	-	3	3	-	-	-	-	-	1	-
CO2	3	3	-	-	-	3	3	-	-	-	-	-	1	-
CO3	3	3	-	2	-	3	3	-	-	-	-	-	1	-
CO4	3	3	2	2	-	3	3	-	-	-	-	-	1	-
CO5	3	2	-	-	-	3	3	-	-	-	-	-	1	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 230EE07 Power Plant Instrumentation

Prerequisite	Programme Name	Semester	Category	L	T	P	C
Nil	All programmes except B.E - EEE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	Understand the methods and instruments used for measuring metal temperature in boilers.
2.	Understand different types of draught plants (natural, forced, induced, balanced) and their power requirements. Learn about fan drives, airflow control, and combustion control techniques.
3.	Understand automation concepts specific to thermal power plants. Learn about boiler automation systems including diagnostic functions and protection mechanisms.
4.	Understand the piping and instrumentation diagrams of different types of nuclear power plants.
5.	Gain an introduction to Industrial Internet of Things (IIoT) applications in power plants. Understand smart grid technologies and their impact on power plant instrumentation.

III - Course Content

Unit - I	Measurement in Boiler and Turbine	9 Periods
Metal temperature measurement in boilers, impulse-piping system for pressure measuring devices, flame monitoring. Introduction to turbine supervising system, pedestal vibration, shaft vibration, eccentricity measurement. Installation of non-contracting transducers for speed measurement, rotor and casing movement and expansion measurement.		
Unit - II	Controls in Boiler	9 Periods
Problems associated with control of multiple pulverizers. Draught plant: Introduction, natural draught, forced draught, induced draught, balanced draught, power requirements for draught systems. Fan drives and control, control of airflow. Combustion control: Fuel/Air ratio, oxygen, CO and CO ₂ trimming, combustion efficiency, excess air, parallel and cross limited combustion control, control of large systems.		
Unit - III	Automation	9 Periods
Automation: Thermal power plant, Boiler Automation – Diagnostic Functions and Protection – Digital Electro – Hydraulic Governor, Man-Machine Interface – Graphic Display of Automated Power plant.		
Unit - IV	Nuclear Power Plant Instrumentation	9 Periods
Piping and instrumentation diagram of different types of nuclear power plant, nuclear reactor control loops, reactor dynamics, excess reactivity, pulse channel and logarithmic instrumentation, control and safety instrumentation, reliability aspects.		
Unit - V	Emerging Trends and Applications	9 Periods
Introduction to the Industrial Internet of Things (IIoT) in power plants. Smart grid technologies and their impact on instrumentation. Simulation and modeling of power plant system.		

TOTAL: 45 Periods

Text Books	1. Philip Kiameh, Power Plant Instrumentation and Control Handbook 2. B. D. Taylor, ' Instrumentation for Engineers and Technicians 3. Modern Power Station Practice – British Electricity International
Reference Books	1. Bela G. Liptak, Instrumentation in Industry 2. P.K. Nag, " Power Plant Engineering " 3. K.K. Ramalingam, " Power Plant Instrumentation "
MOOC/Web Platforms:	1. NPTEL (National Programme on Technology Enhanced Learning) 2. Coursera (e.g., Energy Production, Distribution & Safety) 3. edX (e.g., Smart Grids, Control Systems)

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain basic thermal power plant processes and layout	Understand (K2)
CO2	Identify and describe the operation of instrumentation devices in power plants	Apply (K3)
CO3	Analyze control strategies used in boiler and turbine operations	Analyze (K4)
CO4	Select appropriate control systems for different power plant functions	Analyze (K4)
CO5	Discuss advancements in combined cycle power generation	Understand (K2)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	2	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	3	2	-	-	-	-	-	-	-	-	-	-
CO5	2	2	-	-	3	-	-	-	-	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High

I-Course Name: 23OEE08 Principles of Robotics

Prerequisite	Programme Name	Semester	Category	L	T	P	C
Nil	All programmes except B.E - EEE	V/VI/VII	OEC	3	0	0	3

II-Course Objectives

1.	To introduce the fundamental components and mechanical structure of robotic systems.
2.	To impart knowledge on spatial descriptions, coordinate transformations, and kinematic modeling using D-H parameters.
3.	To analyze and design actuator and sensor systems for robotic control.
4.	To develop trajectory planning techniques and implement control strategies.
5.	To explore the integration of Artificial Intelligence and expert systems in robotics with real-world case studies.

III- Course Content

Unit – I	Fundamentals of Robot	9 Periods
Introduction: Fundamentals and robot - components, joints, degrees of freedom, coordinates. The mechanics & control of mechanical manipulators. Spatial Descriptions and Transformations: Descriptions – Positions, Orientations, and Frames, Mappings, Operators – Translations, Rotations, and Transformations, Transformation arithmetic and transform equations, transformation of free vectors, Representation & Orientation		
Unit – II	Representation and Kinematics of Robotic Structures	9 Periods
Representation and Transformation of joints, links Mechanical Structure notations, Coordinate frames, Description of objects in space, Transformation and fundamental rotation matrices, Position and orientation of a rigid body, Homogeneous transformations, Representation of joints, link representation using D-H parameters, Kinematics: Forward kinematics of multi DOF manipulator - Inverse kinematics of 2DOF manipulator. Homogeneous transformation matrices, translation and rotation matrices		
Unit – III	Elements of Robots	9 Periods
Position and orientation of a rigid body, Homogeneous transformations, Representation of joints, link representation using D-H parameters, Examples of D-H parameters and link transforms, different kinds of actuators – stepper, DC servo and brushless motors, model of a DC servo motor, Types of transmissions, Purpose of sensors, internal and external sensors, common sensors – encoders, tachometers, strain gauge based force-torque sensors, proximity and distance measuring sensors, and vision.		
Unit – IV	Trajectory Planning and Robot Programming	9 Periods
Trajectory planning, joint space techniques, cartesian space formulation. Control of manipulator, PID control scheme, computed torque control, force control of robotic manipulators. Robot Programming Robot Programming: Manual programming – Teach Pendant, Offline Programming - Welding, Online programming – Deburring, Palletizing and Inspection.		
Unit – V	AI and Robotics	9 Periods
Artificial Intelligence in Robotics Expert systems, Artificial Intelligence- Knowledge Representation, AI in Robotics, Case studies		

TOTAL: 45 Periods

Text Books:	1. John J. Craig, <i>Introduction to Robotics: Mechanics and Control</i> , 4th Edition, Pearson Education, Boston, Massachusetts, 2022. ISBN: 978-0-13-784874-4. 2. Mark W. Spong, Seth Hutchinson, and M. Vidyasagar, <i>Robot Modeling and Control</i> , 2nd Edition, Wiley, Hoboken, New Jersey, 2020. ISBN: 978-1-119-52404-5.
Reference Books:	1. Stuart Russell and Peter Norvig, <i>Artificial Intelligence: A Modern Approach</i> , 4th Edition, Pearson, Hoboken, New Jersey, 2020. ISBN: 978-0-13-461099-3. 2. Robert J. Schilling, <i>Fundamentals of Robotics: Analysis and Control</i> , 1st Edition, Pearson Education, Upper Saddle River, New Jersey, 1990. 3. Stuart Russell and Peter Norvig, <i>Artificial Intelligence: A Modern Approach</i> , 4th Edition, Pearson, Hoboken, New Jersey, 2020.
MOOC/Web Platforms:	1. https://archive.nptel.ac.in/courses/112/104/112104298/ 2. Introduction to Robotics IIT Kanpur Prof. T.Asokan

IV-Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Identify and describe the fundamental components, joint types, and degrees of freedom in robotic systems.	Understand (K2)
CO2	Apply spatial transformation techniques to represent positions and orientations of robotic links and end-effectors.	Apply (K3)
CO3	Model robotic joints and links using Denavit-Hartenberg (D-H) parameters and solve forward and inverse kinematics problems.	Apply (K3)
CO4	Analyze and select appropriate actuators and sensors for robotic applications based on functionality and requirements.	Analyse (K4)
CO5	Design and implement trajectory planning and control schemes for robotic manipulators in both joint and Cartesian spaces.	Analyse (K4)

V-Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	1	-	-	-	-	-	-	-	-	-	1	-
CO2	3	3	2	2	-	-	-	-	1	-	1	-	1	-
CO3	3	3	3	2	1	-	-	-	1	-	1	-	1	-
CO4	3	2	3	2	-	-	-	-	1	-	1	-	1	-
CO5	3	2	2	3	2	-	-	-	2	-	2	-	1	-

Mapping: 1-Low, 2-Medium, 3-High

I- Course Name: 23OEE09 Sensors and Transducers

Prerequisite	Programme Name	Semester	Category	L	T	P	C
Nil	All programmes except B.E - EEE	V/VI/VII	OEC	3	0	0	3

II-Course Objectives

1.	To understand the concepts of measurement technology.
2.	To learn the various sensors used to measure various physical parameters.
3.	To learn the fundamentals of signal conditioning, data acquisition and communication systems used in mechatronics system development.

III-Course Content

Unit-I	Introduction to Measurements and Sensors	9 Periods
Basics of Measurements – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types- Performance measures of sensors.		
Unit-II	Variable Resistance and Inductance Sensors	9 Periods
Motion Proximity Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, Linear Variable transducer (LVDT) – Rotary Variable transducer RVDT – Synchro – Microsyn, Accelerometer, – GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR)		
Unit-III	Variable and Other Special Sensors	9 Periods
Types of Strain Guage, Load Cell, Magnetic Sensors –principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers.		
Unit-IV	Automotive Actuators	9 Periods
Photo resistive, Photo conductive cell, photo voltaic, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple. Acoustic Sensors – flow and level measurement, Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors.		
Unit-V	Automatic Temperature Control Actuators	9 Periods
Sample and Hold circuits – Data Acquisition: Single channel and multi-channel data acquisition – Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring		

TOTAL:45 Periods

Text Books:	1. Ernest O Doebelin, "Measurement Systems – Applications and Design", Tata McGraw-Hill, 2009. 2. Sawney A K and Puneet Sawney, "A Course in Mechanical Measurements and Instrumentation and Control", 12th edition, Dhanpat Rai & Co, New Delhi, 2013.
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Reference Books:	1.Patranabis D, "Sensors and Transducers", 2nd Edition, PHI, New Delhi, 2010. 2.John Turner and Martyn Hill, "Instrumentation for Engineers and Scientists", Oxford Science Publications, 1999. 3.Richard Zurawski, "Industrial Communication Technology Handbook" 2nd edition, CRC Press, 2015.
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IV- Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	Expertise in various calibration techniques and signal types for sensors.	Understand (K2)
C02	Apply the various sensors in the Automotive and Mechatronics applications.	Apply (K3)
C03	Study the basic principles of various smart sensors.	Understand (K2)
C04	Implement the DAQ systems with different sensors for real time applications.	Analyze (K4)
C05	Analyze applications of advanced sensor technologies in smart systems.	Analyze (K4)

IV-Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C01	2	-	1	-	-	-	-	-	-	-	-	-	1	-
C02	2	2	3	-	-	-	-	-	-	-	-	-	1	-
C03	1	-	2	-	-	-	-	-	-	-	-	-	1	-
C04	2	2	3	2	1	-	-	-	-	-	-	-	1	-
C05	2	2	2	3	2	-	-	-	-	-	-	-	1	-

Mapping:1-Low,2-Medium,3-High

I-Course Name: 23OEE10 Solar and Wind Energy Resources

Prerequisite	Programme Name	Semester	Category	L	T	P	C
Nil	All programmes except B.E - EEE	V/VI/VII	OEC	3	0	0	3

II-Course Objectives

1.	To introduce the fundamentals of solar energy, its availability, and its role in the renewable energy landscape.
2.	To explain the working principles and performance characteristics of solar cells and photovoltaic technologies.
3.	To enable students to understand the design, components, and operation of photovoltaic (PV) systems.
4.	To provide foundational knowledge on wind energy, including wind resource assessment and conversion principles.
5.	To familiarize students with different types of wind turbines and their performance characteristics in energy generation.

III-Course Content

Unit-I	Introduction to Solar Energy	9 Periods
Basic characteristics of sunlight – solar spectrum – insolation specifics– irradiance and irradiation- pyranometer – Solar PV cell- Simplest equivalent circuit for a photovoltaic cell – Solar cells to modules, Solar cells to arrays I-V characteristics – P-V characteristics – fill factor.		
Unit-II	Performance of Solar Cells	9 Periods
Parameters of solar cells, solar cell technologies – Factors affecting electricity generated by a solar cell, Solar PV module, Standard PV module parameters, IV and PV characteristics of SPV module, Solar PV modules arrays – connection of modules in series and parallel		
Unit-III	Photovoltaic Systems	9 Periods
Introduction to Simplified grid connected PV systems, Current voltage curves for loads – DC motor IV curves - Battery IV curves – maximum power point trackers – hourly IV curves, grid connected systems		
Unit-IV	Introduction to Wind Energy	9 Periods
Nature of the wind – Types of wind turbines, power in the wind – factors influencing wind – wind energy potential and installation in India- wind speed monitoring - wind resource assessment -wind power laws - velocity and power duration curves - Betz limit - site selection.		
Unit-V	Wind Energy Conversion Techniques	9 Periods
Wind energy conversion devices - classification, characteristics- Wind Turbine Generators Asynchronous (Induction) generator- Squirrel cage Induction generator, Wound rotor Induction generator- Optislip Induction generator- Doubly-fed Induction generator. Synchronous generator- Wound rotor generator- Permanent magnet generator, Indian standards		

TOTAL: 45 Periods

Text Books:	1. Rai. G.D. "Non-Conventional Sources of Energy", Khanna Publishers, New Delhi, 2002. 2. Chetan Singh Solanki, 'Solar Photovoltaics: Fundamentals, Technologies, Applications' PHI Learning Publications, 2nd Edition, 2011.
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References	1. Solanki, C.S. "Solar Photovoltaic Technology and Systems", PHI learning Pvt. Ltd., New Delhi, 2013. 2. Rai. G.D. "Non-Conventional Sources of Energy", Khanna Publishers, New Delhi, 2002. 3. S N Bhadra, S Banerjee and D Kastha, 'Wind Electrical Systems', Oxford University Press, 1st Edition, 2005. 4. S. Sumathi, L. Ashok Kumar, P. Surekha, 'Solar PV and Wind Energy Conversion Systems', Springer 2015
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IV-Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the fundamental concepts and significance of solar energy.	Understand (K2)
CO2	Analyze the performance characteristics of solar cells under various conditions.	Analyze (K4)
CO3	Design and evaluate photovoltaic systems for practical applications.	Evaluate (K5)
CO4	Describe the basic principles and potential of wind energy as a renewable source.	Understand (K2)
CO5	Compare and assess different wind energy conversion devices.	Understand (K2)

V-Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	1	1	-	-	-	-	1	-	1	-	-
CO2	3	3	3	2	1	-	-	-	-	1	-	1	-	-
CO3	3	3	3	2	1	-	-	-	-	1	-	1	-	-
CO4	3	3	2	2	2	-	-	-	-	1	-	1	-	-
CO5	3	3	2	2	2	-	-	-	-	1	-	1	-	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23OHS01 English for Competitive Examinations

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All B.E/B.Tech Programmes	V/VI/VII	OEC	3	0	0	3

II. Course Objectives

1.	To train the students in the language components essential to face competitive examinations both at the national (UPSC, Banking, Railway, Defense) and the international level (GRE, TOEFL, IELTS).
2.	To enhance an awareness of the specific patterns in language testing and the respective skills to tackle verbal reasoning and verbal ability tests.
3.	To inculcate effective practices in language-learning in order to improve accuracy in usage of grammar and coherence in writing.

III. Course Content

Unit-I	Vocabulary and Verbal Ability	9 Periods
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 Sentence Construction	9 Periods
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	Reading and Comprehension Skills	9 Periods
Reading - Specific information and detail - Identifying main and supporting ideas - Speed reading techniques Improving global reading skills Linking ideas Summarizing -Under-standing argument - Identifying opinion/attitude and making inferences - Critical reading.		
Unit-IV	Writing and Composition Skills	9 Periods
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- Technical writing.		
Unit-V	Listening and Speaking Skills	9 Periods
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. R.P.Bhatnagar General English for Competitive Examinations. Macmillan India Limited, 2009.
Reference Books	1. Educational Testing Service the Official Guide to the GRE Revised General Test, Tata McGraw Hill, 2010.
	2. The Official Guide to the TOEFL Test, Tata McGraw Hill, 2010.
	3. R Rajagopalan- General English for Competitive Examinations, McGraw Hill Education (India) Private Limited, 2008.
Web Source	http://www.examenglish.com/ , http://www.ets.org/ , http://www.bankxams.com/
	http://civilservicesmentor.com/ , http://www.educationobserver.com
	http://www.cambridgeenglish.org/in/
	http://www.examenglish.com/ , http://www.ets.org/ , http://www.bankxams.com/
	http://civilservicesmentor.com/ , http://www.educationobserver.com
	http://www.cambridgeenglish.org/in/

IV. Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Expand their vocabulary and gain practical techniques to read and comprehend a wide range of texts with the emphasis required.	Understand (K2)
CO2	Identify errors with precision and write with clarity and coherence.	Analyze (K4)
CO3	Understand the importance of task fulfilment and the usage of task-appropriate vocabulary.	Understand (K2)
CO4	Communicate effectively in group discussions, presentations and interviews.	Apply (K3)
CO5	Write topic-based essays with precision and accuracy.	Apply (K3)

V. Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	-	-	-	-	-	-	-	-	2	3	-	2	-	-
CO2	-	-	-	-	-	-	-	-	2	3	-	2	-	-
CO3	-	-	-	-	-	-	-	-	2	3	-	2	-	-
CO4	-	-	-	-	-	-	-	-	2	3	-	2	-	-
CO5	-	-	-	-	-	-	-	-	2	3	-	2	-	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23OHS02 Project Report Writing

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All B.E/B.Tech Programmes	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	Understand the essentials of project writing.
2.	Perceive the difference between general writing and technical writing
3.	Assimilate the fundamental features of report writing.
4.	Understand the essential differences that exist between general and technical writing.
5.	Learn the structure of a technical and project report

III - Course Content

Unit - I	Writing Skills	9 Periods
Essential Grammar and Vocabulary – Passive Voice, Reported Speech, Concord, Signpost words, Cohesive Devices – Paragraph writing - Technical Writing vs. General Writing.		
Unit - II	Project Report	9 Periods
Definition, Structure, Types of Reports, Purpose – Intended Audience – Plagiarism– Report Writing in STEM fields – Experiment – Statistical Analysis.		
Unit - III	Structure of the Project Report: (Part 1)	9 Periods
Framing a Title – Content – Acknowledgement – Funding Details -Abstract – Introduction – Aim of the Study – Background - Writing the research question - Need of the Study/Project Significance, Relevance – Determining the feasibility – Theoretical Framework.		
Unit - IV	Structure of the Project Report: (Part 2)	9 Periods
Literature Review, Research Design, Methods of Data Collection -Tools and Procedures - Data Analysis - Interpretation - Findings – Limitations - Recommendations – Conclusion – Bibliography		
Unit - V	Proof reading a report	9 Periods
Avoiding Typographical Errors – Bibliography in required Format – Font –Spacing – Checking Tables and Illustrations – Presenting a Report Orally – Techniques		
TOTAL:45 Periods		
Books for study & Reference:	- Gerson and Gerson-Technical Communication: Process and Product, 7th Edition, Prentice Hall (2012) - Virendra K. Pamecha - Guide to Project Reports, Project Appraisals and Project Finance (2012) - Daniel Riordan - Technical Report Writing Today (1998) - Darla-Jean Weatherford - Technical Writing for Engineering Professionals (2016) Penwell Publishers	

MOOC/Web Platforms:	https://devimpactinstitute.com/courses/project-management/training-on-report-writing/ https://glomacs.com/training-course/advanced-report-writing-and-presentation-skills https://www.indepthresearch.org/course/effective-report-writing-skills-
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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Write effective project reports.	Analyze (K4)
CO2	Use statistical tools with confidence.	Apply (K3)
CO3	Explain the purpose and intension of the proposed project coherently and with clarity.	Understand (K2)
CO4	Create writing texts to suit achieve the intended purpose.	Evaluate (K5)
CO5	Master the art of writing winning proposals and project	Evaluate (K5)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	-	-	-	-	-	-	-	-	2	3	-	2	-	-
CO2	-	-	-	-	-	-	-	-	2	3	-	2	-	-
CO3	-	-	-	-	-	-	-	-	2	3	-	2	-	-
CO4	-	-	-	-	-	-	-	-	2	3	-	2	-	-
CO5	-	-	-	-	-	-	-	-	2	3	-	2	-	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23OMA01 Algebra and Number Theory

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All B.E/B.Tech Programmes	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To introduce the basic notions of groups, rings, fields which will then be used to solve related problems.
2.	To examine the key questions in the Theory of Numbers.
3.	To give an integrated approach to number theory and abstract algebra, and provide a firm basis for further reading and study in the subject.
4.	To introduce the basic notions of congruences.
5.	To apply the concepts in the real time problems by using theorems.

III - Course Content

Unit I	Groups and Rings	9 Periods
Groups: Definition - Properties (Statements only) - Homomorphism - Isomorphism - Cyclic groups (Statements only) - Cosets - Lagrange's theorem. Rings: Definition - Sub rings - Ring homomorphism - Integral domain - Field - Integer modulo n.		
Unit II	Finite Fields and Polynomials	9 Periods
Rings - Polynomial rings - Irreducible polynomials over finite fields - Factorization of polynomials over finite fields.		
Unit III	Divisibility Theory and Canonical Decompositions	9 Periods
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 Periods
Linear Diophantine equations - Congruence's - Linear Congruence's - Applications: Divisibility tests - Modular exponentiation - Chinese remainder theorem - 2x2 linear systems.		
Unit V	Classical Theorems and Multiplicative Functions	9 Periods
Linear Diophantine equations - Congruence's - Linear Congruence's - Applications: Divisibility tests - Modular exponentiation - Chinese remainder theorem - 2x2 linear systems.		

TOTAL:45 Periods

Text Books:	[1]. Grimaldi, R.P and Ramana, B.V., "Discrete and Combinatorial Mathematics", Pearson Education, 5 th Edition, New Delhi, 2007. [2]. Thomas Koshy, "Elementary Number Theory with Applications", Elsevier Publications, New Delhi, 2002.
Reference Books:	[1]. P. Sivaramakrishna das and C. Vijayalakshmi, "Algebra and Number Theory", Pearson Publications, 2019. [2]. Niven. I, Zuckerman's., and Montgomery, H.L., "An Introduction to Theory of Numbers", John Wiley and Sons, Singapore, 2004. [3]. Lidl.R., and Pitz. G, "Applied Abstract Algebra", Springer Verlag, New Delhi, 2 nd Edition, 2006.
MOOC/ Web Platforms:	http://kcl.digimat.in/nptel/courses/video/111108609/L01.html https://archive.nptel.ac.in/courses/111/106/111106137/ https://nptel.ac.in/courses/111108413 https://www.youtube.com/watch?v=B1AMosLhHGU https://www.slideshare.net/slideshow/number-theory-lesson-1-introduction-to-number-theory/232368762

IV - Course Outcomes

On completion of the course, the students will be able to		Blooms Level Mapped
CO1	Explain the fundamental concepts of advanced algebra and their role in modern mathematics and applied contexts.	Apply (K3)
CO2	Demonstrate accurate and efficient use of advanced algebraic techniques.	Understand (K2)
CO3	Demonstrate their mastery by solving non-trivial problems related to the concepts.	Understand (K2)
CO4	Understand the concepts of congruences and their applications.	Understand (K2)
CO5	Apply the classical Theorems to the real time problems.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	-	-	-	-	2	-	-	2	-	-
CO2	2	2	2	2	-	-	-	-	2	-	-	2	-	-
CO3	3	2	2	2	-	-	-	-	2	-	-	2	-	-
CO4	2	2	2	2	-	-	-	-	2	-	-	2	-	-
CO5	2	2	2	2	-	-	-	-	2	-	-	2	-	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23OMA02 Graph Theory

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All B.E/B.Tech Programmes	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	Impart mathematical modelling to describe and explore real-world phenomena and data.
2.	Provide basic understanding on Linear, quadratic, power and polynomial, exponential, and multi variable models.
3.	Summarize and apply the methodologies involved in framing the real-world problems related to fundamental principles of polynomial equations.

III - Course Content

Unit – I	Introduction	9 Periods
Graphs – Introduction – Isomorphism – Sub graphs – Walks, Paths, Circuits – Connectedness – Components – Euler graphs – Hamiltonian paths and circuits – Trees – Properties of trees – Distance and centers in tree – Rooted and binary trees.		
Unit – II	Trees, Connectivity & Planarity	9 Periods
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 – Network flows – 1-Isomorphism – 2-Isomorphism – Combinational and geometric graphs – Planer graphs – Different representation of a planer graph.		
Unit – III	Matrices, Colouring and Directed Graph	9 Periods
Chromatic number – Chromatic partitioning – Chromatic polynomial – Matching – Covering – Four color problem – Directed graphs – Types of directed graphs – Digraphs and binary relations – Directed paths and connectedness – Euler graphs.		
Unit – IV	Permutations & Combinations	9 Periods
Fundamental principles of counting - Permutations and combinations - Binomial theorem - combinations with repetition - Combinatorial numbers - Principle of inclusion and exclusion - Derangements - Arrangements with forbidden positions.		
Unit – V	Generating Functions	9 Periods
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: 45 Periods

Reference Books:	1. Narsingh Deo, Graph Theory: With Application to Engineering and Computer Science, Prentice Hall of India, 2003. 2. Grimaldi R.P. Discrete and Combinatorial Mathematics: An Applied Introduction, Addison Wesley, 1994. 3. Clark. J and Holton D.A, A First look at Graph Theory. Allied Publishers, 1995 4. Rosen K.H, Discrete Mathematics and Its Applications, Mc Graw Hill, 2007.
MOOC/ Web Platforms:	https://www.youtube.com/watch?v=f1JTtMP6NGw https://www.youtube.com/watch?v=fZqfkj-cb28 https://www.youtube.com/results?search_query=MATRICES%2C+COLOURING+AND+DIRECTED+GRAPH+NPTEL+ https://www.youtube.com/watch?v=Dsi7x-A89Mw https://www.youtube.com/watch?v=QyliHXazzD8

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Write precise and accurate mathematical definitions of objects in graph theory.	Understand (K2)
CO2	Use mathematical definitions to identify and construct examples and to distinguish examples from non-examples	Apply (K3)
CO3	Validate and critically assess a mathematical proof.	Apply (K3)
CO4	Use a combination of theoretical knowledge and independent mathematics thinking in creative investigation of questions in graph theory.	Apply (K3)
CO5	Reason from definitions to construct mathematical proofs.	Analyse (K4)

V - Mapping Table- Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	-	-	-	-	-	-	-	-	3	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	3	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-	3	-	-
CO4	3	3	3	-	-	-	-	-	-	-	-	3	-	-
CO5	3	3	3	-	-	-	-	-	-	-	-	3	-	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23OMA03 Linear Algebra

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All B.E/B.Tech Programmes	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To test the consistency and solve system of linear equations.
2.	To find the basis and dimension of vector space.
3.	To obtain the matrix of linear transformation and its eigenvalues and eigenvectors.
4.	To find orthonormal basis of inner product space and find least square approximation.
5.	To find eigenvalues of a matrix using numerical techniques and perform matrix decomposition

III - Course Content

Unit - I	Matrices and System of Linear Equations	9 Periods
Matrices - Row echelon form - Rank - System of linear equations - Consistency - Gauss elimination method - Gauss Jordan method.		
Unit - II	Vector Spaces	9 Periods
Vector spaces over Real and Complex fields - Subspace - Linear space - Linear independence and dependence - Basis and dimension.		
Unit - III	Linear Transformation	9 Periods
Linear transformation - Rank space and null space - Rank and nullity - Dimension theorem - Matrix representation of linear transformation - Eigenvalues and eigenvectors of linear transformation diagonalization.		
Unit - IV	Inner Product Spaces	9 Periods
Inner product and norms - Properties - Orthogonal, Orthonormal vectors - Gram Schmidt orthonormalization process - Least square approximation.		
Unit - V	Eigen Value Problems and Matrix Decomposition	9 Periods
Eigen value Problems: Power method, Jacobi rotation method - Singular value decomposition - QR decomposition.		

TOTAL: 45 Periods

Text Books	1. Faires J.D. and Burden R., Numerical Methods, Brooks/Cole (Thomson Publications), New Delhi, 2002. 2. Friedberg A.H, Insel A.J. and Spence L, Linear Algebra, Pearson Education, 5 th Edition, 2019.
Reference Books	1. Bernard Kolman, David R. Hill, Introductory Linear Algebra, Pearson Educations, New Delhi, 8 th Edition, 2009. 2. Gerald C.F. and Wheatley P.O, Applied Numerical Analysis, Pearson Educations, New Delhi, 7 th Edition, 2007. 3. Kumaresan S, Linear Algebra - A geometric approach, Prentice Hall of India, New Delhi, Reprint, 2010. 4. Richard Branson, Matrix Operations, Schaum's outline series, 1989.

	5. Strang G, Linear Algebra and its applications, Thomson (Brooks / Cole) New Delhi, 4 th Edition, 2005. 6. Sundarapandian V, Numerical Linear Algebra, Prentice Hall of India, New Delhi, 2014.
MOOC/Web Platforms:	https://nptel.ac.in/courses/111106135 https://nptel.ac.in/courses/111102011 https://www.youtube.com/watch?v=ZLh4Ud_vjB8

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Test the consistency and solve system of linear equations.	Understand (K2)
CO2	Find the basis and dimension of vector space.	Apply (K3)
CO3	Obtain the matrix of linear transformation and its eigenvalues and eigenvectors.	Apply (K3)
CO4	Find orthonormal basis of inner product space and find least square approximation.	Apply (K3)
CO5	Find eigenvalues of a matrix using numerical techniques and perform matrix decomposition.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	2	2	2	1	1	1	1	3	-	-
CO2	3	3	3	3	3	2	2	1	1	1	1	3	-	-
CO3	3	3	3	3	3	2	2	1	1	1	1	3	-	-
CO4	3	3	3	3	3	2	2	1	1	1	1	3	-	-
CO5	3	3	3	3	3	2	2	1	1	1	1	3	-	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 230MA04 Operations Research

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All B.E/B.Tech Programmes	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To provide the concept and an understanding of basic concepts in Operations Research techniques for Analysis and Modeling in Computer Applications.
2.	To understand, develop and solve mathematical model of linear programming problems.
3.	To understand, develop and solve mathematical model of Transport and assignment problems.
4.	To Understand network modeling for planning and scheduling the project activities.

III - Course Content

Unit I	Linear Programming Models	9 Periods
Formulation of LPP, Graphical solution of LPP. Simplex Method, Artificial variables: big-M - Two Phase method , degeneracy and unbound solutions.		
Unit – II	Transportation and Assignment Models	9 Periods
Formulation - Methods for finding basic Feasible Solution - Optimality Test - MODI method Degeneracy in Transportation Problem -Unbalanced Transportation Problem. Assignment Method Mathematical formulation of assignment models – Hungarian Algorithm – Variants of the Assignment problem		
Unit – III	Scheduling by PERT and CPM	9 Periods
Introduction - Rules to frame a Network - Fulkerson's Rule to numbering of events - Activity, Times - Critical Path Computation - Slack and Float - PERT- Steps and computing variance, Merits and demerits of PERT, CPM- Time estimating & Limitations, Comparison between PERT & CPM.		
Unit – IV	Queueing Models	9 Periods
Characteristics of Queueing Models–Poisson Queues-(M / M / 1): (FIFO / ∞ / ∞), (M / M / 1): (FIFO / N / ∞), (M / M / C): (FIFO / ∞ / ∞), (M / M / C): (FIFO / N / ∞) models.		
Unit – V	Game Theory	9 Periods
Competitive game, rectangular game, saddle point, minimax (maximin) method of optimal strategies- value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games		
TOTAL: 45 Periods		
Reference Books:	1. Taha H.A., "Operations Research: An Introduction", 10th Edition, Prentice Hall of India, New Delhi, 2017 2. Kanti Swarup, P.K. Gupta, Man Mohan, "Operations Research", 15 th Revised Edition, S. Chand & Sons Education Publications, New Delhi, 2017 3. Ronald L Rardin, Optimization in Operations Research, 2 nd Edition, Pearson Education, India, 2018 4. Jatinder Kumar, Optimization Techniques in Operations Research, LAP LAMBERT Academic Publishing, 2015 D.S. Hira and P.K. Gupta, Operations Research, 5 th Edition, S. Chand & Sons, 2015.	

MOOC/Web Platforms:	www.digimat.in/nptel/courses/video/111104027/L01.html?utm_source=chatgpt.com https://www.youtube.com/watch?v=Q31jKiEXxdc&utm_source=chatgpt.com www.digimat.in/nptel/courses/video/110104073/L21.html?utm_source=chatgpt.com https://nptel.ac.in/courses/117103017?utm_source=chatgpt.com https://onlinecourses.nptel.ac.in/noc19_ge32/preview?utm_source=chatgpt.com
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IV - Course Outcomes

On Completion of the course, the students will be able to		Bloom's Level Mapped
C01	Understand and apply linear programming to solve operational problem with constraints.	Apply (K3)
C02	Apply transportation and assignment models to find optimal solution.	Apply (K3)
C03	To prepare project scheduling using PERT and CPM.	Apply (K3)
C04	Identify and analyze appropriate queuing model to reduce the waiting time in queue.	Apply (K3)
C05	To choose the best strategy using decision making methods under game theory.	Analyse (K4)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C01	3	3	3	2	-	-	-	-	-	-	-	-	-	-
C02	3	3	3	3	2	-	-	-	-	-	-	-	-	-
C03	3	3	2	2	-	-	-	-	-	-	-	-	-	-
C04	3	3	2	2	-	1	-	-	-	-	-	-	-	-
C05	3	3	2	2	-	-	-	-	-	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23OMA05 Queueing and Reliability Modelling

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All B.E/B.Tech Programmes	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To provide necessary basic concepts in probability and random processes for applications such as random signals, linear systems in communication engineering.
2.	To understand the concept of queueing models and apply in engineering.
3.	To provide the required mathematical support in real life problems and develop probabilistic models which can be used in several areas of science and engineering.
4.	To study the system reliability and hazard function for series and parallel systems.
5.	To implement Markovian Techniques for availability and maintainability which opens up new avenues for research

III - Course Content

Unit - I	Random Processes	9 Periods
Classification – Stationary process – Markov process – Poisson process – Discrete parameter Markov chain – Chapman Kolmogorov equations – Limiting distributions.		
Unit - II	Markovian Queueing Models	9 Periods
Markovian queues – Birth and death processes – Single and multiple server queueing models – Little's formula - Queues with finite waiting rooms.		
Unit - III	Advanced Queueing Models	9 Periods
M/G/1 queue – Pollaczek Khinchin formula - M/D/1 and M/EK/1 as special cases – Series queues – Open Jackson networks.		
Unit - IV	System Reliability	9 Periods
Reliability and hazard functions- Exponential, Normal, Weibull and Gamma failure distribution – Time - dependent hazard models – Reliability of Series and Parallel Systems.		
Unit - V	Maintainability and Availability	9 Periods
Maintainability and Availability functions – Frequency of failures – Two Unit parallel system with repair – k out of m systems.		

TOTAL: 45 Periods

Reference Books:	1. Medhi J, "Stochastic models of Queueing Theory", Academic Press, Elsevier, Amsterdam, 2003. 2. Taha, H.A., "Operations Research", 9th Edition, Pearson India Education Services, Delhi, 2016. 3. Trivedi, K.S., "Probability and Statistics with Reliability, Queueing and Computer Science Applications", 2nd Edition, John Wiley and Sons, 2002. 4. Govil A.K., "Reliability Engineering", Tata-McGraw Hill Publishing Company Ltd., New Delhi, 1983.
MOOC/Web Platforms:	1. https://www.classcentral.com/course/youtube-electronics-probability-random-variables-47668?utm_source=chatgpt.com 2. https://onlinecourses.nptel.ac.in/noc21_ee93/preview?utm_source=chatgpt.com 3. https://onlinecourses.nptel.ac.in/noc21_ee93/preview?utm_source=chatgpt.com 4. https://onlinecourses.nptel.ac.in/noc21_ce58/preview?utm_source 5. https://onlinecourses.nptel.ac.in/noc21_ce58/preview?utm_source

IV - Course Outcomes

On Completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Enable the students to apply the concept of random processes in engineering disciplines.	Apply (K3)
CO2	Students acquire skills in analyzing various queueing models.	Apply (K 3)
CO3	Students can understand and characterize phenomenon which evolve with respect to time in a probabilistic manner.	Apply (K3)
CO4	Students can analyze reliability of the systems for various probability distributions.	Apply (K3)
CO5	Students can be able to formulate problems using the maintainability and availability analyses by using theoretical approach	Analyse (K4)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	-	-	-	-	-	-	2	-	-	2	-	-
CO2	3	3	2	-	-	-	-	-	2	-	-	2	-	-
CO3	3	3	-	2	-	-	-	-	2	-	-	2	-	-
CO4	3	3	2	-	-	-	-	-	2	-	-	2	-	-
CO5	3	3	3	2	-	-	-	-	2	-	-	2	-	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23OMA06 Resource Management Techniques

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All B.E/B.Tech Programmes	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To formulate linear programming problems and solve LPP using simple algorithm.
2.	To solve networking problems.
3.	To formulate and solve integer programming problems.
4.	To solve Non-Linear programming problems.
5.	To understand and solve project management problems.

III - Course Content

Unit - I	Linear Programming	9 Periods
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 Periods
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 Periods
Cutting plan algorithm – Branch and bound methods, Multistage (Dynamic) programming		
Unit - IV	Classical Optimization Theory	9 Periods
Unconstrained external problems, Newton – Raphson method – Equality constraints – Jacobean methods – Lagrangian method – Kuhn – Tucker conditions – Simple problems		
Unit - V	Object Scheduling	9 Periods
Network diagram representation – Critical path method – Time charts and resource leveling – PERT.		

TOTAL:45 Periods

Text Books:	1.H.A. Taha, "Operation Research", Prentice Hall of India, 2002.
Reference Books:	1.Paneer selvam, 'Operations Research' Prentice Hall of India, 2002. 2.Anderson 'Quantitative Methods for Business', 8 th Edition, Thomson Learning, 2002. 3.Winston 'Operations Research for Business', Thomson Learning, 2003. 4.Vohra, 'Quantitative Techniques in Management', Tata Mc Graw Hill, 2002. 5.Anand sarma, 'Operation Research' Himalaya Publishing House, 2003.
MOOC/Web Platforms:	https://share.google/uasnB9X2KP7TbVhjU https://share.google/G2pLV43yVjJHiPWCQ https://share.google/0ddZC1NWcqQyv6bds

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	Understand to formulate linear programming problems and solve LPP using simple algorithm.	Understand (K2)
C02	Understand to solve networking problems.	Understand (K2)
C03	Understand to formulate and solve integer programming problems.	Apply (K3)
C04	Understand to solve Non-Linear programming problems.	Understand (K2)
C05	Understand to solve project management problems.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C01	-	3	3	2	-	-	-	-	-	-	-	-	-	-
C02	-	3	3	2	-	-	-	-	-	-	-	-	-	-
C03	-	3	3	2	-	-	-	-	-	-	-	-	-	-
C04	-	3	3	2	-	-	-	-	-	-	-	-	-	-
C05	-	3	3	2	-	-	-	-	-	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High

I – Course Name: 23OME01 Energy Conservation and Management

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All Programmes except B.E- Mechanical Engineering	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To understand and analyze the Energy Data of Industries.
2.	To carryout energy accounting and balancing.
3.	To conduct energy audit and suggest methodologies for energy savings.
4.	To utilize the available resources in optimal ways.
5.	To understand the energy economics.

III - Course Content

UNIT-I	Introduction	9 Periods
Energy - Power – Past & Present scenario of World; National Energy consumption Data Environmental aspects associated with energy utilization – Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers. Instruments for energy auditing.		
UNIT -II	Electrical Systems	9 Periods
Components of EB billing – HT and LT supply, Transformers, Cable Sizing, Concept of Capacitors, Power Factor Improvement, Harmonics, Electric Motors - Motor Efficiency Computation, Energy Efficient Motors, Illumination – Lux, Lumens, Types of lighting, Efficacy, LED Lighting and scope of Encon in Illumination.		
UNIT-III	Thermal Systems	9 Periods
Stoichiometry, Boilers, Furnaces and Thermic Fluid Heaters – Efficiency computation and encon measures. Steam: Distribution & Usage: Steam Traps, Condensate Recovery, Flash Steam Utilization, Insulators & Refractories		
UNIT-IV	Energy Conservation in Major Utilities	9 Periods
Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems – Cooling Towers – D.G. sets		
UNIT-V	Economics	9 Periods
Energy Economics – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing –ESCO concept		

TOTAL: 45 Periods

TEXT BOOKS	[1]. Energy Manager Training Manual (4 Volumes) available at www.energymanagertraining.com . a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India, 2004.
REFERENCES	[1]. Witte. L.C., P.S. Schmidt, D.R. Brown, "Industrial Energy Management and Utilisation" Hemisphere Publ, Washington, 1988. [2]. Callaghn, P.W. "Design and Management for Energy Conservation", Pergamon Press, Oxford, 1981.

	[3]. Dryden. I.G.C., "The Efficient Use of Energy" Butterworths, London, 1982 [4]. Turner. W.C., "Energy Management Hand book", Wiley, New York, 1982. [5]. Murphy. W.R. and G. Mc KAY, "Energy Management", Butterworths, London 1987
M00C/Web Platforms:	https://www.npcindia.gov.in/NPC/Homes1/e-learning/course?category=MTc= https://www.tpctraining.com/collections/energy-conservation-training

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Remember the knowledge for Basic combustion and furnace design and selection of thermal and mechanical energy equipment.	Understand (K2)
CO2	Study the Importance of Stoichiometry relations, Theoretical air required for complete combustion.	Understand (K2)
CO3	Apply calculation and design tube still heaters.	Apply (K3)
CO4	Study the different heat treatment furnace, Practical and theoretical knowledge burner design.	Apply (K3)
CO5	Apply economic evaluation technique.	Understand (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	-	1	-	1	-	1	-	1	1	-	1	-	-
CO2	3	-	1	-	1	-	1	-	1	1	-	1	-	-
CO3	3	-	1	-	1	-	1	-	1	1	-	1	-	-
CO4	3	-	2	-	1	-	1	-	1	1	-	1	-	-
CO5	3	-	3	-	3	-	1	-	1	1	-	1	-	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23OME02 Energy Technology

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All Programmes except B.E- Mechanical Engineering	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To Understand energy resources and energy consumption
2.	To Understand Conventional energy resources
3.	To study Solar energy, Wind energy
4.	To Learn Biomass energy resources
5.	To Learn Energy conservation in chemical process plants

III - Course Content

UNIT-I	Introduction	8 Periods
Units of energy, conversion factors, general classification of energy, world energy resources and energy consumption, Indian energy resources and energy consumption, energy crisis, energy alternatives, Renewable and non-renewable energy sources and their availability. Prospects of Renewable energy sources		
UNIT-II	Conventional Energy	8 Periods
Conventional energy resources, Thermal, hydel and nuclear reactors, thermal, hydel and nuclear power plants, efficiency, merits and demerits of the above power plants, combustion processes, fluidized bed combustion.		
UNIT-III	Non-Conventional Energy	10 Periods
Solar energy, solar thermal systems, flat plate collectors, focusing collectors, solar water heating, solar cooling, solar distillation, solar refrigeration, solar dryers, solar pond, solar thermal power generation, solar energy application in India, energy plantations. Wind energy, types of windmills, types of wind rotors, Darrieus rotor and Gravian rotor, wind electric power generation, wind power in India, economics of wind farm, ocean wave energy conversion, ocean thermal energy conversion, tidal energy conversion, geothermal energy.		
UNIT-IV	Biomass Energy	10 Periods
Biomass energy resources, thermo-chemical and biochemical methods of biomass conversion, combustion, gasification, pyrolysis, biogas production, ethanol, fuel cells, alkaline fuel cell, phosphoric acid fuel cell, molten carbonate fuel cell, solid oxide fuel cell, solid polymer electrolyte fuel cell, magneto hydrodynamic power generation, energy storage routes like thermal energy storage, chemical, mechanical storage and electrical storage.		
UNIT-V	Energy Conservation	9 Periods
Energy conservation in chemical process plants, energy audit, energy saving in heat exchangers, distillation columns, dryers, ovens and furnaces and boilers, steam economy in chemical plants, energy conservation.		

TOTAL: 45 Periods

Text Books:	1. Rao, S. and Parulekar, B.B., Energy Technology, Khanna Publishers, 2005. 2. Rai, G.D., Non-conventional Energy Sources, Khanna Publishers, New Delhi, 1984. 3. Bansal, N.K., Kleeman, M. and Meliss, M., Renewable Energy Sources and Conversion Technology, Tata McGraw Hill, 1990.
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	4. Nagpal, G.R., Power Plant Engineering, Khanna Publishers, 2008.
Reference Books:	1. Nejat Veziroglu, Alternate Energy Sources, IT, McGraw Hill, New York. 2. El. Wakil, Power Plant Technology, Tata McGraw Hill, New York, 2002. 3. Sukhatme. S.P., Solar Energy - Thermal Collection and Storage, Tata McGraw hill, New Delhi, 1981.
MOOC/Web Platforms:	https://www.coursera.org/courses?query=renewable%20energy https://onlinecourses.nptel.ac.in/noc25_ge53/preview https://www.renewableinstitute.org/training-courses/

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Students will be able to describe the fundamentals and main characteristics of renewable energy sources and their differences compared to fossil fuels.	Understand (K2)
CO2	Students will excel as professionals in the various fields of energy engineering	Understand (K2)
CO3	Compare different renewable energy technologies and choose the most appropriate based on local conditions.	Apply (K3)
CO4	Explain the technological basis for harnessing renewable energy sources.	Apply (K3)
CO5	Identify and critically evaluate current developments and emerging trends within the field of renewable energy technologies and to develop in-depth technical understanding of energy problems at an advanced	Understand (K2)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	-	1	-	1	-	1	-	1	1	-	1	-	-
CO2	3	-	1	-	1	-	1	-	1	1	-	1	-	-
CO3	3	-	1	-	1	-	1	-	1	1	-	1	-	-
CO4	3	-	2	-	1	-	1	-	1	1	-	1	-	-
CO5	3	-	3	-	3	-	1	-	1	1	-	1	-	-

Mapping: 1-Low, 2-Medium, 3-High

I-Course Name: 23OME03 Engineering Graphics Design

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All Programmes except B.E- Mechanical Engineering	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1	Drawing engineering curves.
2	Drawing freehand sketch of simple objects.
3	Drawing orthographic projection of solids and section of solids.
4	Drawing development of solids
5	Drawing isometric and perspective projections of simple solids

III - Course Content

Unit-I	Plane Curves	9 Periods
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 Surface	9 Periods
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 and traces. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.		
Unit-III	Projection of Solids and Freehand Sketching	9 Periods
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	Projection of Sectioned Solids and Development of Surfaces	9 Periods
Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other — obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids — Prisms, pyramids cylinders and cones.		
UNIT-V	Isometric and Perspective Projections	9 Periods
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. Practicing		

TOTAL: 45 Periods

TEXT BOOKS	[1]. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 53rd Edition, 2019
REFERENCES	[1]. Natrajan K.V., "A Text Book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2018. [2]. Parthasarathy, N. S. and Vela Murali, "Engineering Drawing", Oxford University Press, 2015 [3]. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2008.
MOOC/Web Platforms:	https://onlinecourses.nptel.ac.in/noc21_me128/preview https://www.mygreatlearning.com/academy/learn-for-free/courses/engineering-graphics-drawing

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Use BIS conventions and specifications for engineering drawing.	Understand (K2)
CO2	Construct the conic curves, involutes and cycloid.	Understand (K2)
CO3	Solve practical problems involving projection of lines.	Apply (K3)
CO4	Draw the orthographic, isometric and perspective projections of simple solids.	Apply (K3)
CO5	Draw the development of simple solids.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1	2	-	2	-	-	-	-	3	-	2	-	1
CO2	3	1	2	-	2	-	-	-	-	3	-	2	-	1
CO3	3	1	2	-	2	-	-	-	-	3	-	2	-	1
CO4	3	1	2	-	2	-	-	-	-	3	-	2	-	1
CO5	3	1	2	-	2	-	-	-	-	3	-	2	-	1

Mapping: 1-Low, 2-Medium, 3-High

I – Course Name: 23OME04 Foundation of Robotics

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All Programmes except B.E- Mechanical Engineering	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To study the kinematics, drive systems and programming of robots.
2.	To study the basics of robot laws and transmission systems.
3.	To familiarize students with the concepts and techniques of robot manipulator, its kinematics.
4.	To familiarize students with the various Programming and Machine Vision application in robots.
5.	To build confidence among students to evaluate, choose and incorporate robots in engineering systems.

III - Course Content

Unit – I	Fundamentals of Robot	9 Periods
Robot – Definition – Robot Anatomy – Co-ordinate systems, Work Envelope, types and classification – specifications – Pitch, yaw, Roll, Joint Notations, Speed of Motion, Pay Load – Robot Parts and their functions – Need for Robots – Different Applications.- Industrial Robot Types and Their Applications in Automotive Manufacturing.		
Unit – II	Robot Kinematics	9 Periods
Forward kinematics, inverse kinematics and the difference: forward kinematics and inverse, Kinematics of Manipulators with two, three degrees of freedom (in 2 dimensional), four degrees of freedom (in 3 dimensional) – derivations and problems. Homogeneous transformation matrices, translation and rotation matrices. Industrial Implementation of Multi-DOF Robots in Precision Machining.		
Unit – III	Robot Drive Systems and End Effectors	9 Periods
Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo Motors, Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison of All These Drives. End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic grippers, vacuum grippers, internal grippers and external grippers, selection and design considerations of a gripper- Selection Criteria for End Effectors in Automated Packaging Systems.		
Unit – IV	Sensors in Robotics	9 Periods
Force sensors, touch and tactile sensors, proximity sensors, non-contact sensors, safety considerations in robotic cell, proximity sensors, fail safe hazard sensor systems, and compliance mechanism. Machine vision system - camera, frame grabber, sensing and digitizing image data – signal conversion, image storage, lighting techniques, image processing and analysis – data reduction, segmentation, feature extraction, object recognition, other algorithms, applications – Inspection, identification, visual serving and navigation. Proximity Sensors in Automated Guided Vehicles (AGVs) for Warehousing		
Unit – V	Programming and Applications of Robot	9 Periods
Teach pendant programming, lead through programming, robot programming languages – VAL programming – Motion Commands, Sensors commands, End-Effector Commands, and simple programs - Role of robots in inspection, assembly, material handling, underwater, space and medical fields. Application of Robots in Inspection and Quality Assurance in Electronics Manufacturing.		

TOTAL: 45 Periods

Text Books:	1. Ganesh.S.Hedge, "A textbook of Industrial Robotics", Lakshmi Publications, 2006. 2. Mikell. P.Groover, "Industrial Robotics – Technology, Programming and applications" McGraw Hill 2 ND edition 2012.
Reference Books:	1. Fu K.S. Gonzalez R.C. and Lee C.S.G. "Robotics Control, Sensing, Vision and Intelligence", McGraw Hill book co. 2007. 2. Yoram Koren, "Robotics for Engineers", McGraw Hill Book, Co., 2002. 3. Janakiraman P.A., "Robotics and Image Processing", Tata McGraw Hill 2005. 4. John. J.Craig, "Introduction to Robotics: Mechanics and Control" 2nd Edition, 2002. 5. Jazar, "Theory of Applied Robotics: Kinematics, Dynamics and Control", Springer India reprint, 2010.
MOOC/Web Platforms:	NPTEL Videos: https://onlinecourses.nptel.ac.in/noc20_me92/preview https://nptel.ac.in/courses/107106090

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	Interpret the features of robots and technology involved in the control.	Understand (K2)
C02	Apply the basic engineering knowledge and laws for the design of robotics.	Apply (K3)
C03	Explain the basic concepts like various configurations, classification and parts of end effectors compare various end effectors and grippers and tools and sensors used in robots.	Understand (K2)
C04	Explain the concept of kinematics, degeneracy, dexterity and trajectory planning.	Understand (K2)
C05	Demonstrate the image processing and image analysis techniques by machine vision	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C01	3	2	1	1	-	-	-	-	-	-	-	1	-	-
C02	3	2	1	1	-	-	-	-	-	-	-	1	-	-
C03	3	2	1	1	-	-	-	-	-	-	-	1	-	-
C04	3	2	1	1	-	-	-	-	-	-	-	1	-	-
C05	3	2	1	1	-	-	-	-	-	-	-	1	-	-

Mapping: 1-Low, 2-Medium, 3-High

I-Course Name: 23OME05 Industrial Design & Rapid Proto Typing Techniques

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All Programmes except B.E- Mechanical Engineering	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	Understand the fundamentals of user interface (UI) and user experience (UX) design principles.
2.	Gain foundational knowledge of mobile and web application architecture.
3.	Use tools like CAD software to create digital mockups of industrial designs.
4.	Learn various mechanical fabrication methods including 3D printing, laser cutting, and CNC machining.
5.	Learn the fundamentals of electronic prototyping and embedded systems.

III - Course Content

Unit - I	UI/UX	9 Periods
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 Periods
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 Periods
Introduction to Industrial Design - Points, lines, and planes - Sketching and concept generation - Sketch to CAD - Introduction to CAD tools - Types of 3D modeling - Basic 3D Modeling Tools - Part creation - Assembly - Product design and rendering basics - Dimensioning & Tolerancing		
Unit - IV	Mechanical Rapid Prototyping	9 Periods
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 Periods
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, TASCHEN America Llc(2003) 2. Samar Malik, Autodesk Fusion 360 - The Master Guide. 3. Steve Krug, Don't Make Me Think, Revisited: A Common Sense Approach to Web Usability, Pearson,3rd edition(2014)
Reference Books:	1. Rapid Product Development- Synergic integration of time-compression technologies K. P. Karunakaran, V. P. Bapat, Sreenath Babu Akula P. D. Solanki Gaurav Gupta, V.R. Prasanth, Saket Anand, Arnab Sarkar and S. Venkatkrishnan 2. Manufacturing Processes for Engineering Materials -Serope Kalpakjian and Steven R. Schmid Pearson Education
MOOC/Web Platforms:	NPTEL Videos: https:// nptel/courses/video/112105126/L01.html

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	Create quick UI/UX prototypes for customer needs.	Understand (K2)
C02	Develop web application to test product traction / product feature.	Apply (K3)
C03	Develop 3D models for prototyping various product ideas.	Apply (K3)
C04	Built prototypes using Tools and Techniques in a quick iterative methodology.	Apply (K3)
C05	To develop the electronic prototyping with simulation.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C01	3	1	1	-	-	2	1	1	1	-	1	1	-	-
C02	3	1	1	-	-	2	1	1	1	-	1	1	-	-
C03	3	1	1	-	-	2	1	1	1	-	1	1	-	-
C04	3	1	1	-	-	2	1	1	1	-	1	1	-	-
C05	3	1	1	-	-	2	1	1	1	-	1	1	-	-

Mapping: 1-Low, 2-Medium, 3-High

I-Course Name: 23OME06 Industrial Management

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All Programmes except B.E- Mechanical Engineering	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To introduce fundamental concepts of industrial management.
2.	To understand the approaches to the study of Management.
3.	To learn about Decision Making, Organizing and leadership.
4.	To analyze the Managerial Role and functions.
5.	To know about the Supply Chain Management.

III - Course Content

UNIT-I	Introduction	9 Periods
Technology Management - Definition - Functions - Evolution of Modern Management - Scientific Management Development of Management Thought. Approaches to the study of Management, Forms of Organization -Individual Ownership - Partnership - Joint Stock Companies - Co-operative Enterprises - Public Sector Undertakings, Corporate Frame Work- Share Holders - Board of Directors - Committees - Chief Executive Line and Functional Managers, Financial-Legal-Trade Union.		
UNIT -II	Functions of Management	9 Periods
Planning - Nature and Purpose - Objectives - Strategies – Policies and Planning Premises - Decision Making - Organizing - Nature and Process - Premises - Departmentalization - Line and staff - Decentralization -Organizational culture, Staffing - selection and training, Placement - Performance appraisal - Career Strategy – Organizational Development. Leading - Managing human factor – Leadership, Communication, Controlling - Process of Controlling - Controlling techniques, productivity and operations management - Preventive control, Industrial Safety.		
UNIT-III	Organizational Behaviour	9 Periods
Definition - Organization - Managerial Role and functions -Organizational approaches, Individual behaviour - causes - Environmental Effect - Behaviour and Performance, Perception - Organizational Implications. Personality - Contributing factors - Dimension – Need Theories - Process Theories - Job Satisfaction, Learning and Behaviour-Learning Curves, Work Design and approaches.		
UNIT-IV	Group Dynamics	9 Periods
Group Behaviour - Groups - Contributing factors - Group Norms, Communication - Process - Barriers to communication - Effective communication, leadership - formal and informal characteristics – Managerial Grid - Leadership styles - Group Decision Making - Leadership Role in Group Decision, Group Conflicts - Types -Causes - Conflict Resolution -Inter group relations and conflict, Organization centralization and decentralization - Formal and informal - Organizational Structures Organizational Change and Development -Change Process – Resistance to Change - Culture and Ethics.		
UNIT-V	Modern Concepts	9 Periods
Management by Objectives (MBO) - Management by Exception (MBE), Strategic Management - Planning for Future direction - SWOT Analysis -Evolving development strategies, information technology in management Decisions support system-Management Games Business Process Reengineering (BPR) –Enterprises Resource Planning (ERP) - Supply Chain Management (SCM) - Activity Based Management (AM) - Global Perspective - Principles and Steps Advantages and disadvantage.		

TOTAL: 45 Periods

Text Books	Maynard H.B, "Industrial Engineering Hand book", McGraw-Hill, sixth 2008
References	S.Chandran, "Organizational Behaviours", Vikas Publishing House Pvt. Ltd., 1994
MOOC/Web Platforms:	https://www.udemy.com/course/industrial-management/ https://onlinecourses.nptel.ac.in/noc22_me04/preview

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	Explain basic concepts of management; approaches to management; contributors to management studies; various forms of business organization and trade unions function in professional organizations.	Understand (K2)
C02	Discuss the planning; organizing and staffing functions of management in professional organization.	Understand (K2)
C03	Apply the leading; controlling and decision-making functions of management in professional organization.	Apply (K3)
C04	Discuss the organizational theory in professional organization.	Understand (K2)
C05	Apply principles of productivity and modern concepts in management in professional organization.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C01	2	1	-	-	-	-	-	-	-	-	-	-	-	-
C02	-	3	2	3	-	-	-	-	-	-	-	-	-	-
C03	2	3	2	3	-	-	-	-	-	-	-	-	-	-
C04	2	2	3	3	-	-	-	-	-	-	-	-	-	-
C05	2	2	-	-	-	-	-	-	-	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High

I-Course Name: 23OME07 Industrial Safety and Hazard Management

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All Programmes except B.E- Mechanical Engineering	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To Understand the Introduction and basic Terminologies safety.
2.	To enable the students to learn about the Important Statutory Regulations and standards.
3.	To enable students to Conduct and participate the various Safety activities in the industry.
4.	To have knowledge about Workplace Exposures and Hazards.
5.	To assess the various Hazards and consequences through various Risk Assessment Techniques.

III - Course Content

Unit - I	Safety Terminologies	9 Periods
Hazard-Types of Hazard- Risk-Hierarchy of Hazards Control Measures-Lead indicators- lag Indicators-Flammability- Toxicity Time-weighted Average (TWA) - Threshold Limit Value (TLV) - Short Term Exposure Limit (STEL)- Immediately dangerous to life or health (IDLH)- acute and chronic Effects- Routes of Chemical Entry-Personnel Protective Equipment- Health and Safety Policy-Material Safety Data Sheet-MSDS.		
Unit - II	Standards and Regulations	9 Periods
Indian Factories Act-1948- Health- Safety- Hazardous materials and Welfare- ISO 45001:2018 occupational health and safety (OH&S) - Occupational Safety and Health Audit IS14489:1998- Hazard Identification and Risk Analysis- code of practice IS 15656:2006.		
Unit - III	Safety Activities	9 Periods
Toolbox Talk- Role of safety Committee- Responsibilities of Safety Officers and Safety Representatives- Safety Training and Safety Incentives- Mock Drills- On-site Emergency Action Plan- Off-site Emergency Action Plan- Safety poster and Display- Human Error Assessment.		
Unit - IV	Workplace Health and Safety	9 Periods
Noise hazard- Particulate matter- musculoskeletal disorder improper sitting poster and lifting Ergonomics RULE & REBA- Unsafe act & Unsafe Condition- Electrical Hazards- Crane Safety - Toxic gas Release.		
Unit - V	Hazard Identification Techniques	9 Periods
Job Safety Analysis-Preliminary Hazard Analysis-Failure mode and Effects Analysis- Hazard and Operability- Fault Tree Analysis- Event Tree Analysis Qualitative and Quantitative Risk Assessment - Checklist Analysis- Root cause analysis- What-If Analysis- and Hazard Identification and Risk Assessment.		

TOTAL: 45 Periods

Text Books:	1. R.K. Jain and Prof. Sunil S. Rao Industrial Safety, Health and Environment Management Systems KHANNA PUBLISHER 2. L. M. Deshmukh Industrial Safety Management: Hazard Identification and Risk Control McGraw-Hill Education.
Reference Books:	1. Frank Lees (2012) 'Lees' Loss Prevention in Process Industries. Butterworth-Heinemann publications, UK, 4th Edition. 2. John Ridley & John Channing (2008) Safety at Work: Routledge, 7th Edition. 3. Dan Petersen (2003) Techniques of Safety Management: A System Approach. 4. Alan Waring (1996) Safety management system: Chapman & Hall, England 5. Society of Safety Engineers, USA.
MOOC/Web Platforms: ONLINE RESOURCES	ISO 45001:2018 occupational health and safety (OH&S) International Organization for Standardization https://www.iso.org/standard/63787.html Indian Standard code of practice on occupational safety and health audit https://law.resource.org/pub/in/bis/S02/is.14489.1998.pdf Indian Standard code of practice on Hazard Identification and Risk Analysis IS 15656:2006 https://law.resource.org/pub/in/bis/S02/is.15656.2006.pdf

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the basic concept of safety.	Understand (K2)
CO2	Obtain knowledge of Statutory Regulations and standards.	Apply (K3)
CO3	Know about the safety Activities of the working place.	Apply (K3)
CO4	Analyze on the impact of Occupational Exposures and their Remedies.	Analyze (K4)
CO5	Obtain knowledge of Risk Assessment Techniques.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	1	1	3	2	2	3	3	1	3	-	-
CO2	2	3	2	2	1	3	2	3	3	2	1	3	-	-
CO3	2	2	2	2	1	2	2	2	3	2	1	2	-	-
CO4	3	3	3	2	2	3	2	2	3	2	2	3	-	-
CO5	3	2	3	2	2	3	2	2	3	2	2	3	-	-

Mapping: 1-Low, 2-Medium, 3-High

I-Course Name: 23OME08 Introduction to Industrial Automation Systems

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All Programmes except B.E- Mechanical Engineering	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To educate on design of signal conditioning circuits for various applications.
2.	To Introduce signal transmission techniques and their design.
3.	Study of components used in data acquisition systems interface techniques
4.	To educate on the components used in distributed control systems
5.	To introduce the communication buses used in automation industries.

III - Course Content

Unit - I	Introduction	9 Periods
Automation overview, Requirement of automation systems, Architecture of Industrial Automation system, Introduction of PLC and supervisory control and data acquisition (SCADA). Industrial bus systems: Modbus & Profibus		
Unit - II	Automation Components	9 Periods
Sensors for temperature, pressure, force, displacement, speed, flow, level, humidity and pH measurement. Actuators, process control valves, power electronics devices DIAC, TRIAC, power MOSFET and IGBT. Introduction of DC and AC servo drives for motion control- Industrial Internet of Things (IIoT) Enabled Sensors and Actuators		
Unit - III	Computer Aided Measurement and Control Systems	9 Periods
Role of computers in measurement and control, Elements of computer aided measurement and control, man machine interface, computer aided process control hardware, process related interfaces, Communication and networking, Industrial communication systems, Data transfer techniques, Computer aided process control software, Computer based data acquisition system, Internet of things (IoT) for plant automation- Digital Twin Technology for Real-Time Process Monitoring		
Unit - IV	Programmable Logic Controllers	9 Periods
Programmable controllers, Programmable logic controllers, Analog digital input and output modules, PLC programming, Ladder diagram, Sequential flow chart, PLC Communication and networking, PLC selection, PLC Installation, Advantage of using PLC for Industrial automation, Application of PLC to process control industries- Networked PLC Systems for Industry 4.0		
Unit - V	Distributed Control System	9 Periods
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- Nanotechnology in Environmental Remediation- Cybersecurity in Distributed Control Systems		

TOTAL: 45 Periods

Text Books:	1.S.K.Singh, "Industrial Instrumentation", Tata Mcgraw Hill, 2nd edition companies,2003. 2. C D Johnson, "Process Control Instrumentation Technology", Prentice Hall India,8th Edition, 2006. 3. E.A.Parr, Newnes, NewDelhi,"Industrial Control Handbook",3rd Edition, 2000.
Reference Books:	1.John W. Webb and Ronald A. Reis, "Programmable Logic Controllers: Principles and Applications", 5th Edition, Prentice Hall Inc., New Jersey, 2003. 2. Frank D. Petruzella, "Programmable Logic Controllers", 5th Edition, McGraw- Hill, New York, 2016. 3. Krishna Kant, "Computer - Based Industrial Control", 2nd Edition, Prentice Hall, New Delhi, 2011. 4. Gary Dunning, Thomson Delmar, "Programmable Logic Controller", Ceneage Learning, 3 rd Edition,2005.
MOOC/Web Platforms:	nptel.ac.in/courses/108105062

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Design a signal conditioning circuits for various application.	Understand (K2)
CO2	Acquire a detail knowledge on data acquisition system interface and DCS system.	Apply (K3)
CO3	Understand the basics and Importance of communication buses in applied automation engineering.	Understand (K2)
CO4	Ability to design PLC Programmes by Applying Timer/Counter and Arithmetic and Logic Instructions Studied for Ladder Logic and Function Block.	Apply (K3)
CO5	Able to develop a PLC logic for a specific application on real world problem.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	3	2	3	3	-	-	1	1	3	1	1	-	-
CO2	2	3	1	-	-	2	1	1	1	-	1	1	-	-
CO3	2	2	1	-	-	2	1	1	1	-	1	1	-	-
CO4	2	2	1	-	-	2	1	1	1	-	1	1	-	-
CO5	2	2	1	-	-	2	1	1	1	-	1	1	-	-

Mapping: 1-Low, 2-Medium, 3-High

I-Course Name: 23OME09 Introduction to Non- Destructive Testing

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All Programmes except B.E- Mechanical Engineering	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	Understanding the basic importance of NDT in quality assurance.
2.	Imbibing the basic principles of various NDT techniques, its applications, limitations, codes and standards.
3.	Equipping themselves to locate a flaw in various materials, products.
4.	Applying apply the testing methods for inspecting materials in accordance with industry specifications and standards.
5.	Acquiring the knowledge on the selection of the suitable NDT technique for a given application.

III - Course Content

Unit - I	Introduction To NDT & Visual Testing	9 Periods
Concepts of Non-destructive testing-relative merits and limitations-NDT Versus mechanical testing, Fundamentals of Visual Testing – vision, lighting, material attributes, environmental factors, visual perception, direct and indirect methods – mirrors, magnifiers, boroscopes and fibroscopes – light sources and special lighting-Real Case Studies: Examples from aerospace or petrochemical industries where visual testing prevented major failures.		
Unit - II	Liquid Penetrant & Magnetic Particle Testing	9 Periods
Liquid Penetrant Inspection: principle, applications, advantages and limitations, dyes, developers and cleaners, Methods & Interpretation. Magnetic Particle Inspection: Principles, applications, magnetization methods, magnetic particles, Testing Procedure, demagnetization, advantages and limitations, – Interpretation and evaluation of test indications-In-Process Inspection: Use of LPI/MPI in high-volume manufacturing – case from railways and aerospace sectors.		
Unit - III	Eddy Current Testing & Thermography	9 Periods
Eddy Current Testing: Generation of eddy currents– properties– eddy current sensing elements, probes, Instrumentation, Types of arrangement, applications, advantages, limitations – Factors affecting sensing elements and coil impedance, calibration, Interpretation/Evaluation. Thermography- Principle, Contact & Non-Contact inspection methods, Active & Passive methods, Liquid Crystal – Concept, example, advantages & limitations. Electromagnetic spectrum, infrared thermography- approaches, IR detectors, Instrumentation and methods, applications- Industry Use Cases: Case study of IR thermography in solar panel inspection and mechanical bearing faults.		
Unit - IV	Ultrasonic Testing & AET	9 Periods
Ultrasonic Testing: Types of ultrasonic waves, characteristics, attenuation, couplants, probes, EMAT. Inspection methods-pulse echo, transmission and phased array techniques, types of scanning and displays, angle beam inspection of welds, time of flight diffraction (TOFD) technique, Thickness determination by ultrasonic method, Study of A, B and C scan presentations, calibration. Acoustic Emission Technique – Introduction, Types of AE signal, AE wave propagation, Source location, Kaiser effect, AE transducers, Principle, AE		

parameters, AE instrumentation, Advantages & Limitations, Interpretation of Results, AET Applications: Real-time monitoring in power plants, pressure vessels, and structural health monitoring.

Unit – V	Radiography Testing	9 Periods
Sources-X-rays and Gamma rays and their characteristics-absorption, scattering. Filters and screens, Imaging modalities-film radiography and digital radiography (Computed, Direct, Real Time, CT scan). Problems in shadow formation, exposure factors, inverse square law, exposure charts, Penetrameters, safety in radiography- Real-Time RT: Applications in automotive and pipeline inspections with automated image analysis.		

TOTAL: 45 Periods

Text Books:	1. Baldev Raj, T. Jayakumar and M. Thavasimuthu, Practical Non Destructive Testing, Alpha Science International Limited, 3rd edition, 2002. 2. J. Prasad and C. G. K. Nair, Non-Destructive Test and Evaluation of Materials, Tata McGraw- Hill Education, 2nd edition, 2011. 3. Ravi Prakash, "Non-Destructive Testing Techniques", 1st revised edition, New Age International Publishers, 2010.
Reference Books:	1. ASM Metals Handbook, V-17, "Nondestructive Evaluation and Quality Control", American Society of Metals, USA, 2001. 2. Barry Hull and Vernon John, "Nondestructive Testing", Macmillan, 1989. 3. Chuck Hellier, "Handbook of Nondestructive Evaluation", Mc Graw Hill, 2012. 4. Louis Cartz, "Nondestructive Testing", ASM International, USA, 1995.
MOOC/ Web Platforms:	NPTEL Videos: 1. https://nptel.ac.in/courses/113106070 2. https://onlinecourses.nptel.ac.in/noc25 mm29/preview

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	Realize the importance of NDT in various engineering fields.	Understand (K2)
C02	Have a basic knowledge of surface NDE techniques which enables to carry out various inspection in accordance with the established procedures.	Understand (K2)
C03	Calibrate the instrument and inspect for in-service damage in the components by means of Eddy current testing as well as Thermography testing.	Apply (K3)
C04	Differentiate various techniques of UT and AET and select appropriate NDT methods for better evaluation.	Understand (K2)
C05	Interpret the results of Radiography testing and also have the ability to analyse the influence of various parameters on the testing.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	2	3	-	-	2	2	-	-	-	2	-	-
CO2	3	1	2	2	-	-	2	2	-	-	-	2	-	-
CO3	3	2	1	2	-	-	2	2	-	-	-	2	-	-
CO4	3	1	2	2	-	-	2	2	-	-	-	2	-	-
CO5	3	2	2	2	-	-	2	2	-	-	-	2	-	-

Mapping: 1-Low, 2-Medium, 3-High

I-Course Name: 23OME10 Mechatronics

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All Programmes except B.E- Mechanical Engineering	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To understand Mechatronics principles and sensor technologies.
2.	To study the architecture and programming of 8085 microprocessor.
3.	To interface peripherals using 8255 and implement basic control systems.
4.	To develop PLC-based automation with timers, counters, and I/O handling.
5.	To explore actuators and apply Mechatronics design methodology through real-world systems.

III - Course Content

Unit – I	Introduction and Sensors	9 Periods
Introduction to Mechatronics – Systems – Need for Mechatronics – Emerging areas of Mechatronics – Classification of Mechatronics. Sensors and Transducers: Static and Dynamic Characteristics of Sensor, Potentiometers – LVDT – Capacitance Sensors – Strain Gauges – Eddy Current Sensor – Hall Effect Sensor –Temperature Sensors – Light Sensors.		
Unit – II	8085 Microprocessor	9 Periods
Introduction – Pin Configuration - Architecture of 8085 – Addressing Modes – Instruction set, Timing diagram of 8085.		
Unit – III	Programmable Peripheral Interface	9 Periods
Introduction – Architecture of 8255, Keyboard Interfacing, LED display – Interfacing, ADC and DAC Interface, Temperature Control – Stepper Motor Control – Traffic Control Interface.		
Unit – IV	Programmable Logic Controller	9 Periods
Introduction – Architecture – Input / Output Processing – Programming with Timers, Counters and Internal relays – Data Handling – Selection of PLC- Overview, Siemens PLC, Allen Bradley PLC, Schneider electric PLC, Omron PLC, Mitsubishi PLC. Their comparison of various instructions. PLC Applications.		
Unit – V	Actuators and Mechatronics System Design	9 Periods
Types of Stepper and Servo motors – Construction – Working Principle – Characteristics, Stages of Mechatronics Design Process – Comparison of Traditional and Mechatronics Design Concepts with Examples – Case studies of Mechatronics Systems – Pick and Place Robot – Engine Management system – Automatic Car Park Barrier. Automatic Washing Machine, Auto focus camera, exposure control.		

TOTAL: 45 Periods

Text Books:	1. Bolton W., "Mechatronics", Pearson Education, 6th Edition, 2015. 2. Ramesh S Gaonkar, "Microprocessor Architecture, Programming, and Applications with the 8085", Penram International Publishing Private Limited, 6th Edition, 2013.
Reference Books:	1. Davis G. Alciatore and Michael B. Histan, "Introduction to Mechatronics and Measurement systems", McGraw Hill Education, 2011.
MOOC/Web Platforms:	1. nptel.ac.in/courses/112107298

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the role of Mechatronics and classify sensors based on applications.	Understand (K2)
CO2	Analyze the structure and functioning of the 8085 microprocessor.	Analyze (K4)
CO3	Design and interface microprocessor systems using PPI (8255).	Apply (K3)
CO4	Develop basic PLC programs for industrial automation.	Apply (K3)
CO5	Apply Mechatronics design processes using actuators and practical case studies.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	1	-	-	1	-	-	-	-	2	-	-
CO2	3	3	2	1	-	-	1	-	-	-	-	2	-	-
CO3	3	3	2	1	-	-	1	-	-	-	-	2	-	-
CO4	3	3	2	1	-	-	1	-	-	-	-	2	-	-
CO5	3	3	2	1	-	-	1	-	-	-	-	2	-	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23OME11 Nanomaterials and Applications

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All Programmes except B.E- Mechanical Engineering	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	Understanding the evolution of nanomaterials in the scientific era and make them to understand different types of nanomaterials for the future engineering applications.
2.	Gaining knowledge on dimensionality effects on different properties of nanomaterials.
3.	Getting acquainted with the different processing techniques employed for fabricating nanomaterials.
4.	Having knowledge on the different characterization techniques employed to characterize the nanomaterials.
5.	Acquiring knowledge on different applications of nanomaterials in different disciplines of engineering.

III - Course Content

Unit - I	Nanomaterials	9 Periods
Introduction, Classification: 0D, 1D, 2D, 3D nanomaterials and nano-composites, their mechanical, electrical, optical, magnetic properties; Nanomaterials versus bulk materials.		
Unit - II	Thermodynamics & Kinetics of Nanostructured Materials	9 Periods
Size and interface/interphase effects, interfacial thermodynamics, phase diagrams, diffusivity, grain growth, and thermal stability of nanomaterials.		
Unit - III	Processing	9 Periods
Bottom-up and top-down approaches for the synthesis of nanomaterials, mechanical alloying, chemical routes, severe plastic deformation, and electrical wire explosion technique.		
Unit - IV	Structural Characteristics	9 Periods
Principles of emerging nanoscale X-ray techniques such as small angle X-ray scattering and X-ray absorption fine structure (XAFS), electron and neutron diffraction techniques and their application to nanomaterials; SPM, Nanoindentation, Grain size, phase formation, texture, stress analysis		
Unit - V	Applications	9 Periods
Applications of nanoparticles, quantum dots, nanotubes, nanowires, nanocoatings; applications in electronic, electrical and medical industries		

TOTAL: 45 Periods

Text Books:	1. Bhusan, Bharat (Ed), "Springer Handbook of Nanotechnology", 2nd edition, 2007. 2. Carl C. Koch (ed.), Nanostructured Materials, Processing, Properties and Potential Applications, Noyes Publications, Norwich, New York, U.S.A.
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Reference Books:	1. Poole C.P, and Owens F.J., Introduction to Nanotechnology, John Wiley 2003 2. Nalwa H.S., Encyclopedia of Nanoscience and Nanotechnology, American Scientific Publishers 2004 3. Zehetbauer M.J. and Zhu Y.T., Bulk Nanostructured Materials, Wiley 2008 4. Wang Z.L., Characterization of Nanophase Materials, Wiley 2000 5. Gutkin Y., Ovid'ko I.A. and Gutkin M., Plastic Deformation in Nanocrystalline Materials, Springer 2004
MOOC/Web Platforms:	https://www.tutorialsduniya.com/

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	Evaluate nanomaterials and understand the different types of nanomaterials.	Understand (K2)
C02	Recognize the effects of dimensionality of materials on the properties.	Apply (K3)
C03	Process different nanomaterials and use them in engineering applications.	Apply (K3)
C04	Use appropriate techniques for characterizing nanomaterials.	Apply (K3)
C05	Identify and use different nanomaterials for applications in different engineering fields.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C01	2	3	2	3	3	-	-	1	1	3	1	1	-	-
C02	2	3	1	-	-	2	1	1	1	-	1	1	-	-
C03	2	2	1	-	-	2	1	1	1	-	1	1	-	-
C04	2	2	1	-	-	2	1	1	1	-	1	1	-	-
C05	2	2	1	-	-	2	1	1	1	-	1	1	-	-

Mapping: 1-Low, 2-Medium, 3-High

I-Course Name: 23OME12 Nano Technology

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All Programmes except B.E- Mechanical Engineering	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To understand the basic concepts and principles of nanoscience and nanotechnology.
2.	To study the synthesis methods and characterization techniques of nanomaterials.
3.	To explore the mechanical, electrical, magnetic, and optical properties of nanomaterials.
4.	To familiarize students with the applications of nanomaterials in engineering, medicine, and electronics.
5.	To develop awareness of the environmental, health, and safety aspects of nanotechnology.

III - Course Content

Unit – I	Introduction	8 Periods
General definition and size effects–important nano structured materials and nano particles–importance of nano materials- Size effect on thermal, electrical, electronic, mechanical, optical and magnetic properties of nanomaterials- surface area - band gap energy and applications. Photochemistry and Electrochemistry of nanomaterials –Ionic properties of nanomaterials- Nano catalysis.		
Unit – II	Synthesis of Nanomaterials	8 Periods
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.- Laser-Assisted Synthesis of Nanomaterials-Magnetron Sputtering for Thin Film Nanocoatings.		
Unit – III	Nano Composites	10 Periods
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 - Graphene-Based Polymer Nanocomposites.		
Unit – IV	Nano Structures and Characterization Techniques	10 Periods
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 - X-ray Photoelectron Spectroscopy.		
Unit – V	Applications of Nano Materials	9 Periods
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-Nanotechnology in Environmental Remediation.		

TOTAL: 45 Periods

Text Books:	1. Mick Wilson, Kamali Kannangara, Geoff Smith, Michelle Simmom, Burkhard Raguse, "Nano Technology: Basic Science & Engineering Technology", 2005, Overseas Press 2. G. Cao, "Nanostructures & Nanomaterials: Synthesis, Properties & Applications" Imperial College Press, 2004 3. William A Goddard "Handbook of Nanoscience, Engineering and Technology", 3rd Edition, CRC Taylor and Francis group 2012.
Reference Books:	1. R.H.J. Hannink & A.J. Hill, Nanostructure Control, Wood Head Publishing Ltd., Cambridge, 2006. 2. C.N.R. Rao, A. Muller, A.K. Cheetham, The Chemistry of Nanomaterials: Synthesis, Properties and Applications Vol. I & II, 2nd edition, 2005, Wiley VCH Verlag Gbtl & Co 3. Ivor Brodie and Julius J. Muray, 'The physics of Micro/Nano - Fabrication', Springer International Edition, 2010
MOOC/Web Platforms:	nptel.ac.in/courses/113106093

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	Understand the basic properties such as structural, physical, chemical properties of nanomaterials and their applications.	Understand (K2)
C02	Able to acquire knowledge about the different types of nano material.	Apply (K3)
C03	Describes about the shape, size, structure of composite nano materials and their interference.	Understand (K2)
C04	Understand the different characterization techniques for nanomaterials.	Understand (K2)
C05	Develop a deeper knowledge in the application of nanomaterials in different fields.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C01	2	3	2	3	3	-	-	1	1	3	1	1	-	-
C02	2	3	1	-	-	2	1	1	1	-	1	1	-	-
C03	2	2	1	-	-	2	1	1	1	-	1	1	-	-
C04	2	2	1	-	-	2	1	1	1	-	1	1	-	-
C05	2	2	1	-	-	2	1	1	1	-	1	1	-	-

Mapping: 1-Low, 2-Medium, 3-High

I-Course Name: 23OME13 Operation Management

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All Programmes except B.E- Mechanical Engineering	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	Recognize and appreciate the concept of Production and Operations Management in creating and enhancing a firm's competitive advantages.
2.	Describe the concept and contribution of various constituents of Production and Operations Management (both manufacturing and service).
3.	Relate the interdependence of the operations function with the other key functional areas of a firm.
4.	Teach analytical skills and problem-solving tools to the analysis of the operations problems.
5.	Apply scheduling and Lean Concepts for improving System Performance.

III - Course Content

Unit – I	Introduction to Operations Management	9 Periods
Operations Management – Nature, Importance, historical development, transformation processes, differences between services and goods, a system perspective, functions, challenges, current priorities, recent trends; Operations Strategy - Strategic fit , framework; Supply Chain Management		
Unit – II	Forecasting, Capacity and Facility Design	9 Periods
Demand Forecasting - Need, Types, and steps. Overview of Qualitative and Quantitative methods. Capacity Planning - Long range, Types, Developing capacity alternatives. Overview of sales and operations planning. Overview of MRP, MRP II and ERP. Facility Location – Theories, Steps in Selection, Location Models. Facility Layout – Principles, Types, Planning tools and techniques.		
Unit – III	Design of Product, Process and Work Systems	9 Periods
Product Design – Influencing factors, Approaches, Legal, Ethical and Environmental issues. Process – Planning, Selection, Strategy, Major Decisions. Work Study, Procedure. Method Study and Motion Study. Work Measurement and Productivity – Measuring Productivity and Methods to improve productivity.		
Unit – IV	Materials Management	9 Periods
Materials Management – Planning, Budgeting and Control. Purchasing, Functions, Policies, Vendor rating and Value Analysis. Stores Management – Nature, Layout, Classification and Coding. Inventory, Costs and control techniques. Overview of JIT.		
Unit – V	Scheduling and Project Management	9 Periods
Project Management – Scheduling Techniques, PERT, CPM; Scheduling - work centers – nature, importance; Priority rules and techniques, shopfloor control; Flow shop scheduling – Johnson's Algorithm – Gantt charts; personnel scheduling in services.		

TOTAL: 45 Periods

Text Books:	1. Richard B. Chase, Ravi Shankar, F. Robert Jacobs, Nicholas J. Aquilano, Operations and Supply Management, Tata McGraw Hill, 12th Edition, 2010. 2. Norman Gaither and Gregory Frazier, Operations Management, South Western Cengage Learning, 2002.
Reference Books:	1. William J Stevenson, Operations Management, Tata McGraw Hill, 9th Edition, 2009. 2. Russel and Taylor, Operations Management, Wiley, Fifth Edition, 2006. 3. Kanishka Bedi, Production and Operations Management, Oxford University Press, 2004. 4. Chary S. N, Production and Operations Management, Tata McGraw Hill, Third Edition, 2008. 5. Aswathappa K and Shridhara Bhat K, Production and Operations Management, Himalaya Publishing House, Revised Second Edition, 2008. 6. Mahadevan B, Operations Management Theory and practice, Pearson Education, 2007. 7. Pannerselvam R, Production and Operations Management, Prentice Hall India, Second Edition, 2008.
MOOC/Web Platforms:	1. nptel.ac.in/courses/108102191

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	Appreciate the role of Production and Operations management in enabling and enhancing a firm's competitive advantages in the dynamic business environment.	Understand (K2)
C02	Obtain sufficient knowledge and skills to forecast demand for Production and Service Systems.	Understand (K2)
C03	Formulate and Assess Aggregate Planning strategies and Material Requirement Plan.	Understand (K2)
C04	Develop analytical skills to calculate capacity requirements and developing capacity alternatives.	Apply (K3)
C05	Apply scheduling and Lean Concepts for improving System Performance	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C01	3	2	2	1	-	-	1	-	-	-	-	3	-	-
C02	3	3	2	1	-	-	1	-	-	-	-	3	-	-
C03	3	3	2	1	-	-	1	-	-	-	-	3	-	-
C04	3	3	2	1	-	-	1	-	-	-	-	3	-	-
C05	3	3	2	1	-	-	1	-	-	-	-	3	-	-

Mapping: 1-Low, 2-Medium, 3-High

I-Course Name: 23OME14 Production Planning and Control

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All Programmes except B.E- Mechanical Engineering	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To understand the concept of production planning and control act work study.
2.	To apply the concept of product planning.
3.	To analyze the production scheduling.
4.	To apply the Inventory Control concepts.
5.	To prepare the manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

III - Course Content

Unit - I	Overview of Production Planning Control	9 Periods
	Objectives and benefits of planning and control-Functions of production control-Types of production job- batch and continuous-Product development and design-Marketing aspect - Functional aspects Operational aspect-Durability and dependability aspect aesthetic aspect. Profit consideration Standardization, Simplification & specialization- Break even analysis-Economics of a new design. FORECASTING: Importance - Forecasting Techniques- qualitative methods: Jury/Expert Method, Survey method, Sales force composite method, Delphi method and quantitative methods: Simple average, moving average, smoothing coefficient, Least Square method	
Unit - II	Work Study	9 Periods
	Method study, basic procedure-Selection-Recording of process - Critical analysis, Development - Implementation - Micro motion and memo motion study - work measurement - Techniques of work measurement - Time study - Production study - Work sampling - Synthesis from standard data - Predetermined motion time standards.	
Unit - III	Product Planning and Process Planning	9 Periods
	Product planning-Extending the original product information-Value analysis-Problems in lack of product planning-Process planning and routing-Pre requisite information needed for process planning- Steps in process planning-Quantity determination in batch production-Machine capacity, balancing- Analysis of process capabilities in a multi product system.	
Unit - IV	Production Scheduling	9 Periods
	Production Control Systems-Loading and scheduling-Master Scheduling- Scheduling Policies- Scheduling rules-Gantt charts-Perpetual loading-Basic scheduling problems - Line of balance - Flow production scheduling. Batch production scheduling-Product sequencing - Production Control systems- Periodic batch control. Material requirement planning kanban - Dispatching- Progress reporting and expediting- Manufacturing lead time-Téchniques for aligning completion times and due dates.	
Unit - V	Inventory Control and Recent Trends in PPC	9 Periods
	Inventory control-Purpose of holding stock-Effect of demand on inventories-Ordering procedures. Two bin system - Ordering cycle system-Determination of Economic order quantity and economic lot size. ABC analysis - Recorder procedure-Introduction to computer integrated production planning systems elements of JUST IN TIME SYSTEMS-Fundamentals of MRP II and ERP.	

TOTAL: 45 Periods

Text Books:	1. Chary. S.N., "Theory and Problems in Production & Operations Management", Tata McGraw Hill, 1995. 2. Elwood S. Buffa, and Rakesh K. Sarin, "Modern Production / Operations Management", 8th Edition John Wiley and Sons, 2000 3. Jain. K.C. & Aggarwal. L.N., "Production Planning Control and Industrial Management", Khanna Publishers, 1990 4. Kanishka Bedi, "Production and Operations management", 2nd Edition, Oxford university press, 2007. 5. Melynk, Denzler, "Operations management – A value driven approach" Irwin Mcgraw hill. 6. Norman Gaither, G. Frazier, "Operations Management" 9th Edition, Thomson learning IE, 2007 7. Samson Eilon, "Elements of Production Planning and Control", Universal Book Corpn. 1984 8. Upendra Kachru, "Production and Operations Management – Text and cases" 1st Edition, Excel books 2007
Reference Books:	1. Jain, Jain, "Production planning and control", Khanna Publications, 1 st Edition, 2012. 2. Power Plant Engineering Author: P.K. Nag Edition: 4th Edition Publisher: McGraw Hill Education Year: 2014 3. A Textbook of Power Plant Engineering Author: R.K. Rajput Edition: Latest Edition Publisher: Laxmi Publications Year: 2007
MOOC/Web Platforms:	NPTEL Videos: https://nptel/courses/video/112105126/L01.html

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand production planning and control act work study.	Understand (K2)
CO2	Apply product planning.	Apply (K3)
CO3	Apply production scheduling.	Apply (K3)
CO4	Use Inventory Control.	Apply (K3)
CO5	Plan Manufacturing Requirement Planning (MRP II) and Enterprise Resource Planning (ERP).	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1	1	-	-	2	1	1	1	-	1	1	-	-
CO2	3	1	1	-	-	2	1	1	1	-	1	1	-	-
CO3	3	1	1	-	-	2	1	1	1	-	1	1	-	-
CO4	3	1	1	-	-	2	1	1	1	-	1	1	-	-
CO5	3	1	1	-	-	2	1	1	1	-	1	1	-	-

Mapping: 1-Low, 2-Medium, 3-High

I-Course Name: 23OME15 Quality Engineering

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All Programmes except B.E- Mechanical Engineering	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To introduce fundamental concepts, dimensions, and economics of quality engineering.
2.	To impart knowledge on statistical process control using control charts for variables and attributes.
3.	To develop analytical skills in advanced control tools and factorial experimental design.
4.	To evaluate process stability, process capability, and measurement system capability.
5.	To apply acceptance sampling methods, Taguchi techniques, and robust quality design for industrial applications.

III - Course Content

Unit-I	Introduction	9 Periods
Quality Dimensions–Quality definitions–Inspection–Quality control–Quality Assurance–Quality Planning–Quality costs–Economics of quality– Quality loss function.		
Unit -II	Control Charts	9 Periods
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	9 Periods
Warning and modified control limits, control chart for individual measurements, multi-vari chart, chart for moving averages and ranges, cumulative-sum and exponentially weighted moving average control charts. Design and analysis of 2^k factorial experiments.		
Unit-IV	Statistical Process Control	9 Periods
Process stability, process capability analysis using a Histogram or probability plots and control chart. Gauge capability studies, setting specification limits, Analysis of variance (ANOVA): One-way and Two-way.		
Unit-V	Acceptance Sampling	9 Periods
The acceptance sampling fundamental, OC curve, sampling plans for attributes, simple, double, multiple and sequential, sampling plans for variables, MIL-STD- 05D and MIL-STD-414E & IS2500 standards. Taguchi loss function, orthogonal arrays, and signal-to-noise ratio analysis for robust quality design.		

TOTAL: 45 Periods

Text Books:	1. D.C. Montgomery, Design and Analysis of Experiments, John Wiley & Sons, Eighth Edition 2. M.S. Phadke, Quality Engineering Using Robust Design, Prentice Hall, First Edition
Reference Books:	1. S S. Singh, Total Quality Control Essentials, McGraw Hill, First Edition 2. L.S. Srinath, Reliability Engineering, EWP, First Edition

MOOC/Web Platforms:	NPTELVideos: https://www.mooc-list.com/course/quality-engineering-management-edx/ / https://onlinecourses.nptel.ac.in/noc21_mg24
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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	Control the quality of processes using control charts for variables in manufacturing industries.	Understand (K2)
C02	Control the occurrence of defective product and the defects in manufacturing companies.	Apply (K3)
C03	Control the occurrence of defects in services.	Apply (K3)
C04	Analysing and understanding the process capability study.	Analyze (K4)
C05	Developing the acceptance sampling procedures for incoming raw material.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C01	3	2	-	-	-	-	-	1	-	2	-	1	-	-
C02	3	3	2	2	-	-	-	-	2	-	-	1	-	-
C03	2	3	2	2	2	2	-	-	3	2	1	2	-	-
C04	2	3	2	2	2	3	-	-	2	1	2	2	-	-
C05	2	3	3	2	3	2	2	-	2	1	3	2	-	-

Mapping: 1-Low, 2-Medium, 3-High

I-Course Name: 23OME16 Sustainable Manufacturing

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All Programmes except B.E- Mechanical Engineering	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To explain the principles of sustainability and their relevance to modern manufacturing.
2.	To evaluate manufacturing processes for energy efficiency, material usage, and waste generation.
3.	To integrate recycling, reuse, and remanufacturing principles into production systems.
4.	To incorporate concepts such as lean manufacturing, circular economy, and green supply chain management.
5.	To assess emerging technologies such as Industry 4.0, renewable energy integration, and digital twins for sustainability

III - Course Content

Unit - I	Economic Sustainability	9 Periods
Industrial Revolution-Economic sustainability: globalization and international issues Sustainability status - Emerging issues- Innovative products- Reconfiguration manufacturing enterprises - Competitive manufacturing strategies - Performance evaluation- Management for sustainability - Assessments of economic sustainability		
Unit - II	Social and Environmental Sustainability	9 Periods
Social sustainability – Introduction-Work management -Human rights - Societal commitment - Customers -Business practices -Modelling and assessing social sustainability. Environmental issues pertaining to the manufacturing sector: Pollution - Use of resources -Pressure to reduce costs -Environmental management: Processes that minimize negative environmental impacts - environmental legislation and energy costs - need to reduce the carbon footprint of manufacturing Operations-Modelling and assessing environmental sustainability		
Unit - III	Sustainability Practices	9 Periods
Sustainability awareness - Measuring Industry Awareness-Drivers and barriers -Availability of sustainability indicators -Analysis of sustainability practicing -Modeling and assessment of sustainable practicing -Sustainability awareness -Sustainability drivers and barriers - Availability of sustainability indicators- Designing questionnaires- Optimizing Sustainability Indexes-Elements – Cost and time model.		
Unit - IV	Trends in Sustainable Operations	9 Periods
Concepts of competitive strategy and manufacturing strategies and development of a strategic improvement programme - Manufacturing strategy in business success strategy formation and formulation - Structured strategy formulation - Sustainable manufacturing system design options - Approaches to strategy formulation - Realization of new strategies/system designs.		
Unit - V	Trends In Sustainable Operations	9 Periods
Principles of sustainable operations - Life cycle assessment manufacturing and service activities - influence of product design on operations - Process analysis – Capacity management - Quality management -Inventory management - Just-In-Time systems - Resource efficient design - Consumerism and sustainable well-being.		

TOTAL: 45 Periods

Text Books:	1.Ibrahim Garbie, "Sustainability in Manufacturing Enterprises Concepts, Analyses and Assessments for Industry 4.0", Springer International Publishing, United States, 2016, ISBN-13: 978-3319293042. 2. Davim J.P., "Sustainable Manufacturing", John Wiley & Sons., United States, 2010, ISBN: 978-1-848-21212-1.
Reference Books:	1.Anil Markandya, Climate Change and Sustainable Development: Prospects for Developing Countries, Routledge, 2002 2.Systems Analysis for Sustainable Engineering: Theory and Applications, Ni bin Chang, McGraw Hill, Chicago, 2011. 3. S.S Purohit, Green Technology-An approach for sustainable Environment, Agrobio publication, India, 2008. 4.Meadows, D. Randers, J., Meadows. D. (2004) Limits to growths. The 30-year update. Chelsea Green Publishing. • Meadows, D. (2008) Thinking in systems. Chelsea Green Publishing.
MOOC/Web Platforms:	NPTEL Videos: https:// nptel/courses/video/112105126/L01.html

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	Discuss the importance of economic sustainability.	Understand (K2)
C02	The importance of sustainable practices.	Apply (K3)
C03	Identify drivers and barriers for the given conditions.	Apply (K3)
C04	Formulate strategy in sustainable manufacturing.	Apply (K3)
C05	Plan for sustainable operation of industry with environmental, cost consciousness.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C01	3	1	1	-	-	2	1	1	1	-	1	1	-	-
C02	3	1	1	-	-	2	1	1	1	-	1	1	-	-
C03	3	1	1	-	-	2	1	1	1	-	1	1	-	-
C04	3	1	1	-	-	2	1	1	1	-	1	1	-	-
C05	3	1	1	-	-	2	1	1	1	-	1	1	-	-

Mapping: 1-Low, 2-Medium, 3-High

Open Electives

(for other department students)

I - Course Name: 23OEC01 Antenna Fundamentals

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All programmes except B.E - ECE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	Understand and analyze key antenna parameters and matching techniques to evaluate antenna performance.
2.	Design and analyze linear and phased antenna arrays for directional radiation control
3.	Learn techniques for accurate measurement of antenna parameters and overcome practical limitations.
4.	Explore the principles and applications of frequency-independent and modern specialized antennas.
5.	Understand antenna requirements and designs for contemporary wireless, satellite, and radar systems.

III - Course Content

Unit - I	Antenna Fundamentals and Radiation	9 Periods
Definition of antenna parameters – Gain, Directivity, Effective aperture, Radiation Resistance, Band width, Beam width, Input Impedance. Matching – Baluns, Polarization mismatch, Antenna noise temperature.		
Unit - II	Antenna Arrays	9 Periods
N element linear array, Pattern multiplication, Broadside and End fire array – Concept of Phased arrays, Adaptive array.		
Unit - III	Antenna Measurements	9 Periods
Drawbacks in measurement of antenna parameters – methods to overcome drawbacks in antenna measurements - measurement ranges - Impedance - Gain - Radiation pattern - Beam width, Radiation resistance - Antenna efficiency - Directivity - Polarization and phase Measurements.		
Unit - IV	Special Antennas	9 Periods
Principle of frequency independent antennas – Spiral antenna, Helical antenna, Log periodic. Modern antennas- Reconfigurable antenna, Reflector Antenna, Patch Antenna.		
Unit - V	Antennas for Modern Wireless Communications	9 Periods
Antennas for Terrestrial mobile communication - mobile handsets and base stations. Antennas for Satellite Communication, Radar systems, RFID, MEMS antenna, MIMO antenna.		

TOTAL: 45 Periods


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NPR College of Engineering & Technology
(Autonomous),
Natham, Dindigul - 624401

Reference Books:	1. John D Kraus, "Antennas for all Applications", McGraw Hill, 5th Edition, 2005. R.E. Collin, "Antennas and Radio wave propagation", McGraw Hill, 1985. 2. Constantine. A. Balanis, "Antenna Theory Analysis and Design", Wiley student edition, 3rd Edition, 2009. 3. Annapurna Das and Sisir K Das, Microwave Engineering, Tata McGraw Hill Publishing Company Ltd., New Delhi, Second Edition, 2009 4. Edward C. Jordan and Keith G. Balmain, "Electromagnetic Waves and Radiating Systems", Prentice Hall of India, 2006 5. S. Drabowitch, "Modern Antennas", Springer Publications, 2nd Edition, 2007 6. Robert S. Elliott, "Antenna theory and Design", Wiley student edition, 2010. 7. H. Sizon, "Radio Wave Propagation for Telecommunication Applications", First Indian Reprint, Springer Publications, 2007
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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Comprehend antenna parameters and the radiation mechanism of simple antennas to complex antenna structures.	Understand (K2)
CO2	Design antennas for given specifications and perform array synthesis.	Apply (K3)
CO3	Elaborate the radiation mechanism of aperture antennas.	Understand (K2)
CO4	Acquire knowledge on the operation of antennas designed for specific applications and the measurement procedures.	Understand (K2)
CO5	Explain the selection of modern antennas for various applications.	Understand (K2)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23OEC02 Consumer Electronics

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All programmes except B.E - ECE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To provide foundational knowledge of the consumer electronics industry, including classification of products, key components, ergonomic design principles, and power supply technologies.
2.	To understand the working principles and technologies behind modern audio and video systems, including analog/digital formats, display technologies, and streaming media platforms.
3.	To explore the internal architecture and control systems of household appliances, and introduce smart home integration with voice-controlled and energy-efficient technologies
4.	To examine the role of IoT architecture, wireless communication protocols, and AI/ML in enhancing functionality, connectivity, and intelligence of modern consumer devices.
5.	To impart practical knowledge on safety standards, maintenance, fault diagnosis, and to introduce emerging innovations and sustainable practices in consumer electronics.

III - Course Content

Unit – I	Introduction to Consumer Electronics	9 Periods
Overview of consumer electronics industry- Classification: audio-video-communication-home appliances-Key components and block diagrams-Power supplies and batteries- Ergonomics and design aspects.		
Unit – II	Audio and Video Systems	9 Periods
Microphones-loudspeakers-amplifiers Analog and digital audio systems-Smart TVs-OLED-QLED-Set-top boxes, IPTV, streaming systems- Digital cameras, camcorders- imaging technologies.		
Unit – III	Home and Smart Appliances	9 Periods
Washing machines-microwave ovens- air conditioners-refrigerators-Embedded control systems in appliances-Energy efficiency and inverter technology-Introduction to Smart Homes and connected devices-Voice assistants-Amazon Alexa-Google Assistant.		
Unit – IV	IoT, AI and Communication in Consumer Electronics	9 Periods
IoT architecture and sensors in consumer devices-Wireless standards: Wi-Fi, Zigbee-Bluetooth-NFC AI and ML applications in consumer products- Smartphone technologies and wearable devices- Security-privacy and interoperability.		
Unit – V	Troubleshooting, Maintenance and Emerging Trends	9 Periods
Safety standards, regulations (BIS, IEC, RoHS)-Installation and maintenance practices-Fault diagnosis techniques-E-waste management and green electronics-Emerging trends: foldable tech- 8K- AR/VR- sustainable devices.		

TOTAL: 45 Periods

Reference Books:	1.S.P. Bali, "Consumer Electronics", Pearson Education, 2nd Edition, 2010. 2.R.G. Gupta, "Audio and Video Systems", Tata McGraw-Hill, 2nd Edition, 2010. 3.N.P. Bhatt, "Consumer Electronics: Servicing and Maintenance", McGraw Hill, 2nd Edition, 2010. 4.Robert Sobot, "Wireless Communication Electronics: Introduction to RF Circuits and Design", Springer, 2nd Edition, 2021. 5.Dogan Ibrahim, "Internet of Things with PIC Microcontrollers", Newnes, 1st Edition, 2020
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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the principles and features of audio and video systems used in consumer electronics.	Understand (K2)
CO2	Explain the operation of home appliances and their subsystems.	Understand (K2)
CO3	Demonstrate knowledge of digital and smart consumer devices, including IoT-enabled products.	Apply (K3)
CO4	Apply safety, troubleshooting, and maintenance procedures for consumer electronics.	Apply (K3)
CO5	Enumerate emerging trends and technologies such as AI, ML, and sustainability in consumer electronics.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23OEC03 Display Devices Fundamentals

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All programmes except B.E - ECE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To understand the fundamental principles of display systems, human visual perception, and key display parameters.
2.	To explore the structure, operation, and applications of transmissive and reflective displays including LCDs and e-paper.
3.	To study emissive and projection display technologies such as OLED, QLED, CRT, and various projection systems.
4.	To examine near-eye and wearable displays including AR/VR systems, holographic optics, and eye-tracking mechanisms.
5.	To analyze advanced and 3D display technologies including light field, volumetric, autostereoscopic, and touch screen displays.

III - Course Content

Unit - I	Display Fundamentals	9 Periods
Introduction to Displays, Requirements of Displays, Overview of Display Technologies: CRT, Flat Panel, Advanced Displays, Cathode Ray Tube (CRT), Flat Panel Displays, Human Visual System, Colorimetry, Depth Perception and Motion Perception Fundamentals, Fundamental Display Parameters.		
Unit - II	Transmissive and Reflective Displays	9 Periods
Introduction to transmissive Displays, Liquid Crystal Display (LCD), Types of LCD, LED Backlighting in LCDs, Reflective Displays, Electronic Paper (E-Ink), Digital Micromirror Device (DMD), Electrowetting and Electrofluidic Displays, Practical applications of Transmissive and Reflective Displays.		
Unit - III	Emissive and Projection Displays	9 Periods
Emissive Displays, Cathode Ray Tube (CRT), OLED and AMOLED Displays, Quantum Dot LEDs (QLED), Field Emission Displays, Projection Display, Types of Projectors, Holographic Projection, Common Applications of Emissive and Projection Displays.		
Unit - IV	Near-Eye and Wearable Displays	9 Periods
Near-Eye Displays (NED), Head-Mounted Displays (HMD), Combiner Mirrors and Basic Optical Principles, On-Axis and Off-Axis Near-Eye Displays, Smart NEDs and Augmented Reality, Light Field Displays and Holographic NEDs, Contact Lens Displays, Adaptive Displays, Eye Tracking:		
Unit - V	Advanced Display Types and 3D Displays	9 Periods
Introduction to 3D Displays and Their Significance, Spatial and Spectroscopic Displays, Autostereoscopic Displays, Parallax Barrier Displays, Volumetric Displays, Light Field Display, Computer-Generated Holograms (CGH), HDTV and LED Displays, Touch Screen Displays.		

TOTAL: 45 Periods

Reference Books:	1. R G Gupta, Television Engineering and Video Systems, McGraw Hill, India, 2011 (Second Edition). 2. A Veeralakshmi and R Srivel, "Television and Video Engineering", Ane Books, 2013. 3. E.H. Stupp, M. S. Brennesholtz, "Projection Displays", Wiley, 2008 (Second Edition). 4. Joseph A. Castellano, "Handbook of Display Technology", Elsevier, 1992.
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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand and explain the fundamental principles and requirements of various display technologies including CRT, flat panel, and advanced displays.	Understand (K2)
CO2	Describe the human visual system and its impact on display design, including concepts of colorimetry, depth perception, and motion perception.	Understand (K2)
CO3	Differentiate transmissive and reflective display technologies such as LCD, E-Ink, DMD, and their practical applications.	Understand (K2)
CO4	Explain the working principles and applications of emissive and projection displays, including OLED, AMOLED, QLED, and holographic projectors.	Understand (K2)
CO5	Understand near-eye and wearable displays, advanced 3D display technologies, and their significance in modern electronic systems.	Understand (K2)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High



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I - Course Name: 23OEC04 Basics of Embedded Systems

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All programmes except B.E - ECE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To introduce the fundamentals of embedded systems and the architecture, programming, and features of the 8051 microcontroller.
2.	To understand ARM processor architecture, programming, exceptions, and performance analysis techniques.
3.	To study the architecture and functionalities of the MSP430 microcontroller and its peripheral interfaces.
4.	To explore real-time operating systems, task scheduling, interprocess communication, and multiprocessing in embedded systems.
5.	To analyze embedded system design through real-world applications like vending machines, digital cameras, and USB interfaces.

III - Course Content

Unit - I	Introduction to Embedded Systems and Microcontroller	9 Periods
Introduction to Embedded Systems –Structural units in Embedded processor - selection of processor –8/16 bit Microprocessors – Microcontroller for an Embedded System- 8051 Microcontroller – Architecture, Addressing Modes, Instruction Set.		
Unit - II	ARM Processor	9 Periods
ARM Processor – Instruction Set Preliminaries – CPU – Programming Input and Output – Supervisor Mode – Exceptions and Trap – Models for programs – Assembly, Linking and Loading – Compilation Techniques – Program Level Performance Analysis.		
Unit - III	MSP430 Microcontroller	9 Periods
Functional Block diagram of MSP-EXP430F5529LP - Memory Mapped CPU, Exceptions, Architecture of MSP430 - Addressing Modes - Instruction Set, Interrupts, Digital in - outs, Timer, Communication interfaces.		
Unit - IV	Processes and Operating Systems	9 Periods
Structure of a real time system, Task Assignment and Scheduling, Multiple Tasks and Multiple Processes, Pre-emptive real time Operating systems, Priority based scheduling, Distributed Embedded Systems, MPSoCs and shared memory multiprocessors.		
Unit - V	Embedded System Applications	9 Periods
Embedded System Design Process – Model train controller, Chocolate Vending Machine, Digital camera, ATM machine and simple USB back channel.		

TOTAL: 45 Periods

Reference Books:	1. The 8051 Microcontroller: Architecture, Programming, and Applications, Kenneth Ayala, West Publishing Company, 2007 (Unit – I) 2. Marilyn Wolf, Computers as Components – Principles of Embedded Computing System Design, 3rd Edition, Morgan Kaufmann, 2012. (Unit – II, IV, V) 3. John H Davies, MSP430 Microcontroller Basics, Elsevier, 2008. Unit – III, V). 4. Raj Kamal, 'Embedded System-Architecture, Programming, Design', Mc Graw Hill, 2013. 5. Lyla B.Das, Embedded Systems: An Integrated Approach, Pearson Education, 2013. 6. Jane.W.S .Liu, Real – Time Systems, Pearson Education, 2003
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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the architecture and features of 8051.	Understand (K2)
CO2	Explain ARM processor architecture and programming concepts.	Understand (K2)
CO3	Explain MSP430 microcontroller's concepts.	Understand (K2)
CO4	Understand the principles of real-time operating systems.	Understand (K2)
CO5	Apply embedded systems programming, design, and development skills.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23OEC05 Basics of Nano Electronics

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All programmes except B.E - ECE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To introduce the fundamental concepts of nanoelectronics, including quantum effects, nanostructures, and material properties.
2.	To explore bottom-up synthesis techniques for nanomaterials such as sol-gel, CVD, epitaxy, and self-assembly.
3.	To study top-down nanofabrication methods including lithography, ball milling, and vapor phase deposition techniques.
4.	To understand various characterization techniques for nanomaterials including microscopy and spectroscopy tools.
5.	To examine the applications of nanoelectronics in MEMS/NEMS, healthcare, energy, electronics, and transportation sectors.

III - Course Content

Unit - I	Introduction to Nano Electronics	9 Periods
Nano electronics in recent scenario - Crystal Structure –Semiconductors- Band theory– Donors - Acceptors and Deep traps, Mobility – Excitons, Electron confinement - Quantum dots, wires and well, 1D, 2D and 3D Nano structured materials, metal Oxides- Physical, Chemical and Optical properties		
Unit - II	Synthesis of Nano materials - Bottom-up Approaches	9 Periods
Sol-gel, Self-assembled monolayer, Physical and Chemical vapour deposition, thin films, epitaxy- Lithography Top-down Approaches-Grinding, high energy ball milling, Injection molding		
Unit - III	Nano materials - Top-down Approaches	9 Periods
Fundamentals of nano-thin film growth; Vapor phase deposition methods - Physical and chemical vapor phase methods; Langmuir-Blodgett Films; Electrochemical Deposition; laws of electrolysis and deposition		
Unit - IV	Nano materials Characterization	9 Periods
X-ray diffraction, Powder diffraction, Structural analysis, Scanning Electron Microscopy, FESEM, AFM, Transmission Electron Microscope, Spectroscopic techniques: UV-Visible, Infra-red Spectroscopy, rotational, vibrational photo luminescence (PL)		
Unit - V	Applications of Nano Electronics	9 Periods
Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS), Application in Electronics, Medical and Health Care, energy saving and for Transportation		

TOTAL: 45 Periods

Reference Books:	1.Hanson, Fundamentals of Nanoelectronics, Pearson education, 2009 2.Mircea Dragoman and Daniela Dragoman, Nanoelectronics: Principles and Devices, Artech House, 2009 3.Robert Puer, Livio Baldi, Marcel Van de Voorde and Sebastiaan E. Van Nooten, Nanoelectronics: Materials, Devices, Applications, Wiley, 2017
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IV - Course Outcomes

	On completion of the course, the students will be able to	Bloom's Level Mapped
C01	Understand the basics of nano electronics including quantum wires, dots and wells.	Understand (K2)
C02	Explain the bottom-up approaches to synthesize the nano materials.	Understand (K2)
C03	Explain the top-down approaches to synthesize the nano materials.	Understand (K2)
C04	Identify the nano material characterization method.	Apply (K3)
C05	Explain the use of nano devices for various applications.	Understand (K2)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C01	3	3	3	-	-	-	-	-	-	-	-	-	-	-
C02	3	3	3	-	-	-	-	-	-	-	-	-	-	-
C03	3	3	3	-	-	-	-	-	-	-	-	-	-	-
C04	3	3	3	-	-	-	-	-	-	-	-	-	-	-
C05	3	3	3	-	-	-	-	-	-	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23OEC06 Fundamentals of Image Processing

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All programmes except B.E - ECE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To introduce the basic concepts, components, and fundamental steps in digital image processing including image acquisition and representation.
2.	To understand image enhancement techniques in the spatial domain using histogram operations and various spatial filters.
3.	To apply frequency domain techniques for image enhancement and restoration using Fourier transforms and noise reduction filters.
4.	To study color image processing, edge detection, and image segmentation methods for feature isolation and analysis.
5.	To explore image and video compression techniques and introduce basic feature extraction and pattern recognition methods.

III - Course Content

Unit - I	Introduction to Image Processing	9 Periods
Fundamental Steps in Digital Image Processing, Components of Image Processing System Image Acquisition and Sampling Quantization and Resolution. Digital Image Fundamentals - Image Representation (2D functions, pixels) Image Types (Binary, Grayscale, Color), Basic Relationships between Pixels, Neighbors, Connectivity, Distance Metrics. Image File Formats (JPEG, PNG, BMP, TIFF)		
Unit - II	Image Enhancement in the Spatial Domain	9 Periods
Histogram Processing, Histogram Equalization, Matching, Spatial Filtering Smoothing Filters (Mean, Gaussian), Sharpening Filters (Laplacian, Sobel)		
Unit - III	Image Enhancement in the Frequency Domain	9 Periods
Fourier Transform and its Properties, Discrete Fourier Transform (DFT), Filtering in Frequency Domain, Ideal, Butterworth, Gaussian Filters, High-pass and Low-pass Filtering. Image Restoration Model of Image Degradation/Restoration, Noise Models (Gaussian, Salt & Pepper, Speckle), Restoration Techniques, Inverse Filtering, Wiener Filtering.		
Unit - IV	Color Image Processing	9 Periods
Color Models (RGB, CMY, HSV, HSI), Color Transformations, Pseudocolor Image Processing, Full-color Image Processing Color Image Smoothing and Sharpening. Image Segmentation - Point, Line, and Edge Detection, Roberts, Prewitt, Sobel, Canny Thresholding (Global, Adaptive), Region-based Segmentation, Watershed Segmentation		
Unit - V	Image Compression	9 Periods
Need for Compression, Lossless Compression Techniques (Huffman, Run-length), Lossy Compression Techniques (JPEG, Transform Coding), Basics of Video Compression (MPEG) Feature Extraction (SIFT, SURF, HOG), Pattern Recognition Basics		

TOTAL: 45 Periods

Reference Books:	1.Rafael C. Gonzalez and Richard E. Woods," Digital Image Processing", Pearson Education, 4th Edition
	2.Anil K. Jain, " Fundamentals of Digital Image Processing", Prentice Hall.

IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	Understand the fundamentals of digital images and image processing systems.	Understand (K2)
C02	Apply spatial and frequency domain techniques for image enhancement.	Apply (K3)
C03	Analyze and implement image restoration and noise reduction techniques.	Analyze (K4)
C04	Perform color image processing and understand color model.	Apply (K3)
C05	Understand and apply image compression methods.	Understand (K2)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C01	3	3	3	-	-	-	-	-	-	-	-	-	-	-
C02	3	3	3	-	-	-	-	-	-	-	-	-	-	-
C03	3	3	3	-	-	-	-	-	-	-	-	-	-	-
C04	3	3	3	-	-	-	-	-	-	-	-	-	-	-
C05	3	3	3	-	-	-	-	-	-	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23OEC07 Internet of Things

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All programmes except B.E - ECE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To understand the evolution, architectures, and core functional stack of the Internet of Things including fog, edge, and cloud computing.
2.	To explore the key components of an IoT ecosystem such as sensors, actuators, control units, and communication modules.
3.	To study IoT protocols, wireless sensor networks, and enabling technologies including big data and cloud computing.
4.	To learn IoT deployment and programming on platforms like Raspberry Pi and Arduino, including interfacing and cloud connectivity.
5.	To analyze various IoT applications across smart cities, industry, health, environment, agriculture, and home automation.

III - Course Content

Unit - I	Introduction to Internet of Things	9 Periods
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	9 Periods
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	9 Periods
IoT Protocols - IPv6, 6LoWPAN, MQTT, CoAP - RFID, Wireless Sensor Networks, Big Data Analytics, Cloud Computing, Embedded Systems.		
Unit - IV	Open Platforms and Programming	9 Periods
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	9 Periods
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.		

TOTAL: 45 Periods

Reference Books:	1. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017 2. Samuel Greengard, The Internet of Things, The MIT Press, 2015. 3. Perry Lea, "Internet of things for architects", Packt, 2018. 4. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things – Key applications and Protocols", Wiley, 2012. 5. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things – Key applications and Protocols", Wiley, 2012. 6. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011. 7. ArshdeepBahga, Vijay Madiseti, "Internet of Things – A hands-on approach", Universities Press, 2015
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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Explain the concept of IoT.	Understand (K2)
CO2	Understand the communication models and various protocols for IoT.	Understand (K2)
CO3	Design portable IoT using Arduino/Raspberry Pi /open platform.	Understand (K2)
CO4	Apply data analytics and use cloud offerings related to IoT.	Analyze (K4)
CO5	Explain applications of IoT in real time scenario.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 2230EC08 Sensors and Actuators

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All programmes except B.E - ECE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To understand sensor functions, classifications, calibration methods, and principles of transduction with error analysis.
2.	To study the principles, construction, and applications of variable resistance and inductance sensors like strain gauges and LVDTs.
3.	To explore variable capacitance sensors, piezoelectric, Hall effect, semiconductor sensors, and environmental sensors.
4.	To examine various automotive actuators including electromechanical and fluid-mechanical types and their machine ratings.
5.	To analyze different actuators used in automatic temperature control systems and their operational characteristics.

III - Course Content

Unit - I	Introduction to Measurements and Sensors	9 Periods
Sensors: Functions- Classifications- Main technical requirement and trends Units and standards Calibration methods- Classification of errors- Error analysis- Limiting error- Probable error Propagation of error- Odds and uncertainty- principle of transduction-Classification.		
Unit - II	Variable Resistance and Inductance Sensors	9 Periods
Principle of operation- Construction details- Characteristics and applications of resistive potentiometer- Strain gauges- Resistive thermometers- Thermistors- Piezoresistive sensors Inductive potentiometer and LVDT.		
Unit - III	Variable and other Special Sensors	9 Periods
Variable Resistance Sensors, Variable Capacitance and variable permittivity type- capacitor microphone Piezoelectric, Magnetostrictive, Hall Effect, semiconductor sensor- digital transducers-Humidity Sensor. Rain sensor, climatic condition sensor, solar, light sensor, antiglare sensor.		
Unit - IV	Automotive Actuators	9 Periods
Electromechanical actuators - Fluid - mechanical actuators - Electrical machines - Direct - current machines - Three - phase machines - Single - phase alternating - current Machines - Duty - type ratings for electrical machines.		
Unit - V	Automatic Temperature Control Actuators	9 Periods
Different types of actuators used in automatic temperature control - Fixed and variable displacement temperature control		

TOTAL: 45 Periods

Reference Books:	1. Ernest O. Doebelin, Dhanesh N. Manik Doebelin's Measurement Systems: 7th Edition (SIE), McGraw Hill Publishers, 2019. 2. Robert Brandy, "Automotive Electronics and Computer System", Prentice Hall, 2001 3. William Kimberley, "Bosch Automotive Handbook", 6th Edition, Robert Bosch GmbH, 2004. 4. Bosch Automotive Electrics and Automotive Electronics Systems and Components, Networking and Hybrid Drive, 5th Edition, 2007, ISBN No: 978 - 3 - 658 - 01783 - 5. 5. James D Halderman, "Automotive Electrical and Electronics", Prentice Hall, USA, 2013 6. Tom Denton, "Automotive Electrical and Electronics Systems," Third Edition, 2004, SAE International. 7. Patranabis.D, "Sensors and Transducers", 2nd Edition, Prentice Hall India Ltd, 2003 8. William Ribbens, "Understanding Automotive Electronics - An Engineering Perspective", 7th Edition, Elsevier Butterworth - Heinemann Publishers, 2012.
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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	List common types of sensor and actuators used in vehicles.	Understand (K2)
CO2	Design measuring equipment's for the measurement of pressure force, temperature and flow.	Apply (K3)
CO3	Generate new ideas in designing the sensors and actuators for automotive application.	Apply (K3)
CO4	Understand the operation of the sensors, actuators and electronic control.	Understand (K2)
CO5	Explain temperature control actuators for vehicles.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23OEC09 Fundamentals of Wearable Devices

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All programmes except B.E - ECE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To introduce wearable devices, their evolution, types, sensors, applications, and industry trends.
2.	To understand physiological and motion data, basic wearable sensors, biological signals, and user interaction techniques.
3.	To explore wireless health systems, body area networks, integration with smartphones/cloud, and security concerns.
4.	To study wearable applications in healthcare, fitness, rehabilitation, and assistive technologies for special needs.
5.	To examine wearable technology in defense, environmental monitoring, smart lifestyles, and advanced wearable robotics.

III - Course Content

Unit - I	Introduction to Wearable Devices	9 Periods
Introduction to wearable devices – Evolution of wearable computing – Types of wearable devices: Smart watches, Fitness trackers, Smart garments, AR/VR devices – Basic classification of wearable sensors – Applications in healthcare, sports, education, safety, and entertainment – Overview of industry trends and future scope.		
Unit - II	Wearable Data and User Interface	9 Periods
Physiological and motion data: heart rate, steps, sleep, temperature – Introduction to basic sensors: Accelerometers, Gyroscopes – Overview of biological signals: ECG, EEG, EMG – Data visualization techniques – User interaction: Haptic feedback, Gesture and Voice control – Mobile app interfaces and feedback system.		
Unit - III	Wireless Health Systems	9 Periods
Wireless technologies: Bluetooth, Wi-Fi, NFC – Overview of Body Area Networks (BAN) – Integration with smartphones and cloud platforms – Wearable system components: Processing units, batteries, displays – Data synchronization and storage – Privacy and security in wearable systems – Popular wearable platforms		
Unit - IV	Healthcare, Fitness and Assistive Applications	9 Periods
Wearable devices in healthcare – ECG, EEG, EMG monitoring – Chronic disease and elderly care – Smart patches and glucose monitoring – Fitness tracking: step count, heart rate, calorie burn – Gait and posture analysis – Physiotherapy and rehabilitation – Assistive wearables for visually and hearing-impaired – Industrial wearables: fatigue sensors, gas detectors, smart helmets.		
Unit - V	Defense, Environment and Smart Lifestyle Applications	9 Periods
Wearables in military and defense – Smart uniforms – Soldier health monitoring – Wearable GPS and tracking – Body-worn cameras – Exosuits and wearable robotics – Environmental monitoring: UV, gas, and pollution – Smart textiles and LED garments – Haptic wearables for VR and gaming – Navigation aids and safety devices for visually impaired, children, and elderly.		

TOTAL: 45 Periods

Reference Books:	1.Ramfis Nieto, "Designing Wearable Systems: Concepts and Implementation", McGraw-Hill, 2019. 2.John A. Rogers and Roozbeh Ghaffari, "Bio-integrated Electronics: Materials, Systems, and Applications", Cambridge University Press, 2019.
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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
CO1	Understand the fundamentals and evolution of wearable technology.	Understand (K2)
CO2	Explain the types of data and sensors used in wearable systems.	Understand (K2)
CO3	Explain the system components and connectivity of wearable devices.	Understand (K2)
CO4	Recognize smart textile concepts and user-centered wearable designs.	Understand (K2)
CO5	Analyze real-world applications and future developments in wearables.	Understand (K2)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High

I - Course Name: 23OEC10 Wireless Sensor Networks

Prerequisite	Programme Name	Sem	Category	L	T	P	C
Nil	All programmes except B.E - ECE	V/VI/VII	OEC	3	0	0	3

II - Course Objectives

1.	To introduce wireless sensor networks, their architectures, node components, topologies, and short-range wireless standards.
2.	To study MAC and routing protocols tailored for wireless sensor networks with an emphasis on energy efficiency and performance trade-offs.
3.	To understand the 6LoWPAN architecture and integration of IPv6 in low power and lossy networks including routing and mobility support.
4.	To explore application design issues, QoS requirements, energy management, and middleware protocols in WSNs.
5.	To learn simulation tools and programming frameworks such as TinyOS, NesC, Contiki OS, and their use in WSN development and testing.

III - Course Content

Unit - I	Introduction to Wireless Sensor Networks	9 Periods
Introduction to Wireless Sensor Networks – Motivation, Applications, and Challenges, Comparison with Ad Hoc Networks, Node Architecture – Sensor Node Components, Network Architecture – Types of Topologies, Design Principles, Service Interfaces, and Gateway Concepts, Short Range Wireless Communication Standards: IEEE 802.15.4, Zigbee, Bluetooth, Physical Layer and Transceiver Design Considerations.		
Unit - II	MAC and Routing Protocols	9 Periods
MAC Protocols – Fundamentals, Low Duty Cycle Protocols, Wakeup Concepts Contention and Schedule-Based Protocols – SMAC, BMAC, TRAMA Routing Protocols – Design Requirements, Classification SPIN, Directed Diffusion, LEACH, PEGASIS Routing Metrics and Performance Trade-offs.		
Unit - III	6LoWPAN and IPv6 Integration	9 Periods
6LoWPAN Architecture – Protocol Stack and Adaptation Layer Link Layer Addressing and Routing (Mesh-Under, Route-Over) Header Compression – Stateless & Context-Based Fragmentation and Reassembly Mobility Support: Mobile IPv6, Proxy Mobile IPv6, Proxy Home Agent Routing for Low Power and Lossy Networks – ROLL, Border Routing, MANET Integration		
Unit - IV	Application Design Issues	9 Periods
Application Design Issues – End-to-End, Real-Time Streaming, Publish/Subscribe Web Services and Middleware Protocol Paradigms Common Protocols – MQTT-S, ZigBee CAP, SNMP.		
Unit - V	QoS/Energy Management	9 Periods
Real-time Transport QoS Requirements – Delay, Reliability, Throughput Energy Management – Power-aware MAC and Routing, Battery and Transmission Management Trade-offs Between QoS and Energy Efficiency.		

TOTAL: 45 Periods

Reference Books:	1. Holger Karl, Andreas willig, "Protocol and Architecture for Wireless Sensor Networks", John Wiley Publication, 2006. 2. Anna Forster, "Introduction to Wireless Sensor Networks", Wiley, 2017. 3. Zach Shelby Sensinode and Carsten Bormann, "6LoWPAN: The Wireless Embedded Internet" John Wiley and Sons, Ltd, Publication, 2009. 4. Philip Levis, "TinyOS Programming", 2006 -www.tinyos.net. 5. The Contiki Operating System. http://www.sics.se/contiki .
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IV - Course Outcomes

On completion of the course, the students will be able to		Bloom's Level Mapped
C01	Design solutions for WSNs applications.	Apply (K3)
C02	Develop efficient MAC and Routing Protocols.	Analyze (K4)
C03	Design solutions for 6LOWPAN applications.	Apply (K3)
C04	Develop efficient layered protocols in 6LOWPAN.	Analyze (K4)
C05	Use Tiny OS and Contiki OS in WSNs and 6LOWPAN applications.	Apply (K3)

V - Mapping Table - Mapping of COs with POs and PSOs

COs Vs POs/ PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C01	3	3	3	-	-	-	-	-	-	-	-	-	-	-
C02	3	3	3	-	-	-	-	-	-	-	-	-	-	-
C03	3	3	3	-	-	-	-	-	-	-	-	-	-	-
C04	3	3	3	-	-	-	-	-	-	-	-	-	-	-
C05	3	3	3	-	-	-	-	-	-	-	-	-	-	-

Mapping: 1-Low, 2-Medium, 3-High