CURRICULUM & SYLLABUS

CHOICE BASED CREDIT SYSTEM (CBCS)

FOR

BACHELOR OF TECHNOLOGY (B.Tech.)

(4 Year Undergraduate Degree Programme)

IN

ELECTRONICS AND COMMUNICATION ENGINEERING

(In Alignment with National Education Policy, 2020)

[w. e. f. 2025-2026]

FACULTY OF ENGINEERING AND TECHNOLOGY

SRM UNIVERSITY DELHI-NCR, SONEPAT

39, Rajiv Gandhi Education City, Sonepat

Haryana-131029

SRM UNIVERSITY DELHI-NCR, SONEPAT
FACULTY OF ENGINEERING AND TECHNOLOGY

ENGINEERING GRADUATES EMPLOYABILITY ATTRIBUTES (EGEAs)

Effective Communication	An Engineer should be able to 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.
Sound Knowledge and Skills of Basic Sciences & Engineering Sciences	An Engineer should be able to apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
Problem Formulation, Analysis & Solving	An Engineer should be able to identify, formulate, review research literature, and analyze complex Engineering problems reaching substantiated conclusions using principles of mathematics, natural sciences, and engineering sciences.
Design and Development of a Solution	An Engineer must be able to 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.
Investigation	An Engineer should 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.
Modern Tools Usage	An Engineer should be able to create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
The Engineer and the Society	An Engineer should be able to 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.

Individual and Teamwork	An Engineer should be able to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
Lifelong Learning	An Engineer must 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.
Environment and Sustainability	An Engineer must understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
Professional Ethics	An Engineer should be able to apply ethical principles and commit to professional ethics and responsibilities and norms of the Engineering practice.
Project Management and Finance	An Engineer must demonstrate knowledge and understanding of the engineering and management principles and apply these to Engineering work environment, as a member and leader in a team, to manage projects and in multidisciplinary environments.

SRM UNIVERISTY DELHI-NCR, SONEPAT
FACULTY OF ENGINEERING AND TECHNOLOGY

FACULTY OF ENGINEERING PROGRAM EDUCATIONAL OBJECTIVES (EPEOs)

1. Advancement to a professional position by virtue of their knowledge, skills and attitude.
2. Recognition for solving engineering problems and developing design solutions that consider safety and sustainability.
3. Work as successful professionals in diverse engineering disciplines and enterprises;
4. Increasing responsibilities of technical and managerial leadership in their work organizations;
5. Professional development through a commitment to career-long learning.

FACULTY OF ENGINEERING PROGRAM LEARNING OUTCOMES (EPLOs)

1. An ability to identify, formulate, and solve real time engineering & socio-economic problems by applying principles of engineering, science, mathematics, humanities and social sciences
2. An ability to use the advanced skill enhancement techniques and modern engineering tools as per industry 4.0 necessary for engineering practice.
3. An ability to apply engineering design to produce solutions that meet specified needs with realistic considerations of environmental, ethical, health & safety and sustainability
4. an ability to adapt and work with multidisciplinary teams and communicate effectively;
5. An ability to function effectively on a team whose members together provide leadership, to create a collaborative environment, to establish goals and to execute plan tasks.
6. an understanding of professional and ethical responsibility;
7. An ability to acquire and apply new knowledge using appropriate learning strategies with inner quest to learn, unlearn and relearn.

MAPPING MATRIX OF FACULTY OF ENGINEERING PROGRAM EDUCATIONAL OBJECTIVES AND FACULTY OF ENGINEERING PROGRAM LEARNING OUTCOMES

ENGINEERING PROGRAM EDUCATIONAL OBJECTIVES	ENGINEERING PROGRAM LEARNING OUTCOMES
Advancement to a professional position by virtue of their knowledge, skills and attitude.	1. An ability to identify, formulate, and solve real time engineering and socio-economic problems by applying principles of engineering, science, mathematics, humanities and social sciences 2. An ability to use the advanced skill enhancement techniques and modern engineering tools as per industry 4.0 necessary for engineering practice.
Recognition for solving engineering problems and developing design solutions that consider safety and sustainability	2. An ability to use the advanced skill enhancement techniques and modern engineering tools as per industry 4.0 necessary for engineering practice. 3. An ability to apply engineering design to produce solutions that meet specified needs with realistic considerations of environmental, ethical, health & safety and sustainability
Work as successful professionals in diverse engineering disciplines	3. An ability to apply engineering design to produce solutions that meet specified needs with realistic considerations of environmental, ethical, health & safety and sustainability 4. an ability to adapt and work with multidisciplinary teams and communicate effectively;
Increasing responsibilities of technical and managerial leadership in their work organizations;	4. an ability to adapt and work with multidisciplinary teams and communicate effectively; 5. An ability to function effectively on a team whose members together provide leadership, to create a collaborative environment, to establish goals and to execute plan tasks. 6. an understanding of professional and ethical responsibility;
Professional development through a commitment to career-long learning.	6. an understanding of professional and ethical responsibility; 7. An ability to acquire and apply new knowledge using appropriate learning strategies with inner quest to learn, unlearn and relearn.

MAPPING MATRIX OF FACULTY OF ENGINEERING PROGRAM EDUCATIONAL OBJECTIVES AND FACULTY OF ENGINEERINGPROGRAM LEARNING OUTCOMES (TABULAR FORMAT)

Table 1

MAPPING	EPELO1	EPELO2	EPELO3	EPELO4	EPELO5	EPELO6	EPELO7
EPEO1	X	X					
EPEO2		X	X				
EPEO3			X	X			
EPEO4				X	X	X	
EPEO5						X	X

SRM UNIVERSITY DELHI-NCR, SONEPAT

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

ELECTRONICS AND COMMUNICATION ENGINEERING (ECE)

GRADUATES EMPLOYABILITY ATTRIBUTES

The B. Tech program aims at providing a strong foundation in theoretical, practical, and design aspects of Electronics and Communication Engineering (ECE). The UG program is embraced by rigor and span to prepare a practicing engineer for a lifetime of creative work and ongoing technical learning. The curriculum covers all aspects of Electronics and Communication Engineering under the broad categories of VLSI Design, Signal Processing, Embedded Systems, Machine to Machine Communication and Internet of Things (IoT). The syllabus comprises theory and laboratory courses. The theory course can be either a professional core (major) or a professional elective course (minor). There are various specialized identified domains in emerging areas on which minor specializations are offered by the department. Each theory course has a laboratory component, which provides a balanced mix of quality teaching of theoretical concepts and experimental verification of the learned concepts. There are exclusive laboratory courses aimed at imparting the design knowledge of electronic circuits. The Major Project/Internship in the eighth semester and the Minor project work in the seventh semester are aimed to providing opportunities to the students, as well as guiding them to design circuits using the CAD tools and hardware programming using the HDL. Various advanced controller boards are available for training and the design purpose of the IoT and embedded system.

1. An ECE graduate should be able to apply the knowledge of applied basic sciences, engineering sciences, and engineering fundamentals to the solution of complex engineering problems.
2. An ECE graduate engineer should be able to identify, formulate, review research literature, and analyse complex Engineering problems reaching substantiated conclusions using principles of mathematics, natural sciences, and engineering sciences.
3. An ECE graduate engineer must be able to 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. An ECE graduate engineer should 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. An ECE graduate engineer should 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.
6. ECE graduate engineer should be able to create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
7. An ECE graduate engineer should be able to 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
8. An ECE graduate engineer should be able to 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.
9. An ECE graduate engineer should be able to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. An ECE graduate engineer must 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.

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO1: To impart foundation on mathematics, engineering analysis, electronics, and communication involved to enhance their design, modeling and problem-solving capabilities.

PEO2: To create industry-ready engineers by exposing them to the latest areas such as device modeling, Integrated Circuits, Embedded systems, IoT, Artificial Intelligence, Wireless communication, and recent developments in these areas.

PEO3: To kindle the research ability in them by providing opportunities for them to work in research labs to understand the common tools & environments and working ethics to achieve project objectives.

PEO4: To inculcate the habit of working together as a team and also develop leadership abilities in them by introducing them to the various teaching-learning techniques and coordination programmes.

PEO5: To encourage students to participate in technical and non-technical activities to develop innovative, creative, and leadership abilities.

PEO6: To engage students in the lifelong learning process and in the nation-building process by inculcating inter-disciplinary projects ability, adaptability towards the changing professional need and societal needs

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

PROGRAMME LEARNING OUTCOMES (PLOs)

PLO1-Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and IC design and technology concepts towards modelling and prototyping Integrated systems.

PLO2-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.

PLO3-Design/development of solutions: Design methodology to offer hardware solutions to public health, safety and agriculture, consumer electronics along with cultural, societal, and environmental considerations.

PLO4-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.

PLO5-Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PLO6-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.

PLO7-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.

PLO8-Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PLO9-Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

PLO10-Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehended write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PLO11-Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply the set one‘s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PLO12-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.

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO1: Product development: Identify, formulate, and analyze real life problems that are solvable using techniques in electronics and communication engineering and develop innovative, reliable, economic and eco-friendly solutions to such problems.

PSO2: Research aptitude: Research on the current problems and advance the knowledge further in the fields of semiconductor devices and circuits, signal processing, telecommunication, data science etc. using scientific knowledge acquired from the programme and state of the art software and hardware tools available.

MAPPING BETWEEN PROGRAM EDUCATIONAL OBJECTIVES (PEOs) AND PROGRAM LEARNING OUTCOMES (PLOs)

Table 2

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
PEO1	■	■	■	■								
PEO2					■	■	■					
PEO3							■	■				
PEO4									■	■		
PEO5						■	■	■	■	■		
PEO6											■	■

B.TECH. (ELECTRONICS AND COMMUNICATION ENGINEERING)

PROGRAM STRUCTURE IN ALIGNMENT WITH NATIONAL EDUCATION POLICY, 2020

- **Basic Applied Sciences (BAS) and Engineering Science (ES):**

  The purpose of Basic Applied Sciences in Engineering study is to lay a strong foundation of basic principles of various disciplines such as Mathematics, Physics, Chemistry in the mind of the learners, so that they proceed to rest of their years of study with up to date knowledge and training of basic engineering skills. The Engineering Sciences requirements support multiple objectives: first, the courses provide a strong foundation in the basic tools and methodologies common to all engineering disciplines; second, all students are exposed to basics of each discipline allowing for cross-disciplinary competencies; last, there is a multi-disciplinary project component where students from different engineering disciplines come together on a design project, allowing for practice in collaborative team work.

- **Professional Core Courses (PC):** The Professional core courses are aimed at providing the student with a solid foundation in their chosen field of study as per Industry 4.0 skills and knowledge.

- **Practical (P):**

  The labs are fully furnished and well equipped with latest software's to conduct practical as per the requirement of the University Curriculum.

- **Professional Electives (PE) – Programme specific Specialization Electives:**

  The Professional electives, on the other hand, provide the student with an option to gain exposure to different specializations within the discipline, or an opportunity to study one of the subfields in some depth.

- **Ability Enhancement Courses (AEC)**

  Students are required to achieve competency in a Modern Indian Language (MIL) along with English language with special emphasis on language and communication skills. The courses aim at enabling the students to acquire and demonstrate the core linguistic skills, including critical reading and academic writing skills. The focus is on imparting students with necessary skills to articulate their arguments and present their thoughts clearly and coherently and recognize the importance of language as a mediator of knowledge and identity.

- **Skill Enhancement Courses (SEC) – Technical & Soft Skills:**
    - **Technical Skills:** Under Technical Skills Broad categories of training to be imparted in Engineering Graduates of various disciplines with common nomenclature. The training is categorized into three categories: Elementary, Intermediate & Advanced keeping in view interdisciplinary approach. (One Credit Each from 3rd semester to 7th semester)
    - **Soft Skills:** Under Soft skills training six soft skill courses with defined Nomenclature and course content common to all Engineering disciplinesintroduced to inculcate Group Dynamics, Team work & Leadership Traits by engaging students for interactive sessions through Role Play, Group Discussions and for improving presentation &Communication skills of engineering graduates.(One Credit Course from 3rd Semester to 7th semester).

- **Value Added Courses (VAC):**

  Course components relating to skills, attitudes, and values required to take appropriate actions for mitigating the effects of environmental degradation, climate change, and pollution, effective waste management, conservation of biological diversity, management of biological resources, forest and wildlife conservation, and sustainable development and living health and wellness seek to promote an optimal state of physical, emotional, intellectual, social, spiritual, and environmental well-being of a person, the constitutional obligations with special emphasis on constitutional values and fundamental rights and duties

- **Live Projects (LP) & Industrial Visits (IV) and Summer Internship (SI):**
- **Live Projects & Industrial Visits:**
    - ❖ Live Projects is being introduced for all Engineering disciplines from 4th semester onwards till 7th Semester to develop an ability in engineering graduates to apply skillsand knowledge attained to solve real life complex problems (One Credit each semester).

  Apart from this, it will be mandatory to conduct at least 2 Industrial Visits each semester to provide students a proper industrial exposure.

- **Summer Internship (SI):**
    - ❖ Student will be monitored on periodic basis, both by the Faculty Mentor from the Industry and the FacultyIn-charge from the department. The Faculty Mentor from the Industry will submit the Mid-Term and End-Term Evaluation report. However, the faculty In-charge

from the department will take periodic presentation to keep a check on the progress of Student.

- ❖ Students are provided with the internship related document which helps them to prepare, report. In addition to this, it provides a detail to students about internship/project evaluation parameters.

- **Multidisciplinary (Humanities and Social Sciences Courses) Courses (MDC)**

  The open elective subject courses provide the student with wide latitude to pursue their interests, be it in humanities, management, arts or their own chosen field of study in order to have multidisciplinary approach.

SRMUH FOUR YEAR UNDERGRADUATE PROGRAM STRUCTURE IN ALIGNMENT WITH NATIONAL EDUCATION POLICY 2020 (NEP 2020)

Table 3

SL.NO	CATERGORY OF COURSES (Existing)	CATERGORY OF COURSES (As Per NEP-2020)
1.	Basic Applied Sciences	Basic Applied Sciences
2.	Engineering Sciences	Engineering Sciences
3.	Professional Core Courses	Professional Core Courses
4.	Professional Electives-Program Specific Specialization Electives	Professional Electives-Program Specific Specialization Electives
5.	Humanities & Social Sciences including Management courses (Courses aligned with Language)	Ability Enhance Courses (AEC)
6.	Skill Enhancement Courses(Technical & Soft Skills)	Skill Enhancement Courses (Technical & Soft Skills)
7.	Open Electives-Courses from Other Areas & Emerging Fields	Value Added Courses (VAC)
8.	Practicals/Workshops	Practicals/Workshops
9.	Live Projects and Summer Internship	Live Projects and Summer Internship
10.	Humanities and Social Sciences Courses) Courses	Multidisciplinary (Humanities and Social Sciences Courses) Courses (MDC)

SRMUH FOUR YEAR UNDERGRADUATE PROGRAM CREDIT STRUCTURE IN ALIGNMENT WITH NATIONAL EDUCATION POLICY 2020 (NEP 2020)

FOR BACHELOR OF TECHNOLOGY (ELECTRONICS AND COMMUNICATION ENGINEERING) DEGREE COURSE

Table 4

SL. No.	Course Category	Course Code	Number of Courses
1	Basic Applied Sciences	BAS	5
2	Engineering Sciences	ES	6
3	Professional Core	PC	15
4	Professional Electives -Program Specific Specialized Elective Courses	PE	10
5	Ability Enhancement Courses	AEC	4
6	Skill Enhancement courses (Technical andSoft skills)	SEC	10
7	Value Added Courses	VAC	5
8	Practical / Workshop	P/W	10
9	Live Project & Industrial Visit and Summer Internship	LP/SI	6
10	Humanities and Social Sciences (Including Management Courses) (Multidisciplinary)	MDC	3
TOTAL NUMBER OF COURSES			73

SRMUH FOUR YEAR UNDERGRADUATE PROGRAM CREDIT STRUCTURE IN ALIGNMENT WITH NATIONAL EDUCATION POLICY, 2020

BACHELOR OF TECHNOLOGY

(ELECTRONICS AND COMMUNICATION ENGINEERING)

Table 5

SL.NO	COURSES CATEGORY	COURSE CODE	CREDIT RANGE (180-190)
1.	Basic Applied Sciences	BAS	**88**
2.	Engineering Sciences	ES	
3.	Professional Core Courses	PC	
4.	Professional Electives-Program Specific Specialization Electives	PE	**30**
5.	Ability Enhance Courses (AEC)	AEC	**7**
6.	Skill Enhancement Courses(Technical & Soft Skills)	SEC	**10**
7.	Value Added Courses (VAC)	VAC	**8**
8.	Practicals/Workshops	P/W	**10**
9.	Live Projects and Summer Internship	LP/SI	**20**
10.	Humanities & Social Sciences including Management courses (Multidisciplinary)	MDC	**9**
	Total		**182**

SRMUH FOUR YEAR UNDERGRADUATE PROGRAM CREDIT STRUCTURE

SEMESTER WISE IN ALIGNMENT WITH NATIONAL EDUCATION POLICY, 2020

BACHELOR OF TECHNOLOGY

(ELECTRONICS AND COMMUNICATION ENGINEERING)

S.NO	COURSES CATERGORY	COURSE CODE	I	II	III	IV	V	VI	VII	VIII	CREDIT	%
1.	Basic Applied Sciences	BAS	9	9	4						22	12
2.	Engineering Sciences	ES	9/8	8/9							17	10
3.	Professional Core Courses	PC	-	-	12	12	14	11			49	28
4.	Professional Electives-Program Specific	PE	-	-	3	3	3	6	15		30	16
5.	Ability Enhance Courses (AEC)	AEC	2/5	5/2							7	4
6.	Skill Enhancement Courses(Technical & Soft Skills)	SEC	-	-	2	2	2	2	2		10	6
7.	Value Added Courses (VAC)	VAC	2	2	2	2					8	3
8.	Practicals/Workshops (Major)	P/W	-	-	2	2	2	2	2		10	5
9.	Live Projects and Summer Internship	LP/SI	-	-		1	1	1	5	12	20	11
10.	Humanities & Social Sciences including	MDC	-	-		3	3	3			9	5
	Total		24/22	24/22	25	25	25	25	24	12	182	100

SEMESTER – I

SL. No	Code	Category	Course Name	Hours per week				Credits
				L	T	P	Total Hours	
THEORY								
1	25AS101	(BAS)	Engineering Mathematics-I	3	1	0	4	4
OR								
1 (a)	25AS107	(BAS)	Mathematics-I (For BME students)	2	0	0	2	2
1 (b)	25AS109	(BAS)	Biology (For BME students)	1	1	0	2	2
2	25AS103/ 25AS105	(BAS)	Quantum Computation and Communication / Applied Chemistry	3	1	0	4	4
3	25EE101/ 25EC101	(ES)	Basic Electrical Engineering / Basic Electronics Engineering	3	0	0	3	3
4	25ME101	(ES)	Fundamentals of Robotics and AI	3	0	0	3	3
	OR							
	25CS101	(ES)	Fundamentals of Computer & C Programming	3	0	0	3	3
5	25HS101	(AEC)	Communicative English	2	0	0	2	2
6	25HIN101 / 25FLGR101 / 25FLFR101	(AEC)	Hindi-I/German-I/French-I	2	0	0	2	2
7	25ESEB101/ 25VAC101	(VAC)	Environmental Bioengineering / Indian Constitution and Polity	2	0	0	2	2
Total Credits (Theory)				**18/16**	**2**	**0**	**20/18**	**20/18**
PRACTICAL								
8	25AS153/ 25AS155	(BAS)	Quantum Physics Lab / Applied Chemistry Lab	0	0	2	2	1
9	23EE151/25EC151	(ES)	Basic Electrical Engineering Lab / Basic Electronics Engineering Lab	0	0	2	2	1
10	25ME151/25CS151	(ES)	Design thinking and Engineering practices Lab / C Programming Lab	0	0	2	2	1
11	25ME153/25HS151	(ES)/ (AEC)	Engineering Graphics & Design Lab/ Communicative English Lab	0	0	2	2	1`
Total Credits (Practical)				**0**	**0**	**8**	**8**	**4**
TOTAL CREDITS (THEORY + PRACTICAL)				**18/16**	**2**	**8**	**28/26**	**24/22**

SEMESTER – II

SL. No	Code	Category	Course Name	Hours per week				Credits
				L	T	P	Total Hours	
THEORY								
1	25AS202	(BAS)	Engineering Mathematics-II	3	1	0	4	4
OR								
1	25AS204	(BAS)	Mathematics-II (For BME students)	3	1	0	4	4
2	25AS206/ 25AS208	(BAS)	Quantum Computation and Communication / Applied Chemistry	3	1	0	4	4
3	25EE202/ 25EC202	(ES)	Basic Electrical Engineering / Basic Electronics Engineering	3	0	0	3	3
4	25ME202	(ES)	Fundamentals of Robotics and AI*	3	0	0	3	3
	OR							
	25CS202	(ES)	Fundamentals of Computer & C Programming	3	0	0	3	3
5	25HS202	(AEC)	Communicative English	2	0	0	2	2
6	25HIN202 / 25FLGR202 / 25FLFR202	(AEC)	Hindi-I/German-I/French-I	2	0	0	2	2
7	25ESEB202/ 25VAC202	(VAC)	Environmental Bioengineering / Indian Constitution and Polity	2	0	0	2	2
Total Credits (Theory)				**18/16**	**2**	**0**	**20/18**	**20/18**
PRACTICAL								
8	25AS256/ 25AS258	(BAS)	Quantum Physics Lab / Applied Chemistry Lab	0	0	2	2	1
9	23EE252/25EC252	(ES)	Basic Electrical Engineering Lab / Basic Electronics Engineering Lab	0	0	2	2	1
10	25ME252/25CS252	(ES)	Design Thinking and Engineering Practices Lab* / C Programming Lab	0	0	2	2	1
11	25ME254/25HS252	(ES)/ (AEC)	Engineering Graphics & Design Lab/ Communicative English Lab	0	0	2	2	1`
Total Credits (Practical)				**0**	**0**	**8**	**8**	**4**
TOTAL CREDITS (THEORY + PRACTICAL)				**18/16**	**2**	**8**	**28/26**	**24/22**

*Engineering Mechanics (25CE202) and Basic Civil Engineering Lab (25CE252) will be offered to Civil Engineering students.

SEMESTER – III

S. No	Category	Code	Course	L	T	P	C
THEORY							
1	PC	25EC203	Digital Systems	3	0	0	3
2	PC	25EC205	Signals and Systems	3	0	0	3
3	PC	25EC207	Electromagnetic Field Theory	3	0	0	3
4	PC	25EC209	Fundamental of Electronics Devices	3	0	0	3
5	PE	25EPEXXX	Professional Elective-I	3	0	0	3
6	BAS	24AS301	Engineering Mathematics - III	3	1	0	4
7	VAC	25VAC103	Sports, Yoga and Fitness	1	0	2	2
TOTAL CREDITS (THEORY)				**19**	**1**	**2**	**21**
PRACTICAL							
8	P	25EC211	Electronics Devices Lab	0	0	2	1
9	P	25EC213	Digital Systems Lab	0	0	2	1
TOTAL CREDITS (PRACTICAL)				**0**	**0**	**4**	**2**
SKILL ENHANCEMENT							
10	SEC	24SS351	Effective Communication Skills	0	0	2	1
11	SEC	24CS0201A/24ME0201/24CS0201B/24CE0201/25EC0201	Data Structure and Algorithms using C or C++/Industry Automation Level-I/ Digital Marketing/Fundamentals of CAD for Engineers/Graphical Programming using Simulink	0	0	2	1
TOTAL CREDITS (SKILL ENHANCEMENT)				**0**	**0**	**4**	**2**
TOTAL CREDITS (THEORY+PRACTICAL+SKILL ENHANCEMENT)				**19**	**1**	**10**	**25**

SEMESTER – IV

Sl. No	Category	Code	Course	L	T	P	C
THEORY							
1	PC	25EC208	Programming Using Python	3	0	0	3
2	PC	25EC202	Electronic Circuits	3	0	0	3
3	PC	25EC204	Linear Integrated Electronics	3	0	0	3
4	PC	25EC206	Transmission Lines and Waveguides	3	0	0	3
5	PE	25EPEXXX	Professional Elective -II	3	0	0	3
6	MDC	24MDC401	Multidisciplinary Elective-I	3	0	0	3
7	VAC	25VAC201	Environmental Management and Legislation	2	0	0	2
TOTAL CREDITS (THEORY)				**20**	**0**	**0**	**20**
PRACTICAL							
8	P	25EC212	Electronic Circuits Lab	0	0	2	1
9	P	25EC214	Advance Simulation Lab	0	0	2	1
10	LP/SI	25LP202	#Live Projects and Industrial Visit	0	0	2	1
TOTAL CREDITS (PRACTICAL)				**0**	**0**	**6**	**3**
SKILL ENHANCEMENT							
11	SEC	23SS452	Teamwork & Interpersonal Skills	0	0	2	1
12	SEC	24CS0202A/24 CS0202B	Design Thinking and Augmented Virtual Reality/Programming Using Python for Engineers	0	0	2	1
TOTAL CREDITS (SKILL ENHANCEMENT)				**0**	**0**	**4**	**2**
TOTAL CREDITS (THEORY+PRACTICAL+SKILL ENHANCEMENT)				**20**	**0**	**10**	**25**

Industry Visit to be carried out during 4th semester. Evaluation to be carried out during end of 4th semester.

SEMESTER – V

Sl. No	Category	Code	Course	L	T	P	C
THEORY							
1	PC	25EC303	Analog and Digital Communication	3	1	0	4
2	PC	25EC305	Antenna and Wave Propagation	3	1	0	4
3	PC	25EC307	Microprocessors and Interfacing	3	0	0	3
4	PC	25EC301	Machine Learning using Python	3	0	0	3
5	PE	25EPEXXX	Professional Elective-III	3	0	0	3
6	MDC	24MDC501	Multidisciplinary Elective-II	3	0	0	3
TOTAL CREDITS (THEORY)				**18**	**2**	**0**	**20**
PRACTICAL							
7	P	25EC311	Microprocessors Lab	0	0	2	1
8	P	25EC313	Communication Lab	0	0	2	1
9	LP/SI	24LP301	#Live Project & Summer Internship	0	0	2	1
TOTAL CREDITS (PRACTICAL)				**0**	**0**	**6**	**3**
SKILL ENHANCEMENT							
10	SEC	23SS553	Presentation & Speaking Skills	0	0	2	1
11	SEC	24CS0301A/24CS0301B/24CS0301C/24ME0301/24CE0301/25EC0301	Wearable Technology/Big Data Analytics, Tools and Techniques/Machine Learning using Python/Industry Automation Level-II/RCC Structure Drawing Training/Programming of Microcontroller	0	0	2	1
TOTAL CREDITS (SKILL ENHANCEMENT)				**0**	**0**	**4**	**2**
TOTAL CREDITS (THEORY+PRACTICAL+SKILL ENHANCEMENT)				**18**	**2**	**10**	**25**

To be carried out during semester break of 4th semester. Evaluation to be carried out during 5th semester.

SEMESTER – VI

Sl. No	Category	Code	Course	L	T	P	C
THEORY							
1	PC	25EC302	RF and Microwave Engineering	3	1	0	4
2	PC	25EC304	Optical Fibre Communication	3	1	0	4
3	PC	25EC306	Digital VLSI Design	3	0	0	3
4	PE	25EPEXXX	Professional Elective -IV	3	0	0	3
5	PE	25EPEXXX	Professional Elective -V	3	0	0	3
6	MDC	24MDC601	Multidisciplinary Elective-III	3	0	0	3
TOTAL CREDITS (THEORY)				**18**	**2**	**0**	**20**
PRACTICAL							
7	P	25EC312	Microwave and Optical Communication Lab	0	0	2	1
8	P	25EC314	Digital VLSI Design Lab	0	0	2	1
9	LP/SI	25LP302	#Live Projects & Industrial Visit	0	0	2	1
TOTAL CREDITS (PRACTICAL)				**0**	**0**	**6**	**3**
SKILL ENHANCEMENT							
10	SEC	23SS654	Professional Writing Skills	0	0	2	1
11	SEC	24CS0302A/24EC0302/24CE0302/24CS0302B	Artificial Intelligence and Machine Learning/MATLAB for Engineers/ Structural Analysis using FEM-based Tools/Data Analytics Tools	0	0	2	1
TOTAL CREDITS (SKILL ENHANCEMENT)				**0**	**0**	**4**	**2**
TOTAL CREDITS (THEORY+PRACTICAL+SKILL ENHANCEMENT)				**18**	**2**	**10**	**25**

*****The XX part of the course code will depend upon the elective chosen by the student

Industry Visit to be carried out during 6th semester. Evaluation to be carried out during end of 6th semester.

SEMESTER – VII

Sl. No	Category	Code	Course	L	T	P	C
THEORY							
1	**PE**	25EPEXXX	Professional Elective -VI	3	0	0	3
2	**PE**	25EPEXXX	Professional Elective -VII	3	0	0	3
3	**PE**	25EPEXXX	Professional Elective -VIII	3	0	0	3
4	**PE**	25EPEXXX	Professional Elective -IX	3	0	0	3
5	**PE**	25EPEXXX	Professional Elective – X	**3**	**0**	**0**	**3**
TOTAL CREDITS (THEORY)				**15**	**0**	**0**	**15**
PRACTICAL							
6	P	25EPEXXX	PE Lab	0	0	2	1
7	P	25EPEXXX	PE Lab	0	0	2	1
8	LP	25LP411	# Live Projects & Summer Internship	0	0	2	1
9	LP	25LP413	**Minor Project	0	0	8	4
TOTAL CREDITS (PRACTICAL)				**0**	**0**	**14**	**7**
SKILL ENHANCEMENT							
10	SEC	23SS755	Interpersonal Skills: Strategies	0	0	2	1
11	SEC	24CE0401/24EC0401/24CS0401	Building information modelling / FPGA for Embedded Systems/Essentials of Blockchain and IoT	0	0	2	1
TOTAL CREDITS (SKILL ENHANCEMENT)				**0**	**0**	**4**	**2**
TOTAL CREDITS (THEORY+PRACTICAL+SKILL ENHANCEMENT)				**15**	**0**	**18**	**24**

The XX parts of the course code will depend upon the elective chosen by the student.

**To be monitored at the Institute Level. Teaching Load for ERP

#To be carried out after 6th semester during semester break. Evaluation to be carriedout in 7th Semester.

SEMESTER – VIII

Course Category	Course Code	Course Name	Hours Per Week			Credits
			L	T	P	
LP	25LP402	*Major Project (Industrial Internship)	0	0	24 (6)**	12

***To be monitored at the Institute Level**

****Teaching Load**

L : Lecture	**BAS : Basic Applied Sciences**
T : Tutorials	**ES : Engineering Sciences**
P: Practical	**PC : Professional Core Courses**
	PE : Professional Electives
	P/W : Practical / Workshop
	AEC : Ability Enhancement Courses
	VAC : Value Added Courses
	SEC : Skills Enhancement Course
	LP : Live Projects & Summer Internship
	MDC : Multidisciplinary Courses

PROGRAM SPECIALIZATION CATEGORY-I

PROGRAM ELECTIVE SPECIALIZATION COURSES UNDER THE DEGREE OF ELECTRONICS AND COMMUNICATION ENGINEERING

Basket-I of Program Elective Courses

[Specialization in VLSI Design]

S. No.	Elective	Category	Course Code	Course Name	L	T	P	C
1.	I	PE	25EPE211	Circuit Analysis & Synthesis	3	0	0	3
2.	II	PE	25EPE212	Digital Signal Processing	3	0	0	3
3.	III	PE	25EPE311	Solid-State Device Modelling/ Instrumentation and Control Engineering	3	0	0	3
4.	IV	PE	25EPE312	Embedded System Design using Microcontrollers	3	0	0	3
5.	V	PE	25EPE314	Mixed Signal System Design	3	0	0	3
6.	VI	PE	25EPE411	VLSI Fabrication Technology	3	0	0	3
7.	VII	PE	25EPE413	HDL Programming and System Design	3	0	2	4
8.	VIII	PE	25EPE415	ASIC and FPGA system design	3	0	2	4
9.	IX	PE	25EPE417	VLSI Testing	3	0	0	3
10.	X	PE	25EPE419	Low power VLSI Design	3	0	0	3

Note: Students may opt one course in 6^{th} semester and one course in 7^{th} semester apart from the elective list (as elective) from NPTEL on recommendation of departmental committee.

PROGRAM SPECIALIZATION CATEGORY-II

PROGRAM ELECTIVE SPECIALIZATION COURSES UNDER THE DEGREE OF ELECTRONICS AND COMMUNICATION ENGINEERING

Basket-II of Program Elective Courses

[Specialization in Communication and Network Design]

S. No.	Elective	Category	Course Code	Course Name	L	T	P	C
1.	I	PE	25EPE211	Circuit Analysis & Synthesis	3	0	0	3
2.	II	PE	25EPE212	Digital Signal Processing	3	0	0	3
3.	III	PE	25EPE321	Neural Network and Fuzzy logic/ Instrumentation and Control Engineering	3	0	0	3
4.	IV	PE	25EPE322	Introduction to Machine Learning	3	0	0	3
5.	V	PE	25EPE324	Advanced Wireless Communication	3	0	0	3
6.	VI	PE	25EPE421	Network Security	3	0	0	3
7.	VII	PE	25EPE423	Data Communication and Network	3	0	2	4
8.	VIII	PE	25EPE425	Internet of Things (IoT) and Applications	3	0	2	4
9.	IX	PE	25EPE427	Information Theory and Coding	3	0	0	3
10.	X	PE	25EPE429	Network Modelling using Reinforcement Learning	3	0	2	4

Note: Students may opt one course in 6^{th} semester and one course in 7^{th} semester apart from the elective list (as elective) from NPTEL on recommendation of departmental committee.

PROGRAM SPECIALIZATION CATEGORY-III

PROGRAM ELECTIVE SPECIALIZATION COURSES UNDER THE DEGREE OF ELECTRONICS AND COMMUNICATION ENGINEERING

Basket-III of Program Elective Courses

[Specialization in Electronics and Communication Engineering]

S. No.	Elective	Category	Course Code	Course Name	L	T	P	C
1.	I	PE	25EPE211	Circuit Analysis & Synthesis	3	0	0	3
2.	II	PE	25EPE212	Digital Signal Processing	3	0	0	3
3.	III	PE	25EPE311	Solid-State Device Modelling	3	0	0	3
			25EPE321	Neural Network and Fuzzy logic	3	0	0	3
			25EPE331	Control Engineering	3	0	0	3
4.	IV	PE	25EPE312	Embedded System Design using Microcontrollers	3	0	0	3
			25EPE322	Introduction to Machine Learning	3	0	0	3
			25EPE332	Data Science	3	0	0	3
5.	V	PE	25EPE314	Mixed Signal System Design	3	0	0	3
			25EPE324	Advanced Wireless Communication	3	0	0	3
			25EPE334	AI and Expert Systems	3	0	0	3
			25EPE344	Electronic Instrumentation and Measurement	3	0	0	3

6.	VI	PE	25EPE411	VLSI Fabrication Technology	3	0	0	3
			25EPE421	Network Security	3	0	0	3
			25EPE431	Deep Learning	3	0	0	3
7.	VII	PE	25EPE413	HDL Programming and System Design	3	0	2	4
			25EPE423	Data Communication and Network	3	0	2	4
8.	VIII	PE	25EPE415	ASIC and FPGA system design	3	0	2	4
			25EPE425	Internet of Things (IoT) and Applications	3	0	2	4
9.	IX	PE	25EPE417	VLSI Testing	3	0	0	3
			25EPE427	Information Theory and Coding	3	0	0	3
10.	X	PE	25EPE419	Low power VLSI Design	3	0	0	3
			25EPE429	Network Modelling using Reinforcement Learning	3	0	0	3

Note: Students may opt one course in 6^{th} semester and one course in 7^{th} semester apart from the elective list (as elective) from NPTEL on recommendation of departmental committee.

NPTEL COURSE LIST

S. No.	Name of the Course	L	T	P	C
1.	Hardware modelling using Verilog	3	0	0	3
2.	VLSI Physical Design	3	0	0	3
3.	Mapping Signal Processing Algorithms to Architectures	3	0	0	3
4.	Digital IC Design	3	0	0	3
5.	Power Management Integrated Circuits	3	0	0	3
6.	Microprocessors and Interfacing	3	0	0	3
7.	Introduction to Time - Varying Electrical Networks	3	0	0	3
8.	System Design Through VERILOG	3	0	0	3
9.	Circuit Analysis for Analog Designers	3	0	0	3
10.	Design and Analysis of VLSI Subsystems	3	0	0	3
11.	Physics of Nanoscale Devices	3	0	0	3
12.	Phase-locked loops	3	0	0	3
13.	VLSI Interconnects	3	0	0	3
14.	Semiconductor device modelling and Simulation	3	0	0	3
15.	VLSI Design Flow: RTL to GDS	3	0	0	3
16.	Integrated Circuits and Applications	3	0	0	3
17.	RF Transceiver Design	3	0	0	3
18.	VLSI Physical Design with Timing Analysis	3	0	0	3
19.	Basics of software-defined radios and practical applications	3	0	0	3
20.	Analog Signal Processing	3	0	0	3
21.	Coding theory	3	0	0	3
22.	Optical Wireless Communications for Beyond 5G Networks and IoT	3	0	0	3
23.	Integrated Photonics Devices and Circuits	3	0	0	3
24.	Design for internet of things	3	0	0	3
25.	Optical Fiber Sensors	3	0	0	3

Elective Laboratory Courses

Elective	Category	Course Code	Course Name	L	T	P	C
I	P	25EPE451	Embedded System Design Lab	0	0	2	1
II	P	25EPE453	ASIC and FPGA system design Lab	0	0	2	1
III	P	25EPE455	Data Communication Lab	0	0	2	1
IV	P	25EPE457	AI and Expert Systems Lab	0	0	2	1
V	P	25EPE459	Neural Network Lab	0	0	2	1

Note: Student may opt any two elective from the above list irrespective of the internal specialization.

SKILL ENHANCEMENT COURSES (SEC)

Category	Course Code	Course Name	L	T	P	Credits
TECHNICAL TRAINING						
SEC	24CS0201A/24ME0201/24CS0201B/24CE0201/25EC0201	Data Structure and Algorithms using C or C++/Industry Automation Level-I/ Digital Marketing/Fundamentals of CAD for Engineers/Graphical Programming using Simulink	0	0	2	1
SEC	24CS0202A/24CS0202B	Design Thinking and Augmented Virtual Reality/Programming Using Python for Engineers	0	0	2	1
SEC	24CS0301A/24CS0301B/24CS0301C/24ME0301/24CE0301/25EC0301	Wearable Technology/Big Data Analytics, Tools and Techniques/Machine Learning using Python/Industry Automation Level-II/RCC Structure Drawing Training/Programming of Microcontroller	0	0	2	1
SEC	24CS0302A/24EC0302/24CE0302/24CS0302B	Artificial Intelligence and Machine Learning/MATLAB for Engineers/ Structural Analysis using FEM-based Tools/Data Analytics Tools	0	0	2	1
SEC	24CE0401/24EC0401/24CS0401	Building information modelling / FPGA for Embedded Systems/Essentials of Blockchain and IoT	0	0	2	1
SOFT SKILL						
SEC	23SS351	Effective Communication Skills	0	0	2	1
SEC	23SS452	Teamwork & Interpersonal Skills	0	0	2	1
SEC	23SS553	Presentation Skills	0	0	2	1
SEC	23SS654	Professional Skills	0	0	2	1
SEC	23AR755	Aptitude & Reasoning	0	0	2	1

ABILITY ENHANCEMENT COURSES (AEC)

Total: 6 (3*2) Credits						
University Pool Common to all UG Programs						
Code	**Category**	**Course**	**L**	**T**	**P**	**C**
24HS101/24HS201	(AEC)	Communicative English	2	0	0	2
24 HIN101-I/24FLGR-I/24FLFR-I	(AEC)	Hindi/ German/French (Phase-I)	2	0	0	2
24 HIN101-II/24FLGR-II/24FLFR-II	(AEC)	Hindi/ German/French (Phase-II)	2	0	0	2
24HS151/24HS251	(AEC)	Communicative English laboratory	0	0	2	1

VALUE ADDED COURSES (VAC)

Total: 8 (2*4) Credits						
Code	**Category**	**Course**	**L**	**T**	**P**	**C**
23ESEB101/23ESEB201	(VAC)	Environment Bioengineering	2	0	0	2
25VAC201	(VAC)	Environmental Management and Legislation	2	0	0	2
23VAC102/23VAC202	(VAC)	Indian Constitution and Polity	2	0	0	2
25VAC103	(VAC)	Sports, Yoga and Fitness	1	0	2	2

Note:

1. All Courses are compulsory for the students.
2. Students would be encouraged to opt NCC/NSS.

MULTI-DISCIPLINARY COURSES (MDC)

Total: 9 (3*3) Credits						
Code	**Category**	**Course**	**L**	**T**	**P**	**C**
23MDC101/24MDC101A/24MDC101B/24MDC101C/24MDC101D	(MDC-I)	Statistical Methods/Computer-Based Numerical and Statistical Technique/Probability and Random Process/Biostatistics/Numerical Methods	3	0	0	3
23MDC102		Environmental Geosciences & Disaster Management	3	0	0	3
23MDC301		IPR in Business	3	0	0	3
23MDC302		Library Information Sciences & Media Literacy	3	0	0	3
23MDC401		Management Process & Organizational Behaviour	3	0	0	3
23MDC103	(MDC-II)	Photonics	3	0	0	3
23MDC104		Chemistry & Society	3	0	0	3
23MDC303		Psychology and Emotional Intelligence	3	0	0	3
23MDC304		Indian Economy	3	0	0	3
23MDC402		Creating an Entrepreneurial Mind	3	0	0	3
24MDC 106A/24MDC 106B		Numerical Methods in BME/Discrete Mathematics	3	0	0	3
23MDC105	(MDC-III)	Life Sciences & Public Health	3	0	0	3
23MDC305		Electoral Literacy in India	3	0	0	3
23MDC403		Personal Financial Planning	3	0	0	3
23MDC404		Interior Design	3	0	0	3
24MDC107		Probability & Statistics	3	0	0	3

Note

1. These courses will be of introductory level and shall have 3 credits.
2. Student will not be allowed to choose or repeat the courses already gone through in class XII and present in Program core and specialization.
3. Student will have option to choose any 3 out of the pool.

*Course shall be based on applications, tools and techniques.

ENGINEERING MATHEMATICS-I	
Course Code: 25AS101	**Continuous Evaluation:** 30 Marks
Credits: 4	**End Semester Examination:** 70 Marks
L T P : 3 1 0	
Prerequisite: 12th Mathematics	

COURSE OBJECTIVES (COs)

1. To provide students the understanding of matrix and its applications.
2. To introduce the concept of functions of several variables, Partial differentiation, and its applications.
3. To demonstrate the applications of Multiple Integrals.
4. To describe the concepts of vector calculus.
5. To illustrate the concept of convergence, divergence of sequences and series of real numbers and improper integration.

COURSE LEARNING OUTCOMES (CLOs)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Apply the techniques of matrices to real-world mathematical and computational problems.
2. Apply the knowledge of partial differentiation in engineering problems.
3. Calculate line, surface, and volume integrals.
4. Illustrate different real-world problems related to vector calculus
5. Explain convergence behaviour of sequences and series of real numbers and improper integration.

COURSE CONTENTS

UNIT	COURSE CONTENTS	HOURS
UNIT-I	**Matrix:** Types of Matrices, Elementary Transformations, Inverse of a square matrix by elementary transformation, Rank of a matrix (Echelon and Normal forms), Linear Dependence & Independence of vectors, Solution of system of linear equations (AX = 0 and AX = B), Eigenvalues and Eigenvectors, Cayley Hamilton theorem. **Application domain problems**: Cryptography (Coding and Decoding), Image and Image Processing, data storage and analysis.	12
UNIT-II	Functions of several variables, Partial Derivatives, Homogenous function, Euler's theorem for homogenous functions, Deductions from Euler's theorem, Total Derivatives, Chain Rule, Composite function of two variables, Differentiation of implicit functions, Applications of Partial Derivatives- Taylor's theorem for two variables, Maxima and minima for two variables, Jacobians. **Application domain problems**: Approximations and error analysis	12
UNIT-III	**Multiple integral:** Evaluation of Double integrals, Change of Order of Integration, Double integration in polar coordinates, Change of Variables, Triple integrals - Evaluation of triple integrals over a given region, Applications of Multiple	12

	Integrals – Area (Cartesian Coordinates). Beta and Gamma functions and their properties. **Application domain problems**: Centre of Mass, Moment of Inertia, Solid of revolution and Kinetic energy	
UNIT-IV	Vector calculus: Differentiation of vectors, Scalar and vector point functions, Gradient, Divergence, Curl, Directional derivatives, Vector Integration- Line, Surface and Volume integrals, Green's Theorem, Gauss' divergence theorem and Stroke's theorem (without proof). **Application domain problems**: Equation of continuity, Equation of motion, Inverse square law of force	12
UNIT-V	Sequence & Series: Convergence, divergence and oscillation of a series, Geometric Series, General properties of series, Test of convergence – Comparison test, Integral test, Comparison of Ratios, D'Alembert's Ratio test, Cauchy root test. **Application domain problems**: Computational geometry, Image processing.	12

TEXT BOOKS

1. Grewal B.S, Higher Engineering Mathematics, Khanna Publications, 45th Edition, 2020.
2. Jain R. K., Iyengar S. R. K., Advanced Engineering Mathematics, 7th Edition, Narosa Publishing House, 2021.
3. Kreyszig. E, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons. Singapore, 2017.
4. Bali N.P., Goyal M, Advanced Engineering Mathematics, Laxmi Publications, New Delhi, 2018.

REFERENCE BOOKS

1. Bali N.P., Goyal M, Advanced Engineering Mathematics, Laxmi Publications, New Delhi, 2018.
2. Dass H. K., Advanced Engineering Mathematics, Sultan Chand Publication, Delhi, 2018.

Mapping Matrix of Course Objectives (COs) and Course Learning Outcomes (CLOs)

SEM	SUBCODE	Course Name	Course Objectives	CLO1	CLO2	CLO3	CLO4	CLO5
I/II	25AS 101	ENGINEERING MATHEMATICS-I	CO1	x				
			CO2		x			
			CO3			x		
			CO4				x	
			CO5					x

Mathematics-I (For BME only)	
Course Code: 25AS107	**Continuous Evaluation:** 30 Marks
Credits: 2	**End Semester Examination:** 70 Marks
L T P : 2 0 0	
Prerequisite: Nil	

COURSE OBJECTIVES (COs)

1. To introduce the concept of Matrices and Determinants.
2. To demonstrate the concept of Differentiation.
3. To introduce the concept of Integration.
4. To create the knowledge of Differential Equations.

COURSE LEARNING OUTCOMES (CLOs)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Develop the essential tool of matrices and determinants.
2. Apply the knowledge of differentiation in Bio-engineering.
3. Solve problems related to integration.
4. Illustrate the concepts of differential equations.

COURSE CONTENTS

UNIT	COURSE CONTENTS	HOURS
UNIT-I	Introduction of matrices, Types of Matrices, Operations on Matrices, Transpose of a Matrix, Symmetric and Skew- Symmetric Matrices, Elementary Operation of a Matrix, Invertible Matrices. Introduction of Determinant, Properties of Determinants, Area of a triangle, Minor and Cofactors, Adjoint and Inverse of a Matrix. **Application domain problems:** Image and Image Processing, data storage and analysis, Gene sequencing, RNA, DNA analysis.	**8**
UNIT-II	Introduction, Continuity, Differentiability-Chain Rule, Derivatives of implicit functions, Derivatives of Trigonometric functions and Inverse trigonometric functions, Derivatives of Exponential and Logarithmic functions. **Application domain problems:** Enabling the modeling and analysis of dynamic biological systems.	**8**
UNIT-III	Introduction, Elementary Properties, Integration by method of Substitution, Integration using trigonometric identities, Integration by Partial fractions, Integration by parts. **Application domain problems:** Analyzing medical data	**7**
UNIT-IV	Introduction, Order and Degree of Differentiation equation, Solution of first order differential equations by method of variable separable, Homogeneous, Linear differential equation, Reducible to linear differential equation, Exact differential equation. **Application domain problems:** Various biological components interact and change over time, Epidemiology	**7**

TEXT BOOK

1. 1. Srimanta Pal and Subodh C. Bhunia, Engineering Mathematics, Oxford first edition, 2015.
2. 2. Grewal B.S, Higher Engineering Mathematics, Khanna Publications, 44th Edition, 2017.
3. Jain R. K., Iyengar S. R. K., Advanced Engineering Mathematics, 6th Edition, Narosa Publishing House, 2019.
4. Kreyszig. E, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons. Singapore, 2015.

REFERENCE BOOKS

1. Dass H. K., Advanced Engineering Mathematics, Sultan Chand Publication, Delhi, 2018.

Mapping Matrix of Course Objectives (COs) and Course Learning Outcomes (CLOs)

SEM	SUBCODE	Course Name	Course Objectives	CLO1	CLO2	CLO3	CLO4
I/II	25AS107	Mathematics-I (For BME only)	CO1	x			
			CO2		x		
			CO3			x	
			CO4				x

BIOLOGY (For BME only)	
Course Code: 25AS109	**Continuous Evaluation:** 30 Marks
Credits: 2	**End Semester Examination:** 70 Marks
L T P : 1 1 0	
Prerequisite: Nil	

COURSE OBJECTIVES (COs)

1. To study the basic living structure and their functions.
2. To focus on different physiological processes and introduce the concept of cell signaling and their role in diseases.
3. To understand the fundamental concepts of genetics in prokaryotes and eukaryotes.
4. To learn about the various levels of organization that plants and animals have, as well as the various activities that they do.
5. To investigate biological topics using a scientific method and get well-informed findings.
6. To integrate biological and engineering knowledge.

COURSE LEARNING OUTCOMES (CLOs)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Explain the complicated relationship between different cellular structures and their roles.
2. Employ experimental ways to solve genetic problems.
3. Explain how animals respond to changes in their environment.
4. When dealing with biological impediments and challenges, problem-solving abilities should be applied.
5. Analyse and interpret the data using appropriate biological methods.
6. Make connections between the various portions of the topics covered in the course.

COURSE CONTENTS

UNIT	COURSE CONTENTS	HOURS
UNIT-I	**NATURE OF LIVING THINGS** Definition of life, Miller's experiment, theories and evidences of origin of life, levels of biological organization, classification of living world, difference between prokaryotes and eukaryotes, Evolutionary processes: Lamarckism, Darwinism, role of mutations and isolating mechanisms, adaptive radiation.	8
UNIT-II	**MOLECULAR ORGANIZATION OF CELL** Difference between animal and plant cell, salient features of intracellular organelles, cell division and cell cycle. Basic idea for Cell division, Mitosis, Meiosis. Basic idea how Central Dogma of life, Introduction to major biomolecules Carbohydrates, fats and proteins.	8
UNIT-III	**FUNDAMENTALS OF GENETICS** Mendelian principles, pleiotropy, epistasis, linkage and crossing over, Mendel's laws - monohybrid - dihybrid inheritance- multiple alleles-structure and organization of chromosome in prokaryote and Eukaryotes. Linkage - types of linkage -crossing over and their types.	7
UNIT-IV	**UNIT IV: PHYSIOLOGY** Animal Physiology: Hormones and their mode of action, types of asexual and sexual reproduction, stages of embryogenesis.	7

TEXT BOOKS

1. Purves et al, Life: The Science of Biology.
2. R. Dulbecco, The Design of Life.
3. Samantha Fowler, Concepts of Biology, Publisher: OpenStax.
4. J. M. Mwaniki, Fundamentals of Biology, Longhorn Publishers and Worldreader

REFERENCE BOOKS

1. Keith Wilson & John Walker, "Practical Biochemistry - Principles & Techniques", Oxford University Press.
2. Thyaga Rajan S, Selvamurugan N, Rajesh M.P, Nazeer, Richard Thilagaraj R.A. Barathi. W.S and. Jaganathan, M.K "Biology for Engineers", W.H. Hill, New Delhi.
3. Robert Weaver, "Molecular Biology", MCGraw-Hill.
4. The Biomedical Engineering –Handbook, Joseph D. Bronzino, CRC press.
5. Fundamentals Of Biology -Haupt Arthur W Books Publisher: Read Books Genre: Science, ISBN: 9781406707397, 97814067073
6. Basic Concepts In Biology 6/E by Starr Cengage Learning Inc

Mapping Matrix of Course Objectives (COs) and Course Learning Outcomes (CLOs)

SEM	SUBCODE	Course Name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5	CLO 6
I	25AS109	BIOLOGY (For BME only)	CO1	x					
			CO2	x	x				
			CO3		x	x			
			CO4				x	x	
			CO5				x	x	
			CO6					x	x

QUANTUM COMPUTATION AND COMMUNICATION	
Course Code: 25AS103/25AS206	**Continuous Evaluation:** 30 Marks
Credits: 4	**End Semester Examination:** 70 Marks
L T P : 3 1 0	
Prerequisite: Nil	

COURSE OBJECTIVES (COs)

1. To reinforce the classical foundations relevant to modern physics and quantum theory.
2. To introduce key experiments and principles that led to the development of quantum mechanics.
3. To develop a conceptual and mathematical understanding of quantum mechanics and its postulates.
4. To introduce the Dirac notation and operator formalism central to quantum computation.
5. To familiarize students with classical and quantum logic gates and their role in quantum algorithms.

COURSE LEARNING OUTCOMES (CLOs)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Analyze and solve problems related to classical systems including SHM, resonance, and LCR circuits.
2. Interpret foundational experiments like black body radiation, photoelectric effect, and Compton scattering within the quantum framework.
3. Apply the uncertainty principle, Schrödinger equation, and quantum postulates to idealized systems such as the particle in a 1D box.
4. Represent quantum states and operators using Dirac notation and apply linear algebra tools such as eigenvalues and commutators.
5. Differentiate between classical and quantum logic gates and construct basic quantum circuits using standard gate sets.

COURSE CONTENTS

UNIT	COURSE CONTENTS	HOURS
UNIT-I	**CLASSICAL PHYSICS:** Review of Newtonian Mechanics, Simple Harmonic Motion (SHM), Differential Equation of SHM and its Solutions, Conservation of Energy. Mass-string System, Simple pendulum, LC circuit, Qualitative discussion of damped harmonic and forced harmonic motion, resonance and its applications.	**10**
UNIT-II	**BASICS OF QUANTUM MECHANICS:** Black body problem, Photoelectric effect and Compton scattering (conceptual), stability of atom, dual nature of light and matter, de-Broglie Hypothesis of matter waves, Phase & Group velocities, Davison-Germer experiment.	**10**
UNIT-III	**APPLICATIONS OF QUANTUM MECHANICS:** **10**	**10**

	Uncertainty principle, application of uncertainty principle, significance of wave functions, postulates of quantum mechanics**,** Schrodinger time dependent and time independent equations, particle in a box (1-D infinite potential well).	
UNIT-IV	**MATHEMATICAL TOOLS OF QUANTUM COMPUTATION:** Dirac notation: properties of kets and bras, bra-ket algebra and their matrix representation, Operators and its matrix representation: Hermitian adjoint, Hermitian conjugate rules, Hermitian and skew-Hermitian, projection operators, commutators algebra, inverse and unitary operators, Eigenvalues and Eigenvectors of an operator.	**15**
UNIT-V	**QUANTUM COMMUNICATION:** Classical gates (AND, OR, NOT, NAND, XOR), Qubit and its physical realization, Bloch sphere, Quantum logic gates and matrix forms, Pauli Gates: X, Y, Z gates, Hadamard Gate, S and T gates, identity gate, CNOT gate, controlled-Z gate. Application of quantum gates in quantum computation.	**15**

TEXT BOOKS

1. David J. Griffiths, *Introduction to Quantum Mechanics*, 2nd Edition, 2004, Pearson Education.
2. Michael A. Nielsen and Isaac L. Chuang, *Quantum Computation and Quantum Information*, 10th Anniversary Edition, 2010, Cambridge University Press.
3. H.C. Verma, *Concepts of Physics*, Volume 1, 2008, Bharati Bhawan Publishers.

REFERENCE BOOKS

1. Nouredine Zettili, *Quantum Mechanics: Concepts and Applications*, 2nd Edition, 2009, Wiley.
2. Eleanor Rieffel and Wolfgang Polak, *Quantum Computing: A Gentle Introduction*, 2011, MIT Press.
3. J.J. Sakurai and Jim Napolitano, *Modern Quantum Mechanics*, 2nd Edition, 2011, Cambridge University Press.
4. Albert Paul Malvino, Donald P Leach, Goutam Saha, Digital principles and applications, 7th Edition, 2011, Tata McGraw-Hill Pvt. Ltd.

Mapping Matrix of Course Objectives (COs) and Course Learning Outcomes (CLOs)

SEM	SUBCODE	Course Name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
I/II	**25AS103/25AS206**	QUANTUM COMPUTATION AND COMMUNICATION	CO1	x				
			CO2	x	x			
			CO3			x		
			CO4				x	
			CO5					x

Quantum Physics Lab	
Course Code: 25AS153/25AS256	**Continuous Evaluation:** 40 Marks
Credits: 1	**End Semester Examination:** 60 Marks
L T P : 0 0 2	
Prerequisite: Nil	

COURSE OBJECTIVES (COs)

1. To gain practical knowledge by applying the experimental methods to correlate with the Physics theory.
2. To learn the usage of electrical and optical systems for various measurements.
3. To apply the analytical techniques and graphical analysis to the experimental data.

COURSE LEARNING OUTCOMES (CLOs)

The syllabus has been prepared in accordance with National Education Policy (NEP).
After completion of course, students would be able to:

1. Use the different measuring devices and meters to record the data with precision.
2. Develop basic communication skills through working in groups in performing the laboratory experiments and by interpreting the results.
3. Apply the mathematical concepts/equations to obtain quantitative results.

LIST OF EXPERIMENTS

(Students are required to complete/perform any 10 experiments from the list below)

Experiment 1: To study the characteristic of LDR and finding the dark resistance.
Experiment 2: To determine the wavelength of sodium light by Newton's ring experiment.
Experiment 3: To determine the wavelength of the given laser source using standard grating.
Experiment 4: To determine Planck's constant.
Experiment 5: To study the I-V characteristics of a PN junction diode.
Experiment 6: To determine the energy band gap by four-probe method.
Experiment 7: To study the solar cell characteristic.
Experiment 8: To determine the dispersive power of a given prism.
Experiment 9: To determine the moment of inertia of the disc and rigidity modulus of the wire by torsional pendulum.
Experiment 10: e/m by J.J. Thomson
Experiment 11: Stern - Gerlach experiment
Experiment 12: Logic gates.

TEXT BOOKS

1. Chattopadhyay, D., Rakshit, P. C and Saha, B., "An advanced Course in Practical Physics", 2nd edition, Books & Allied Ltd, Calcutta, 1990.
2. Chauhan and Singh, "Advanced practical physics", Revised edition, Pragati Prakashan Meerut, 1985.

REFERENCE BOOKS

1. Thiruvadigal. J. D., Ponnusamy S. Vasuhi, P. S. and Kumar. C, "Hand Book of Practical physics", 5th edition, Vibrant Publication, Chennai, 2007.
2. Engineering Practical Physics, by S. Panigrahi and B. Mallick, (CENGAG Elearning).

Mapping Matrix of Course Objectives (COs) and Course Learning Outcomes (CLOs)

SEM	SUBCODE	Course Name	Course Objectives	CLO1	CLO2	CLO3
I/II	25AS153/25AS256	Quantum Physics Lab	CO1	x		
			CO2		x	
			CO3		x	x

Applied Chemistry	
Course Code: 25AS105 /25AS208	**Continuous Evaluation:** 30 Marks
Credits: 4	**End Semester Examination:** 70 Marks
L T P : 3 1 0	
Prerequisite: Nil	

COURSE OBJECTIVES (COs)

1. The knowledge of fundamentals of water quality parameters and the treatment of water.
2. To understand the fundamental concepts of electrochemistry and corrosion.
3. To explain states of matter, phase diagram and related applications.
4. To learn various types of polymers, and to understand the basics of spectroscopy.
5. To learn an introductory idea about nanomaterials.

COURSE LEARNING OUTCOMES (CLOs)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Identify and analyze the quality of water.
2. Demonstrate the working of electrochemical cells and batteries.
3. Explain states of matter, phase diagram, related applications.
4. Analyze the application aspects of polymers and spectroscopy.
5. Describe the properties of nanomaterials and its synthesis.

COURSE CONTENTS

UNIT	COURSE CONTENTS	HOURS
UNIT-0	**Introduction:** Atomic and molecular masses, mole concept and molar mass, percentage composition, redox reactions, Chemical and ionic equilibrium; Acid & bases.	**6**
UNIT-I	**Water Technology:** Reasons for hardness-units of hardness-determination of hardness and alkalinity-Water for steam generation-Boiler Troubles-Scale, Sludge formation, Boiler corrosion, Caustic Embrittlement-Internal Treatments-Softening of Hard water- Ion Exchange process -Water for drinking purposes-Purification-Sterilization and disinfection: Chlorination, Reverse Osmosis and Electro Dialysis.	**10**
UNIT-II	**Electrochemistry:** Nernst Law and its applications, Electrode Potential, Electrochemical cell, Concentration Cell, Electrochemical Series, Batteries and Cells; Primary Batteries and Secondary Batteries. **Corrosion:** Electrochemical theory of corrosion, Galvanic series, Types of corrosion; Differential metal corrosion, Differential aeration corrosion (Pitting and water line corrosion), Stress corrosion (caustic embrittlement in boilers), Factors affecting, metal coatings- Galvanizing and Timing, Corrosion inhibitors, protection.	**16**
UNIT-III	**The Phase rule:** Statement of Gibb's phase rule and explanation of the terms involved, Phase diagram of one component system-water system, Condensed phase rule, Phase diagram of two components System-Eutectic, Pb-Ag system.	**8**

UNIT-IV	**Polymer:** Terminologies, Classification of polymer, Preparation of special polymer-Nylon6,6, Polyethylene, Polystyrene, Teflon, Polymethyl-methacrylate, Bakelite. **UV Spectroscopy:** Lambert Beer's Law, Principles and applications of UV-Visible Molecular Absorption Spectroscopy; Chromophores, effect of conjugation on chromophores.	**12**
UNIT-V	**Nano Materials:** Introduction and classification (0D, 1D, 2D) with examples, size dependent properties, Top-down and Bottom-up approaches of nanomaterial synthesis. Introductory idea on synthesis of nanomaterials *via* green synthetic route.	**8**

TEXT BOOKS

1. Engineering Chemistry (NPTEL web-book) by B. L. Tembe, Kamaludddin, and M.M. S. Krishan.
2. Fundamentals of Molecular Spectroscopy by Banwell, Tata McGraw-Hill Education.
3. Textbook of Nanoscience and Nanotechnology, McGraw Hillw Hill Education (India) Pvt. Ltd., 2012.) Pvt. Ltd., 2012.
4. Engineering Chemistry by Jain and Jain, Dhanpat Rai Publication.
5. Engineering Chemistry by Prasanta Rath, Cenage Learning India Private Ltd., 2015.td., 2015.
6. A Textbook of Engineering Chemistry by Shashi Chawla, Dhanpat Rai & Co., 2020 & Co., 2020.
7. Inorganic Chemistry by Donald A. Tarr and Gary Miessler, Pearson India, Third Edition.
8. Molecular Spectroscopy, Ira N. Levine, John Wiley and Sons.

REFERENCE BOOKS

1. Inorganic Chemistry by W. Overton, Rounk, and Armstrong, Oxford University Press, 6th edition.
2. Advanced Engineering Chemistry by M.R. Senapati, University Science Press, India.
3. A Textbook of Engineering Chemistry by S. S. Dara, 10th Edition, S. Chand & Company Ltd., New Delhi, 2003.
4. J.D. Concise Inorganic Chemistry.
5. Inorganic Chemistry, Catherine E. Housecroft and Alan G. Sharpe, 2nd Edition
6. Huheey, J. E., Keiter, E. A., Keiter, R. L. & Medhi, O.K. Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Education India.

Mapping Matrix of Course Objectives (COs) and Course Learning Outcomes (CLOs)

SEM	SUBCODE	Course Name	Course Objectives	CLO1	CLO2	CLO3	CLO4	CLO5
			CO1	x				

I/II	25AS105 /25AS208	Applied Chemistry	CO2	x	x			
			CO3			x		
			CO4				x	
			CO5					x

Applied Chemistry Lab	
Course Code: 25AS155/25AS258	**Continuous Evaluation:** 40 Marks
Credits: 1	**End Semester Examination:** 60 Marks
L T P : 0 0 2	
Prerequisite: Nil	

COURSE OBJECTIVES (COs)

An integrated laboratory course consists of experiments from applied chemistry and is designed:

1. To impart the knowledge and understanding of principles of measurement techniques.
2. To understand the principle involved in the synthesis of chemical compounds, and quantitative analysis.

COURSE LEARNING OUTCOMES (CLOs)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Explain the basic concepts of measurement techniques.
2. Execute synthesis of compounds and determination quantitative analysis.

LIST OF EXPERIMENTS

(A Student is supposed to complete/perform minimum 8-10 of experiments)

1. Determination of total hardness of water by EDTA method.
2. Determination of dissolved oxygen in a sample of water.
3. Determination of percentage of available chlorine in a sample of bleaching powder.
4. Standardization of $KMnO_4$ using sodium oxalate. Determination of ferrous iron in Mohr's salt by potassium permanganate.
5. Determination of Viscosity of addition polymer by Ostwald Viscometer.
6. Determination of alkalinity of given sample.
7. Estimation of calcium in limestone.
8. Acid-Base Titration by Potentiometry.
9. Preparation of Silver/Iron nano particles.
10. Preparation of Bakelite.
11. Preparation of Urea formaldehyde resin.
12. To record UV-Spectrum of $KMnO_4$ and $K_2Cr_2O_7$.
13. Estimation of nickel in given sample solution
14. Estimation of nitrite in given sample solution.

TEXT BOOKS

1. Vogel's Textbook of Quantitative Chemical Analysis (Latest ed.), Revised by G.H. Jeffery, J. Bassett, J. Mendham & R.C. Denney, Longman Scientific & Technical, England

2. Applied Chemistry: Theory and Practice (Latest ed.), by O.P. Vermani & A.K. Narula, New Age International Publications.

REFERENCE BOOKS

1. Dara, S.S.;A text book on Experiments and Calculations in Engineering Chemistry (ninth edition); S. Chand,2003.

2. Rani, S.; Laboratory Manual on Engineering Chemistry; DhanpatRai,1998.
3. Department Laboratory Manual.

Mapping Matrix of Course Objectives (COs) and Course Learning Outcomes (CLOs)

SEM	SUBCODE	Course Name	Course Objectives	CLO1	CLO2
I/II	25AS155/25AS258	Applied Chemistry Lab	CO1	x	
			CO2		x

BASIC ELECTRICAL ENGINEERING	
Course Code:25EE101/25EE202	**Continuous Evaluation:**30 Marks
Credits: 3	**End Semester Examination:** 70 Marks
L T P : 3 0 0	
Prerequisite: Nil	

COURSE OBJECTIVES (COs)

1. To impart knowledge about the electrical quantities and to understand the impact of electricity in a global and societal context.
2. To introduce the fundamental concepts relevant to DC and AC circuits and network theorems.
3. To understand the concept of electrical machines in real-life applications.
4. To familiarize the sources of renewable energy and electric vehicles and their progress in recent years

COURSE LEARNING OUTCOMES (CLOs)

After completion of the course, students would be able to:

1. To apply various network laws and theorems in DC circuits.
2. To compute different AC quantities with phasor representation.
3. To realize the operation of single-phase circuits and induction motors
4. To understand the basic concept of a poly-phase system.
5. To define various renewable resources available in power generation.

COURSE CONTENTS

UNIT	COURSE CONTENTS	HOURS
UNIT-I	**DC Circuits** Ohm's Law and Kirchhoff's Laws, Analysis of Series, parallel, and series-parallel circuits excited by independent voltage sources, Star-delta transformation, Mesh current Analysis, Node voltage analysis, Thevenin's theorem, Norton's theorem, Superposition theorem, Maximum power transfer theorem	**9**
UNIT-II	**Single-Phase A.C. Circuits** Sinusoidal signal, instantaneous and peak values, RMS and average values, crest and peak factor, Concept of phase, Analysis with phasor diagrams of R-L, R-C and R-L-C circuits; Real power, reactive power, apparent power and power factor, Resonance in series R-L-C circuit, Quality factor and Bandwidth, Introduction to earthing.	**9**
UNIT-III	**Electrical Machines** **A. Transformers:** Magnetic circuits, Review of laws of electromagnetism, Flux, MMF and their relation, analysis of magnetic and electric circuits, Principle of operation and construction of single-phase transformers (core and shell types). EMF equation, losses, efficiency, and voltage regulation. **B. Three-Phase Induction Motor:** Concept of rotating magnetic field; Principle of operation, types and constructional features, Slip and its significance; Applications of squirrel cage and slip ring motors; Torque-speed characteristics of 3-phase induction motor.	**9**

UNIT-IV	**Poly-Phase System***:* Advantages of 3-phase system, Generation of 3-phase voltages, Voltage, current, and power in a star and delta connected systems, 3-phase balanced and unbalanced circuits, Power measurement in 3-phase circuits using the two-wattmeter method.	**9**
UNIT-V	**Renewable Sources:** Sources of Electrical Power, Introduction to Wind, Solar, Fuel cell, Tidal, Geothermal, Hydroelectric, Thermal-steam, diesel, gas power plants **Electric Vehicles:** What is an EV, Benefits of EVs, EV and its types: BEV, PHEV, HEV, and FCEV, EV scenario in India.	**9**

TEXT BOOKS

1. FundamentalofElectricCircuitsbyCharlesKAlexanderandMatthewN.O.Sadiku,TMHPublication.
2. Electrical Engineering Fundamentals by Vincent DelToro, PHIPublication.
3. Basic Electrical Engineering by V N Mittal & Arvind Mittal, TMHPublication.
4. BasicElectricalTechnologybyA.E.Fitzgerald,McGrawHillPublication.

REFERENCE BOOKS

1. KothariDPandNagrathIJ,"BasicElectricalEngineering",TataMcGrawHill, 1991.

Mapping Matrix of Course Objectives (COs) and Course Learning Outcomes (CLOs)

SEM	SUBCODE	Course Name	Course Objectives	CLO1	CLO2	CLO3	CLO4	CLO5
I/II	**25EE101/ 25EE202**	BASIC ELECTRICALENGINEERING	CO1	x				
			CO2			x		
			CO3		x	x	x	
			CO4					x

BASIC ELECTRICAL ENGINEERING LAB	
Course Code: 23EE151/23EE252	**Continuous Evaluation:**40 Marks
Credits: 1	**End Semester Examination:** 60 Marks
L T P : 0 0 2	
Prerequisite: Nil	

COURSE OBJECTIVES (COs)

1. To impart basic knowledge of electrical quantities such as current, voltage, power, energy etc.
2. To familiarize students with basic circuit components and their connections.
3. To explain working principle of transformer and electrical measuring instruments such as ammeter, voltmeter, wattmeter, energy meter, digital storage oscilloscope etc.

COURSE LEARNING OUTCOMES (CLOs)

After completion of the course, students would be able to:

1. Verify fundamental laws like Ohm's Law, KCL, KVL, etc.
2. Understand the calibration of energy meter.
3. Understand open circuit and short circuit test of single-phase transformer.
4. Analyse RLC series and parallel circuits.

LIST OF EXPERIMENTS

(A Student is supposed to complete/perform minimum **10** experiments)

1. To verify Kirchhoff's voltage and Current Laws
2. To verify Superposition Theorem
3. To verify Thevenin's Theorem
4. To verify Maximum Power Transfer Theorem
5. To verify Norton's Theorem
6. To measure power and power factor in single phase AC circuit.
7. To verify Series and parallel RLC circuit
8. To conduct open circuit and short circuit test on a single-phase transformer
9. To perform Load test on single phase transformer
10. Calibration of Single Phase & Three Phase Energy Meter
11. To study Digital Storage Oscilloscope
12. To study the balanced three phase system for star and delta connected load
13. To study about earthing and their types.

TEXT BOOKS

1. Handbook of Laboratory Experiments in Electronics and Electrical Engineering by A M Zungeru, J M Chuma, H U Ezea
2. Electrical Measurements & Measuring Instruments by E.W. Golding & F.C. Widdis
3. Electronic Measurement & Instrumentation by H.S. Kalsi
4. Electrical & Electronic Measurement & Instrumentation by A.K. Sawhney ,E. Fitzgerald, C. Kingsley and S. Umans, Electric Machinery, McGraw-Hill Co. Inc.
5. D. P. Kothari and I. J. Nagrath, Electrical Machines, Tata McGraw-Hill.

REFERENCE BOOKS

1. M.G. Say, Alternating Current Machines, Pitman Publishing.
2. Alexander S. Langsdorf, Theory of Alternating Current Machinery, Tata McGraw-Hill.

Mapping Matrix of Course Objectives (COs) and Course Learning Outcomes (CLOs)

SEM	SUBCODE	Course Name	Course Objectives	CLO1	CLO2	CLO3	CLO4
I/II	**23EE 151/23 EE252**	BASIC ELECTRICAL ENGINEERING LAB	CO1	x	x		x
			CO2	x			x
			CO3	x	x	x	x

BASIC ELECTRONICS ENGINEERING	
Course Code: 25EC101/25EC202	**Continuous Evaluation:**30 Marks
Credits: 3	**End Semester Examination:** 70 Marks
L T P : 3 0 0	
Prerequisite: Nil	

COURSE OBJECTIVES (COs)

At the end of the course, the student will be able to:

1. Analyze the characteristics and applications of semiconductor diodes, including Zener diodes, and their role in power supply and wave-shaping circuits.
2. Understand the operation, biasing, and characteristics of BJT, and apply them in amplification and switching circuits.
3. Understand the operation, biasing, and characteristics of FETs, and apply them in amplification and switching circuits
4. Design and implement analog circuits using op-amps for integration, differentiation, and signal conditioning applications.
5. Understand and simplify digital logic expressions using Boolean algebra, and design combinational digital circuits.

COURSE LEARNING OUTCOMES (CLOs)

After completion of the course, students would be able to:

1. Understand and analyze the operation and characteristics of semiconductor diodes and their applications in rectifiers, clippers, and voltage regulators.
2. Demonstrate and evaluate the working principles, biasing, and applications of BJTs in switching and amplifier circuits.
3. Design and simulate analog electronic circuits using FET and Op-amps for real-time signal processing.
4. Comprehend and apply the fundamental concepts of digital logic, Boolean algebra, and combinational circuits.
5. Interpret electronic component datasheets, test devices using multimeters, and troubleshoot circuits effectively.

COURSE CONTENTS

UNIT	COURSE CONTENTS	HOURS
UNIT-I	**DIODE THEORY AND APPLICATIONS**: Overview of p-n junction diode structure, Basic idea of forward and reverse biasing in diodes. Ideal diode characteristics and assumptions. Structure and working principle of Zener diode, VI characteristics of Zener diode in breakdown region, Zener diode as a voltage regulator, half and Full Wave Rectifier: Circuit diagram, operation, and waveform analysis, Calculation of average and RMS output voltage, Ripple factor and efficiency, Transformer requirements and peak inverse voltage (PIV) analysis.	9
UNIT-II	**BIPOLAR JUNCTION TRANSISTORS AND ITS BIASING**: BJT structure and working principle (NPN/PNP), CE, CB, and CC configurations: input/output characteristics and applications, BJT current and voltage relations, Switching operation of BJT: cut-off, active, and saturation regions, DC load line: operating point (Q-point) determination, Biasing methods: base bias, emitter feedback bias, collector feedback bias, voltage divider bias, Thermal runaway and stability factor.	9

UNIT-III	**FIELD EFFECT TRANSISTORS (FET) AND ITS BIASING:** Introduction to JFET: structure, operation, and characteristics, Biasing methods for JFET: self-bias, voltage-divider bias, current source bias, FET operation in ohmic and active regions, Introduction to MOSFETs: D-type and E-type structures and operation, MOSFET as a switch: operation, input/output characteristics, E-MOSFET DC biasing technique.	9
UNIT-IV	OP-AMP: Ideal op-amp characteristics and internal block diagram, Op-amp equivalent circuit model, Inverting and non-inverting op-amp configurations, summing amplifier using op-amp (inverting and non-inverting), Differential amplifier, integrator and differentiator circuits (ideal structure only).	9
UNIT-V	DIGITAL ELECTRONICS: Number systems: Binary, Decimal, Octal, Hexadecimal and their conversions. Basic logic gates: AND, OR, NOT, NAND, NOR, XOR, XNOR – symbols, truth tables, logic expressions, Consensus theorem , Boolean algebra: laws, identities, and logic simplification, De Morgan's Theorems and duality principle, Transposition theorem, Consensus theorem , Universal gates and their use in implementing any logic function, Algebraic simplification using Boolean laws and Karnaugh Maps (K-Maps upto three variable), NAND and NOR based gate implementation techniques, Combinational circuits: Half adder and Full adder, Half Subtractor, Full Subtractor design and logic expressions,	9

TEXT BOOKS

1. Electronic Devices and Circuit Theory - by Rober L. Boylestad 11th Edition, Pearson Publication, 2014
2. Digital Design by M. Morris Mano, 5th Edition, Pearson Publication, 2016
3. Floyd T.L., Buchla D.L., "Electronics Fundamentals: Circuits, Devices and Applications", 8th 2010 Edition
4. Stallings, W., "Computer Organization and Architecture", 5th Ed., 2001 Pearson Education

REFERENCE BOOKS

1. Millman J., Halkias C.C., Jit S., "Electronic Devices and Circuits", Tata McGraw-Hill, 2nd 2007 Edition
2. Muthu subramanian.R, Salivahanan. S, Muraleedharan. K. A, "Basic Electrical, Electronics and Computer Engineering", Tata McGraw - Hill, 1999.
3. Microelectronic Circuits by A. S. Sedra and Kenneth C. Smith 7th Edition, Oxford University, Press. 2017

Mapping Matrix of Course Objectives (COs) and Course Learning Outcomes (CLOs)

SEM	SUBCODE	Course Name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
I/II	**25EC101 /25EC202**	Basic Electronics Engineering	CO1	□				
			CO2		□			
			CO3			□		
			CO4				□	
			CO5					□

BASIC ELECTRONICS ENGINEERING LAB	
Course Code: 25EC151/25EC252	**Continuous Evaluation:**40 Marks
Credits: 1	**End Semester Examination:** 60 Marks
L T P : 0 0 2	
Prerequisite: Nil	

COURSE OBJECTIVES (COs)

1. To understand semiconductor device Characteristics.
2. To design and evaluate rectifier circuits.
3. To characterize transistor and FET operation.
4. To design and test OP-AMP circuits.
5. To demonstrate digital logic design.

COURSE LEARNING OUTCOMES (CLOs)

1. To analyze PN junction, Zener diodes, and their applications in circuits.
2. To construct and compare half-wave, full-wave, and bridge rectifiers with filters.
3. To investigate BJT (CB), JFET, and MOSFET configurations and their regions of operation.
4. To implement and verify analog circuits (voltage follower, inverting/summing amplifiers).
5. To build and validate combinational circuits (logic gates, adders) and Boolean theorems.

LIST OF EXPERIMENTS

1. To study and analyze the V-I characteristics of a PN junction diode in both forward and reverse bias conditions using Silicon and Germanium diodes.
2. To examine the V-I characteristics of a Zener diode in forward and reverse bias, and to observe the Zener breakdown phenomenon and its application in voltage regulation.
3. To study the output waveform of a half-wave rectifier with and without a filter capacitor, and to observe how the capacitor smooths the pulsating DC output by reducing ripple.
4. To analyze the characteristics of a full-wave center-tapped rectifier, observe its output waveform, and evaluate the effect of filter capacitors of varying values on ripple reduction and waveform smoothness.
5. To construct and test a bridge rectifier circuit, monitor its output waveform, and investigate the improvement in waveform smoothness with the use of different filter capacitor values.
6. To study the input and output characteristics of a transistor in Common Base (CB) configuration.
7. To study the output characteristics of an N-channel JFET, and to observe the behavior of the JFET in ohmic and saturation regions.
8. To study the output characteristics of an N-channel MOSFET and to analyze the MOSFET's behavior in the ohmic and saturation regions.
9. To design and analyze a voltage follower circuit using an operational amplifier (OP-AMP) and verify that the output voltage exactly follows the input voltage with a unity gain (A=1).
10. To design and verify the operation of an inverting amplifier using an OP-AMP, and to measure the output voltage for a given input voltage with a known gain, validating the relationship: $Vo=-A \cdot V_i$.
11. To design and verify the operation of a summing amplifier using an operational amplifier (OP-AMP) and to measure the output voltage for different input voltages, demonstrating linear summation with unity gain.
12. To design and verify the truth tables of basic logic gates (AND, OR, NAND, NOR, XOR, and XNOR) using digital ICs on a breadboard.
13. To experimentally **verify the Consensus Theorem** of Boolean algebra using logic gates and validate its application in simplifying digital circuits.
14. To design and verify the working of a **half adder circuit** using basic logic gates (AND and XOR).

15. To design and verify the working of a **full adder circuit** using basic logic gates (AND, OR and XOR).

REFERENCE: LABORATORY MANUAL

Mapping Matrix of Course Objectives (COs) and Course Learning Outcomes (CLOs)

SEM	SUBCODE	Course Name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
I/II	25EC151/25EC252	BASIC ELECTRONICS ENGINEERING LAB	CO1	□				
			CO2		□			
			CO3			□		
			CO4				□	
			CO5					□

FUNDAMENTALS OF ROBOTICS & AI	
Course Code: 25ME101/25ME202	**Continuous Evaluation:**30 Marks
Credits: 3	**End Semester Examination:** 70 Marks
L T P : 3 0 0	
Prerequisite: Nil	

COURSE OBJECTIVES (COs)

The objectives of this course are to:

1. Understand and discuss the fundamental elementary concepts of Robotics.
2. Provide insight into different types of robots.
3. Explain intelligent module for robotic motion control.
4. Educate on various path planning techniques.
5. Illustrate the working of innovative robotic devices

COURSE LEARNING OUTCOMES (CLOs)

By the end of this course, students will be able to:

1. Describe the fundamental concepts, history, and components of robotics.
2. Classify various types of robots and analyze their configurations and kinematics.
3. Explain different drive systems, end effectors, and control methods used in robotic systems.
4. Evaluate applications of robotics in industrial, medical, agricultural, and autonomous systems.
5. Demonstrate a basic understanding of Artificial Intelligence concepts relevant to robotics.

COURSE CONTENTS

UNIT	COURSE CONTENTS	HOURS
UNIT -I	**Introduction To Robotics:** Introduction to Robotics and Automation, laws of robot, brief history of robotics, basic components of robot, robot specifications, classification of robots, human system and robotics, safety measures in robotics, social impact, Robotics market and the future prospects, advantages and disadvantages of robots.	9
UNIT -II	**Robot Anatomy And Motion Analysis:** Anatomy of a Robot, Robot configurations: polar, cylindrical, Cartesian, and jointed arm configurations, Robot links and joints, Degrees of freedom: types of movements, vertical, radial and rotational traverse, roll, pitch and yaw, Wok volume/envelope, Robot kinematics: Introduction to direct and inverse kinematics, transformations and rotation matrix.	9
UNIT -III	**Robot Drives and End Effectors:** Robot drive systems: Hydraulic, Pneumatic and Electric drive systems, classification of end effectors, mechanical grippers, vacuum grippers, magnetic grippers, adhesive gripper, gripper force analysis and gripper design, 1 DoF, 2 DoF, multiple degrees of freedom robot hand, tools as end effectors, Robot control types: limited sequence control, point-to-point control, playback with continuous path control, and intelligent control.	9
UNIT -IV	**Robotics Applications: Material Handling:** Pick and place, palletizing and depalletizing, machining loading and unloading, welding & assembly, Medical, agricultural and space applications, unmanned vehicles: ground, Ariel and underwater applications, robotic for computer integrated manufacturing. Types of robots: Manipulator, Legged robot, wheeled robot, aerial robots, Industrial	9

	robots, Humanoids, Robots, Autonomous robots, and Swarm robots	
UNIT -V	**Fundamentals of Artificial Intelligence:** Introduction to Artificial Intelligence: definition, goals, and brief history; basic concepts of AI: learning, reasoning, and problem-solving; knowledge representation and simple rule-based systems; overview of machine learning: supervised and unsupervised learning; role of AI in enabling intelligent behavior in robots.	9

TEXT BOOKS

1. S.R. Deb, Robotics Technology and flexible automation, Tata McGraw-Hill Education, 2009.
2. Mikell P. Grooveret. al., "Industrial Robots - Technology, Programming and Applications",McGraw Hill, Special Edition, (2012).
3. Ganesh S Hegde, "A textbook on Industrial Robotics", University science press, 3rdedition, 2017.
4. Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Eastern Economy Edition, Prentice Hall of India Pvt. Ltd., 2006.
5. Fu K S, Gonzalez R C, Lee C.S.G, "Robotics: Control, Sensing, Vision and Intelligence",McGraw Hill,1987. https://www.robots.com/applications.

Mapping Matrix of Course Objectives (COs) and Course Learning Outcomes (CLOs)

SEM	SUB CODE	Course Name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
I/II	**25ME101 /25ME202**	FUNDAMENTALS OF ROBOTICS & AI	CO1	✓				
			CO2	✓				
			CO3		✓			
			CO4			✓		✓
			CO5				✓	

DESIGN THINKING AND ENGINEERING PRACTICES LAB	
Course Code: 25ME151/25ME252	**Continuous Evaluation:**40 Marks
Credits: 2	**End Semester Examination:** 60 Marks
L T P : 0 0 2	
Prerequisite: Nil	

COURSE OBJECTIVES (COs)

1. To introduce students to the fundamentals of design thinking and its application in engineering problem-solving.
2. To understandworkshop tools used in carpentry, welding, sheet metal, and machining
3. To provide hands-on experience in basic engineering practices such as welding, carpentry, machining, and sheet metal work.
4. To foster creativity, teamwork, and practical skills through physical prototyping.
5. To understand safety, tools, and standard practices involved in common engineering operations.

COURSE LEARNING OUTCOMES (CLOs)

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

1. Apply design thinking principles to simple engineering problems
2. Operate basic workshop tools used in carpentry, welding, sheet metal, and machining
3. Demonstrate hands-on skills through the fabrication of simple mechanical components
4. Work effectively as a team member in engineering practice sessions
5. Apply workshop safety protocols and proper tool handling procedures

LIST OF EXPERIMENTS

1. Introduction to Design Thinking : Empathize, Define, Ideate, Prototype, Test – with engineering case examples
2. Safety and Workshop Orientation : Personal Protective Equipment (PPE), safety signs, hazard zones, and tool use policies
3. Carpentry Practice : Sawing, chiselling, planning, drilling – make a dovetail or T-joint
4. Welding Practice : Arc welding (butt & lap joints), electrode selection, safety protocols
5. Sheet Metal Work : Cutting, bending, rivet joining, tray/box making
6. Machining Practice : Lathe operation (facing, turning), drilling, tapping
7. Mini Project (Design + Fabrication) : Students form teams to design and fabricate a small product using at least 2 workshop processes
8. Presentation & Evaluation : Final demonstration of project, reflection on design thinking, peer review

TEXT BOOKS

1. **K.C. John***"Mechanical Workshop Practice"*, PHI Learning Pvt. Ltd., Latest Edition.
   ☞ Covers carpentry, welding, fitting, machining, and safety practices.
2. **Sanjay Moizuddi***"Introduction to Design Thinking"*, Pearson Education, 1st Edition.
   ☞Introduces the design thinking process with real-world applications in engineering.
3. **Raghavendra, K. and Krishnamurthy, L.***"Engineering Workshop Practice"*, PHI Learning Pvt. Ltd.
   ☞ A practical reference for workshop tools and exercises (wood, metal, welding).
4. **P. Kannaiah& K.L. Narayana***"Workshop Manual"*, Scitech Publications.
   ☞ Detailed procedural steps for carpentry, sheet metal, fitting, and machining.
5. **IDEO.org***"The Field Guide to Human-Centered Design"*, IDEO Press (Free PDF available online)
   ☞ A hands-on reference for applying empathy, prototyping, and iteration in design

thinking.

6. **Tapan P. Bagchi***"Engineering Design"*, Wiley India Pvt. Ltd.

☞ Explores the fundamentals of creative problem-solving and product design.

Mapping Matrix of Course Objectives (COs) and Course Learning Outcomes (CLOs)

SEM	SUB CODE	Course Name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
I/II	25ME151/25ME252	DESIGN THINKING AND ENGINEERING PRACTICES LAB	CO1	✓				
			CO2		✓			
			CO3			✓		
			CO4				✓	
			CO5					✓

FUNDAMENTALS OF COMPUTER & C PROGRAMMING	
Course Code: 25CS101/25CS202	**Continuous Evaluation:**30 Marks
Credits: 3	**End Semester Examination:** 70 Marks
L T P : 3 0 0	
Prerequisite: Nil	

COURSE OBJECTIVES (COs)

1. To familiarize and understand the basic concepts of digital computers and computer programming.
2. To impart adequate knowledge on the need of programming languages and problem solving techniques.
3. To analyze and construct effective algorithms.
4. To develop problem solving ability using programming.
5. To employ good programming practices such as incremental development, data integrity checking and adherence to style guidelines.

COURSE LEARNING OUTCOMES (CLOs)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Understand the fundamental concepts of computers, both hardware and software.
2. Learn and understand the major system software that help in developing an application.
3. Apply and analyse the basic programming constructs in context of C programming language.
4. Analyse and evaluate the derived datatypes (array) and the operations that can be performed on them, along with the concept of modularity through functions
5. Create and manipulate a database or data storage through files.
6. Learn a programming approach to solve problems.

COURSE CONTENTS

UNIT	COURSE CONTENTS	HOURS
UNIT -I	**INTRODUCTION OF COMPUTER SYSTEM** Anatomy of a digital Computer, Different Units of Computer, System, Hardware & Software, Classification of Computer Systems, Number systems, Operating System: Definition, working & its functions, Basic concepts of Computer Networks, Network Topologies.	9
UNIT -II	**INTRODUCTION TO SYSTEM SOFTWARE** Programming language- Definition, types; Syntax & Semantics, Type of programming errors, Assembler, Linker, Loader, Compiler, Interpreter, debuggers, Algorithms, flowcharts and their symbols.	9
UNIT -III	**BASICS OF 'C' LANGUAGE** C Fundamentals, Basic data types, variables and scope, storage classes, operators and expressions, formatted input/ output, expressions, selection statements, loops and their applications.	9
UNIT -IV	**ARRAY & FUNCTION** Arrays, functions, recursive functions, pointers and arrays. Strings literals, arrays of strings; applications. Storage Classes and Pre-processor Directives.	9
UNIT -V	**STRUCTURE & FILE SYSTEM** Structures, Declaring a Structure, Accessing Structure Elements, Storing Structure elements, Array of Structures, Unions and Enumerations, Dynamic memory allocation. File Input/Output, Data	9

	Organization, File Operations, Opening a File, Reading from a File, Closing the File, Writing to a File, File Opening Modes.	

TEXT BOOKS

1. The C Programming Language by Dennis M Ritchie, Brian W. Kernigham, 1988, PHI.
2. Computer System & Programming in C by S Kumar & S Jain, Nano Edge Publications, Meerut.
3. Fundamentals of Computing and C Programming, R. B. Patel, Khanna Publications, 2014, New Delhi.
4. Let Us C, YashwantKanetkar, 20th Edition, BPB Publications, 2024.
5. Computer Fundamentals and Programming in C, ReemaTheraja, 2nd Edition, Oxford, 2016.

OPEN EDUCATIONAL RESOURCES

1. **Programming in C:** https://en.wikibooks.org/wiki/C_Programming
2. **C Programming and Data Structures:** https://nptel.ac.in/courses/106/105/106105171/
3. **Harvard's CS50 (Introduction to Computer Science):** https://cs50.harvard.edu/x/

REFERENCE BOOKS

1. Information technology, Dennis P. Curtin, Kim Foley, KunalSen, Cathleen Morin, 1998, TMH.
2. Theory and problem of programming with C, Byron C Gottfried, TMH.

Mapping Matrix of Course Objectives (COs) and Course Learning Outcomes (CLOs)

SEM	SUB CODE	Course Name	Course Objectives	CLO1	CLO 2	CLO 3	CLO4	CLO 5	CLO 6
I/II	25CS101/25CS202	FUNDAMENTALS OF COMPUTER & C PROGRAMMING	CO1	x	x				
			CO2		x	x			
			CO3			x	x		
			CO4					x	
			CO5						x

C PROGRAMMING LAB	
Course Code: 25CS151/25CS252	**Continuous Evaluation:** 40 Marks
Credits: 1	**End Semester Examination:** 60 Marks
L T P : 0 0 2	
Prerequisite: Nil	

COURSE OBJECTIVES (COs)

1. To develop problem solving ability using programming.
2. To impart adequate knowledge on the need of programming languages and problem solving techniques.
3. To develop a methodological way of problem solving.
4. To learn a programming approach to solve problems.

COURSE LEARNING OUTCOMES (CLOs)

The syllabus has been prepared in alignment with National Education Policy (NEP). After completion of course, students would be able to:

1. Understand the Typical C Program Development Environment, compiling, debugging, Linking and executing.
2. Introduction to C Programming using Control Statements and Repetition Statement.
3. Apply and practice logical formulations to solve some simple problems leading to specific applications.
4. Design effectively the required programming components that efficiently solve computing problems in the real world.
5. Employ good programming practices such as incremental development, data integrity checking and adherence to style guidelines.

LIST OF EXPERIMENTS

1. Implement a C program to determine the largest of three numbers using the if-else construct
2. Implement a program to find the largest among ten numbers using for-statement.
3. Design a program to compute average height by gender based on inputs of sex code and height.
4. Implement a function-based program to find the roots of a quadratic equation using a **switch-case** construct.
5. Implement logic to find the largest and second largest in an array of 50 integers.
6. Implement matrix multiplication using nested loops and two-dimensional array.
7. Implement a sorting algorithm to arrange a list of numbers in ascending order.
8. Develop an ATM simulation system that supports balance, deposit, withdraw options using switch-case.
9. Implement a recursive program to generate Fibonacci series.
10. Implement a program to swap two numbers using both call by value and call by reference.
11. Implement string operations to check whether a given string is a palindrome.
12. Develop a structure-based program to manage student records with add, view, and update functionality.
13. Implement file handling operations to create a file and write user input to it.
14. Write a program which manipulates structures into files (write, read, and update records).
15. Mini Project –Write a program to develop a small application using functions, arrays, structures, and file handling. Choose one of the following:

i) Student Record Management System
ii) Quiz Game
iii) Hospital Patient Entry System
iv) Railway Reservation System

TEXT BOOKS

1. C Programming Language by Dennis M Ritchie, Brian W. Kernigham, 2nd Edition, Pearson.
2. Computer System & Programming in C by S Kumar & S Jain, Nano Edge Publications, Meerut.
3. Fundamentals of Computing and C Programming, R. B. Patel, Khanna Publications, 2010, New Delhi.

REFERENCE BOOKS

1. Let Us C, Yashwant Kanetkar, 20th Edition, BPB Publications.
2. Computer Fundamentals and Programming in C, Reema Theraja, Oxford
3. Information technology, Dennis P. Curtin, Kim Foley, Kunal Sen, Cathleen Morin, 1998, TMH.

OPEN EDUCATIONAL RESOURCES

1. MIT Open Course ware: https://ocw.mit.edu/courses/6-087-practical- programming-in-c-january-iap-2010/resources/mit6_087iap10_lec01/

Mapping Matrix of Course Objectives (COs) and Course Learning Outcomes (CLOs)

SEM	SUB CODE	Course Name	Course Objectives	CLO1	CLO 2	CLO 3	CLO4	CLO 5
I/II	25CS151/25CS252	C PROGRAMMING LAB	CO1	√				
			CO2		√	√		
			CO3				√	
			CO4					√

MAPPED SDGs: SDG-4, SDG-9

COMMUNICATIVE ENGLISH	
Course Code: 25HS101/25HS202	**Continuous Evaluation:**30 Marks
Credits: 2	**End Semester Examination:** 70 Marks
L T P : 2 0 0	
Prerequisite: Basic Knowledge of English	

COURSE OBJECTIVES (COs)

1. To prepare the students for their career which will require them to listen, read, speak, and write in English both for their professional as well as interpersonal communication
2. To write clear, coherent, and well-organized texts, such as emails, essays, reports, and other forms of written communication.
3. To enable students to identify the common mistakes made by most learners of English and not make those errors both in their writing and speaking.
4. To enhance student's ability to understand spoken English in various contexts, including conversations, lectures, and media.
5. To enhance student's vocabulary and master key grammatical structures, enabling them to communicate more effectively and accurately.

COURSE LEARNING OUTCOMES (CLOs)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Recall and identify English vocabulary words and grammatical structures.
2. Analyse the structure and organization of written texts, identifying the introduction, body, and conclusion.
3. Examine how the use of specific language techniques impacts the effectiveness of communication.
4. Assess and critique public speeches and presentations based on clarity, coherence, and persuasiveness.
5. Evaluate one's own language skills and identify areas for improvement.

COURSE CONTENTS

UNIT	COURSE CONTENTS	HOURS
UNIT -I	**Introduction to Communication** Elements and Process of Communication, Types and Barriers to Communications, Grice Conversational Maxims and Cooperative Principles, Verbal and non-verbal communication, Body Language: Proxemics, Chronemics, and Haptics, Identifying and rectifying common errors: Types of Sentences (Statements, interrogative, exclamatory, Optative, and imperative, Wh/How-questions, question-tags), Basic Grammar: - Articles, Prepositions, Cliches, Collocations, and Punctuations, Case studies based on Communication Skills https://pressbooks.bccampus.ca/technicalwriting/chapter/casestudy-costpoorcommunication/	**6**
UNIT -II	**Workplace Communication** Communication Challenges in a Culturally Diverse Workplace; Ethics in Communication, Bias-free communication, Effective Business Presentations: Importance in workplace communication; Planning, Preparing, Organizing, Rehearsing, and Delivering Oral presentations, Handling Questions; and PowerPoint Presentation, Case Studies based on communication challenges in the workplace	**6**

UNIT -III	**Effective Writing** Paragraph Writing: Topic Sentence, Guided composition, Free-writing, Reading comprehension practice: Technical and General text, use of different techniques (skimming and scanning), Selection of Words; Coherence and Cohesion, Use of discourse markers concerning technical writing, Case Studies based on technical writing skills	**6**
UNIT -IV	**Business Writing at Work** Cover Letters and Applications, Writing notices and circulars, Email Writing and Memorandum, Writing reports	**6**

TEXTBOOKS

1. English Grammar in Use. Raymond Murphy. Cambridge UP.4th Edition.
2. Business Communication by Carol M Lehman, Debbie D Dufrene, and Mala Sinha. Cengage Learning. 2nd Edition.
3. A Textbook of English Phonetics for Indian Students by T. Balasubramanian [Macmillan]
4. Soft Skills: Key to Success in Workplace and Life by Meenakshi Raman and Shalini Upadhyay. Cengage Learning. 2018 Edition.

Mapping Matrix of Course Objectives (COs) and Course Learning Outcomes (CLOs)

SEM	SUB CODE	Course Name	Course Objectives	CLO1	CLO 2	CLO 3	CLO 4	CLO 5
I/II	**25HS101/25HS202**	COMMUNICATIVE ENGLISH	CO1	□	□	□		
			CO2		□		□	
			CO3			□		
			CO4				□	□
			CO5					□

COMMUNICATIVE ENGLISH LAB	
Course Code: 25HS151/25HS252	**Continuous Evaluation:**40 Marks

Credits: 1	**End Semester Examination:** 60 Marks
L T P : 0 0 2	
Prerequisite: Basic Knowledge of English	

COURSE OBJECTIVES (COs)

1. To prepare the students for their career which will require them to listen to, read, speak, and write in English both for their professional as well as interpersonal communication
2. To empower the students to improve both abilities to communicate and their linguistic
3. To increase their competence and boost their confidence.
4. To enable the students to properly communicate and express themselves in writing.
5. To enable students to identify the common mistakes made by most learners of English and not make those errors both in their writing and speaking.

COURSE LEARNING OUTCOMES (CLOs)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Summarize conversations, demonstrating understanding of the content.
2. Apply communication strategies to maintain conversations and express ideas clearly.
3. Critique and assess various spoken interactions to identify strengths and areas for improvement in communication.
4. Create engaging dialogues or role-plays that demonstrate real-life communicative scenarios.
5. Develop and present persuasive arguments or opinions on various topics in English.

LIST OF ACTIVITIES

UNIT	COURSE CONTENTS	HOURS
UNIT -I	• Listening and Speaking • Accent in speech (British and American) • Practicing Sounds of English: Stress and Intonation Patterns	4
UNIT -II	• Role-play • Extempore • JAM (Just a minute)	4
UNIT -III	• Presentations • Interview Simulations • Telephone Etiquettes	4
UNIT -IV	• Formal speech- Welcome Speech and Vote of thanks • Public Speaking and Rhetoric • Group Discussions and Debates	4

TEXT BOOKS

1. English Grammar in Use. Raymond Murphy. Cambridge UP.4th Edition.

2. Business Communication by Carol M Lehman, Debbie D Dufrene and Mala Sinha. Cengage Learning. 2nd Edition.
3. A Textbook of English Phonetics for Indian Students by T. Balasubramanian [MACMILLAN]
4. Soft Skills: Key to Success in Workplace and Life by Meenakshi Raman and Shalini Upadhyay. Cengage Learning. 2018 Edition.

REFERENCE BOOKS

1. Technical Communication, Principle and Practice by Meenakshi Raman &Sangeeta Sharma, Oxford University Press.
2. Communication skill by Sanjay Kumar &PuspaLata, Oxford University Press. 2nd Edition.
3. Business Communication Today by Courtland L Bovee and Thill, Pearson

MAPPING MATRIX OF COURSE OBJECTIVES (COs) & COURSE LEARNING OBJECTIVES (CLOs)

SEM	SUB CODE	Course Name	Course Objectives	CLO1	CLO 2	CLO 3	CLO 4	CLO 5
I/II	25HS151 /25HS252	COMMUNICATIVE ENGLISH LAB	CO1	□	□	□		
			CO2		□		□	
			CO3			□	□	
			CO4				□	
			CO5					□

ENGINEERING GRAPHICS & DESIGN LAB	
Course Code: 25ME153/25ME254	**Continuous Evaluation:** 40 Marks
Credits: 1	**End Semester Examination:**60 Marks
L T P : 0 0 2	
Prerequisite: NIL	

COURSE OBJECTIVES (COs)

1. To draw orthographic projections of lines, planes and solids.
2. To construct isometric scale, isometric projections and views.
3. To draw sections of solids including cylinders, cones, prisms and pyramids.
4. To draw projections of lines, planes, solids, isometric projections

COURSE LEARNING OUTCOMES (CLOs)

Once the course is completed, the students will be able to

1. Understand orthographic projections of points and lines in any position through Auto CAD.
2. Imagine and convert isometric view in to orthographic projections and vice versa.
3. Understand the simple machine components and draw its projections

LIST OF EXPERIMENTS

UNIT	COURSE CONTENTS	HOURS
UNIT-I	**INTRODUCTION TO ENGINEERING GRAPHICS AND AUTOCAD** Principles of Engineering Graphics and its significance - Usage of drawing instruments -Lettering and Dimensioning Standards - The concepts of Computer Aided Drafting for Engineering Drawing - Introduction to AutoCAD software - AutoCAD commands, tools and its usage - Geometrical Constructions	3
UNIT-II	**ORTHOGRAPHIC PROJECTIONS** Orthographic Projections - First angle projections - Visualization concepts and principles - Layout of views - Conversion of pictorial diagram into orthographic projections	3
UNIT-III	**PROJECTION OF PLANES AND SOLIDS** Projections of Planes (polygonal and circular surfaces) inclined to the HP only - Projection of simple solids like Prisms, Pyramids, Cylinders, and Cones (Axis inclined to the HP only) by change of position method. .	3
UNIT-IV	**SECTIONS OF SOLIDS AND DEVELOPMENT OF SURFACES** Sectioning of Simple solids in a simple vertical position using a cutting plane inclined to the HP only, and obtaining the true shape of the section - Development of the lateral surfaces of simple solids like Prisms, Pyramids, Cylinders, and Cones.	3
UNIT-V	**ISOMETRIC PROJECTIONS AND CAD APPLICATIONS** Principles of Isometric projections - Isometric scale and view - Isometric view of simple solids (Prisms, Pyramids,	3

	Cylinders, and Cones) - Combination of two solids in simple vertical positions - Applications of CAD software in drafting real-world scenarios.	

TEXT BOOKS:

1. Engineering Drawing - N.D. Bhatt & V.M. Panchal, Charotar Publishing House, Gujarat.
2. Computer Aided Engineering Drawing S. Trymbaka Murthy, 4th Ed, University Press
3. Engineering Drawing by N. S. Parthasarathy and Vela Murali Oxford University Press

REFERENCE BOOKS:

1. Engineering Graphics - K.R. Gopala krishna, Subash Publishers Bangalore.
2. Graphics for Design and Production-Luzadder Warren J., Duff John M., Eastern Economy Edition, Prentice-Hall of India Pvt. Ltd.,New Delhi.
3. Computer Aided Engineering drawing, Prof. M. H. Annaiah, New Age International Publisher

Mapping Matrix of Course Objectives (COs) and Course Learning Outcomes (CLOs)

SEM	SUB CODE	Course Name	Course Objectives	CLO1	CLO 2	CLO 3
I/II	**25ME153/25ME254**	ENGINEERING GRAPHICS & DESIGN LAB	CO1	√		
			CO2		√	
			CO3			√
			CO4			√

HINDI -I	
Course Code:25HIN101/25HIN202	**Continuous Evaluation:** 30 Marks
Credits: 2	**End Semester Examination:** 70 Marks
L T P : 2 0 0	
Prerequisite: Nil	

COURSE OBJECTIVES (COs)

हिन्दी हिषय केप्रश्नपत्र की सामग्री में ज्ञान तथा हिक्षा केबदलते परिदृश्य को ध्यान में िखा गया िै।हिन्दी केभक्तिकाल, ीहतकाल औि आधुहनककाल के कहियोंों की कहिताओंों को पाठ्यक्रम में ाहमल हकया ै | व्याकिण की हिहभन्न कोहियोंों तथा भाषा के सम्प्रेषण से हिन्दी का प्रचाि-प्रसाि ोगा।सोंचाि कौि ल के द्वाि ा छात्रोंों का ज्ञान परिमाहजित ोगा।साहित्येति छात्रोंों कज्ञानिधिन, भाषायीक्षमता एिम् अहभृक्ति भी इस पाठ्यक्रम का लक्ष्य िै।

COURSE LEARNING OUTCOMES (CLOs)

पाठ्यक्रमपरिणाम **1.Knowledge**

Outcome ज्ञानकापरिणाम

At the end of the course, the student should be able to

पाठ्यक्रम केअोंत में छात्र सक्षम ोना चाहिए

1. -हिन्दी क़प्रमुख कहि जो पाठ्यक्रम में ाहमल ै ,उनकी कहिताओंों की व्याख्या औि काव्यगत हिेषताओंों को छात्र समझेंगे।
2. छात्रोंों को काव्य में स ,अलोंकाि औि छन्द का ज्ञान प्राप्त ोगा|
3. -व्याकिण केअध्ययन से छात्रोंों को भाषा बोलने, हलखने औि पढने में सायता प्राप्त ोगी।

2.Skill Outcome

कौि ल का परिणाम

At the end of the course, the student should be able to

पाठ्यक्रम केअोंत में छात्रसक्षम ोना चाहिए

1. -हिंदी कहियोंों ि उनकी कहिताओंों से परिहचत ो जाऐंगे।
2. छात्र दोे औि कहिता समझने में सक्षम ोोंगे।
3. -व्याकिण केज्ञान केसाथ– साथ ब्ोोंे कउच्चाि ण केबोध से अिगत ोोंगे।

COURSE CONTENTS

UNIT	COURSE CONTENTS	HOURS
UNIT-I	इस इकाई में हिंदी भक्तिकाल केप्रमुख कहिकबीि दास ि ं। कबीि दास -कबीि दास केदोे 5 दोे	8
UNIT-II	इस इकाई में हिंदी ीहतकाल केप्रमुख कहि हबिाीलाल ं। हबिाीलाल- हबिाीलाल के दोे 5दोे	7
UNIT-III	इस इकाई में हिंदी आधुहनककाल केप्रमुख कहि माखनलाल चतुेदी ं। माखनलाल चतुेदी (पुष्पकीअहभलाषा) कहिता	7
UNIT-IV	यि इकाई सोंचाि कौि ल से सम्बक्तित ि. इसमें (i) हिंदी केप्रमुख मुाि े औि लोकोक्तियाँ (ii) आत्मपरिचय (self-introduction), साक्षात्काि कौि ल (interview skills), कायिक्रमसोंचालन/मोंचप्रबोंधन (event management)	8

METHODOLOGY पिहत

- कक्षाव्याख्यान

-व्याकिण के माध्यम से हिंदी ि ब्ो ो ं का उच्चा ि ण ि लेखन काअभ्यास हकया जाएगा|
-समय-समय पि छात्रों को प्रदत्तकायि हदया जाएगा|
- साप्ताहिकप्रश्नाि ली|

REFERENCE BOOKS/ TEXT BOOKS

आिश्यक पुस्तकें औि सामग्री

1. -कबीि ग्रन्थाि ली ,सोंपादक-श्यामसुन्दिदास ,काि ी नागिी प्रचारिणी सभा|
2. हबिाि ी सतसई ,साहित्यसोंस्थान प्रयाग|
3. -भाषाहिज्ञान ,डॉ .भोलानाथ हतिाि ी, हकताब मिल इलाि ाबाद|
4. -हिंदीव्याकिण ,कामताप्रसादगुरु ,प्रभातप्रकाि नहदल्ली

GERMAN-I	
Course Code:25FLGR101	**Continuous Evaluation:** 30 Marks
Credits: 2	**End Semester Examination:** 70 Marks
L T P : 2 0 0	
Prerequisite: Basics of English Language	

COURSE OBJECTIVES (COs)

The objective of this course is to impart basic knowledge of German language to the students. The course intends to grow the ability of verbal and written communication. Overall, the objective is to facilitate comprehension of daily life contexts in German, both oral as well as written.

1. To develop oral and written skills of understanding, expressing and exchanging information in German language.
2. To develop awareness of the nature of language and language learning.
3. To develop the ability to construct sentences and frame questions.
4. To provide German language as a competitive edge in career choices.
5. To know some of the aspects of the culture of the countries where German language is spoken.

COURSE LEARNING OUTCOMES (CLOs)

After completion of the course the students will have the ability to:

1. Read and write short, simple texts.
2. Understand and take part in short, simple conversations using the skills acquired.
3. Know some aspects of the culture of the countries where the German language is spoken.
4. Read a text and/or e-mail during any employment.

COURSE CONTENTS

UNIT	COURSE CONTENTS	HOURS
UNIT-I	- Informationen über Deutschland - Buchstaben, die Aussprache, Wochentage, Monate - Begrüßung, Wie geht's? , sich vorstellen, Zahlen, W-Familie	8
UNIT-II	- Über Personen sprechen (Name, Herkunft, Adresse, Telefonnummer, Alter, Beruf, Familie), - Länder und Sprachen, Berufe, Satzstruktur, Familienmitglieder, Farben, Wetter - Personalpronomen, Konjugation von Verben (sein, haben, heißen, wohnen, kommen, machen, lernen, arbeiten, studieren)	8
UNIT-III	- Nomen (Genus, Singular-Plural), Bestimmter Artikel, Unbestimmter Artikel,Negation, W-Frage, Ja-Nein-Frage - Über Sachen sprechen - Sachen des Alltagslebens(Obst und Gemüse, Schulsachen), Haushaltswaren, Adjektive	7
UNIT-IV	- Akkusativ, Artikel und Personalpronomen im Akkusativ	8

	- Unregelmäßige Verben - Kleidung, Lebensmittel Leseverstehen.	

TEXT BOOKS

1. Netzwerk Neu A1 (Kursbuch+Arbeitsbuch)by StefanieDengler, et al.Ernst Klett Sprachen., 2019.

OPEN EDUCATIONAL RESOURCES

2. **Website for additional materials:**https://www.nthuleen.com/teach.html

REFERENCE BOOKS

1. Studio D A1, Hermann Funk, Christina Kuhn, Silke Demme, 2010, Cornlesen.
2. Einfach Grammatik: Übungsgrammatik Deutsch A1 bis B1, Paul Rusch, Helen Schmitz, 2012, Langenscheidt.
3. Berliner Platz - neu: Lehr- und Arbeitsbuch, Christiane Lemcke, Lutz Rohrmann, Theo Scherling, 2009, Klett Sprachen.
4. Tangram aktuell 1: A1, Rosa-MariaDallapiaza, Eduard von Jan, Sabine Dinsel, 1998, Hueber Verlag.
5. Lernziel Deutsch: Deutsch als Fremdsprache, Teil 1, Wolfgang Hieber, 1984, Max Hueber Verlag

Mapping Matrix of Course Objectives (COs) and Course Learning Outcomes (CLOs)

SEM	SUB CODE	Course Name	Course Objectives	CLO1	CLO2	CLO3	CLO4
I	25FLGR101	**GERMAN-I**	CO1	√	√		
			CO2	√			
			CO3		√		
			CO4				√
			CO5			√	

FRENCH-1	
Course Code: 25FLFR101	**Continuous Evaluation:** 30 Marks
Credits: 2	**End Semester Examination:** 70 Marks
L T P : 2 0 0	
Prerequisite: Basics of English Language	

COURSE OBJECTIVES (COs)

1. To develop the skills to construct short and simple sentences.
2. To prepare the students to identify themselves with the culture of the Francophone world.
3. To develop in students a good degree of understanding of syntactic, lexical, grammatical and stylistic features of the French language.
4. To demonstrate differences and diversity of the French speaking world with their own

COURSE LEARNING OUTCOMES (CLOs)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of the course, students would be able to:

1. Speak themselves in French used in daily conversations.
2. Explain cultural artefacts, practices and perspectives of the French speaking world.
3. Apply linguistic knowledge to analyse a simple text, identifying its salient features, and thus express themselves effectively in French.
4. Contrast culture of the French speaking world with their own, and hence demonstrate an increased awareness towards its key practices and perspectives.

COURSE CONTENTS

UNIT	Unités	Objectifs de Communication	Grammaire	Lexique	Heures
UNIT-I	**La Salutation et l'Introduction**	Saluer. Entrer en Contact. S'Excuser. Remercier. Se Présenter/Présenter Quelqu'un.	Pronoms Personnels Sujets. L'Alphabet. Les Articles Indéfinis. Les Verbes en -ER au Présent.	Salutations, Les Nombres. Les Objets de la Classe. La Nationalité.	8
UNIT-II	**On Partage des Renseignements**	Demander de Se Présenter. Donner des Renseignements Personnels.	Etre et Avoir au Présent. Les Verbes en -ER au Présent. Adjectifs de Nationalités. L'Interrogation.	Adjectifs de Nationalité, Métiers et Secteurs Professionnels, Goûts et Intérêts	8

UNIT-III	**Ma Ville et Mon Quartier**	Décrire et Qualifier Ville ou Quartier. Localiser. Demander et Donner Directions.	Verbe Vivre. Articles Définis (Le, la, les). Il y a/ Il n'y a pas. Prépositions. Adjectifs Qualificatifs. Impératif.	Prépositions de lieux. Vocabulaire des Sites. Etablissements et Service de Ville.	7
UNIT-IV	**Mes Intérêts et Goûts**	Parler de Ses Goûts et de Ses Loisirs. Donner Son Impression sur le Caractère de Quelqu'un.	Présent des Verbes en -ER, et du Verbe Faire. Négation, Adjectifs Possessifs.	Avoir l'air. Loisirs. L'Expression des Goûts. Faire du/ de la. Ma Famille.	7

TEXT BOOKS

1. Version Originale 1, Livre de l'élève: Denyer M. & Agustin GarmendiaA. & Olivieri M L L., éd. Maisons des Langues, Paris. 2013.

REFERENCE BOOKS

1. Alter Ego 1, Livre d'élève, Berthet A. & Hugo C. & Kizirian M. V. &Sampsonis B. & Waendendries M., éd Hachette, Paris, 2006.
2. Connexions 1, Loiseau Y. & Mérieux R., éd. Didier, Paris, 2004.
3. Le Nouveau Sans Frontiers, Vol. 1, P. Dominique, J. Girardet et al,CLE International, Paris, 2013.

Le Robert & Nathan Conjugation, Paperback, Le Robert Nathan

Mapping Matrix of Course Objectives (COs) and Course Learning Outcomes (CLOs)

SEM	SUB CODE	Course Name	Course Objectives	CLO1	CLO2	CLO3	CLO4
I	25FLFR101	**FRENCH-I**	CO1	√		√	
			CO2		√		√
			CO3			√	
			CO4				√

ENVIRONMENTAL BIOENGINEERING	
Course Code:25ESEB101/25ESEB202	**Continuous Evaluation:**30 Marks
Credits: 3	**End Semester Examination:** 70 Marks
L T P : 3 0 0	
Prerequisite: Nil	

Course Objectives (COs) - The Course is designed with the following objectives:

1. To provide a comprehensive understanding of the relationship between humans and the environment.
2. Aims to introduce students to the different components of the environment.
3. To develop the understanding of pollution, its causes, and their effects
4. To familiarize the students with the different biological concepts. Including artificial intelligence and its applications.

Course Learning Outcomes (CLOs) –The Syllabus has been prepared in accordance with the NEP-2020 and based on the UGC curriculum framework. Upon completion of this course, learners will be able to:

1. Analyse the environmental pollution and sensitize themselves to adverse health impacts of pollution.
2. Demonstrate to safeguard the Earth's environment and its resources.
3. Explain sustainable development, its goals, challenges, and global strategies.
4. Improve biological concepts using an engineering approach.

COURSE CONTENTS

UNIT	COURSE CONTENTS	HOURS
UNIT-I	**Human and Environment** Introduction to earth environment, Scope and importance. Components of the environment: Lithosphere, Hydrosphere, Biosphere, Atmosphere. The man- environment interaction, Population growth and natural resource exploitation, Industrial revolution, and its impact on the environment. Understanding of pollutant and pollution; Types of Pollution, Air pollution: Water pollution, Soil pollution and solid waste, Noise pollution, Thermal pollution and their impact on human health.	**8**
UNIT-II	**Natural Resources, Sustainable Development & Sustainable living** Overview of natural resources, Classification of natural resources, Resources: Forests, wetlands, Status and challenges. Water resources: Types of water resources, issues and challenges; Soil and mineral resources, Energy resources: renewable and non-renewable sources of energy. Biodiversity and its distribution, Levels and types of biodiversity; Biodiversity in India and the world; Biodiversity hotspots; Introduction to sustainable development: Sustainable Development Goals (SDGs)-targets and indicators, challenges, and strategies for SDGs. Ways to live in sustainable manner- Conservation of energy, water at home, plantation, waste segregation, kitchen	**8**

	gardening.	
UNIT-III	**Introduction of Bioengineering:** Significance of biology, fundamental similarities, and differences between science and engineering- humans as the best machines, brain as a computer, comparison between eye camera, **Biomolecules**: molecules of the life – monomeric unit and polymeric structure, carbohydrates, proteins; nucleotides and lipids. Bio-engineering introduction and current status in Agriculture, Medicine (vaccine and biosensors) enzyme technology, and environment, and the role of artificial intelligence and robotics in human health monitoring.	**7**
UNIT-IV	**Bioengineering in Environment Protection:** What is environmental bioengineering? Applications of bioengineering in the environment Protection. Global environmental problems and bioengineering approaches for their management. Sewage treatment, bio fertilizers, biofuels, bioreactors, bioremediation, and bioengineering for biomedical waste management. Role of artificial intelligence in handling biomedical waste	**7**

RECOMMENDED TEXT BOOKS:

1. Masters, G. M., &Ela, W. P. (2008). Introduction to environmental engineering and science Englewood Cliffs, NJ: Prentice Hall.
2. Jackson, A. R., & Jackson, J. M. (2000). Environmental Science: The Natural Environment and Human Impact. Pearson Education.
3. Rajagopalan, R. (2011). Environmental Studies: From Crisis to Cure. India: Oxford University Press
4. Environmental Studies for Undergraduate Courses by ErachBharucha, UGC New Delhi
5. Biology: a Gopal approach Campbell, N.A Reece, J.B Urry, Lisa; Cain M.L Wasserman, S.A Minorsky, P. V Jackson, R. B Person Education ltd.

REFERENCE BOOKS:

1. A.K De Environmental Chemistry New age Publisher, 2016.
2. "Ecology & Environment" P D Sharma, Rastogi Publications, 2009.
3. www.ipcc.org; https://www.ipcc.ch/report/sixth-assessment-report-cycle/.
4. Central Pollution Control Board Web page for various pollution standards. https://cpcb.nic.in/ standards.
5. Principles of Biochemistry (V Edition) by Nelson, D.L; and Cox, M. M. W. H Freeman and company.

Mapping Matrix of Course Objectives (COs) and Course Learning Outcomes (CLOs)

SEM	SUB	Course Name	Course	CLO	CLO	CLO	CLO

	CODE		Objectives	1	2	3	4
I/II	25ESEB101/25ESEB202	**ENVIRONMENTAL BIOENGINEERING**	CO1	√			
			CO2		√		
			CO3			√	
			CO4				√

INDIAN CONSTITUTION & POLITY	
Course Code: 25VAC101/25VAC202	**Continuous Evaluation:**30 Marks
Credits: 2	**End Semester Examination:** 70 Marks
L T P : 3 0 0	
Prerequisite: Nil	

COURSE OBJECTIVES (COs)

1. To acquaint the students with the fundamental concepts of democracy, diversity and the Constitution.
2. To make students understand the functioning of the three wings of the State
3. To make the students appreciate the purpose of decentralised administration under the Constitution and its functioning
4. To make students analyse and discuss various rights and duties under the Constitution of India

COURSE LEARNING OUTCOMES (CLOs)

The syllabus has been prepared in alignment with National Education Policy (NEP). After completion of course, students would be able to:

1. Explain the concept of democracy, diversity and the Constitutional Values
2. Describe the functioning of the three wings of the State
3. Sketch the functioning of decentralised administration under the Constitution of India and appreciate the political dimensions.
4. Examine the scope of various rights and duties under the Constitution of India.

COURSE CONTENTS

UNIT	COURSE CONTENTS	HOURS
UNIT-I	**DEMOCRACY, DIVERSITY AND THE CONSTITUTION:** • Concept of democracy and importance of right to vote • Electoral Politics • Concepts of diversity and discrimination on the grounds of gender, religion and caste • Concept of democratic government • Constitution design and salient features • Preamble to the Constitution of India	**8**
UNIT-II	**THE THREE WINGS OF THE STATE :** • The definition of State in Constitution of India • Parliament, the State legislature and the making of laws • Concept of cooperative federalism • The Executive and Administration • Role of Governor and the President of India • The Judiciary	**8**
UNIT-III	**LOCAL GOVERNMENT AND ADMINISTRATION:** • Panchayati Raj System • Rural and Urban administration • Social and Economic Justice for the marginalized	**7**

	• Directive Principles of State Policy	
UNIT-IV	**RIGHTS AND DUTIES:** • Fundamental Rights (Part III of the Constitution) • Protection of Fundamental Rights – Writ petitions in High Court and Supreme Court of India • Fundamental Duties • The concept of Fraternity and secularism • Public utilities and privatization	**7**

RECOMMENDED TEXT BOOKS:

1. D.D. Basu, *Introduction to the Constitution of India,* (LexisNexis, 26th Ed., 2022).
2. M. Laxmikant, *Indian Polity*(McGraw Hill, 7th Ed., 2023)
3. Subhash C. Kashyap, *Constitution of India* (Vitasta Publishing Pvt. Ltd, 1st Ed., 2019)

REFERENCE BOOKS:

1. M.P. Jain*, Indian Constitutional* Law (Lexis Nexis, 8th Ed., 2018).
2. H.M. Seervai, *Constitutional Law of India* (Law & Justice 4th Ed., 2023)
3. P.M. Bakshi, *The Constitution of India*, (Universal Law Publishing Co.,18th Ed., 2022)
4. J.N.Pandey*, Constitutional Law of India*(Central Law Agency, 59th Ed.,2022, Allahabad

Mapping Matrix of Course Objectives (COs) and Course Learning Outcomes (CLOs)

SEM	SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
I/II	25VAC101/25VAC202	INDIAN CONSTITUTION & POLITY	CO1	x	x	x	
			CO2		x		x
			CO3			x	x
			CO4				x

SEMESTER II

ENGINEERING MATHEMATICS-II (COMMON TO ALL BRANCHES EXCEPT BIO MEDICAL ENGINEERING)	
Course Code:25AS202	**Continuous Evaluation:** 30 Marks
Credits: 4	**End Semester Examination:** 70Marks
L T P : 3 1 0	
Prerequisite: Engineering Mathematics-I	

COURSE OBJECTIVES (COs):

1. To enable students to have skills that will help them to solve real-world problems based on different types differential equations.
2. To explain basics of vector spaces and linear transformations.
3. To describe Laplace and inverse Laplace transforms with their properties.
4. To understand Analytic functions, Construction of Analytic Functions
5. To equip the students with concept of Complex Integration, Tayler's and Laurent's Expansions, Residues and Singularities.

COURSE LEARNING OUTCOMES (CLOs):

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Interpret various physical models through higher order differential equation and solve such linear ordinary differential equation.
2. Describe the basics of vector spaces and linear transformations.
3. Apply Laplace transforms to find the solution of initial value problems.
4. Demonstrate the concept of Analytic functions & its constructions.
5. Evaluate Complex Integration, Taylor's and Laurent's Expansion, Singularities and Residues.

COURSE CONTENTS

UNIT	COURSE CONTENTS	HOURS
UNIT-I	Linear differential equation with constant Coefficient, Complimentary Functions, Particular Integrals, Euler – Cauchy differential equations, Second order linear differential equations – Variation of Parameters & Method of undetermined coefficient. **Application domain problems:** Electric field, rate of growth and decay of population dynamic, Antenna Design	12
UNIT-II	Binary composition, internal and external composition, Vector Spaces- Definition and Examples, Vector subspaces, Linear combination of Vectors, Basis and Dimension of Vector Spaces. Linear transformations, Properties of Linear Transformation, Null space and range of linear Transformation, Matrix representation of linear transformation. **Application domain problems:** Image processing, Creating and manipulating 3D models	12
UNIT-III	Laplace Transforms, Existence theorem, Standard Properties, Laplace transforms of Derivatives and Integrals, Unit Step Function, Laplace Transform of	12

	Periodic functions, Inverse Laplace Transforms, Convolution theorem, Applications of Laplace transforms for solving IVP. **Application domain problems:** Signal transformation and control systems	
UNIT-IV	Function of complex variables: Limit, continuity, Differentiability and Analyticity of functions, Cauchy-Riemann Equations (Cartesian and polar forms), Harmonic functions, Construction of Analytic Function, Determination of Harmonic conjugate, Milne-Thomson's method. **Application domain problems:** Special functions and error functions, Computer graphics for rendering images, modelling surfaces, and creating visual effects.	12
UNIT-V	Line integral, Cauchy's Integral Theorem, Cauchy's Integral Formula, Cauchy's Integral Formula for Derivatives, Cauchy's Inequality, Taylor's, and Laurent's Expansions (statements only), Singularities, Poles and Residues, Cauchy's residue Theorem, Applications - Evaluation of real integrals f (sin θ, cos θ) over (0, 2π). **Application domain problems:** Electrical circuits, Image processing and communication system, Diffraction on a flat screen.	12

TEXT BOOKS/REFERENCE BOOKS

1. Srimanta Pal and Subodh C. Bhunia, Engineering Mathematics, Oxford first edition, 2015.
2. Grewal B.S, Higher Engineering Mathematics, Khanna Publications, 44th Edition, 2017
3. S. H. Friedberg, Arnold J. Insel, E. S.Lawrence, Linear Algebra, 4th Ed., Prentice- Hall of India Pvt. Ltd., New Delhi, 2004.
4. E. Kreyszig, Advanced Engineering Mathematics, Wiley-India, 10th Edition, 2017
5. Kandasamy P et al. Engineering Mathematics, S. Chand & Co., New Delhi, revised edition.
6. Dass H. K., Advanced engineering Mathematics, Sultan Chand Publication, Delhi, 2013.

Mapping Matrix of Course Objectives (COs) and Course Learning Outcomes (CLOs)

SEM	SUB CODE	Course Name	Course Objectives	CLO1	CLO2	CLO3	CLO4	CLO5
II	25AS202	ENGINEERING MATHEMATICS-II	CO1	✓				
			CO2		✓			
			CO3			✓		
			CO4				✓	
			CO5					✓

Mathematics-II (For BME only)	
Course Code: 25AS204	**Continuous Evaluation:** 30 Marks
Credits: 4	**End Semester Examination:** 70Marks
L T P : 3 1 0	
Prerequisite: Mathematics-I	

COURSE OBJECTIVES (COs):

1. To familiarize with the concept of complex variables.
2. To introduce the concept of successive differentiation and nth derivatives.
3. To introduce the concept of Differentiation of several variables.
4. To familiarize with concepts of vector and vector differentiation.
5. To introduce the concept of differential equations and their applications

COURSE LEARNING OUTCOMES (CLOs):

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Apply the knowledge to construct analytic functions.
2. Execute the higher order differentiation.
3. Develop the essential tool of differentiation of several variables.
4. Illustrate the concept of vector differentiation.
5. Apply the knowledge of differential equations in solving problems

COURSE CONTENTS

UNIT	COURSE CONTENTS	HOURS
UNIT-I	Complex numbers and their properties, Complex plane, Polar form of complex numbers, Powers and Roots, Sets of Points in the Complex plane, De-Moivre's theorem and its simple applications. **Application domain problems:** Signal processing of bio-signals	12
UNIT-II	Successivedifferentiation,n^{th}orderderivativesofstandardfunctions,Leibnitztheorem(withoutproof) **Application domain problems:** Population dynamics	12
UNIT-III	Introduction, Limit & Continuity, Partial derivatives, Homogeneous functions and Euler's theorem, Total derivatives, Jacobians, Properties of Jacobians. **Application domain problems:** Analysis of blood flow, stability analysis	12
UNIT-IV	Introduction, Scalar and vector point functions, differentiation formulae, Level surface, Gradient, Divergence, Curl, Directional derivatives, Simple Applications. **Application domain problems:** Analysis of bio fluids in biomechanics	12
UNIT-V	Linear differential equation with constant Coefficient, Complimentary Functions, Particular Integrals, Euler – Cauchy differential equations, Second order linear differential equations – Variation of Parameters & Method of undetermined coefficient. **Application domain problems :**Mathematical modelling in biology	12

TEXTBOOKS/REFERENCE BOOKS

1. Grewal B.S,Higher Engineering Mathematics,KhannaPublications,45thEdition,2020.
2. Jain R. K., Iyengar S. R. K., Advanced Engineering Mathematics, 7th Edition, Narosa Publishing House, 2021.
3. BaliN.P.,Goyal M,Advanced Engineering Mathematics, Laxmi Publications, NewDelhi,2018.

4. Dass H.K.,Advanced Engineering Mathematics, SultanChandPublication,Delhi,2018.

Mapping Matrix of Course Objectives (COs) and Course Learning Outcomes (CLOs)

SEM	SUB CODE	Course Name	Course Objectives	CLO1	CLO2	CLO3	CLO4	CLO5
II	25AS204	**Mathematics-II**	CO1	✓				
			CO2		✓			
			CO3			✓		
			CO4				✓	
			CO5					✓

HINDI -II	
Course Code: 25HIN202	**Continuous Evaluation:** 30 Marks
Credits: 2	**End Semester Examination:** 70 Marks
L T P : 2 0 0	
Prerequisite: Nil	

COURSE OBJECTIVES (COs)

हिंदी हिषय के प्रश्नपत्र की सामग्री हनधाि्ण में ज्ञान तथा हिक्षा के बदलते परिप्रेक्ष्य को ध्यान में ि्खा गया ि्ै। इस सत्र में हिंदी लघु कथाओं को सक्तिहलत हकया गया ि्ै ।छात्रों की मौक्तखक अहभव्यक्ति की क्षमता का हिकास किने में हनहित मूल्ोों का मित्वपूणि योगदान ि्ोताि्ै , इससे हिद्याहथियों की कल्पनाि्क्ति के हिकास के साथ-साथ मनोि्ोों जन भी ि्ोताि्ै ।सोंचाि कौि्ल में मुि्ाि्े ,लोकोक्तियों ,पत्रलेखनऔअपहितगद्यांि की समझ के द्वाि्ा हिंदीकाप्रचाि-प्रसाि ि्ोगा ।इस प्रकाि साहित्य के ज्ञान की अहभृक्ति ि्ैश्वीकिण के सोंदभि में प्रासोंहगकता औि उपयोहगकता हसध्द किती ि्ै

COURSE LEARNING OUTCOMES (CLOs)

पाठ्यक्रमपरिणाम

1. Knowledge Outcome

ज्ञान का परिणाम

At the end of the course, the student should be able to

1. पाठ्यक्रम केअोंत में छात्र सक्षम ि्ोना चाहिए
2. हिंदी लघुकथाओं कमूल उद्देश्य को समझने में हिद्याथी हनपुण ि्ो जाएंगे ।लघुकथाओं से क्या हिक्षा हमलती ि्ै ? इसका ज्ञान छात्रों को ि्ोगा ।व्याकिण केअध्ययन से हिद्याहथियों को भाषा बोलने, हलखने औि पढ़ने में सायता प्राप्त ि्ोगी

2. Skill Outcome

कौि्ल का परिणाम

At the end of the course, the student should be able to

(At the end of the course, the student should be able to)

1. -पाठ्यक्रम केअोंत में छात्र सक्षम ि्ोना चाहिए
2. -हिंदी लघुकथाओं से मनोि्ोोंजन भी ि्ोगा|
3. -हिद्याथी लघुकथाओं कमूलकथ्य को समझेंगे|
4. -हिचाि तत्व केबोध से अिगत ि्ोोंगे|
5. -हिंदी में पत्र लेखन औि अपहित गद्यांि को समझने में सक्षम ि्ोोंगे|

COURSE CONTENTS

UNIT	COURSE CONTENTS	HOURS
UNIT-I	इस इकाई में हिंदी लघुकथाओं का सोंहक्षप्त परिचय हदया गया ि्ै– 1.हिंदी लघुकथा का सामान्य परिचय| 2,हिंदीलघुकथाकेप्रमुखप्रकाि|	8
UNIT-II	इस इकाई में हिंदी की दो लघुकथाएों सक्तिहलत की गई ि्ैं- 1. अोंगूिकीबेल 2. हकसानऔि्ग	8
UNIT-III	इस इकाई में हिंदी की दो लघुकथाएों सक्तिहलत की गई ि्ैं- 1 बुि्ाईकाफल 2. चाि्हिद्वानब्राह्मण	7

UNIT-IV	यि इकाई सोंचाि कौि‍ल से सम्बोंहधत ि‍ै**,**इसमें (i) प्रेसरिपोि‍ि, हिज्ञापन, अनुि‍ाद (ii)हिंदी पत्र लेखनऔअपहित गद्योंि‍ को समझना ि‍ तकि‍ सोंगत उत्ति‍ देना अपेहक्षत ि‍ै|	7

METHODOLOG पिहत

- कक्षाव्याख्यान

-व्याकिण के माध्यम से हिंदी ि‍ब्ोोों का उच्चाि‍ण ि‍ लेखन काअभ्यास हकया जाएगा|

-समय-समय पि छात्रों को प्रदत्तकायि हदया जाएगा|

- साप्ताहिकप्रश्नाि‍ली|

-दैहनकप्रश्नाि‍ली

REFERENCE BOOKS/ TEXT BOOKS

आिश्यक पुस्तकें औ सामग्री

1. पाठ्यक्रममेंहनधाि‍रितलघुकथाओंकासोंकलन|
2. -भाषाहिज्ञान ,डॉ .भोलानाथहतिाि‍ी, हकताबमिलइलाि‍ाबाद|
3. -हिंदीव्याकिण ,कामताप्रसादगुरु ,प्रभातप्रकाि‍न

GERMAN-II	
Course Code:25FLGR202	**Continuous Evaluation:** 30 Marks
Credits: 2	**End Semester Examination:** 70 Marks
L T P : 2 0 0	
Prerequisite: GERMAN-I	

COURSE OBJECTIVES (COs)

The objective of this course is to impart basic knowledge of German language to the students. The course intends to grow the ability of verbal and written communication. Overall, the objective is to facilitate comprehension of daily life contexts in German, both oral as well as written.

1. To develop oral and written skills of understanding, expressing and exchanging information in German language.
2. To develop awareness of the nature of language and language learning.
3. To develop the ability to construct sentences and frame questions.
4. To provide German language as a competitive edge in career choices.
5. To know some of the aspects of the culture of the countries where German language is spoken.

COURSE LEARNING OUTCOMES (CLOs)

After completion of the course the students will have the ability to:

1. Read and write short, simple texts.
2. Understand and take part in short, simple conversations using the skills acquired.
3. Know some aspects of the culture of the countries where the German language is spoken.
4. Read a text and/or e-mail during any employment.

COURSE CONTENTS

UNIT	COURSE CONTENTS	HOURS
UNIT-I	- Zeitangabe, Tageszeit, Uhrzeit, der Tagesablauf - Präpositionen mit Akkusativ, Ordinalzahlen - Wegbeschreibung, die Himmelsrichtungen - Die Gebäude, Verkehrsmittel	8
UNIT-II	- Das Haus - Modalverben - Essen und Trinken, Messeinheiten, Einkaufen - Körperteile und Krankheiten - Futur	8
UNIT-III	- Dativ, Artikel und Personalpronomen im Dativ - Präpositionen mit Dativ, die Wechselpräpositionen - Possessiv-Artikel, die Konnektoren - Schreiben Teil 1 - Trennbare Verben	7
UNIT-IV	- Schreiben Teil 2 (E- Mail Schreiben) - Perfekt - Vergangenheit erzählen, Das Wochenende, Lebenslauf	7

TEXT BOOKS

1.Netzwerk Neu A1 (Kursbuch+Arbeitsbuch)by StefanieDengler, et al.Ernst Klett Sprachen., 2019.

OPEN EDUCATIONAL RESOURCES

1. Website for additional materials:https://www.nthuleen.com/teach.html

REFERENCE BOOKS

1. Studio D A1, Hermann Funk, Christina Kuhn, Silke Demme, 2010, Cornlesen.
2. Einfach Grammatik: Übungsgrammatik Deutsch A1 bis B1, Paul Rusch, Helen Schmitz, 2012, Langenscheidt.
3. Berliner Platz - neu: Lehr- und Arbeitsbuch, Christiane Lemcke, Lutz Rohrmann, Theo Scherling, 2009, Klett Sprachen.
4. Tangram aktuell 1: A1, Rosa-MariaDallapiaza, Eduard von Jan, Sabine Dinsel, 1998, Hueber Verlag.
5. Lernziel Deutsch: Deutsch als Fremdsprache, Teil 1, Wolfgang Hieber, 1984, Max Hueber Verlag.

Mapping Matrix of Course Objectives (COs) and Course Learning Outcomes (CLOs)

SEM	SUB CODE	Course Name	Course Objectives	CLO1	CLO2	CLO3	CLO4
II	25FLGR202	**GERMAN-II**	CO1	√	√		
			CO2	√			
			CO3		√		
			CO4				√
			CO5			√	

FRENCH-II	
Course Code: 25FLFR202	**Continuous Evaluation:** 30 Marks
Credits: 2	**End Semester Examination:** 70 Marks
L T P : 2 0 0	
Prerequisite: French-I	

COURSE OBJECTIVES (COs)

1. To develop the skills to construct short and simple sentences.
2. To prepare the students to identify themselves with the culture of the Francophone world.
3. To develop in students a good degree of understanding of syntactic, lexical, grammatical and stylistic features of the French language.
4. To demonstrate differences and diversity of the French speaking world with their own

COURSE LEARNING OUTCOMES (CLOs)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of the course, students would be able to:

1. Express themselves in French used in daily conversations.
2. Recognise and explain cultural artefacts, practices and perspectives of the French speaking world.
3. Apply linguistic knowledge to analyse a simple text, identifying its salient features, and thus express themselves effectively in French.
4. Contrast culture of the French speaking world with their own, andhence demonstrate an increased awareness towards its key practices and perspectives.

COURSE CONTENTS

UNIT	Unités	Objectifs de Communication	Grammaire	Lexique	Heures
UNIT-I	**Journée Typique**	Parler d'habitudes, Exprimer l'Heure, S'Informer sur l'Heure, Moment et Fréquence.	Verbes Pronominaux au Présent. Verbes Aller et Sortir	Heure, Moments de la Journée. Activités Quotidiennes. Adverb. Météo.	8
UNIT-II	**Achats**	S'informer sur un Produit. Acheter et Vendre un Produit. Donner Son Avis. Parler du temps.	Adjectifs Interrogatifs. Adjectifs Démonstratifs(Ce, cette, ces). Genre et Nombre. Verbe Prendre.	Vêtements. Couleurs. Fruits et Légumes.	8

UNIT-III	**Alimentation**	Parler des Plats et des Aliments. Commander un Menu dans un Restaurant. Situer une Action dans le Futur	Future Proche: Aller +Infinitif. Articles Partitifs(du/de la/des/d'). Pronoms COD. Future.	Aliments. Vocabulaire des Quantités.	7
UNIT-IV	**expérience vécue**	Parler du passé. Parler d'expériences. Parler de ce que nous savons faire.	Passé Composé. Imparfait	Verbes Savoir, Pouvoir et Connaître. Adjectifs Qualificatifs. Vocabulaire des Savoirs et Compétences. Récit de Vie.	7

TEXT BOOKS

1. Version Originale 1, Livre de l'élève: Denyer M. & Agustin GarmendiaA. & Olivieri M L L., éd. Maisons des Langues, Paris. 2013.

REFERENCE BOOKS

1. Alter Ego 1, Livre d'élève, Berthet A. & Hugo C. & Kizirian M. V. &Sampsonis B. & Waendendries M., éd Hachette, Paris, 2006.
2. Connexions 1, Loiseau Y. & Mérieux R., éd. Didier, Paris, 2004.
3. Le Nouveau Sans Frontiers, Vol. 1, P. Dominique, J. Girardet et al,CLE International, Paris, 2013.
4. Le Robert & Nathan Conjugation, Paperback, Le Robert Nathan.

Mapping Matrix of Course Objectives (COs) and Course Learning Outcomes (CLOs)

SEM	SUB CODE	Course Name	Course Objectives	CLO1	CLO2	CLO3	CLO4
II	25FLFR202	**FRENCH-II**	CO1	√		√	
			CO2		√		√
			CO3			√	
			CO4				√

Engineering Mathematics-III (COMMON TO ALL BRANCHES EXCEPT BIO MEDICAL ENGINEERING)	
Course Code:24AS301	Continuous Evaluation: 40 Marks
Credits: 4	End Semester Examination:60 Marks
L T P : 3 1 0	
Prerequisite: Engineering Mathematics - II	

COURSE EDUCTIONAL OBJECTIVES (CEOs)

1. To familiarize the students with concepts of Fourier series.
2. To familiarize the students with partial differential equations and their solution.
3. To solve boundary value problems, Heat and Wave equations.
4. To gain good knowledge in the application of Fourier transform.
5. To demonstrate understanding Z-transform.

COURSE LEARNING OUTCOMES (CLOs)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Demonstrate Fourier series in engineering applications.
2. Elaborate different types of partial differential equations.
3. Find solutions of boundary value problems including heat and wave equations.
4. Apply and analyze Fourier transforms with different applications.
5. Evaluate the problems using z-transforms.

MAPPING COURSE EDUCTIONAL OBJECTIVES (CEOs) & COURSE LEARNING OUTCOMES (CLOs)

CLO / CEO	CLO-01	CLO-02	CLO-03	CLO-04	CLO-05
CEO-01	✓				
CEO-02		✓			
CEO-03			✓		
CEO-04				✓	
CEO-05					✓

COURSE CONTENTS

UNIT	CONTENTS	HOURS
UNIT-I	Periodic functions, Fourier Series, Dirichlet's Conditions for a Fourier Series, Fourier Series of discontinuous functions, Even and Odd functions, Half-range series (Period 0 to π), Change of Interval and Functions having arbitrary Period, Half-period Series, Parseval's Formula, Practical Harmonic Analysis. Application domain problems: Signal and vibration analysis	**9**
UNIT-II	Introduction, Partial Differential Equations, Order, Method of Formation of Partial Differential Equations, Solution of Equation by Direct Integration, Lagrange's Linear Equation of first order. Solution of Linear Partial Differential Equations with Constant Coefficients. Application domain problems: Scientific computing of modelling problem in real world scenario	**9**
UNIT-III	Classification of Partial Differential Equations, Method of Separation of Variables, Solution of One -Dimensional Wave Equation, Solution of One-Dimensional Heat Equation. Application domain problems: Modelling problem of mechanics	**9**
UNIT-IV	Introduction, Linear Property, Shifting Property, Change of Scale Property, Modulation Theorem, Fourier Transform of Derivatives, Fourier transform of Integrals, Fourier Transform of Dirac-Delta Function, Fourier Cosine Transform, Fourier Sine Transform, Fourier Sine and Cosine Transforms of Derivatives, Finite Fourier cosine Transform, Finite Fourier sine Transform, Convolution Theorem, Parseval's Identity (without proof)- applications. Application domain problems: Analyzing and processing signals in the time and frequency domains.	**9**
UNIT-V	Introduction, Definition of Z- transform, Linear property, Frequency Shifting, First Shifting, Second Shifting, Differentiation in z-domain, Initial and Final value theorems, Convolution theorem, Z-transforms of basic functions, Inverse Z – transform using partial fraction and long division methods. Simple applications of Z – transform to difference equations. Application domain problems: Analyzing frequency responses of discrete system	**9**

TEXT BOOKS/REFERENCE BOOKS

1. Grewal B.S, Higher Engineering Mathematics, Khanna Publications, 45th Edition, 2020.
2. Raisinghania M.D., Advanced Differential Equations, S. Chand Publishing, 2018
3. Ramana B.V., Higher Engineering Mathematics, McGraw Hill Education, 2017.
4. Churchill R.V. and Brown J., Fourier series and Boundary Value Problems, McGraw-Hill Book Education, 8th Edition, 2017.
5. Kreyszig, E., Advanced Engineering Mathematics, Wiley-India, 10th Edition, 2017.

		L	T	P	C
25EC201	**FUNDAMENTALS OF ELECTRONIC DEVICES**	**3**	**0**	**0**	**3**
	Prerequisite				

COURSE OBJECTIVES (CO)

1. Introduce students to the basic principles and operation of electronic devices. Provide a thorough understanding of semiconductor materials and their role in electronic devices.
2. Familiarize students with different types of electronic devices, including diodes and transistors.
3. Examine the operating principles of different types of transistors, such as bipolar junction transistors (BJTs), field-effect transistors (FETs) and MOSFET.
4. Introduce students to the concepts of biasing, small-signal modeling, and amplifier configurations using transistors.
5. Discuss the limitations and challenges associated with electronic devices and potential ways to overcome them.

COURSE LEARNING OUTCOMES (CLO)

By the end of the course, students should be able to:

1. Understand the basic principles of electronic devices and the differences between passive and active components and explain the operation and characteristics of diodes, including rectification and signal modulation.
2. Analyse and model the behaviour of diodes under different biasing conditions.
3. Describe the operating principles of different types of bipolar junction transistors (BJTs), field-effect transistors (FETs) and MOSFET and their applications in electronic circuits.
4. Design and analyse simple electronic circuits using diodes bipolar junction transistors (BJTs), field-effect transistors (FETs) and MOSFET and understand the role of electronic devices in integrated circuits and their impact on circuit performance.
5. Evaluate the limitations of electronic devices and suggest potential improvements or alternative solutions and work collaboratively in teams to complete electronic devices-related projects and assignments.

MAPPING MATRIX OF CO AND CLO

CLO / CO	CLO 01	CLO 02	CLO 03	CLO 04	CLO 05
CO 01					
CO02					
CO 03					
CO 04					
CO 05					

COURSE CONTENTS

UNIT	CONTENTS	HOURS
UNIT-I	**ENERGY BANDS AND EXCESS CARRIERS IN SEMICONDUCTORS** **Energy bands and excess carriers in semiconductors:** Theory of semiconductors**,** Bonding forces and Energy Bands in Solids – Charge Carriers in Semiconductors – Carrier concentrations – Drift of Carriers in Electric and Magnetic Fields – Invariance of the Fermi level at Equilibrium, Diffusion of Carriers, Carrier Lifetime	9
UNIT-II	**JUNCTIONS DIODES** **Junctions:** Equilibrium Conditions – Forward and Reverse Biased Junctions – Reverse Bias Breakdown, AC and DC resistances, V-I characteristics of junction diode, Piece wise liner diode. **Application of junction Diode:** Rectifiers, wave shaping circuits: clippers, clampers. **Zener Diode:** Construction and operation of Zener diode, Avalanche Breakdown, Zener Breakdown, application of Zener diode, voltage regulation. Application of junction diodes in practical (Power supply, regulators etc) circuits and verification using simulation/physical setup**.**	9
UNIT-III	**TRANSISTOR** **Bipolar Junction Transistors:** Fundamentals of BJT Operation – Minority Carrier Distributions and Terminal Currents, Biasing configurations, mode of operation, input and output characteristics, BJT as switch, Amplification with BJT's, Concept of load line, stability analysis, Frequency Limitations of Transistors. Application of transistor switching and amplification circuits and verification using simulation/physical setup.	9
UNIT-IV	**FIELD EFFECT TRANSISTORS** Introduction to FETs:, Concept of Unipolar vs Bipolar devices, Comparison between FET and BJT, Basic structure and operation of FET Junction Field Effect Transistor (JFET):Construction of n-channel and p-channel JFET, Working principle and characteristics, Output Characteristics Transfer Characteristics, Parameters: IDSS, VP, gm ,Biasing techniques, Applications and limitations of JFET, Metal Oxide Semiconductor FET (MOSFET): Types: Depletion and Enhancement type, Construction of n-channel and p-channel MOSFET, Working principle in different modes, Transfer and Output Characteristics, Comparison between JFET and MOSFET, FET Biasing and Applications: Biasing techniques for MOSFET and JFET, Small signal model of FET, FET as an amplifier (basic configuration), FET as a switch, Use of FET in analog and digital circuits, CMOS Technology (Introduction Only):Basic concept of CMOS pair.	9
UNIT-V	**SPECIAL DIODES** Introduction to Special Diodes, Zener Diode ,Structure and working principle-I characteristics, Zener breakdown vs Avalanche breakdown, Voltage regulation using Zener diode, Design of simple voltage regulator circuits, Schottky Diode, Metal-Semiconductor junction, Light Emitting Diode (LED) and Laser Diode: Working principle of LED, I-V characteristics, luminous efficiency, materials used, Applications in lighting and optical communication, Basics of Laser diode, Photodiode and Solar Cell: Working of Photodiode (Reverse bias operation), Characteristics and response to light intensity, Structure and operation of Solar Cel, Energy conversion and I-V characteristics, Varactor Diode, Capacitance–voltage relationship, Use in tuning circuits and frequency modulation, Tunnel Diode: Negative resistance region, Quantum mechanical tunnelling, V-I characteristics and high-frequency applications	9

TEXTBOOKS

1. Ben G. Streetman and Sanjay Kumar Banerjee. *"Solid State Electronic Devices*", 6th Edition, Pearson Education
2. Robert L. Boylestad and Louis Nashelsky, "*Electronic Devices and Circuit Theory*", 9th Edition – Pearson Education, International Edition.

REFERENCE

1. Donald A. Neamen, "*Semiconductor Physics and Devices*, 2nd Edition, Irwin publishers.
2. S.M. Sze , "*Physics of Semiconductor Devices*", 2nd edition, Wiley Eastern

		L	T	P	C
25EC203	**DIGITAL SYSTEMS**	**3**	**1**	**0**	**3**
	Prerequisite				
	Nil				

COURSE OBJECTIVES (CO)

1. Introduce students to the fundamental concepts and principles of digital electronics and examine various logic families and their characteristics
2. Familiarize students with the design and analysis of digital circuits and enable students to apply Boolean algebra and logic simplification techniques in digital circuit design.
3. Provide hands-on experience in building and testing digital circuits using hardware components and simulation software.
4. Introduce students to sequential logic circuits and their applications in digital systems, Discuss the significance of timing and synchronization in digital systems.
5. Explore the basics of digital memory and storage devices, familiarize students with programmable logic devices (PLDs) and their applications and introduce students to digital integrated circuits and their practical implementation

COURSE LEARNING OUTCOMES (CLO).

By the end of the course, students should be able to:

1. Compare and contrast various logic families (TTL, CMOS, etc.) and their advantages and disadvantages.
2. Describe the basic concepts of digital electronics and explain the binary number system.
3. Design and analyse combinational logic circuits using Boolean algebra and Karnaugh maps. And implement digital circuits using logic gates, multiplexers, and decoders.
4. Construct and analyse sequential logic circuits including flip-flops, counters, and shift registers, use software tools to simulate and verify the functionality of digital circuits. And demonstrate proficiency in troubleshooting digital circuits and identifying potential issues.
5. Analyse the limitations and challenges associated with digital circuits and propose solutions, discuss the principles of clocking and timing in digital systems, design and implement simple digital systems using programmable logic devices (PLDs), explain the operation and applications of digital memory devices like ROM, RAM, and flash memory and work collaboratively in teams to complete digital electronics projects and assignments.

MAPPING MATRIX OF CO AND CLO

CLO / CO	CLO 01	CLO 02	CLO 03	CLO 04	CLO 05
CO 01					
CO02					
CO 03					
CO 04					
CO 05					

COURSE CONTENTS

UNIT	CONTENTS	HOURS
UNIT-I	**NUMBER SYSTEMS - BOOLEAN ALGEBRA AND LOGIC GATES** Number System and its arithmetic, Signed binary numbers, Binary codes, - Boolean algebra – Canonical and standard forms. Digital logic gates, POS simplification, NAND and NOR implementation, Map method – four and five variable map methods –Products of Sums Simplification - Don't care conditions. Quine - McCluskey Method.	9
UNIT-II	**GATE LEVEL MINIMIZATION & COMBINATIONAL LOGIC** Two-Level Logic Implementation: Canonical forms (SOP and POS),Implementation using AND-OR, OR-AND,NAND-NAND and NOR-NOR logic: Universal gate realization ,Logic minimization using Karnaugh Maps (up to 4 variables), EX-OR and EX-NOR Functions : Properties and truth tables, Parity generation and checking, Applications in adders and error detection : Combinational Circuits: Analysis and Design Procedure, General approach: From problem specification to logic circuit, Circuit analysis using truth tables and logic identities, Arithmetic Circuits: Binary Adder: Half Adder, Full Adder, Binary Subtractor: Half and Full Subtractor, Decimal Adder: BCD Adder – Logic design and correction logic Binary Multiplier, multiplication using add-and-shift logic, Magnitude Comparator:1-bit and multi-bit comparator logic, Cascading comparators, Data Routing Circuits: Multiplexer (MUX),Demultiplexer (DEMUX), Decoder and Encoder	9
UNIT-III	**SYNCHRONOUS SEQUENTIAL LOGIC** Introduction to Sequential Circuits: Combinational vs Sequential circuits, Memory elements and feedback, Latches and Flip-Flops: SR Latch (NOR and NAND based),D, T, JK Flip-Flops – Truth tables and excitation tables, Edge-triggered and level-triggered concepts, Master-slave configuration, Analysis of Clocked Sequential Circuits: Derivation of state table and state diagram, Transition table, output table, Analysis using flip-flop input equations, State Reduction and Assignment: Concept of equivalent states, Techniques of state minimization, State assignment strategies (binary and one-hot encoding), Sequential Circuit Design Procedure, Design examples using D, T, JK flip-flops, Registers and Shift Registers: Concept of register, Types of shift registers: SISO, SIPO, PISO, PIPO, Applications: Data storage, data transfer, sequence generator, Counters: Ripple (Asynchronous) Counters, up/down counters, Synchronous Counters, Design of mod-n counters, Johnson Counter, Ring Counter and Timing diagrams and applications.	9
UNIT-IV	**ASYNCHRONUS SEQUENTIAL LOGIC AND MEMORY** Asynchronous Sequential Logic: Analysis of clocked sequential circuits with state machine designing, State reduction and assignments, and Design procedure. Analysis procedure of Asynchronous sequential circuits, circuit with latches, design procedure, Reduction of state and flow table, Race-free state assignment, Hazards.	9
UNIT-V	**DIGITAL INTEGRATED CIRCUITS AND PROGRAMMABLE LOGIC** Introduction to Logic Families: Classification: Digital circuit characteristics: Logic levels, speed, power, and complexity, Bipolar Transistor Characteristics, RTL and DTL Circuits, Resistor-Transistor Logic (RTL), Circuit diagram, working, and limitations, Diode-Transistor Logic (DTL), Structure, operation, improvement over RTL, Applications and historical significance, Transistor-Transistor Logic (TTL), Standard TTL gates (NAND-based), Totem-pole output configuration, TTL characteristics: noise margin, power-speed trade-off, Active pull-up, Open collector outputs, Emitter Coupled Logic (ECL), ECL circuit operation using differential amplifiers, Characteristics: very low voltage swing, highest speed, high power consumption, MOS and CMOS Logic Families, NMOS and PMOS logic gates, CMOS Inverter: Construction and operation, CMOS characteristics: low power, high noise margin, rail-to-rail output and CMOS Transmission Gate Circuits	9

TEXT BOOKS

1. John M Yarbrough -Digital Logic Applications and Design, Thomson Learning,2001.
2. Donald D. Givone, —Digital Principles and Design, McGraw Hill, 2002.
3. Charles H Roth Jr., Larry L. Kinney —Fundamentals of Logic Design, Cengage Learning, 7th Edition.

REFERENCES:

1. D. P. Kothari and J. S Dhillon, —Digital Circuits and Design, Pearson, 2016,
2. Morris Mano, —Digital Design, Prentice Hall of India, Third Edition.
3. K. A. Navas, —Electronics Lab Manual, Volume I, PHI, 5th Edition, 2015.

		L	T	P	C
25EC205	**SIGNALS AND SYSTEMS**	**3**	**1**	**0**	**3**
	Prerequisite				
	Nil				

COURSE OBJECTIVES (CO)

1. Introduce students to the fundamental concepts and principles of signals and systems, familiarize students with various types of signals, such as continuous-time and discrete-time signals, enable students to understand the properties and representations of signals in both time and frequency domains and provide a thorough understanding of linear time-invariant (LTI) systems and their analysis.
2. Introduce students to the concept of convolution and its importance in signal processing and examine the Fourier series and Fourier transform, along with their applications in signal analysis.
3. Examine the Fourier transform, along with their applications in signal analysis and introduce basic concepts of system stability and system response to different input signals
4. Explore the Laplace transform and its role in analysing linear continuous-time systems and introduce basic concepts of system stability and system response to different input signals
5. Discuss the importance of sampling and quantization in digital signal processing, introduce the Z-transform and its applications in analysing discrete-time systems and introduce basic concepts of system stability and system response to different input signals and introduce students to the basics of discrete-time and continuous-time system modelling.

COURSE LEARNING OUTCOMES (CLO)

By the end of the course, students should be able to:

1. Understand the concepts of signals and systems and differentiate between continuous-time and discrete-time signals, analyse and interpret signals in both time and frequency domains using mathematical techniques.
2. Understand the concept of convolution and its significance in signal processing, analyse and interpret the response of linear time-invariant (LTI) systems to different input signals and apply Fourier series to analyse periodic and aperiodic signals.
3. Apply Fourier transform to analyse periodic and aperiodic signals and analyse and interpret the response of linear time-invariant (LTI) systems to different input signals.
4. Utilize Laplace transform and the Z-transform to analyse continuous-time linear systems and their stability.
5. Model and analyse simple discrete-time and continuous-time systems using mathematical representations and work collaboratively in teams to complete signal and systems-related projects and assignments.

MAPPING MATRIX OF CO AND CLO

CLO / CO	CLO 01	CLO 02	CLO 03	CLO 04	CLO 05
CO 01					
CO02					
CO 03					
CO 04					
CO 05					

COURSE CONTENTS

UNIT	CONTENTS	HOURS
UNIT-I	**CLASSIFICATION OF SIGNALS AND SYSTEMS** Classification of Signals: Continuous time signals - Discrete time signals – Periodic and Aperiodic signals –Even and odd signals – Energy and power signals –Deterministic and random signals –Complex exponential and Sinusoidal signals. Unit step, Unit ramp, Unit impulse – Representation of signals in terms of unit impulse. Classification of Systems: Continuous time systems- Discrete time systems - Linear system – Time Invariant system – causal system – BIBO system – Systems with and without memory – LTI system	9
UNIT-II	**ANALYSIS OF CT SIGNALS** Fourier Series Representation of Continuous-Time Periodic Signals, Introduction to periodic signals, Trigonometric and exponential Fourier series, Fourier coefficients and their physical interpretation Dirichlet's conditions and convergence. Properties of Continuous-Time Fourier Series, Linearity, Time shifting, Time reversal, Frequency shifting, Differentiation and integration in time domain, Symmetry properties (even/odd), Parseval's relation (power computation using coefficients), Signal Spectral Characteristics :Frequency spectrum (Amplitude and Phase Spectrum),Power Density Spectrum (PDS) for periodic signals, Practical relevance: Audio, communication signal analysis, Band-Limited and Complex Analytic Signals, Definition and properties of band-limited signals, Applications in sampling and signal reconstruction, Complex analytic signals: Concept and significance, Introduction to Hilbert Transform (qualitative only), System modelling and Analysis, Differential equations as system models Impulse response (h(t)) of LTI systems, Convolution integral: System output computation Frequency response, Use of Fourier series and Fourier transform in system characterization.	9
UNIT-III	**FOURIER TRANSFORM** Fourier transform: Representation of Continuous time signals- Properties of Continuous time Fourier transform –properties-Linearity, time inversion, Scaling, Multiplication in time domain, multiplication in frequency domain, differentiation, Integration, Duality Theorem, phase velocity, Group velocity – Transfer Function calculation, System output modeling, Partial fraction method. Analysis and characterization of CT system using Fourier transform.	9
UNIT-IV	**LAPLACE TRANSFORM** Laplace transform-region of convergence, properties of Laplace Transform-Linearity, time shifting, frequency shifting, multiplication, Transfer Function calculation, System output modeling, Partial fraction method. Analysis and characterization of CT system using FT transform.	9
UNIT-V	**Z-TRANSFORM** Continuous and discrete signal, sampling , sampling theorem, Discrete time Fourier transform (DTFT), system modeling in terms of difference equation- impulse response – Convolution sum - Frequency response. Z transform: Unilateral &Bilateral Z transforms – properties Linearity, time inversion, Scaling, Multiplication in time domain, multiplication in frequency domain, differentiation, Integration. Inverse Z transform: Power series expansion –Partial fraction method. Analysis and characterization of DT system using Z transform.	9

TEXTBOOKS

1. Simon Haykin and Barry Van Veen "*Signals and Systems*", John Wiley & Sons In, 2001.
2. Alan V. Oppenheim et al, "*Signals and Systems*", Pearson Education., 1997.
3. M. Mandal and A. Asif, "Continuous and Discrete Time Signals and Systems, Cambridge, 2007.

REFERENCE

1. John G. Proakis and Manolakis, "Digital Signal Processing, Principles, Algorithms, and Applications", Pearson Education, 3rdedition, 2002.
2. D.C. Lay, Linear Algebra and its Applications, Pearson, 200.
3. K. Huffman & R. Kunz, Linear Algebra, Prentice- Hall, 1971.
4. S.S. Soliman & M.D. Srinath, Continuous and Discrete Signals and Systems, Prentice- Hall, 1990.

		L	T	P	C
25EC207	**ELECTROMAGNETIC FIELD THEORY**	3	1	0	3
	Prerequisite				
	19MA0102				

COURSE OBJECTIVES (CO)

1. Introduce students to the fundamental principles and laws of electromagnetic field theory, familiarize students with vector calculus and coordinate systems necessary for the analysis of electromagnetic fields.
2. Provide a comprehensive understanding of static electric and magnetic fields and their properties, introduce students to the concept of electromagnetic waves and their propagation in free space and different media.
3. Enable students to analyse the behaviour of electromagnetic fields in various practical engineering scenarios, Introduce the concept of electromagnetic boundary conditions and their applications.
4. Provide an understanding of Maxwell's equations and their significance in describing electromagnetic phenomena.
5. Familiarize students with the principles of transmission lines and waveguides.

COURSE LEARNING OUTCOMES (CLO)

By the end of the course, students should be able to:

1. Understand the fundamental concepts of electric and magnetic fields and their interrelation, apply vector calculus to analyse electromagnetic phenomena in different coordinate systems.
2. Calculate electric and magnetic fields for various charge and current distributions.
3. Explain the concept of capacitance, inductance, and resistance in the context of electromagnetic fields and analyse the behaviour of dielectric and magnetic materials in the presence of electromagnetic fields.
4. Apply Maxwell's equations to predict and analyse electromagnetic phenomena in different situations and describe the behaviour of electromagnetic waves in different media and calculate their propagation characteristics.
5. analyse practical engineering scenarios involving electromagnetic fields, such as transmission lines and waveguides, utilize electromagnetic field simulation software for practical analysis and design purposes and work collaboratively in teams to complete electromagnetic field theory-related projects and assignments.

MAPPING MATRIX OF CO AND CLO

CLO / CO	CLO 01	CLO 02	CLO 03	CLO 04	CLO 05
CO 01					
CO02					
CO 03					
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COURSE CONTENTS

UNIT	CONTENTS	HOURS
UNIT-I	**COORDINATE SYSTEMS AND TRANSFORMATION:** Scalars and Vectors, Vector algebra, Cartesian co-ordinate system, Vector Components and unit vectors. Scalar field and Vector field. Dot product and Cross product, Gradient of a scalar field. Divergence and Curl of a vector field. Co – ordinate systems: cylindrical and spherical, relation between different coordinate systems. Expression for gradient, divergence and curl in rectangular, cylindrical and spherical co-ordinate systems. Numerical.	9
UNIT-II	**STATIC ELECTRIC** Coulomb's law, Electric field intensity and its evaluation for (i) point charge (ii) line charge (iii) surface charge (iv) volume charge distributions. Electric flux density, Gauss law and its applications. Maxwell's first equation (Electrostatics). Divergence theorem. Energy expended in moving a point charge in an electric field. The potential field of a point charge. The dipole. Energy density in the electrostatic field. Numerical.	9
UNIT-III	**MAGNETOSTATIC** Lorentz force, magnetic field intensity (H). Biot–Savart's Law. Ampere's Circuit Law – H due to straight conductors, circular loop, infinite sheet of current, Magnetic flux density (B) – B in free space, – Boundary conditions, scalar and vector potential	9
UNIT-IV	**MAXWELLS EQUATIONS AND TIME VARYING FIELDS** Maxwell's Equations: For steady fields in point form and integral form-Faraday's law displacement current-Maxwell's equations in point form and integral form for time-varying fields-Comparison of field and circuit theory. Wave Equations – Uniform Plane Wave Motion in Free Space, Conductors and Dielectrics – Velocity, Wavelength, Intrinsic Impedance and Skin Depth – Poynting Theorem – Poynting Vector and its Significance.	9
UNIT-V	**PARALLEL PLATE WAVE GUIDED & APPLICATIONS** Waves between parallel planes: Transverse electric waves-Transverse magnetic waves characteristic of TE and TM waves-TEM waves. Velocity of propagation-Attenuation in parallel plane guides-Wave impedance	9

TEXTBOOKS

1. William Hayat and John A.Buck., "Engineering Electromagnetics", Tata McGraw-Hill Publishing Ltd, 7th edition 2006.
2. G.S.N.Raju., "Electromagnetic Field Theory and Transmission Lines" Pearson Education, First Indian print 2005

REFERENCE

1. Matthew N. O. Sadiku., "Elements of Electromagnetics", Oxford University Press,3rd edition, First Indian edition 2006
2. Gangadhar K.A, "Field Theory", Khanna Publications,2000
3. Muthu Subramanian R and Senthil Kumar N, "Electromagnetic field theory", Anuradha publications,1999

		L	T	P	C
25EC211	**ELECTRONICS DEVICES LAB**	**0**	**0**	**2**	**1**
	Prerequisite				

COURSE OBJECTIVES (CO)

1: Understand the working principles and characteristics of semiconductor diodes (PN junction, Zener, LED, Photodiode).
2: Analyze rectifier circuits (half-wave, full-wave, bridge) and evaluate the role of filters in reducing ripple voltage.
3: Investigate the input/output characteristics of BJT in different configurations (CE, CC).
4: Examine the operation of FETs (JFET & MOSFET) in different regions (ohmic, saturation).
5: Demonstrate the application of optoelectronic devices (LED & Photodiode) in practical circuits.

COURSE LEARNING OUTCOMES (CLO)

1: Explain the V-I characteristics of semiconductor diodes (PN junction, Zener) and compare the behavior of Silicon and Germanium diodes under forward and reverse bias conditions.
2: Design and test rectifier circuits (full-wave center-tapped and bridge), analyze output waveforms, and evaluate the effect of filter capacitors on ripple voltage reduction."
3: Investigate the input/output characteristics of BJT in Common Emitter (CE) and Common Collector (CC) configurations and interpret key parameters (β, input/output resistance).
4: Experimentally determine the output characteristics of N-channel JFET and MOSFET, and compare their operation in ohmic and saturation regions.
5: Measure the forward voltage drop of an LED and the photocurrent in a photodiode under illumination, relating observations to optoelectronic principles.

MAPPING MATRIX OF CO AND CLO

CLO / CO	CLO 01	CLO 02	CLO 03	CLO 04	CLO 05
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LIST OF EXPERIMENTS

1. To examine the V-I behaviour of a PN junction diode in forward and reverse bias configurations, comparing Silicon and Germanium diodes
2. To examine the V-I characteristics of a Zener diode in forward and reverse bias, and to observe the Zener breakdown phenomenon and its application in voltage regulation.
3. To analyse the characteristics of a full-wave centre-tapped rectifier, observe its output waveform, and evaluate the effect of filter capacitors of varying values on ripple reduction and waveform smoothness.
4. To construct and test a bridge rectifier circuit, monitor its output waveform, and investigate the improvement in waveform smoothness with the use of different filter capacitor values.
5. To study the input and output characteristics of a transistor in Common Emitter (CE) configuration.
6. To study the input and output characteristics of a transistor in Common Collector (CC) configuration.
7. To examine the output characteristics of an N-channel JFET and investigate its operation in both the ohmic and saturation regions.
8. To analyse the output characteristics of an N-channel MOSFET and study its performance in the ohmic and saturation regions.
9. To measure forward voltage drop and study current-intensity relationship in light emission diode.
10. To investigate light-sensitive I-V characteristics and measure responsivity under illumination from photodiode.

REFERENCE: LABORATORY MANUAL

		L	T	P	C
25EC213	**DIGITAL SYSTEM LAB**	**0**	**0**	**2**	**1**
	Prerequisite				
	Nil				

COURSE OBJECTIVES (CO)

1. Demonstrate understanding of basic digital components
2. Design and analyze combinational logic circuits
3. Implement and test sequential logic circuits
4. Apply Boolean algebra in practical circuits
5. Develop problem-solving skills through digital system design

COURSE LEARNING OUTCOMES (CLO)

1. Explain the working principles and truth tables of logic gates (AND, OR, NAND, etc.) and flip-flops (SR, JK, D, T).
2. Construct and verify arithmetic circuits (adders), multiplexers, encoders/decoders, and code converters using logic gates.
3. Build and evaluate counters (ripple, synchronous, Mod-N) and shift registers (SISO, SIPO), analyzing their timing characteristics.
4. Validate Boolean theorems and simplify digital circuits using logic gates and flip-flops.
5. Troubleshoot and optimize digital circuits (e.g., counters, adders) to achieve desired functionality.

MAPPING MATRIX OF CO AND CLO

CLO / CO	CLO 01	CLO 02	CLO 03	CLO 04	CLO 05
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LIST OF EXPERIMENTS

1: To analyse the truth tables and operational characteristics of basic logic gates (AND, OR, NOT, NAND, NOR, XOR, XNOR) and flip-flops (SR, JK, D, T).
2: To design and verify the truth tables of half adder and full adder circuits using logic gates, and evaluate their application in arithmetic operations.
3: To construct a 2-bit magnitude comparator circuit, test its functionality, and interpret the output conditions (A>B, A<B, A=B).
4: To implement encoder and decoder circuits (e.g., 4:2 encoder, 2:4 decoder), observe input-output relationships, and discuss their use in data conversion.
5: To demonstrate the operation of multiplexers (MUX) and de-multiplexers (DEMUX) by configuring them for data selection/distribution and validating their truth tables.
6: To design a code converter circuit (e.g., BCD to Excess-3 or Gray to Binary) and verify the accuracy of conversion through experimental testing.
7: To build a synchronous counter (e.g., MOD-4 or MOD-8), analyse its output waveform, and compare its performance with asynchronous counters.
8: To construct a ripple counter using JK flip-flops, observe propagation delays, and plot the timing diagram for different clock frequencies.
9: To design a Mod-N counter (e.g., MOD-5 or MOD-10) using flip-flops and logic gates, and validate its counting sequence experimentally.
10: To study Serial-In-Serial-Out (SISO) and Serial-In-Parallel-Out (SIPO) shift registers by loading data bits and observing storage/transfer patterns.
11: To test the SR flip-flop's truth table, observe its output transitions, and identify race conditions or invalid states.
12: To configure a JK flip-flop, verify its truth table, and demonstrate its toggling in response to clock pulses.
13: To analyse the T flip-flop's operation by measuring its output frequency for a given input clock signal.
14: To assemble a decade counter (MOD-10) using flip-flops, decode its outputs using a 7-segment display, and validate the counting sequence (0-9).

REFERENCE: LABORATORY MANUAL

		L	T	P	C
25EC208	**PROGRAMMING USING PYTHON**	**3**	**0**	**0**	**3**
	Prerequisite				

COURSE OBJECTIVES (CO)

1. Demonstrate proficiency in Python syntax, control structures, and basic operations using dynamic typing and type conversion.
2. Manipulate built-in data structures (lists, tuples, sets, dictionaries) and strings using indexing, slicing, and built-in functions.
3. Implement functions, recursion, and functional programming techniques (lambda, map, filter, reduce) to solve computational problems.
4. Design Python classes with inheritance, polymorphism, encapsulation, and abstraction using dunder methods and decorators.
5. Develop advanced Python programs using iterators, generators, threading, and multiprocessing, while managing memory (garbage collection).

COURSE LEARNING OUTCOMES (CLO)

By the end of the course, students should be able to:

1. Python programs using control structures (if-else, loops), operators, and dynamic typing.
2. Process and manipulate strings/data structures with indexing, slicing, and built-in methods.
3. Develop recursive functions and apply functional programming tools (lambda, map) for data transformations.
4. Construct object-oriented programs with classes, inheritance, and polymorphism.
5. Optimize programs using advanced features (generators, threading) and memory management techniques

MAPPING OF CO'S AND CLO'S

CO \ CLO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CO 01					
CO 02					
CO 03					
CO 04					
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COURSE CONTENTS

UNIT	UNIT CONTENTS	HOURS
UNIT-I	**Unit 1: Python Basics and Control Structures** Introduction to Python: Print Function, Variables (Dynamic Typing/Binding), Data Types, Keywords and Identifiers, User Input, Type Conversion and Literals. Operators and Conditional Statements: Operators, If-Else, Nested If-Else and Indentation Loops and Flow Control: While Loop, For Loop, Nested Loops, Break, Continue, Pass.	9
UNIT-II	**Python Data Structures and String Handling** String Handling: String Basics, Indexing and Slicing, Editing and Deleting Strings and String Operations and Functions. Built-in Data Structures: Lists, Tuples, Sets and Dictionaries. Built-in Functions, Built-in Modules.	9
UNIT-III	**Functions, Recursion, and Functional Programming** Functions: Defining Functions, Parameters and Return Values. Recursion, Memorization Techniques. Functional Programming: Lambda Functions, Map, Filter, Reduce, Higher-Order Functions	9
UNIT-IV	**Object-Oriented Programming Basic Concepts** Object-Oriented Programming in Python: Class, Object, Inheritance, Polymorphism, Encapsulation, Abstraction, Dunder Methods, Property Decorators.	9
UNIT-V	**Object-Oriented Programming Advanced Concepts** Advanced Python Programming: Python Deep Dive (Mutability, Garbage Collection, Variable Referencing) Iterators, Generators and Threading and Multiprocessing.	9

TEXTBOOKS

1. S, G., & A, V. (2018). Introduction to Python Programming (1st ed.). Chapman and Hall/CRC.
2. Boschetti, A., & Massaron, L. (2018). Python Data Science Essentials: A practitioner's guide covering essential data science principles, tools, and techniques, 3rd Edition. Packt Publishing.

REFERENCE

1. Shovic, J. C., & Simpson, A. (2019). Python All-In-One for Dummies (1st ed.). For Dummies.

		L	T	P	C
25EC202	**ELECTRONIC CIRCUITS**	**3**	**1**	**0**	**4**
	Prerequisite				
	Fundamental of electronic Devices				

COURSE OBJECTIVES (CO)

1. Introduce students to the fundamental principles and analysis techniques of analog electronic circuits, familiarize students with frequency response and the analysis of AC circuits with various models for BJT and FET family
2. Provide a comprehensive understanding of feedback mechanisms and their importance in circuit stability and performance, introduce students to the design and analysis of various amplifiers and operational amplifier circuits.
3. Introduce students to the design of analog amplifiers and oscillators.
4. Explore the concept of power amplifiers and their applications in audio and radio frequency circuits.
5. Familiarize students with the concept of multi shaping circuits and their applications and introduce the concept of generation and implementation of Signal.

COURSE LEARNING OUTCOMES (CLO)

By the end of the course, students should be able to:

1. Understand the fundamental concepts of analog electronic circuits and differentiate them from digital circuits, analyse and design basic BJT and FET amplifier configurations and analyse the frequency response of analog circuits and understand their bandwidth and filtering characteristics
2. Understand the concept of feedback in electronic circuits and its impact on circuit stability and performance and design and analyse various amplifier circuits and understand their applications.
3. Analyse and design simple oscillators for specific frequency responses.
4. Understand the principles of power amplifiers and design basic audio and radio frequency amplifiers.
5. Understand the concept of multi shaping circuits and their applications and work collaboratively in teams to complete analog electronics-related projects and assignments.

MAPPING MATRIX OF CO AND CLO

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CO 01	■				
CO02		■			
CO 03			■		
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COURSE CONTENTS

UNIT	CONTENTS	HOURS
UNIT-I	**BIASING METHODS AND SMALL SIGNAL MODELS (BJT)** Small-Signal Modelling: Small-Signal Equivalent Circuits (Hybrid-π and re models), Calculation of Amplifier Parameters: Voltage Gain (Av), Current Gain (Ai), Power Gain (Ap), Input and Output Impedance (Zi, Zo), Single and Multistage Amplifiers: Small-Signal Analysis of BJT (CE, CB, CC Configurations), Cascade Amplifier (CE-CB), Darlington and Bootstrap Amplifiers, Differential Amplifier (Basics), Large-Signal Behaviour: BJT Large-Signal Model (Cut-off, Active, Saturation)	9
UNIT-II	**BIASING METHODS AND SMALL SIGNAL MODELS (JFET, AND MOSFET)** Small-Signal Modelling: Small-Signal Equivalent Circuits (gm, ro models), Calculation of Amplifier Parameters (Av, Ai, Zi, Zo), FET Amplifiers: Small-Signal Analysis of JFET/MOSFET (CS, CG, CD Configurations), Cascade and Darlington Configurations, Differential Amplifier (FET-based) , Large-Signal Behaviour : FET Large-Signal Model (Triode, Saturation, Cut-off)	9
UNIT-III	**FEEDBACK AMPLIFIERS AND OSCILLATORS** Feedback Concepts: Types of Feedback (Voltage, Current, Series, Shunt), Analysis of Feedback Amplifiers (Gain Stability, Bandwidth Extension), Oscillator Principles: Barkhausen Criterion for Oscillation, Start-up and Amplitude Stabilization Mechanisms, Oscillator Circuits: RC Oscillators (Phase Shift, Wien Bridge),LC Oscillators (Hartley, Colpitts) and Crystal Oscillators.	9
UNIT-IV	**LARGE SIGNAL AND TUNED AMPLIFIERS** Large-Signal (Power) Amplifiers : Class-A Amplifier (Efficiency, Power Dissipation), Class-B and Class-AB Push-Pull Amplifiers, Complementary Symmetry Amplifiers, Class-B, Heat Sink Design Tuned Amplifiers : Single Tuned Amplifiers, Double Tuned and Synchronously Tuned Amplifiers	9
UNIT-V	**FREQUENCY RESPONSE AND WAVE SHAPING CIIRCUITS** Frequency Response of Amplifiers: Low-Frequency Response (Coupling and Bypass Capacitors), High-Frequency Response (Miller Effect, Junction Capacitances), Nonlinear Wave Shaping Circuits, Multivibrators: Astable, Monostable, Bistable, Schmitt Trigger (Hysteresis Analysis), Time Base Generators (Sawtooth Wave Generation)	9

TEXTBOOKS

1. Robert l. Boylsted, Louis Nashelsky," *Electronic Devices and circuit Theory*", Pearson, 1997. 2.G K Mithal, "*Electronic Devices & Circuits*", Khanna Publishers, 1993.

REFERENCES

1. David A Bell, "*Electronic Devices and Circuits*", Prentice Hall of India, 1998.
2. JacobMillman, Christos C Halkias, "*Electron Devices and Circuits*", Tata McGraw Hill, Edition 1991 Donald L Schilling, Charles Belove, "*Electronic Circuits*", 3rd edition, 1989.
3. Stanley G. Burns , Paul R,Bond, " *Principles of Electronic Circuits* " ,Galgottia publishers.

		L	T	P	C
25EC204	**ANALOG INTEGRATED ELECTRONICS**	**3**	**0**	**0**	**3**
	Prerequisite				

COURSE OBJECTIVES (CO)

1. Introduce students to the fundamental principles and analysis techniques of linear integrated circuits, familiarize students with the characteristics and operation of linear integrated circuits, including operational amplifiers (Op-Amps) and enable students to understand the design and analysis of basic linear circuits using Op-Amps.
2. Introduce the concept of feedback in linear integrated circuits and its impact on circuit performance, provide a comprehensive understanding of various linear integrated circuit building blocks, such as voltage regulators, comparators, and timers and familiarize students with the application of linear integrated circuits in signal conditioning, filtering, and signal generation.
3. Explore the concept of active filters and their design using Op-Amps.
4. Introduce students to the principles of analog-to-digital converters (ADCs) and digital-to-analog converters (DACs).
5. Familiarize students with the design and analysis of practical linear integrated circuit circuits.

COURSE LEARNING OUTCOMES (CLO)

By the end of the course, students should be able to:

1. Understand the fundamental principles of linear integrated circuits and their applications, analyze and design basic linear circuits using operational amplifiers (Op-Amps) in different configurations and understand the concept of feedback in linear circuits and its impact on circuit stability and performance.
2. Analyze the frequency response of linear integrated circuits and understand their filtering characteristics and design and analyze practical linear integrated circuits for signal conditioning and amplification.
3. Design and analyze active filters using Op-Amps for specific frequency responses.
4. Analyze the characteristics and applications of analog-to-digital converters (ADCs) and digital-to-analog converters (DACs).
5. Work with various linear integrated circuit building blocks and demonstrate their practical applications, Identify and troubleshoot issues in linear integrated circuits and propose appropriate solutions and work collaboratively in teams to complete linear integrated circuits-related projects and assignments.

MAPPING MATRIX OF CO AND CLO

CO \ CLO	CLO 01	CLO 02	CLO 03	CLO 04	CLO 05
CO 01	■				
CO02		■			
CO 03			■		
CO 04				■	
CO 05					■

COURSE CONTENTS

UNIT	CONTENTS	HOURS
UNIT-I:	**FUNDAMENTALS** Introduction to operational amplifiers: The difference amplifier and the ideal operational amplifier models, concept of negative feedback and virtual short, Analysis of simple operational amplifier circuits, Frequency response of amplifiers Bode plots. Feedback: Feedback topologies and analysis for discrete transistor amplifiers, stability of feedback circuits using Barkhuizen criteria. Basic op-amp circuits: Inverting and Non-inverting voltage amplifiers-Voltage follower-Summing, scaling and averaging amplifiers-Differential amplifiers-AC amplifiers. Internal Schematic of 741 op-amps.	9
UNIT-II:	**OP – AMP APPLICATIONS** Linear Applications: Current and voltage sources, Instrumentation Amplifiers-V-to-I and I-to-V converters-Differentiators and Integrators. Non-linear Applications: Precision Rectifiers-Wave Shaping Circuits (Clipper and Clampers)-Log Operational Trans conductance amplifier (OTA)- Comparators and its applications-Sample and Hold circuit.	9
UNIT- III:	**OSCILLATORS AND FREQUENCY GENERATORS** Op-amp oscillators: -Wien Bridge and phase shift oscillators-Square / Triangle / Ramp function generators Single Chip oscillators and Frequency generators: Voltage controlled oscillator-555 Timer-555 Monostable operation and its applications-555 Astable operation and its applications-Phase Locked Loop-Operation of 565 PLL-Closed loop analysis of PLL-PLL applications	9
UNIT-IV	**ACTIVE FILTERS** Filter Fundamentals: Definition and purpose of filters in analog signal processing, Classification of filters: Passive vs. Active Filters, Types of filters based on frequency response, Low-pass, High-pass, Band-pass, and Band-stop filters, Applications of filters in communication, instrumentation, and control systems. Filter Order and Poles: Concept of filter order: First-order, second-order, and higher-order filters, Definition and significance of poles and zeros in filter design, Characteristics and comparison of: Butterworth filters, Chebyshev filters, Bessel filters – linear phase response, good for signal integrity,	10
UNIT-V	**DATA CONVERSION DEVICES** Advantages and disadvantages of working in the digital domain, Digital to Analog Conversion: DAC Specifications-DAC circuits-Weighted Resistor DAC-R-2R Ladder DAC-Inverted R-2R Ladder DAC-Monolithic DAC, Analog to Digital conversion: ADC specifications-ADC circuits-Ramp Type ADC-Successive Approximation ADC-Dual Slope ADC-Flash Type ADC-Tracking ADC-Monolithic ADC	8

TEXT BOOK

1. Roy Choudhury and Shail Jain, " Linear Integrated Circuits", Wiley Eastern Ltd,1995
2. Ramakant A. Gayakwad, "Op-Amps and Linear Integrated Circuits", 4th edition, Pearson education.

REFERENCE

1. Coughlin & Driscoll, "Operational-Amplifiers and Linear Integrated Circuits", 6th edition, Pearson education.
2. Sergio Franco, "Design with operational amplifier and analog integrated circuits", McGraw Hill, 1997.

		L	T	P	C
25EC206	**TRANSMISSION LINES AND WAVEGUIDES**	**3**	**1**	**0**	**3**
	Prerequisite				
	19EC0201				

COURSE OBJECTIVES (CO)

1. Introduce students to the fundamental principles and concepts of transmission lines and waveguides in electrical engineering and Familiarize students with the characteristics of different types of transmission lines, such as coaxial cables and microstrip lines and Enable students to understand the analysis and modelling of transmission lines for various applications.
2. Introduce the concept of waveguides and their applications in guiding electromagnetic waves.
3. Provide a comprehensive understanding of the behaviour of waveguides for different modes of propagation.
4. Explore the principles of impedance matching and signal reflection in transmission lines and waveguides and familiarize students with the basics of signal integrity in high-speed digital transmission lines.
5. Provide hands-on experience with the design and analysis of practical transmission line and waveguide systems.

COURSE LEARNING OUTCOMES (CLO)

By the end of the course, students will be able to:

1. Understand the fundamental principles of transmission lines and waveguides and differentiate them from other guided transmission media, analyse and model different types of transmission lines, including their characteristic impedance, attenuation, and phase constant and design and analyse practical transmission line structures for specific applications, such as impedance matching and signal integrity.
2. Understand the concepts of signal reflection and standing waves in transmission lines and waveguides.
3. Analyze the behavior of waveguides for different modes of propagation, including TE and TM modes and design and analyze microwave circuits using transmission lines and waveguides, such as filters and couplers.
4. Work with simulation software and measurement tools to design and analyse practical transmission line and waveguide systems.
5. Identify and troubleshoot issues in transmission line and waveguide systems and propose appropriate solutions and work collaboratively in teams to complete transmission lines and waveguides-related projects and assignments.

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COURSE CONTENTS

UNIT	UNIT CONTENTS	HOURS
UNIT-I	**TRANSMISSION LINE THEORY** General theory of Transmission lines - the transmission line – general solution - The infinite line– Wavelength, velocity of propagation – Waveform distortion – the distortion less line – Loading and different methods of loading – Line not terminated in Z0 – Reflection coefficient – calculation of current, voltage, power delivered and efficiency of transmission – Input and transfer impedance - Open and short-circuited lines – reflection factor and reflection loss.	9
UNIT-II	**HIGH FREQUENCY PLANER TRANSMISSION LINES** Transmission line equations at radio frequencies - Line of Zero dissipation – Voltage and current on the dissipation less line, Standing Waves, Nodes , Standing Wave Ratio – Input impedance of the dissipation less line - Open and short circuited lines, Microstrip Line: Introduction to planar transmission lines for RF and microwave circuits, Structure of a microstrip line: conductor, dielectric substrate, ground plane, Effective dielectric constant, impedance, and phase velocity, Empirical formulas for characteristic impedance, Design considerations: width of the strip, substrate material and height, Applications in patch antennas, RF filters, and matching networks. Coplanar Waveguides (CPW): Structure and comparison with microstrip line, Advantages of CPW: easy integration with active devices, ground-signal-ground layout, Field distribution and quasi-TEM mode propagation, Design equations for impedance control, Applications in MMICs and high-frequency circuits.	8
UNIT-III	**IMPEDANCE MATCHING TECHNIQUES** Impedance matching: Quarter wave transformer – Impedance matching by stubs – Single stub and double stub matching – Smith chart – Solutions of problems using Smith chart – Single and double stub matching using Smith chart.	9
UNIT-IV	**RECANGULAR WAVEGUIDE** Field Components, TE, TM Modes, Dominant TE10 mode, Characteristics wave impedance, cutoff frequency, group and phase velocities, Impossibility of TEM in waveguides, Design, Field Distribution, Power, and Attenuation in Magic Tee	9
UNIT-V	**CIRCULAR WAVEGUIDES** Introduction to circular waveguide, TE, TM modes propagation in circular waveguide, mode numbering system, power transmission in circular waveguide, excitation modes in circular waveguides, Design, Field Distribution, Power, and Attenuation in Coaxial Cable	10

TEXTBOOKS:

1. John D. Ryder, “Networks, Lines and Fields”, PHI, 1991.
2. Sudhakar. A, Shyammohan S Palli, “Circuits and Networks – Analysis and Synthesis”, Tata McGraw Hill, 2nd Edition, 2002.

REFERENCE:

1. Umesh Sinha, “Transmission Lines and Networks”, Satya Prakashan

		L	T	P	C
25EC212	**ELECTRONIC CIRCUITS LAB**	**0**	**0**	**2**	**2**
	Prerequisite				
	Nil				

COURSE OBJECTIVES (CO)

1: Understand and analyze the operation and frequency response of amplifier circuits using BJT, FET, and Op-Amps.
2: Design and analyze various sinusoidal and non-sinusoidal oscillator circuits using discrete and IC-based components.
3: Evaluate the performance and efficiency of power amplifiers and multivibrators through measurement and waveform analysis.
4: Implement analog signal processing circuits such as filters, DACs, and ADCs using operational amplifiers and standard ICs.
5: Apply simulation tools and experimental setups to validate theoretical concepts of waveform generation, conversion, and analysis.

COURSE LEARNING OUTCOMES (CLO)

1: Explain the working principles of amplifiers, oscillators, and multivibrators using electronic components.
2: Construct electronic circuits using discrete components and ICs based on given design specifications.
3: Measure and interpret key parameters like gain, bandwidth, frequency, duty cycle, and efficiency using test instruments.
4: Simulate and analyze analog circuits including filters, ADCs, DACs, and waveform generators using circuit simulation tools.
5: Compare theoretical and practical results to validate circuit behavior and recommend optimizations.

MAPPING MATRIX OF CO AND CLO

CO \ CLO	CLO 01	CLO 02	CLO 03	CLO 04	CLO 05
CO 01					
CO02					
CO 03					
CO 04					
CO 05					

LIST OF EXPERIMENTS

Group 1: (Using only discrete components)

1. To design and analyse the frequency response of an RC coupled amplifier using either a BJT or FET, and to determine the bandwidth, mid-band gain, and cut-off frequencies.
2. To design and construct a Colpitts oscillator using a BJT and to observe the generated sinusoidal waveform, determine the oscillation frequency, and verify the conditions for sustained oscillation.
3. To construct a Class-A or Class-AB power amplifier circuit and evaluate its efficiency by measuring input DC power and output AC power across a load.
4. To design and analyse the frequency response of a single tuned amplifier, and to determine the resonant frequency, bandwidth, and quality factor (Q-factor) of the circuit.
5. To investigate and compare the frequency response characteristics of a BJT amplifier with and without negative feedback, and to observe the changes in gain, bandwidth, and stability due to feedback.

Group 2: (Using IC 741 – IC 555 and any other equivalent IC's)

6. To design and verify the operation of a differential amplifier using an operational amplifier (OP-AMP), and to measure the output voltage as the difference between two input voltages, assuming unity gain and equal resistor values.
7. To study the frequency response of an OP-AMP-based integrator circuit by applying a sinusoidal signal from a function generator, and to observe the effect of varying R and C values on the output waveform using an oscilloscope.
8. To analyse the behaviour of an OP-AMP-based differentiator circuit by applying a sinusoidal signal from a function generator and observing the effect of varying resistor (R) and capacitor (C) values on the output waveform.
9. To design and construct a Wien Bridge Oscillator and an RC Phase Shift Oscillator using transistors or operational amplifiers, and to study the waveform, determine the frequency of oscillation, and verify the conditions for sustained oscillation.
10. To design and implement an Astable Multivibrator using 555 and to analyse the continuously oscillating square wave output, determine its time period, frequency, and duty cycle.
11. To construct a Monostable Multivibrator using 555, and to observe the generation of a single output pulse in response to a triggering input signal. Also, to measure the pulse width and compare it with the theoretical value.
12. To design and implement a Bistable Multivibrator circuit using BJT or Op-Amp, and to analyse its operation as a flip-flop circuit with two stable states, controlled by external triggering.

Group 3: Simulation experiments.

13. To design and implement active Band Pass and Notch filters using operational amplifiers, and to observe and analyze their frequency response, bandwidth, center frequency, and attenuation characteristics.
14. To construct and evaluate a Digital-to-Analog Converter (DAC) using any one standard method (e.g., Binary Weighted Resistor or R-2R Ladder Network) and to verify the analog output for a given digital input.
15. To implement and study the working of an Analog-to-Digital Converter (ADC) using any one method (e.g., Successive Approximation, Counter-type, or Flash ADC), and to convert analog input signals into corresponding digital output values.
16. To design and construct a Ramp Generator circuit using operational amplifiers or transistors, and to analyze the characteristics of the generated ramp waveform in terms of slope, frequency, and linearity.

REFERENCE: LAB MANUAL

SEMESTER – V

		L	T	P	C
25EC303	**ANALOG AND DIGITAL COMMUNICATION**	**3**	**1**	**0**	**3**
	Prerequisite				
	Fundamental of Electronic Devices				

COURSE OBJECTIVES (CO)

1. Grasp the basic concepts of analog and digital communication, including the need for modulation and different modulation schemes.
2. Learn about various AM types (DSBFC, DSBSC, SSB, VSB) and their characteristics such as modulation index, spectra, power relations, and bandwidth requirements.
3. Study phase and frequency modulation, including narrow band FM, wide band FM, and their respective modulation indices, spectra, power relations, and bandwidth.
4. Explore the principles of pulse modulation, sampling theorem, and the digital representation of analog signals along with noise considerations.
5. Analyse various digital modulation systems like PCM, DPCM, Delta Modulation, and understand the concepts of baseband and passband data transmission, including error probabilities and performance comparisons.

COURSE LEARNING OUTCOMES (CLO)

By the end of the course, students should be able to:

1. Ability to describe the need for modulation and differentiate between amplitude, phase, and frequency modulation techniques.
2. Capability to calculate and analyse modulation index, spectra, power relations, and bandwidth for different AM systems and design basic AM transmitters and receivers.
3. Proficiency in generating and detecting FM signals using direct and indirect methods and understanding FM receiver components like the PLL method and stereo FM.
4. Skill in generating and demodulating pulse amplitude modulation (PAM), pulse width modulation (PWM), and pulse position modulation (PPM) signals, and grasping the concepts of digital transmission, aliasing, and sampling.
5. Ability to implement PCM, DPCM, and Delta Modulation systems, evaluate their noise performance, and understand the principles of baseband and passband data transmission, including matched filter reception and signal space diagrams for modulation schemes like BFSK, BPSK, and QPSK.

MAPPING MATRIX OF CO AND CLO:-

CO \ CLO	CLO 01	CLO 02	CLO 03	CLO 04	CLO 05
CO 01	■				
CO02		■			
CO 03			■		
CO 04				■	
CO 05					■

COURSE CONTENTS

UNIT	CONTENTS	HOURS
UNIT-I	**MPLITUDE MODULATION SYSTEMS** Introduction to Communication – Analog and Digital - Modulation - Need for modulation - Amplitude Modulation -DSBFC, DSBSC, SSB, VSB - Modulation index, Spectra, Power relations and Bandwidth. AM Generation: Square law and Switching modulator - DSBSC Generation: Balanced and Ring modulator, SSB and VSB Generator: Hilbert Transform method. AM Detection: Envelope detector and Superheterodyne detector - Quadrature Amplitude Modulation.	9
UNIT-II	**ANGLE MODULATION:** Phase and Frequency Modulation - Narrow Band FM & Wide Band FM - Modulation index, Spectra, Power relations and Transmission Bandwidth. FM Generator and Transmitter: Direct method and Indirect method. FM Detector: Slope detector, Ratio Detector method and PLL method. - FM Receiver - Stereo FM	9
UNIT-III	**PULSE MODULATION** Pulse Modulation, Digital Transmission of Analog Signals: Sampling Theorem, Sampling Process-Aliasing-Natural Sampling-Flat and its applications, Pulse Amplitude Modulation (PAM), Pulse Width Modulation, Pulse Position Modulation. Their generation and Demodulation, Digital Representation of Analog Signals, Bandwidth-Noise trade off-TDM	9
UNIT-IV	**DIGITAL MODULATION SYSTEMS** Quantization of Signals-Quantization error-PCM Systems-Noise Considerations in PCM system-Over all Signal-to-noise ratio for PCM system-Threshold effectChannel Capacity-Virtues, Limitations & Modification of PCM system-PCM Signal Multiplexing- Differential PCM- Delta Modulation-Noise Considerations in Delta Modulation- SNR Calculations-Comparison of PCM, DPCM & DM	9
UNIT-V	**BASE BAND PULSE TRANSMISSION PASS BAND DATA TRANSMISSION** Matched filter receiver-Probability error of the Matched filter-Inter symbol interference-Nyquist criterion for distortion less base band transmission- Correlative coding-Base band M-array PAM transmission-Eye pattern. Pass Band Transmission Model-Generation, Detection, Signal Space Diagram, Probability of Error of BFSK, BPSK, QPSK Schemes- Comparison of BFSK, BPSK & QPSK.	9

TEXTBOOKS

1. Simon Haykin, “Digital Communication Systems”, John Wiley, 2013.
2. Herbert Taub, Donald L. Schilling, Goutam Saha, “Principle of Communication Systems”, 4th Edition, McGraw Hill, 2013.
3. Simon Haykin, “Communication Systems”, John Wiley & Sons, 5th Edition, 2009
4. R.P. Singh & S.D.Spare, “Communication Systems, Analog & Digital”, 3rd Edition, Tata McGraw Hill, 2017

REFERENCE

1. John G. Proakis, “Digital Communications”, 5th Edition, McGraw Hill, 2018.
2. Bernard Sklar, “Digital Communication, Fundamentals and Application”, Pearson, 2nd Edition, 2012.
3. Upamanyu Madhow, “Introduction to Communication Systems”, 1st Edition, 2014
4. J.G.Proakis, M.Salehi, “Fundamentals of Communication Systems”, 2nd Edition, Pearson Education 2014.
5. B.P. Lathi, Zhi Ding & Hari Mohan Gupta,” Modern Digital and Analog Communication”,4th Edition, 2017

23EC0305	**Antenna and Wave Propagation**	**3**	**1**	**0**	**3**
	Prerequisite				
	Nil				

COURSE OBJECTIVES (CO)

1. Introduce students to the fundamental principles and concepts of antenna systems in communication and radar applications and familiarize students with different types of antennas and their characteristics, enable students to understand the principles of electromagnetic wave propagation and radiation and introduce students to the design and analysis of basic antennas, such as dipole antennas and monopole antennas.
2. Provide a comprehensive understanding of antenna arrays and their applications in beam-forming and direction finding.
3. Introduce the concept of antenna impedance matching and its importance in maximizing power transfer and familiarize students with the principles of antenna measurement and testing techniques.
4. Explore the application of antennas in wireless communication systems, satellite communication, and radar systems.
5. Introduce students to the concepts of antenna modelling and simulation using software tools and provide hands-on experience with designing and implementing practical antenna systems.

COURSE LEARNING OUTCOMES (CLO)

By the end of the course, students should be able to:

1. Understand the fundamental principles of antenna systems and their importance in communication and radar engineering, identify different types of antennas and their characteristics, including radiation patterns and impedance and analyse the principles of electromagnetic wave propagation and understand how antennas radiate and receive electromagnetic waves.
2. Design and analyse basic antennas, such as dipole antennas, for specific applications and understand the principles of antenna arrays and their use in beam-forming and direction finding.
3. Apply impedance matching techniques to design efficient antenna systems and use measurement and testing techniques to evaluate the performance of antenna systems.
4. Model and simulate antennas using software tools to optimize their design and performance and apply antennas in wireless communication systems, satellite communication, and radar systems, considering their specific requirements.
5. Work with practical antenna design tools and simulation software to implement antenna systems for specific engineering tasks and collaborate in teams to design and implement antenna systems for practical engineering projects and applications.

MAPPING MATRIX OF CO AND CLO:-

CLO / CO	CLO 01	CLO 02	CLO 03	CLO 04	CLO 05
CO 01	■				
CO02		■			
CO 03			■		
CO 04				■	
CO 05					■

COURSE CONTENTS

UNIT	UNIT CONTENTS	HOURS
UNIT-I	**ANTENNA FUNDAMENTALS** Introduction, Basic Antenna Parameters, Patterns, Beam Area (or Beam Solid Angle)ΩA, Radiation Intensity, Beam Efficiency, Directivity D and Gain G, Directivity and Resolution, Antenna Apertures, Effective Height, The radio Communication link, Fields from Oscillating Dipole, Single-to-Noise Ratio(SNR), Antenna Temperature, Antenna Impedance, Retarded Potential, Far Field due to an alternating current element, Power radiated by a current element, Field variation due to sinusoidal current distribution	10
UNIT-II	**ANTENNA ARRAY** Introduction, Point Source, Arrays of Two Isotropic Point Sources, Non-isotropic but Similar Point Sources and the Principle of Pattern Multiplication, Various forms of antenna arrays – Broadside, End fire, Array of "N" sources – design and analysis of End fire and Broadside case.	9
UNIT-III	**SPECIAL PURPOSE ANTENNAS** The Loop Antenna. Design and its Characteristic Properties, Application of Loop Antennas, Far Field Patterns of Circular Loop Antennas with Uniform Current, Helical Antennas, The Log-Periodic Antenna, Antenna design consideration of satellite communication and UWB. **REFLECTOR ANTENNAS** The Parabola-General Properties, Parabolic and Paraboloid Reflectors, A comparison Between Parabolic and Paraboloid Reflectors.	10
UNIT-IV	**ANTENNA DESIGN AND MEASUREMENTS** Design and analysis of Micro strip Antenna, Horn Antenna and CPW Feed Bowtie Antenna, Antenna Measurements Introduction, Antenna Measurement ranges, Radiation pattern Measurements, Gain and Directivity Measurements, Spectrum Analyzer	9
UNIT-V	**RADIO WAVE PROPAGATION** Ground Wave Propagation: Plane Earth Reflection, Space Wave and Surface Wave, Space Wave Propagation: Introduction, Field Strength Relation, Effects of Imperfect Earth, Effects of Curvature of Earth, Sky wave Propagation: Introduction structural Details of the ionosphere, Wave Propagation Mechanism, Refraction and Reflection of Sky Waves by ionosphere, Critical Frequency, MUF, LUF, Virtual Height and Skip Distance, Relation Between MUF and the Skip Distance.	10

TEXT BOOK

1. Constantine A. Balanis, "Antenna Theory analysis and Design", II Edition, John wiley and Sons.
2. R. E. Collin, "Antennas and Radio Wave Propagation", McGraw Hill International Editions, 1985.

REFERENCE:

1. Robert S. Elliott, "Antenna Hand Book", Joseph J. Carr, Galgotia Publication, New Delhi, 1995.
2. K.D. Prasad, "Antenna and Wave Propagation", Tech India Publications, New Delhi, 1996.
3. John. D. Kraus, "Antennas", McGraw Hill International Editions, 1988

		L	T	P	C
25EC307	MICROPROCESSOR AND INTERFACING	3	1	0	3
	Prerequisite				

COURSE OBJECTIVES (CO)

1. Introduce students to the fundamental principles and architecture of microprocessors, familiarize students with the organization and operation of microprocessors and their instruction sets and Enable students to understand the basics of microcontroller-based systems and their applications.
2. Familiarize students with the basics of interrupt handling and its role in real-time systems.
3. Introduce students to the concept of serial and parallel communication protocols and their implementation in microprocessor-based systems and Introduce the concept of interfacing different peripherals and devices with microprocessors, provide a comprehensive understanding of the input-output (I/O) concepts and interfacing techniques and introduce students to memory and I/O interfacing techniques for external devices and memory components.
4. Familiarize students with the basics of interrupt handling and its role in real-time systems And Introduce students to the concept of serial and parallel communication protocols and their implementation in microprocessor-based systems.
5. Provide hands-on experience with designing and implementing microprocessor-based systems and interfacing with peripheral devices.

COURSE LEARNING OUTCOMES (CLO)

By the end of the course, students should be able to:

1. Understand the fundamental principles of microprocessors, their architecture, and instruction sets, analyse and interpret microprocessor-based assembly language programs and design and implement basic microcontroller-based systems for specific applications.
2. Handle interrupts and design real-time systems using microprocessors.
3. Implement serial and parallel communication protocols in microprocessor-based systems.
4. Interface different peripherals, such as displays, keyboards, and sensors, with microprocessors, implement input-output (I/O) concepts and interfacing techniques in microprocessor-based systems, design and implement memory and I/O interfacing techniques for external devices and memory components.
5. Use simulation software and development tools to model and test microprocessor-based systems and work collaboratively in teams to design and implement microprocessor-based projects with interfacing to peripheral devices.

MAPPING MATRIX OF CO AND CLO: -

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CO 01					
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CO 03					
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COURSE CONTENTS

UNIT	UNIT CONTENTS	HOURS
UNIT-I	**INTEL 8085 ARCHITECTURE** Evolution and introduction to microprocessor, origin of microprocessor, classifications, types of memory, input and output devices, 8085 Microprocessor Architecture, Address, Data And Control Buses, 8085 Pin Functions, Demultiplexing of Buses, Generation Of Control Signals, Instruction Cycle, Machine Cycles, T-States, Memory Interfacing, addressing modes of 8085.	9
UNIT-II	**INSTRUCTION SET & ASSEMBLY LANGUAGE PROGRAMMING WITH 8085** Classification of Instruction Set of 8085, sample programmes, method of data transfer modes, memory mapped and I/O mapped data transfer, programmed data transfer, direct memory access, parallel data transfer, serial data transfer & Assembler Directives- Assembly Language Programming with 8085.	9
UNIT-III	**INTEL 8086 ARCHITECTURE** Introduction to 8086 – Microprocessor architecture – Addressing modes - Instruction set and assembler directives – Assembly language programming – Modular Programming - Linking and Relocation - Stacks - Procedures – Macros – Interrupts and interrupt service routines	10
UNIT-IV	**INSTRUCTION SET & ASSEMBLY LANGUAGE PROGRAMMING WITH 8086** Classification of Instruction Set of 8086, sample programmes, method of data transfer modes, memory segmentation, memory mapped and I/O mapped data transfer, programmed data transfer, direct memory access, parallel data transfer, serial data transfer & Assembler Directives- Assembly Language Programming with 8086.	9
UNIT-V	**PERIPHERAL INTERFACES** Interfacing Concepts, Ports, Interfacing Of I/O Devices, Interrupts In 8085, Interfacing of Data Converters (DTo-A and A-To-D), Programmable Interfacing Devices Like 8255A PPI, 8253/8254 Timer, 8259A PIT, Serial I/O Concepts, SID And SOD, 8251A USART. Interfacing of above chips with 8085.	10

TEXTBOOKS

1. A. K. Ray and K. M. Bhurchandi, "Advanced *Microprocessors and Peripherals*",TataMcGrawHill, 2000.
2. N.senthilkumar,M.saravanan, S. Jeevananthan and S K Shah, " *Microprocessor And Interfacing*",3rd Edition, Oxford University Press , 2015

REFERENCE

1. Doughlas.V.Hall, *Microprocessor and Interfacing : Programming and Hardware*, 2nd edition, McGraw Hill, 1991
2. Kenneth.J.Ayala, *8051 Microcontroller Architecture, Programming and Applications*.2nd edition, Thomson.

		L	T	P	C
25EC311	**MICROPROCESSORS LAB**	**0**	**0**	**2**	**2**
	Prerequisite				
	Nil				

COURSE OBJECTIVES

1: Understand the architecture, instruction set, and programming techniques of 8085 and 8086 microprocessors.
2: Develop assembly language programs using 8085 and 8086, for arithmetic, logical, and data manipulation tasks.
3: Interface peripheral devices such as stepper motors, ADC, DAC, timers, and interrupt controllers with microprocessors.
4: Analyze and implement real-time embedded control systems like temperature controllers using microprocessor-based interfacing.
5: Interpret and debug assembly language programs and interfacing circuits using simulation or hardware tools.

COURSE LEARNING OUTCOME

The students will be able to

1. Write and execute assembly language programs to perform 8-bit and 16-bit arithmetic operations using 8085 and 8086 microprocessors.
2. Identify and use the appropriate addressing modes and instruction sets of 8086 and 8051 for logical and control operations.
3. Design and implement microprocessor-based systems to control external devices like stepper motors and temperature sensors through proper interfacing.
4. Interface and program peripheral devices (8253 timer, 8259 interrupt controller, ADC, DAC) with 8086 using assembly language.
5. Debug and test assembly programs and interfacing circuits using simulation tools or hardware kits, ensuring correct functional outputs.

6. MAPPING MATRIX OF CO AND CLO: -

CLO / CO	CLO 01	CLO 02	CLO 03	CLO 04	CLO 05
CO 01					
CO02					
CO 03					
CO 04					
CO 05					

LIST OF EXPERIMENTS

PART I-8085 MICROPROCESSOR

1. 8-bit and 16-bit Addition and Subtraction.
2. Multiplication and Division using Loops..
3. Find the Largest Number in a Set.
4. Sort an Array in Ascending/Descending Order.
5. Generate Fibonacci Series.
6. Calculate the Sum of First N Natural Numbers..
7. Convert BCD to Binary and Binary to BCD.
8. Design a Delay Routine using Register Pairs.

PART II-8086 MICROPROCESSOR

1. Perform 16-bit Addition using 8086.
2. Perform 16-bit Subtraction using 8086.
3. Perform 16-bit Multiplication using 8086.
4. Perform 16-bit Division using 8086.
5. Find the Largest Number in an Array using 8086.
6. Find the Smallest Number in an Array using 8086.
7. Sort Numbers in Ascending Order using 8086.
8. Sort Numbers in Descending Order using 8086.
9. Compute Sum of Series using 8086.

PART III-INTERFACING

1. Stepper motor interface
2. Programmable timer interface
3. A/D and D/A converters
4. Programmable Interrupt Controller
5. Temperature Controller.

REFERENCE: MANUAL LAB

		L	T	P	C
25EC313	**COMMUNICATION LAB**	**0**	**0**	**2**	**1**
	Prerequisite				
	Nil				

COURSE OBJECTIVES

1. To carry out experiments on various Digital communications modulation schemes using kits. MATLABsoftware is used to simulate the digital modulation techniques
2. It is intended to demonstrate the architecture of Digital communication link components to the students.
3. Students must understand the role of each module present in the communication links.
4. They have to study by evaluating the comparing the performance of each technique used in various modules

COURSE LEARING OUTCOMES

1. To help the students to experiment on Digital communication systems using kits and to use software's to simulate them.
2. Ability to comprehend and appreciate the significance and role of this course in the present contemporary world.
3. Ability to experimentally analyze the performance of various kinds of signaling used in Digital communication systems and their bandwidth requirement.
4. They get hands on experience on system construction and performance evaluation and ability to study issues from communication links and channels, and their equalization techniques

MAPPING MATRIX OF CO AND CLO: -

CLO / CO	CLO 01	CLO 02	CLO 03	CLO 04
CO 01				
CO02				
CO 03				
CO 04				

LIST OF EXPERIMENTS

HARDWARE

1. Amplitude Modulation and Demodulation
2. Frequency Modulation and Demodulation
3. Pre-emphasis and De-emphasis
4. Pulse Amplitude Modulation and Demodulation
5. TDM Pulse Amplitude Modulation (Analog Multiplexing)
6. ASK Modulation and demodulation.
7. FSK Modulation and demodulation.
8. PSK Modulation and demodulation.
9. Pulse Code Modulation and demodulation
10. Differential pulse code modulation and demodulation
11. Delta Modulation and demodulation
12. Time Division Multiplexing
13. Data formatting

SOFTWARE – PYTHON

1. Simulation of Amplitude Modulation with Noise
2. Simulation of Frequency Modulation with Noise
3. Simulation of Phase Modulation with Noise
4. Simulation of DSB-SC Amplitude Modulation
5. Simulation of SSB-SC Amplitude Modulation
6. ASK Modulation and demodulation
7. FSK Modulation and Demodulation
8. PSK Modulation and Demodulation
9. DPSK Modulation and demodulation
10. QPSK Modulation
11. Delta modulation and demodulation

SEMESTER-VI

		L	T	P	C
25EC302	**RF AND MICROWAVE ENGINEERING**	**3**	**0**	**0**	**3**
	Prerequisite				

COURSE OBJECTIVES (CO)

1. Introduce students to the fundamental principles and concepts of radio frequency (RF) filter, familiarize students with the characteristics and behaviour of RF filter and enable students to understand the design and analysis of passive RF filter.
2. Introduce the concept of active RF components and devices, including attenuators and equalizers and provide a comprehensive understanding of RF system parameters.
3. Introduce students to the analysis and design of microwave components.
4. Analyse the principles microwave devices and their applications amplifier and oscillator and Explore the principles of its measurement.
5. Provide hands-on experience with designing and analysing practical RF and microwave circuits and systems.

COURSE LEARNING OUTCOMES (CLO)

By the end of the course, students should be able to:

1. Understand the fundamental principles of radio frequency (RF) filter and their applications in various industries, analyses the behaviour of electromagnetic waves in the RF and microwave frequency ranges and design and design and analyses different types of RF filters, including low-pass, high-pass, band-pass, and band-stop filters.
2. Analyse and design concept of active RF components and devices, including attenuators and equalizers and provide a comprehensive understanding of RF system parameters.
3. Understand the operation and design principles of microwave components and devices.
4. Understand the operation and design principles of microwave devices and their applications as amplifier, oscillator and its measurement.
5. Work with simulation software and measurement tools to design and analyses practical RF and microwave circuits and systems, collaborate in teams to design and implement RF and microwave engineering projects for specific engineering tasks and applications.

MAPPING MATRIX OF CO AND CLO: -

CLO / CO	CLO 01	CLO 02	CLO 03	CLO 04	CLO 05
CO 01					
CO02					
CO 03					
CO 04					
CO 05					

UNIT	CONTENTS	HOURS
UNIT-I	**RF FILTERS** Characteristic impedance of symmetrical networks filter fundamentals. Design of filters: Constant K, Low Pass, High Pass, Band Pass, Band Elimination, m-derived sections and composite filters	9
UNIT-II	**ATTENUATORS AND EQUALIZERS** Attenuators: T, n, Lattice Attenuators, Bridged T attenuator, L-Type Attenuator. Equalizers: inverse network, series, full series, shunt, full shunt, constant resistance T, constant resistance n, constant resistance lattice and bridged T network.	9
UNIT-III	**MICROWAVE COMPONENTS** Introduction to microwave transmission- applications and limitations- Directional coupler, E&H plane Tee-Magic Tee- Circulators- Isolators-Attenuators and Phase Shifters- Impedance matching techniques. Physical Implementation of Microwave junctions, Directional couplers, Study its characteristics.	9
UNIT-IV	**MICROWAVE AMPLIFIERS AND OSCILLATORS** klystron amplifiers-Reflex Klystron Oscillators-Magnetron oscillators-TWT amplifiers. Physical Implementation of Klystron amplifiers, Magnetron and TWT amplifiers and Study its performance.	9
UNIT-V	**MICROWAVE SEMICONDUCTOR DEVICES AND MEASUREMENTS** Principles of Microwave transistor and FET- Gunn Oscillators- IMPATT, TRAPATT and BARITT devices-PIN diode and TUNNEL diode. Microwave Measurements: Power, Frequency, Impedance, VSWR. .	9

COURSE CONTENTS

TEXTBOOKS

1. Samuel Y. Liao, "Microwave Devices and Circuits", 3rd edition, Pearson education.
2. Reinhold Ludwig, Pavel Bretchko, 'RF circuit design, theory and applications', Pearson Asia Education, Edition 2001.

REFERENCE

1. R. E. Collin, "Foundations for Microwave Engineering", 2nd Edition, Tata McGraw Hill, 1992.
2. D. Pozar, "Microwave Engineering", John Wiley & Sons, New York, 1998.
3. Mathew M. Radmanesh, "Radio Frequency and Microwave Electronics", Pearson Asia Education,2001

		L	T	P	C
25EC304	**OPTICAL FIBER COMMUNICATION**	**3**	**1**	**0**	**3**
	Prerequisite				
	Nil				

COURSE OBJECTIVES

1. Introduce students to the fundamental principles and concepts of optical fibre communication, familiarize students with the characteristics of optical fibres and their advantages in communication systems and enable students to understand the principles of light propagation in optical fibres and dispersion effects.
2. Provide a comprehensive understanding of different transmission characteristics for optical signals and familiarize students with the principles of attenuation, dispersion, radiation etc in optical communication.
3. Introduce the concept of optical sources, detectors, and amplifiers used in optical communication systems.
4. Introduce students to the design and analysis of optical communication links, communication components and systems.
5. Provide hands-on experience with designing and implementing practical optical fibre communication systems.

COURSE LEARNING OUTCOMES

By the end of the course, students should be able to:

10. Understand the fundamental principles of optical fibre communication and its significance in modern communication technologies, analyses the characteristics and advantages of optical fibres over other communication media.
11. Analyse the principles of light propagation in optical fibres, including attenuation, dispersion, and nonlinearity effects,
12. Understand the operation and characteristics of optical sources, detectors, and amplifiers used in optical communication systems.
13. Design and analyse optical communication links and systems for specific transmission requirements and understand the principles of optical network architectures, including PONs and WDM systems.
14. Work with simulation software, measurement tools to design and analyses practical optical fibre communication systems and collaborate in teams to design and implement optical fibre communication projects for specific engineering tasks and applications.

MAPPING MATRIX OF CO AND CLO: -

CO \ CLO	CLO 01	CLO 02	CLO 03	CLO 04	CLO 05
CO 01					
CO02					
CO 03					
CO 04					
CO 05					

COURSE CONTENTS

UNIT	CONTENTS	HOURS
UNIT-I	**INTRODUCTION OF OPTICAL FIBERS** Introduction to Optical Fiber Communication: Evolution and advantages of fiber optics, Basic structure of an optical fiber (core, cladding, jacket), Applications in communication, sensing, and data transfer, Total Internal Reflection (TIR), and light-gathering capacity, Relationship with fiber efficiency and bandwidth, Electromagnetic Wave Nature of Light, Maxwell's equations in dielectric media, Wave equation for electric and magnetic fields in optical fibers, Polarization and phase behavior of propagating light, Modes in Planar Optical Waveguide, Definition of modes: guided, leaky, and radiation, Mode formation in slab (planar) waveguide, Cutoff condition and mode field distribution, Phase Velocity and Group Velocity: Concept of phase velocity and group velocity, Mathematical definitions and physical significance, Mode Coupling: Introduction to intermodal and intramodal coupling, Causes: imperfections, bends, and manufacturing variations, Effects on signal integrity and modal dispersion, Step Index and Graded Index Fibers: Structure and refractive index profile of step-index fiber, graded-index fiber, V-number and mode calculation, Comparison in terms of dispersion, bandwidth, and applications.	9
UNIT-II	**TRANSMISSION CHARACTERSTICS OF OPTICAL FIBERS** Attenuation, material absorption losses in silica glass Fibers, linear scattering losses, non-scattering losses, Fiber bend losses, dispersion, chromatic dispersion, Intermodal dispersion, polarization	9
UNIT-III	**OPTICAL SOURCES AND COUPLING** Absorption and emission of radiation, Einstein relations, Optical Sources: - Light source materials – LED –Structure – Quantum efficiency, population inversion, optical feedback and laser oscillation, threshold condition for laser oscillation, Modulation. Laser diode –Modes and threshold condition – Structures and radiation pattern – Modulation. Power launching and coupling, lensing scheme, Fiber to Fiber joints, Fiber splicing	9
UNIT-IV	**OPTICAL DETECTORS AND MEASUREMENTS** Quantum efficiency, responsivity, Optical detectors: – Physical principles – PIN and APD diodes – Photo detector noise – SNR – Detector response time. Optical Link Design: Point- to- point links – System considerations – Link power budget – Rise time budget-Fiber Attenuation Measurements-Dispersion Measurements-Fiber Numerical Aperture Measurements	9
UNIT-V	**OPTICAL NETWORKS** Network Concepts, Network topologies- SONET/SDH: – Optical specifications – SONET frame structure – SONET layers - SONET/SDH networks. High speed lightwave links, Optical Add/Drop Multiplexers, Optical Switching, Operational principles of WDM – Broadcast and select WDM networks – Single hop networks – Wavelength routed networks – Optical Network Deployment : Long Haul Networks, Metropolitan area networks, Access networks, Local Area Networks- Optical Ethernet: Network protection, restoration and survivability.	9

TEXTBOOKS

1. Gerd Keiser, "Optical Fiber Communication" McGraw –Hill International, Singapore, 3rd edition, 2000.
2. Rajiv Ramaswami, Kumar N. Sivaranjan, "Optical Networks A Practical Perspective", 2nd edition, Elsevier, 2004.

REFERENCE

1. Djafar K. Mynbaev and Lowell L. Scheiner, "Fiber-Optic Communications Technology", 1st edition, Pearson Education, 2001.
2. John Powers, "An Introduction to Fiber Optic Systems", 2nd edition, Irwin-McGraw Hill, 1999.

		L	T	P	C
25EC306	**DIGITAL VLSI DESIGN**	**3**	**1**	**0**	**3**
	Prerequisite				

COURSE OBJECTIVES:

1. Introduce students to the fundamental principles and concepts of CMOS digital VLSI design and enable students to understand the FPGA and CPLD, computer aided design technology.
2. Introduce the concept of transistor sizing and its impact on circuit performance, provide a comprehensive understanding of sequential logic circuits and design techniques and familiarize students with advanced CMOS logic families and design methodologies.
3. Introduce students to layout and physical design considerations in CMOS VLSI circuits, explore the principles of clock distribution and timing analysis in digital VLSI circuits and introduce students to power consumption and dissipation considerations in CMOS VLSI designs.
4. Familiarize students with the CMOS fabrication process and the characteristics of CMOS technology.
5. Provide hands-on experience with designing and implementing practical CMOS digital VLSI circuits.

COURSE OUTCOME

By the end of the course, students should be able to:

1. Understand the fundamental principles and concepts of CMOS digital VLSI design and their applications in modern integrated circuits.
2. Design and analyse basic CMOS digital gates and logic circuits for specific functionality, apply transistor sizing techniques to optimize the performance of CMOS logic circuits.
3. Implement physical layout considerations and constraints in CMOS VLSI designs and analyse and optimize the timing and clock distribution in digital VLSI circuits and analyse the power consumption and dissipation in CMOS VLSI circuits and propose power reduction techniques.
4. Analyse and interpret the characteristics of CMOS technology and the CMOS fabrication process.
5. Work with electronic design automation (EDA) software tools for CMOS VLSI design and simulation and collaborate in teams to design and implement CMOS digital VLSI projects for specific engineering tasks and applications.

MAPPING MATRIX OF CO AND CLO: -

CO \ CLO	CLO 01	CLO 02	CLO 03	CLO 04	CLO 05
CO 01	■				
CO02		■			
CO 03			■		
CO 04				■	
CO 05					■

COURSE CONTENTS

UNIT	CONTENTS	HOURS
UNIT-I	**INTRODUCTION** Overview of VLSI design methodology, VLSI design flow, Design hierarchy, Concept of regularity, Modularity, and Locality, VLSI design style, Design quality, package technology, introduction to FPGA and CPLD, computer aided design technology.	9
UNIT-II	**PHYSICS OF MOS SYSTEM** MOS Transistor: The Metal Oxide Semiconductor (MOS) structure, The MOS System under external bias, Structure and Operation of MOS transistor, MOSFET Current-Voltage characteristics, Threshold Voltage, Body Bias concept, Geometric Scaling Theory – Full-Voltage Scaling, Constant-Voltage Scaling, small-geometry effects, MOSFET capacitances	9
UNIT-III	**NMOS AND CMOS INVERTER** Introduction, Resistive load Inverter, Inverter with n-type MOSFET load (Enhancement and Depletion type MOSFET load), CMOS Inverter: Basic Circuit and DC Operation – DC Characteristics, Noise Margins, and Inverter Switching Characteristics – Switching Intervals, High-to-Low time, Low-to- High time, Maximum Switching Frequency, Estimation of Interconnect Parasitic, Calculation of interconnect delay, RC Delay Model, Elmore Delay Model, Switching Power Dissipation of CMOS Inverters, Concept of Stick Diagram and Layout. FinFET Device: Introduction (Need of FinFET device), structure, Comparison between FinFET and Planar MOSFET.	9
UNIT-IV	**STATIC AND DYNAMIC CMOS LOGIC** CMOS NAND Gate, CMOS NOR Gate, Complex Logic functions: Exclusive OR and Equivalence Gates, Adder Circuits, Pseudo NMOS Logic Gates, Schmitt Trigger Circuits, Transmission Gate, TG based logic circuits, CMOS SRAM Cell, Dynamic Logic Circuit Concepts and CMOS Dynamic Logic Families: Dynamic Logic, Domino logic, NORA logic, Introduction Hardware description Language (HDL)- VHDL & its Test Benches.	9
UNIT-V	**INTRODUCTION TO VLSI FABRICATION PROCESS** VLSI Fabrication Technology: Crystal Growth, Epitaxial- Growth Techniques, Thermal Oxidation, Lithography, Dry and Wet Chemical Etching, Ion implantation, CMOS Fabrication Process, Latch-up.	9

TEXTBOOKS:

1. Kang, S. and Leblebici, Y., CMOS Digital Integrated Circuits – Analysis and Design, Tata McGraw Hill (2008) 3rd ed.
2. Weste, N.H.E. and Eshraghian, K., CMOS VLSI Design: A Circuits and Systems Perspective, eddision Wesley (1998) 2nd ed.
3. J. Bhaskar, "*VHDL Primer*", 1st edition, BSP, 2002

REFERENCE:

1. Rabaey, J.M., Chandrakasen, A.P. and Nikolic, B., Digital Integrated Circuits – A Design perspective, Pearson Education (2007) 2nd ed.
2. Baker, R.J., Lee, H. W. and Boyce, D. E., CMOS Circuit Design, Layout and Simulation, Wiley - IEEE Press (2004) 2nd ed.

		L	T	P	C
25EC312	MICROWAVE AND OPTICAL COMMUNICATION LAB	0	0	2	2
	Prerequisite				
	Nil				

COURSE OBJECTIVES

1. To have a detailed practical study on microwave equipment
2. To study the optical devices and to use in the appropriate application

COURSE LEARNING OUTCOME

1. To know and understand how communication is being established at microwave
2. Frequencies and using Fiber in optical communication.

MAPPING MATRIX OF CO AND CLO: -

CLO / CO	CLO 01	CLO 02	CLO 03	CLO 04	CLO 05
CO 01					
CO02					
CO 03					
CO 04					
CO 05					

LIST OF EXPERIMENTS MICROWAVE EXPERIMENTS

1. Characteristics of Reflex Klystron
2. Study of power distribution in Directional coupler, E & H plane and Magic tee.
3. Wavelength and Frequency measurement.
4. Impedance measurement by slotted line method.
5. Gain and radiation pattern of Horn antenna.
6. Design of Micro strip antenna.
7.

OPTICAL COMMUNICATION EXPERIMENTS

1. D C Characteristics of LED and PIN photo diode.
2. D C Characteristics of Laser diode.
3. Measurement of Numerical aperture, propagation and bending loss in fiber
4. Fiber Optic Analog Link.
5. Fiber Optic Digital Link.
6.

SPICE SIMULATION

1. Frequency response of RF amplifier.
2. Frequency response of IF amplifier.
3. Amplitude modulation

REFERENCE: LABORATORY MANUAL

		L	T	P	C
25EC314	**CMOS VLSI DESIGN LAB**	**0**	**0**	**2**	**2**
	Prerequisite				
	Nil				

COURSE OBJECTIVES

1. Understand the fundamentals of hardware description languages and their role in digital system design.
2. Develop VHDL models for basic combinational and sequential digital circuits.
3. Simulate and verify the functionality of digital designs using VHDL testbenches and simulation tools.
4. Design and implement Finite State Machines (FSMs) and arithmetic logic units (ALUs) using structural and behavioural modelling.
5. Analyse and debug timing behaviour and functional correctness of digital systems using simulation waveforms and reports.

COURSE OUTCOME

1: Write VHDL code to describe basic combinational logic circuits such as gates, adders, multiplexers, and decoders.
2: Model sequential circuits like counters, shift registers, and flip-flops using different VHDL modeling styles.
3: Simulate and verify digital circuits using VHDL testbenches and waveform analysis.
4: Design Finite State Machines (FSMs) and implement real-time digital functions like sequence detectors using VHDL.
5: Analyze the performance of digital designs through simulation outputs and correct functional or timing-related errors.

MAPPING MATRIX OF CO AND CLO: -

CLO / CO	CLO 01	CLO 02	CLO 03	CLO 04	CLO 05
CO 01	■				
CO02		■			
CO 03			■		
CO 04				■	
CO 05					■

LIST OF EXPERIMENTS

1. To implement and simulate basic logic gates using behavioral modeling in VHDL.
2. To model, simulate, and verify 4-bit half adder and full adder circuits using dataflow modeling.
3. To develop VHDL code for a multiplexer and demultiplexer and validate their truth tables via simulation.
4. To implement decoder and encoder circuits using structural modeling in VHDL and simulate their operation.
5. To write VHDL code for a 4-bit magnitude comparator and simulate to verify equality, greater than, and less than conditions.
6. To create up/down counters using sequential modeling in VHDL and simulate timing diagrams.
7. To design and simulate 4-bit shift registers using VHDL, demonstrating shift operations and control logic.
8. To implement a Moore or Mealy type FSM in VHDL to detect a specific bit pattern in a serial data stream.
9. To implement a simple 4-bit ALU that can perform arithmetic and logic operations using VHDL and simulate its functionality.
10. develop VHDL testbenches for verifying functionality and timing behavior of a combinational or sequential circuit.

REFERENCE: LABORATORY MANUAL

SEMESTER VII

		L	T	P	C
25LP413	**MINOR PROJECT**	**0**	**0**	**8**	**4**
	Prerequisite				
	Nil				

LEARNING OUTCOME

1. Student will be able to design and implement a major project by applying Engineering knowledge:
2. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
3. Problem analysis skill: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

SEMESTER VIII

		L	T	P	C
25LP402	**MAJOR PROJECT**	**0**	**0**	**24**	**12**
	Prerequisite				
	Nil				

		L	T	P	C
25EPE211	**CIRCUIT ANALYSIS & SYNTHESIS**	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

COURSE OBJECTIVES (CO)

1. Introduce students to the fundamental principles and techniques of network analysis and synthesis, familiarize students with different types of electrical networks and their applications. And introduce the concept of network theorems and their applications in simplifying complex circuits.
2. Provide a comprehensive understanding of transient state analysis of networks using Laplace transforms and Fourier analysis.
3. Introduce the concept of graph theory and the analysis networks.
4. Explore the principles of two-port network analysis and their applications in transmission lines and amplifiers.
5. Familiarize students with network synthesis techniques for designing desired network responses, introduce students to the principles of network stability and control in feedback systems and provide hands-on experience with designing and analysing practical electrical networks.

COURSE LEARNING OUTCOMES (CLO)

By the end of the course, students should be able to:

1. Understand the fundamental principles and concepts of electrical network analysis and synthesis, interpret the behaviour and characteristics and apply network theorems to simplify and analyse complex circuits.
2. analyse electrical networks in transient state using Laplace transforms and Fourier analysis.
3. Understand the principles of graph theory, apply them to design and analyse different networks.
4. Analyse and design two-port networks for specific applications in transmission lines and amplifiers.
5. Design and synthesize networks with desired frequency responses using appropriate techniques, analyse the stability and control of networks in feedback systems, use simulation software and measurement tools to model and test electrical networks and collaborate in teams to design and implement network-related projects and assignments.

Mapping of CO's and CLO's :-

CLO / CO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CO 01	■				
CO 02		■			
CO 03			■		
CO 04				■	
CO 05					■

COURSE CONTENTS

UNIT	CONTENTS	HOURS
UNIT-I:	**AC Network Theorems:** Nodal analysis and mesh analysis, Source Transformation Theorem – Duality Theorem – Linearity & Superposition Theorem – Thevenin's& Norton's Theorem– Maximum Power Transfer theorem, Millman's Theorem and Δ-Y and Y-Δ Conversions.	12
UNIT-II:	**TRANSIENT ANALYSIS** Basics – Source free and Forced Response of RL, RC and RLC Series Circuits- Forced Response of RL, RC & RLC Series circuits with Sinusoidal **Excitation** – Time Constant & Natural frequency of Oscillation – Laplace Transform Application to the Solution of RL, RC & RLC Transient Circuits.	8
UNIT-III:	**Graph Theory** Graph Theory fundamentals, Matrix Representation of Graphs, Formulation of Network Response Equations using Incidence Matrix, Duality in Networks. Computation of Ladder and Non-Ladder Networks	8
UNIT-IV:	**Two Port Networks** Parameters of Two Port Networks, Correlation between Two Port Parameters, Two Port, Relation between Port Parameters, Transfer Functions using Two Port Parameters, Interconnection of Two Ports , Reciprocal and Symmetric Networks, Terminated Two Port Networks, Interconnections of Two Port Networks,	9
UNIT-V:	**Network Synthesis** Active Network Synthesis and Realizability: Elements of Relizability Theory, Hurwitz Polynomial, Positive Real Functions (PRF), Characteristics of PRF, Methodology for Simple Network Synthesis, Synthesis of Two Element Type One Port Network. Image Impedance, Iterative Impedance, Waveform Symmetry and Filter Networks.	12

TEXTBOOKS

1. Franklin F. Kuo, "Network Analysis and synthesis", Wiley India Pvt Ltd.
2. MS Sukhija, T.K. Nagsarkar, "Circuits and Networks", Oxford University Publication.
3. Hayt W. H., Kemmerly J. E. and Durbin S. M., "Engineering Circuit Analysis", 6th Ed., Tata McGraw-Hill Publishing Company Ltd.,2008.

REFERENCE BOOKS

1. ME Van Valkenberg, "Network Analysis", Prentice Hall of India Ltd.
2. Ghosh, "Network Theory: Analysis and Synthesis", PHI Learning Pvt. Ltd

		L	T	P	C
25EPE212	DIGITAL SIGNAL PROCESSING	3	0	0	3
	Prerequisite				
	Nil				

COURSE OBJECTIVES (CO)

1. Introduce students to the fundamental principles and concepts of digital signal processing, familiarize students with the properties and characteristics of discrete-time signals and systems and enable students to understand the basics of sampling theorem and its practical implementation.
2. Provide a comprehensive understanding of the discrete Fourier transform (DFT) and its relationship with the fast Fourier transform (FFT) algorithm.
3. Familiarize students with the principles of FIR and IIR filters and its applications, Introduce students to the design and analysis of digital signal processing algorithms for various applications.
4. Provide hands-on experience with designing and implementing practical digital signal processing algorithms

COURSE LEARNING OUTCOMES (CLO)

By the end of the course, students should be able to:

1. Understand the fundamental principles and concepts of digital signal processing and its importance in various engineering fields, analyse and interpret discrete-time signals and systems using mathematical techniques.
2. Understand the principles of the discrete Fourier transform (DFT), apply the fast Fourier transform (FFT) algorithm for efficient spectral analysis and Design and implement digital signal processing algorithms, such as convolution, correlation, and spectral estimation.
3. Analyse and interpret the spectral characteristics of signals using different signal processing techniques, design and implement digital filters (FIR & IIR) for specific signal processing applications
4. Work with simulation software and programming tools to design and implement practical digital signal processing algorithms and collaborate in teams to design and implement digital signal processing projects for specific engineering tasks and applications.

Mapping of CO's and CLO's: -

CLO / CO	CLO 1	CLO 2	CLO 3	CLO 4
CO 01				
CO 02				
CO 03				
CO 04				

COURSE CONTENTS

UNIT	CONTENTS	HOURS
UNIT-I:	**INTRODUCTION** Analog vs. Digital Signal Processing: Basic differences, advantages, and application domains, Classification of Systems: Continuous-time & discrete-time systems,– Linear vs. Non-linear, Causal vs. Non-causal, Static vs. Dynamic, Time-invariant vs. Time-variant, Recursive vs. Non-recursive, Stable vs. Unstable, Classification of Signals: Continuous and discrete signals , Energy and power signals, Mathematical Representation of Signals: Unit impulse, step, exponential, sinusoidal, Signal operations: shifting, scaling, folding, Spectral Density of Signals: Energy spectral density and power spectral density, Sampling and Quantization: Sampling theorem, Nyquist rate, Aliasing, anti-aliasing filters, Quantization techniques, quantization error, signal reconstruction	9
UNIT-II:	**DFT** Overview of Discrete Signals and Sampling Review, Introduction to DFT: DFT definition and comparison with CTFT & DTFT, Properties of DFT: Linearity, Time shifting, Frequency shifting, Conjugate symmetry, Circular convolution, Twiddle Factor and its Role in DFT: Circular and Linear Convolution, Graphical method, Matrix method, Overlap-add and overlap-save methods, Applications of DFT: Signal filtering, spectrum analysis.	9
UNIT-III:	**DISCRETE FOURIER TRANSFORM & COMPUTATION** Limitations of Direct DFT Computation : Need for FFT (Fast Fourier Transform),FFT Algorithm: Radix-2 Decimation-in-Time (DIT), Radix-2 Decimation-in-Frequency (DIF), Butterfly diagram structure, Magnitude and Phase Representation using FFT, Realization of Discrete-Time Systems, Direct Form I and II, Cascade form, Parallel form, Ladder and Lattice structures, Signal flow graphs and block diagrams	9
UNIT-IV:	**DESIGN OF FIR DIGITAL FILTERS** FIR vs. IIR Filters: Characteristics, stability, phase response, FIR Filter Realization Techniques: Direct, parallel, and cascade forms, Design of FIR Filters Using Window Techniques, Rectangular, Hamming, Hanning, Blackman, Kaiser windows, Trade-offs between main lobe width and side lobe attenuation, Linear Phase FIR Filters, Finite Word Length Effects, Quantization error, round-off error, Product round-off error, Limit cycle oscillations: zero-input and overflow-induced, Need for Scaling, Scaling to prevent overflow in DSP systems	9
UNIT-V:	**DESIGN OF IIR DIGITAL FILTER** Analog Filter Design Approaches: Butterworth approximation, Chebyshev approximation, IIR Filter Design from Analog Filters, Impulse invariant transformation, Bilinear transformation, Frequency warping and pre-warping techniques, Comparison between FIR and IIR filters, Digital Signal Processor (DSP) Architectures: General structure of DSP processors, Types of DSPs: Fixed-point vs. Floating-point, Features: MAC unit, pipelining, Harvard architecture.	9

TEXTBOOKS

1. J.G. Proakis and D.G. Manolakis, 'Digital Signal Processing Principles, Algorithms and Applications', Pearson Education, New Delhi, PHI. 2003
2. S.K. Mitra, 'Digital Signal Processing – A Computer Based Approach', McGraw Hill Edu, 2013.
3. Lonnie C.Ludeman ,"Fundamentals of Digital Signal Processing",Wiley,2013

REFERENCE BOOKS

1. Robert Schilling & Sandra L.Harris, Introduction to Digital Signal Processing using Matlab", Cengage Learning,2014.
2. B.P.Lathi, 'Principles of Signal Processing and Linear Systems', Oxford University Press, 2010 3. Taan S. ElAli, 'Discrete Systems and Digital Signal Processing with Mat Lab', CRC Press, 2009.
3. SenM.kuo, woonseng…s.gan, "Digital Signal Processors, Architecture, Implementations & Applications, Pearson,2013
4. DimitrisG.Manolakis, Vinay K. Ingle, applied Digital Signal Processing, Cambridge,2012

		L	T	P	C
23EPE311	**SOLID STATE DEVICE MODELLING**	**3**	**1**	**0**	**3**
	Prerequisite				
	Nil				

COURSE OBJECTIVES (CO)

1. Introduce students to the fundamental principles and concepts of solid-state devices and their behaviour, familiarize students with the various semiconductor devices, such as diodes, transistors, and MOSFETs and enable students to understand the physical and electrical characteristics of different solid-state devices.
2. Introduce the concept of device modelling and its significance in circuit design and analysis.
3. Provide a comprehensive understanding of the mathematical models used to describe solid-state device behaviour.
4. Familiarize students with the SPICE simulation tool and its application in device modelling and circuit simulation, introduce students to the process of parameter extraction for device models.
5. Explore the principles of advanced device models, such as high-frequency models and compact models.

COURSE LEARNING OUTCOMES (CLO)

By the end of the course, students should be able to:

1. Understand the fundamental principles and concepts of solid-state devices and their applications in modern electronics and analyse and interpret the characteristics of different semiconductor devices, including diodes, transistors, and MOSFETs.
2. Analyse the physical and electrical behaviour of solid-state devices under various operating conditions.
3. Design and implement mathematical models to describe the behaviour of solid-state devices.
4. Apply SPICE simulation for device modelling and analyse the performance of circuits containing solid-state devices and understand the process of parameter extraction for device models and apply it to obtain accurate simulations.
5. Design and analyse electronic circuits using solid-state device models for specific engineering applications and analyse and apply advanced device models, such as high-frequency models and compact models, for specialized circuit design.

Mapping of CO's and CLO's :-

CLO / CO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CO 01					
CO 02					
CO 03					
CO 04					
CO 05					

COURSE CONTENTS

UNIT	CONTENTS	HOURS
UNIT-I:	**Semiconductor Devices and their applications** Applications of diodes – clippers, clampers, multipliers, Types of diodes – Zener diode, Tunnel diode, Schottky diode, LED, PIN diode, Photodiode etc, BJT- CB, CE, CC configurations, biasing, FET biasing, MOSFET biasing, NMOS, PMOS, CMOS, Device modelling.	**9**
UNIT-II:	**Diode circuits** Ideal and Practical diode, Clipper, Clamper. Power Supply: Rectifiers, Half wave, Full wave, Bridge rectifier, filter circuits, Voltage regulation using shunt & series regulator circuits, Voltage regulation using IC 723	**9**
UNIT-III:	**Operational Amplifiers** The ideal Op-Amp, equivalent circuit of Op-Amp, ideal voltage transfer curve, open loop Op-Amp configurations, Op-Amp parameters, block diagram representation of feedback configurations, frequency response, high frequency Op-Amp.	**9**
UNIT-IV:	**Active Filters and Oscillators** Active filters: low pass filter, high pass filter, band-pass filters, band reject filters, all pass filters, comparators and oscillators.	**9**
UNIT-V:	**Specialized IC Applications** The 555 Timer as monostable, astable multivibrator, phase locked loops operating principles, 565 PLL applications, voltage regulators- fixed, adjustable, switching, special. Analog switch and analog multiplier.	**9**

Text Books:

1. Millman, Halkias and Satyabrata Jit, Electronic Devices and Circuits, 4th edition, McGraw Hill Education (India) Private Limited, 2015.
2. Robert L. Boylestad and Louis Nashelsky, Electronic devices and circuit theory, 11th edition, Prentice Hall India Ltd, 2015.
3. Ramakant A. Gayakwad, Op-Amps and linear integrated Circuits 4th edition, Pearson Education, 2015.

		L	T	P	C
25EC301	**CONTROL SYSTEM**	**3**	**1**	**0**	**3**
	Prerequisite				
	Fundamental of Electronic Devices				

COURSE OBJECTIVES (CO)

1. Familiarize students with the different types of control systems and their applications in various engineering fields, enable students to understand the mathematical modelling of dynamic systems for control analysis and introduce the concept of feedback control and its role in regulating and stabilizing systems.
2. Provide a comprehensive understanding of control system components, such as controllers, sensors, and actuators and Introduce students to various control strategies, such as proportional, integral, and derivative (PID) control.
3. Explore the principles of frequency domain and time domain analysis of control systems.
4. Introduce students to the fundamental principles and concepts of control systems and Familiarize students with various instruments used for measurement in control systems and introduce students to the fundamental principles and concepts of Instruments.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Understand the fundamental principles of instrumentation and control systems and their role in various engineering applications, Identify and select appropriate instrument for measuring different process variables in control systems and understand the fundamental principles of instrumentation systems and their importance in engineering applications.
2. Identify different types of control systems and their use in specific engineering fields. Formulate mathematical models of dynamic systems for control analysis and design.
3. Analyse and interpret the stability and performance of control systems using time domain and frequency domain methods, Design control systems to achieve desired performance specifications, such as transient response and steady-state error.
4. Design and implement feedback control systems using proportional, integral, and derivative (PID) control strategies and analyse the response of control systems to different inputs and disturbances.

MAPPING MATRIX OF CO AND CLO:-

CLO / CO	CLO 01	CLO 02	CLO 03	CLO 04	CLO 05
CO 01					
CO02					
CO 03					
CO 04					
CO 05					

COURSE CONTENTS

UNIT	CONTENTS	HOURS
UNIT-I	**TRANSFER FUNCTIONS** Introduction and Classification of Control Systems: Definition and significance of control systems in engineering, Classification: Linear vs., Nonlinear, Time-invariant vs. Time-varying, Continuous vs. Discrete, SISO vs. MIMO systems, Transfer Function Concept: Definition of transfer function for linear time-invariant (LTI) systems, Assumptions and limitations of transfer function approach, Mathematical Modelling of Physical Systems: Modelling of mechanical translational and rotational systems using Newton's and D'Alembert's laws, Modelling of electrical systems using Kirchhoff's laws, Mechanical–Electrical Analogies: Force-voltage and force-current analogies, Block Diagram Reduction Techniques : Series, parallel, feedback loops, and simplifying block diagrams, Signal Flow Graphs: Mason's Gain Formula for evaluating system transfer functions	9
UNIT-II	**TRANSIENT AND STEADY STATE ANALYSIS** Standard Test Signals: Unit step, unit ramp, unit impulse, parabolic input, Time Response of First-Order Systems, Mathematical derivation and graphical interpretation of response to step, ramp, impulse inputs, Time Response of Second-Order Systems: Natural frequency, damping ratio, Under-damped, critically damped, and over-damped system responses ,Step response characteristics, Time-Domain Specifications: Rise time, peak time, maximum overshoot, settling time, steady-state value, Steady-State Error Analysis: Static error constants (position, velocity, acceleration), System type and error coefficients.	9
UNIT-III	**STABILITY AND ROOT LOCUS TECHNIQUES** Stability of Control Systems: Concept of bounded input–bounded output (BIBO) stability, Characteristic equation and root location in the S-plane, Routh-Hurwitz Stability Criterion: Necessary and sufficient conditions for system stability, Routh array construction and interpretation, Relative stability and special cases (zero rows, sign changes),Root Locus Technique: Definition and importance in controller design, Basic rules for constructing root locus plots, Root locus for unity feedback systems, Impact of adding poles and zeros	9
UNIT-IV	**STABILITY ANALYSIS & FREQUENCY DOMAIN ANALYSIS** Frequency Response and Bode Plots: Frequency response for second-order systems, Magnitude and phase plots, Gain margin and phase margin, Polar Plots and Nyquist Plots,Plotting frequency response in polar form, Nyquist stability criterion: encirclement of critical point, Nichols Chart and Constant M and N Circles, Performance representation in frequency domain, Interpretation for gain/phase changes, Minimum Phase and Non-Minimum Phase Systems :Definition and behavior comparison	9
UNIT-V	**STATE-VARIABLE ANALYSIS** State-Space Representation: Vector-matrix form of state equations, Conversion from high-order differential equations to state space, State Transition Matrix and Equations: Definition and solution using matrix exponential, Homogeneous and non-homogeneous systems, Relationship Between State Equations and Transfer Functions: Deriving transfer function from state-space and vice versa, Similarity Transformation and Canonical Forms: Diagonalization and Jordan canonical forms, Controllable and observable canonical forms, Controllability and Observability, Kalman's tests and physical interpretation, Design implications and system design feasibility	9

TEXTBOOKS

1. Katsuhiko Ogata, "*Modern Control Engineering*" second edition, Prentice Hall of India Private Limited, New Delhi, 1995.
2. Nagrath, I J ,and Gopal, M., "*Control Systems Engineering*", 1st edition,Wiley and Sons, 1985.

REFERENCE

1. Benjamin C Kuo, "Automatic Control System", 7th edition, Prentice Hall of India Private Limited, New Delhi, 1993.
2. Gajic Z., Lelic M., "Modern Control System Engineering", Prentice Hall of India Private Limited, New Delhi, 1996.
3. Richard .C. Dorf and Robert. H. Bishop, "Modern Control System Engineering", Addison Wesley, 1999.

		L	T	P	C
25EPE312	EMBEDDED SYSTEM DESIGN USING MICROCONTROLLER	3	1	0	3
	Prerequisite				
	Nil				

COURSE OBJECTIVES (CO)

1. Introduce students to the fundamental principles and concepts of embedded systems and microcontrollers, familiarize students with the architecture and components of microcontrollers. And enable students to understand the process of embedded system design, including hardware and software considerations.
2. Introduce the concept of programming microcontrollers using a high-level language and assembly language.
3. Provide a comprehensive understanding of interfacing peripherals and sensors with microcontrollers.
4. Familiarize students with real-time operating systems (RTOS) and their applications in embedded systems.
5. Introduce students to embedded system debugging and testing techniques and explore the principles of power management and optimization in embedded systems.

COURSE LEARNING OUTCOMES (CLO)

By the end of the course, students should be able to:

1. Understand the fundamental principles and concepts of embedded systems and their applications in various industries, analyse and interpret the architecture and components of microcontrollers and their role in embedded system design.
2. Design and implement embedded systems, considering both hardware and software aspects.
3. Program microcontrollers using high-level language and assembly language for specific applications and interface peripherals and sensors with microcontrollers for data acquisition and control.
4. Apply real-time operating systems (RTOS) to manage concurrent tasks in embedded systems.
5. Apply debugging and testing techniques to identify and resolve issues in embedded system designs and design and implement power management techniques to optimize energy consumption in embedded systems.

Mapping of CO's and CLO's

CLO / CO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CO 01	■				
CO 02		■			
CO 03			■		
CO 04				■	
CO 05					■

COURSE CONTENTS

UNIT	CONTENTS	HOURS
UNIT-I	ARCHITECTURE OF 8051 Comparison of Microprocessor and Microcontroller - Block diagram of Microcontroller –Functions of each block - Pin details of 8051 – ALU –ROM – RAM – Memory Organization of 8051 - Special function registers – Program Counter – PSW register –Stack - I/O Ports – Timer – Interrupt – Serial Port – Oscillator and Clock - Clock Cycle – State - Machine Cycle – Instruction cycle – Reset – Power on Reset – Overview of 8051 family INSTRUCTION SET OF 8051 Instruction set of 8051 – Classification of 8051 Instructions - Data transfer instructions – Arithmetic Instructions – Logical instructions –Branching instructions – Bit Manipulation Instructions	**9**
UNIT-II	ASSEMBLER AND ADDRESSING MODES Assembling and running an 8051 program –Structure of Assembly Language –Assembler directives - Different addressing modes of 8051 PROGRAMMES: Multibyte Addition – 8 Bit Multiplication and Division – Biggest Number / Smallest Number – Ascending order / Descending order – BCD to HEX Conversion – HEX to BCD Conversion – BCD to ASCII Conversion – ASCII to Binary Conversion – Odd Parity Generator – Even Parity Generator - Time delay routines	**9**
UNIT-III	I/O Bit addresses for I/O and RAM – I/O programming – I/O bit manipulation programming. TIMER Programming 8051 Timers – Timer 0 and Timer 1 registers – Different modes of Timer – Mode 0 Programming – Mode 1 Programming - Mode 2 Programming - Mode 3 Programming - Counter programming – Different modes of Counter – Mode 0 Programming – Mode 1 Programming - Mode 2 Programming - Mode 3 Programming (simple programs	**9**
UNIT-IV	SERIAL COMMUNICATION: Basics of Serial programming – RS 232 Standards - 8051 connection to RS 232 – 8051 Serial Communication Programming – Programming 8051 to transmit data serially - Programming 8051 to Receive data serially. INTERRUPT: 8051 Interrupt s – Programming Timer Interrupts – Programming external hardware interrupts – Programming the serial communication interrupt – Interrupt priority in 8051 (simple programs).	**9**
UNIT-V	IC 8255: IC 8255 – Block Diagram – Modes of 8255.INTERFACING TECHNIQUES: Interfacing external memory to 8051– 8051 interfacing with the 8255 – ASM Programming – Relays – Sensor interfacing – ADC interfacing – DAC interfacing - Keyboard interfacing – Seven segment LED Display Interfacing. PROTOCOLS: Introduction to CANBUS, MODBUS & I2C Protocol	**9**

TEXTBOOKS:

1. 8051 Microcontroller and Embedded Systems using Assembly and C by Mazidi, Mazidi and D.MacKinlay, 2006 Pearson Education Low Price Edition first.
2. Rajkamal, 'Embedded system-Architecture, Programming, Design', TataMcgraw Hill,2011.
3. Peckol, "Embedded System Design", John Wiley,2010.

REFERENCES:

1. Tammy Noergaard, "Embedded Systems Architecture", Elsevier, 2006.
2. Han-Way Huang, "Embedded system Design using C8051", Cengage Learning,2009.
3. Rajib Mall "Real-Time systems Theory and Practice" Pearson Education, 2007.
4. Shibu.k.v, "Introduction to Embedded Systems", TataMcgraw Hill, 2009

		L	T	P	C
25EPE314	**MIXED SIGNAL SYSTEM DESIGN**	**3**	**1**	**0**	**3**
	Prerequisite				
	Nil				

COURSE OBJECTIVES (CO)

1. Introduce students to the fundamental principles and concepts of mixed-signal system design and familiarize students with the challenges and considerations in integrating analog and digital components in a single system.
2. Enable students to understand the specifications and requirements for mixed-signal systems in various applications
3. Introduce the concept of data converters (ADCs and DACs) and their role in mixed-signal systems.
4. Provide a comprehensive understanding of mixed-signal simulation and verification techniques and Familiarize students with the principles of noise analysis and signal integrity in mixed-signal systems.
5. Introduce students to the design of mixed-signal integrated circuits (ICs) and explore the principles of low-power design and optimization in mixed-signal systems.

COURSE LEARNING OUTCOMES (CLO)

By the end of the course, students should be able to:

1. Understand the fundamental principles and concepts of mixed-signal system design and their applications in modern electronic systems and analyse and interpret the challenges and considerations in integrating analog and digital components in a mixed-signal system.
2. Design and implement mixed-signal systems to meet specific specifications and requirements.
3. Analyse the performance and characteristics of data converters (ADCs and DACs) and apply them in mixed-signal system designs and apply mixed-signal simulation and verification techniques to validate the functionality and performance of mixed-signal systems.
4. Analyse and mitigate noise issues and signal integrity problems in mixed-signal systems.
5. Design mixed-signal ICs and PCBs for specific engineering applications and apply low-power design techniques to optimize energy consumption in mixed-signal systems.

Mapping of CO's and CLO's :-

CLO / CO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CO 01	■				
CO 02		■			
CO 03			■		
CO 04				■	
CO 05					■

COURSE CONTENTS

UNIT	CONTENTS	HOURS
UNIT-I	**SUBMICRON CMOS CIRCUIT DESIGN** Submicron CMOS: Overview and Models, CMOS process flow, Capacitors and Resistors. Digital circuit design: The MOSFET Switch, Delay Elements, An Adder. Analog Circuit Design: Biasing, Op-Amp Design, Circuit Noise.	**9**
UNIT-II	**INTEGRATOR BASED CMOS FILTERS** Integrator Building Blocks- low pass filter, Active RC integrators, MOSFET-C Integrators, gm- C integrators, Discrete time integrators. Filtering Topologies: The Bilinear transfer function, The Biquadratic transfer function, Filters using Noise shaping.	**9**
UNIT-III	**DATA CONVERTER ARCHITECTURES** DAC Architectures- Resistor string, R-2R ladder Networks, Current Steering, Charge Scaling DACs, Cyclic DAC, and Pipeline DAC. ADC Architectures- Flash, Two-step flash ADC, Pipeline ADC, Integrating ADC's, Successive Approximation ADC.	**9**
UNIT-IV	**DATA CONVERTER MODELLING AND SNR** Sampling and Aliasing: A modelling approach, Impulse sampling, The sample and Hold, Quantization noise. Data converter SNR: An overview, Clock Jitter, Improving SNR using Averaging, Decimating filter for ADCs, Interpolating filter for DACs, Band pass and High pass sinc filters - Using feedback to improve SNR.	**9**
UNIT-V	**OSCILLATORS AND PLL** LC oscillators, Voltage Controlled Oscillators. Simple PLL, Charge pumps PLLs, non-ideal effects in PLLs, Delay Locked Loops.	**9**

TEXTBOOKS:

1. CMOS Mixed Signal Circuit Design by R.Jacob Baker, Wiley India, IEEE Press, reprint 2008.

REFERENCES:

1. Design of Analog CMOS Integrated Circuits by Behzad Razavi, McGraw Hill, 33rd Re- print, 2016.
2. CMOS Circuit Design, Layout and Simulation by R.Jacob Baker, Wiley India, IEEE Press, Second Edition, reprint 2009.

		L	T	P	C
25EPE314	**VLSI FABRICATION TECHNOLOGY**	**3**	**1**	**0**	**3**
	Prerequisite				
	Nil				

COURSE OBJECTIVES (CO)

1. Introduce students to the fundamental principles and concepts of VLSI (Very Large-Scale Integration) fabrication technology and familiarize students with the various process steps involved in semiconductor device fabrication.
2. Enable students to understand the materials and equipment used in VLSI fabrication.
3. Introduce the concept of cleanroom practices and safety protocols in semiconductor manufacturing.
4. Provide a comprehensive understanding of photolithography, etching, deposition, and diffusion processes used in VLSI fabrication.
5. Familiarize students with process integration and yield improvement techniques in VLSI manufacturing and introduce students to the challenges and advancements in VLSI fabrication technology.

COURSE LEARNING OUTCOMES (CLO)

By the end of the course, students should be able to:

1. Understand the fundamental principles and concepts of VLSI fabrication technology and its significance in modern semiconductor manufacturing and analyse and interpret the various process steps involved in VLSI fabrication, from device design to wafer processing.
2. Identify and explain the materials and equipment used in different VLSI fabrication processes and apply cleanroom practices and safety protocols in semiconductor manufacturing environments.
3. Analyze and describe the photolithography, etching, deposition, and diffusion processes used in VLSI fabrication.
4. Apply process integration techniques to design and manufacture complex VLSI circuits.
5. Analyze and interpret yield improvement techniques to enhance manufacturing efficiency and product quality in VLSI fabrication and understand the challenges and advancements in VLSI fabrication technology and their impact on semiconductor devices.

Mapping of CO's and CLO's :-

CLO / CO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CO 01	■				
CO 02		■			
CO 03			■		
CO 04				■	
CO 05					■

COURSE CONTENTS

UNIT	CONTENTS	HOURS
UNIT-I	The Semiconductor Industry - The Solid-State Era - Integrated Circuits (ICs), Process and Product Trends, Stages of Manufacturing, The Junction Transistor, The Nano Era, Intrinsic Semiconductors, Semiconducting Compounds, Semiconductor Silicon Preparation, Crystal Growth, Wafer Preparation, Chemical Mechanical Polishing (CMP), Oxidation and Engineered Wafers (Substrates)	**9**
UNIT-II	Overview of Wafer Fabrication, Wafer Terminology, , Chip Terminology, Packaging, Contamination Sources, Cleanroom Materials and Supplies, Wafer Surface Cleaning, Accumulative Wafer-Fabrication Yield, Accumulative Wafer-Fabrication Yield	**9**
UNIT-III	Oxidation, Silicon Dioxide Layer Uses, Thermal Oxidation Mechanisms, , Oxidation Processes, Post oxidation Evaluation, The Ten-Step Patterning Process—Surface Preparation to Exposure, The Ten-Step Patterning Process—Developing to Final Inspection, Issues of VLSI/ULSI Patterning, Photoresist Process Advances, Etch Profile Control	**9**
UNIT-IV	Doping- Introduction, , Formation of a Doped Region by Diffusion, Diffusion Process Steps, Introduction to Ion Implantation, Dopant Concentration in Implanted Regions. Introduction to Layer Deposition, Chemical Vapor Deposition , SOS and SOI, Introduction to Metallization. Deposition Methods.	**9**
UNIT-V	Wafer Electrical Measurements, Physical Measurement Methods, , Contamination Identification, The Business of Wafer Fabrication, Automation, Equipment Standards, Inventory Control, Alternative (Scaled) Transistor Designs, Superconductors, Packaging Processes, Package Design, Package Process Flows	**9**

TEXT BOOKS:

1. Peter Van Zant, “Microchip Fabrication: A Practical Guide to Semiconductor Processing”, McGraw- Hill Professional, Sixth Edition, 2014.

RESFERENCE:

1. Marc J. Madou, “Fundamentals of Microfabrication and Nanotechnology – Volume II”, CRC Press, Third Edition, 2011.
2. James D. Plummer, Michael D. Deal, Peter B. Griffin, “Silicon VLSI Technology: Fundamentals, Practice and Modelling”, Prentice Hall India Private Limited, 2000.
3. Stephen Campbell, “Science of Microelectronic Fabrication”, Oxford University Press, 2001.
4. Gary. S. May and S. M. Sze, “Fundamentals of semiconductor fabrication”, John Wiley, First Edition, 2003.

		L	T	P	C
25EPE413	**Microprocessor and Interfacing Lab**	**3**	**1**	**0**	**3**
	Prerequisite				
	Nil				

COURSE OBJECTIVES (CO)

1. Introduce students to the fundamental principles and concepts of Hardware Description Languages (HDLs) and their role in digital system design and familiarize students with HDL programming languages such as Verilog or VHDL.
2. Enable students to understand the design flow of digital systems using HDLs.
3. Introduce the concept of synthesizable and non-synthesizable HDL constructs.
4. Provide a comprehensive understanding of modeling digital circuits and components using HDLs.
5. Familiarize students with verification and simulation techniques for HDL designs and introduce students to FPGA and ASIC implementation using HDLs.

COURSE LEARNING OUTCOMES (CLO)

By the end of the course, students should be able to:

1. Understand the fundamental principles and concepts of HDLs and their importance in digital system design and analyse and interpret HDL programming languages such as Verilog or VHDL for modelling digital circuits.
2. Design and implement digital systems using HDLs and understand the design flow.
3. Distinguish between synthesizable and non-synthesizable HDL constructs for hardware implementation.
4. Model and simulate digital circuits and components using HDLs and verify and test HDL designs using simulation techniques and testbenches.
5. Implement digital systems on FPGA or ASIC platforms using HDLs and Apply HDL-based system design to solve practical engineering problems.

Mapping of CO's and CLO's :-

CLO / CO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CO 01					
CO 02					
CO 03					
CO 04					
CO 05					

COURSE CONTENTS

UNIT	CONTENTS	HOURS
UNIT-I:	Introduction to Logic Design with Verilog: Structural models of combination logic, logic simulation, design verification, test methodology, propagation delay, truth table models of combinational and sequential logic with Verilog modules, ports, gate types, gate delays, dataflow modelling, continuous assignments delays, expressions, operators, operands, operator types	**9**
UNIT-II:	Logic Design With Behavioural Models of Combinational And Sequential Logic: Behavioural Modelling, data types for behavioural Modelling, Behavioural models of combinational logic, propagation delay and continuous assignments, lathes and level sensitive circuits in Verilog, cyclic behavioural models of flip flops and latches, cyclic behaviour and edge detection, a comparison of styles for Behavioural Modelling.	**9**
UNIT-III:	Behavioural models of multiplexers, encoders and decoders data flow model of a LFSR machines with multicycle operations, algorithmic state machine charts for Behavioural Modelling, ASMD charts, Behavioural models of counters, shift registers and register files, switch debounce, metastability, synchronizers for asynchronous signals.	**9**
UNIT-IV:	Introduction to synthesis: synthesis of combinational logic, synthesis of sequential logic with latches, synthesis of three state devices and bus interfaces, synthesis of sequential logic with flip flops, synthesis of explicit state machines registered logic.	**9**
UNIT-V:	Programmable logic devices, storage devices, programmable logic array programmable array logic, programmability of PLDs CPLDs.	**9**

TEXT BOOK(s):

1. Michael D Ciletti - Advanced Digital Design with the VERILOG HDL, 2ND Edition, PHI, 2009. Detailed Syllabus (ECE) Page 105 of 201 R.V.R. & J.C.College of Engineering (Autonomous) R-16

2. Samir Palnitkar - Verilog HDL, 2nd edition, Pearson Education, 2003.

REFERENCE

1. Stephen Brown and Zvonko Vranesic - Fundamentals of Digital Logic with Verilog, 2nd Edition, TMH, 2008.

2. Z Navabi - Verilog Digital System Design, 2nd Edition, McGraw Hill, 2005.

		L	T	P	C
25EPE415	ASIC AND FPGA SYSTEM DESIGN	3	1	0	3
	Prerequisite				
	Nil				

COURSE OBJECTIVES (CO)

1. Introduce students to the fundamental principles and concepts of ASIC (Application-Specific Integrated Circuit) and FPGA (Field-Programmable Gate Array) system design and familiarize students with the architecture and components of ASICs and FPGAs.
2. Enable students to understand the design flow and methodologies for ASIC and FPGA development.
3. Introduce the concept of hardware description languages (HDLs) and their role in ASIC and FPGA design and provide a comprehensive understanding of the design considerations for ASIC and FPGA implementations.
4. Familiarize students with the use of design tools and synthesis techniques for ASIC and FPGA development.
5. Introduce students to the concept of verification and testing of ASIC and FPGA designs.

COURSE LEARNING OUTCOMES (CLO)

By the end of the course, students should be able to:

1. Understand the fundamental principles and concepts of ASIC and FPGA system design and their significance in modern digital systems and analyse and interpret the architecture and components of ASICs and FPGAs for specific application domains.
2. Design and implement digital systems using ASIC and FPGA platforms, considering design flow and methodologies.
3. Use hardware description languages (HDLs) to model and simulate digital circuits for ASIC and FPGA designs and analyse and apply design considerations, such as performance, power, and area trade-offs, for ASIC and FPGA implementations.
4. Work with design tools and synthesis techniques to develop ASIC and FPGA designs and apply verification and testing techniques to validate the functionality and performance of ASIC and FPGA designs.
5. Design and implement complex digital systems on ASIC and FPGA platforms to solve practical engineering problems.

Mapping of CO's and CLO's :-

CO \ CLO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CO 01	■				
CO 02		■			
CO 03			■		
CO 04				■	
CO 05					■

COURSE CONTENTS

UNIT	CONTENTS	HOURS
UNIT-I	**OVERVIEW OF ASIC AND PLD** Types of ASICs - Design flow – CAD tools used in ASIC Design – Programming Technologies: Antifuse – static RAM – EPROM and EEPROM technology, Programmable Logic Devices: ROMs and EPROMs – PLA –PAL. Gate Arrays – CPLDs and FPGAs	**9**
UNIT-II	**ASIC PHYSICAL DESIGN** System partition -partitioning - partitioning methods – interconnect delay models and measurement of delay - floor planning - placement – Routing: global routing - detailed routing - special routing - circuit extraction - DRC	**9**
UNIT-III	**LOGIC SYNTHESIS, SIMULATION AND TESTING** Design systems - Logic Synthesis - Half gate ASIC -Schematic entry - Low level design language - PLA tools -EDIF- CFI design representation. Verilog and logic synthesis - VHDL and logic synthesis - types of simulation -boundary scan test - fault simulation - automatic test pattern generation.	**9**
UNIT-IV	**FPGA** Field Programmable gate arrays- Logic blocks, routing architecture, Design flow technology - mapping for FPGAs, Xilinx XC4000, Spartan II and Virtex II FPGAs - Apex and Cyclone FPGAs	**9**
UNIT-V	**SOC DESIGN** Design Methodologies – Processes and Flows - Embedded software development for SOC – Techniques for SOC Testing – Configurable SOC – Hardware / Software codesign Case studies: Digital camera, Bluetooth radio / modem, SDRAM and USB.	**9**

TEXT BOOK:

1. M.J.S .Smith, "Application Specific Integrated Circuits, Addison -Wesley Longman Inc.,199FPGA-Based
2. System Design book by Wayne Wolf

REFERENCES:

1. S. Trimberger, Field Programmable Gate Array Technology, Edr, Kluwer Academic Publications, 1994.
2. John V.Oldfield, Richard C Dore, Field Programmable Gate Arrays, Wiley Publications1995.
3. P.K.Chan & S. Mourad, Digital Design Using Field Programmable Gate Array, Prentice Hall, 1994.

		L	T	P	C
25EPE417	**VLSI TESTING**	**3**	**1**	**0**	**3**
	Prerequisite				
	Nil				

COURSE OBJECTIVES (CO)

1. Introduce students to the fundamental principles and concepts of VLSI testing and its significance in semiconductor manufacturing and familiarize students with the various types of faults that can occur in VLSI circuits.
2. Enable students to understand the techniques and methodologies used in VLSI testing for fault detection and diagnosis.
3. Introduce the concept of test generation and fault modelling in VLSI circuits.
4. Provide a comprehensive understanding of test compression and design-for-testability (DFT) techniques and familiarize students with scan chains, boundary scan, and built-in self-test (BIST) methodologies.
5. Introduce students to the challenges and advancements in VLSI testing.

COURSE LEARNING OUTCOMES (CLO)

By the end of the course, students should be able to:

1. Understand the fundamental principles and concepts of VLSI testing and its role in ensuring the quality and reliability of semiconductor devices and analyse and interpret the types of faults that can occur in VLSI circuits and their impact on device performance.
2. Apply techniques and methodologies for VLSI testing to detect and diagnose faults in digital circuits.
3. Design and generate tests to detect various types of faults in VLSI circuits and apply test compression and DFT techniques to optimize test time and resource requirements.
4. Design and implement scan chains, boundary scan, and BIST methodologies for VLSI testing.
5. Analyse and interpret test results to evaluate the quality and reliability of VLSI circuits and understand the challenges and advancements in VLSI testing, such as at-speed testing and defect-oriented testing.

Mapping of CO's and CLO's: -

CLO / CO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CO 01					
CO 02					
CO 03					
CO 04					
CO 05					

COURSE CONTENTS

UNIT	CONTENTS	HOURS
UNIT-I	**Basics of Testing and Fault Modelling** Introduction to Testing - Faults in digital circuits - Modelling of faults - Logical Fault Models - Fault detection - Fault location - Fault dominance - Logic Simulation - Types of simulation - Delay models - Gate level Event-driven simulation.	**9**
UNIT-II	**Test Generation for Combinational and Sequential** Circuits Test generation for combinational logic circuits - Testable combinational logic circuit design - Test generation for sequential circuits - design of testable sequential circuits.	**9**
UNIT-III	**Design for Testability** Design for Testability - Ad-hoc design - Generic scan-based design - Classical scan-based design – System level DFT approaches.	**9**
UNIT-IV	**Self-Test and Test Algorithms** Built-In Self-Test - Test pattern generation for BIST - Circular BIST - BIST Architectures - Testable Memory Design - Test algorithms - Test generation for Embedded RAMs.	**9**
UNIT-V	**Fault Diagnosis** Logic Level Diagnosis - Diagnosis by UUT reduction - Fault Diagnosis for Combinational Circuits - Self-checking design - System Level Diagnosis.	**9**

TEXTBOOKS

1. M. Abramovic, M.A. Breuer and A.D. Friedman, "Digital Systems and 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.

REFERENCES

1. P.K. Lala, "Digital Circuit Testing and Testability", Academic Press, 2002.
2. A.L. Crouch, "Design Test for Digital IC's and Embedded Core Systems", Prentice Hall International.

		L	T	P	C
25EPE419	**LOW POWER VLSI DESIGN**	**3**	**1**	**0**	**3**
	Prerequisite				
	Nil				

COURSE OBJECTIVES (CO)

1. Introduce students to the fundamental principles and concepts of low-power VLSI design and familiarize students with the challenges and considerations in designing low-power VLSI circuits and systems.
2. Enable students to understand different low-power design techniques and methodologies.
3. Introduce the concept of power optimization and trade-offs in VLSI circuits and provide a comprehensive understanding of power-gating, voltage scaling, and clock gating techniques.
4. Familiarize students with circuit-level and system-level power reduction strategies.
5. Introduce students to low-power design for various VLSI applications, such as IoT, mobile devices, and wearable electronics.

COURSE LEARNING OUTCOMES (CLO)

By the end of the course, students should be able to:

1. Understand the fundamental principles and concepts of low-power VLSI design and its significance in modern electronic systems and analyse and interpret the challenges and considerations in designing low-power VLSI circuits and systems.
2. Design and implement low-power VLSI circuits using various power optimization techniques and methodologies.
3. Analyse and evaluate power consumption in VLSI circuits and explore power trade-offs during design and apply power-gating, voltage scaling, and clock gating techniques to achieve power reduction in VLSI circuits.
4. Apply circuit-level and system-level power reduction strategies in VLSI design.
5. Design low-power VLSI systems for specific engineering applications, such as IoT devices and mobile electronics.

MAPPING OF CO & CLO

CLO / CO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CO 01	■				
CO 02		■			
CO 03			■		
CO 04				■	
CO 05					■

COURSE CONTENTS

UNIT	CONTENTS	HOURS
UNIT-I	**Introduction** Need for low power VLSI chips, Sources of power dissipation on Digital Integrated circuits. Emerging Low power approaches.	**9**
UNIT-II	**Device & Technology Impact on Low Power** Dynamic dissipation in CMOS, Transistor sizing& gate oxide thickness, Impact of technology Scaling, Technology & Device innovation.	**9**
UNIT-III	**Power analysis** Simulation Power Analysis: SPICE circuit simulators, gate level logic simulation, capacitive power estimation, static state power, gate level capacitance estimation, architecture level analysis, data correlation analysis in DSP systems, Monte Carlo simulation. Probabilistic power analysis: Random logic signals, probability & frequency, probabilistic power analysis techniques, signal entropy.	**9**
UNIT-IV	**Power Circuits** Transistor and gate sizing, network restructuring and Reorganization. Special Flip Flops & Latches design, high capacitance nodes, low power digital cells library. Logic level: Gate reorganization, signal gating, logic encoding, state machine encoding, pre-computation logic. Low power Architecture & Systems: Power & performance management, switching activity reduction, parallel architecture with voltage reduction, flow graph transformation, low power arithmetic components.	**9**
UNIT-V	**Low power Clock Distribution** Power dissipation in clock distribution, single driver Vs distributed buffers, Zero skew Vs tolerable skew, chip & package co design of clock network. Special Techniques: Power Reduction in Clock networks, CMOS Floating Node, Low Power Bus Delay balancing, and Low Power Techniques for SRAM.	**9**

TEXTBOOKS:

1. Gary K. Yeap, “Practical Low Power Digital VLSI Design”, KAP, 2002
2. Rabaey, Pedram, “Low Power Design Methodologies” Kluwer Academic

REFERENCES:

1. Kaushik Roy, Sharat Prasad, “Low-Power CMOS VLSI Circuit Design” Wiley, 2000
2. Yeo, “CMOS/BiCMOS ULSI Low Voltage Low Power” Pearson Education

		L	T	P	C
25EPE211	**CIRCUIT ANALYSIS & SYNTHESIS**	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

COURSE OBJECTIVES (CO)

6. Introduce students to the fundamental principles and techniques of network analysis and synthesis, familiarize students with different types of electrical networks and their applications. And introduce the concept of network theorems and their applications in simplifying complex circuits.
7. Provide a comprehensive understanding of transient state analysis of networks using Laplace transforms and Fourier analysis.
8. Introduce the concept of graph theory and the analysis networks.
9. Explore the principles of two-port network analysis and their applications in transmission lines and amplifiers.
10. Familiarize students with network synthesis techniques for designing desired network responses, introduce students to the principles of network stability and control in feedback systems and provide hands-on experience with designing and analysing practical electrical networks.

COURSE LEARNING OUTCOMES (CLO)

By the end of the course, students should be able to:

6. Understand the fundamental principles and concepts of electrical network analysis and synthesis, interpret the behaviour and characteristics and apply network theorems to simplify and analyze complex circuits.
7. Analyze electrical networks in transient state using Laplace transforms and Fourier analysis.
8. Understand the principles of graph theory, apply them to design and analyse different networks.
9. Analyze and design two-port networks for specific applications in transmission lines and amplifiers.
10. Design and synthesize networks with desired frequency responses using appropriate techniques, analyse the stability and control of networks in feedback systems, use simulation software and measurement tools to model and test electrical networks and collaborate in teams to design and implement network-related projects and assignments.

Mapping of CO's and CLO's :-

CLO / CO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CO 01					
CO 02					
CO 03					
CO 04					
CO 05					

COURSE CONTENTS

UNIT	CONTENTS	HOURS
UNIT-I	**AC Network Theorems:** Nodal analysis and mesh analysis, Source Transformation Theorem – Duality Theorem – Linearity & Superposition Theorem – Thevenin's& Norton's Theorem– Maximum Power Transfer theorem, Millman's Theorem and Δ-Y and Y-Δ Conversions.	12
UNIT-II	**TRANSIENT ANALYSIS** Basics – Source free and Forced Response of RL, RC and RLC Series Circuits- Forced Response of RL, RC & RLC Series circuits with Sinusoidal **Excitation** – Time Constant & Natural frequency of Oscillation – Laplace Transform Application to the Solution of RL, RC & RLC Transient Circuits.	8
UNIT-III	**Graph Theory** Graph Theory fundamentals, Matrix Representation of Graphs, Formulation of Network Response Equations using Incidence Matrix, Duality in Networks. Computation of Ladder and Non-Ladder Networks	8
UNIT-IV	**Two Port Networks** Parameters of Two Port Networks, Correlation between Two Port Parameters, Two Port, Relation between Port Parameters, Transfer Functions using Two Port Parameters, Interconnection of Two Ports , Reciprocal and Symmetric Networks, Terminated Two Port Networks, Interconnections of Two Port Networks,	9
UNIT-V	**Network Synthesis** Active Network Synthesis and Realizability: Elements of Relizability Theory, Hurwitz Polynomial, Positive Real Functions (PRF), Characteristics of PRF, Methodology for Simple Network Synthesis, Synthesis of Two Element Type One Port Network. Image Impedance, Iterative Impedance, Waveform Symmetry and Filter Networks.	12

TEXTBOOKS

1. Franklin F. Kuo, "Network Analysis and synthesis", Wiley India Pvt Ltd.
2. MS Sukhija, T.K. Nagsarkar, "Circuits and Networks", Oxford University Publication.
3. Hayt W. H., Kemmerly J. E. and Durbin S. M., "Engineering Circuit Analysis", 6th Ed., Tata McGraw-Hill Publishing Company Ltd.,2008.

REFERENCE BOOKS

1. ME Van Valkenberg, "Network Analysis", Prentice Hall of India Ltd.
2. Ghosh, "Network Theory: Analysis and Synthesis", PHI Learning Pvt. Ltd

		L	T	P	C
25EPE212	**DIGITAL SIGNAL PROCESSING**	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

COURSE OBJECTIVES (CO)

5. Introduce students to the fundamental principles and concepts of digital signal processing, familiarize students with the properties and characteristics of discrete-time signals and systems and enable students to understand the basics of sampling theorem and its practical implementation.
6. Provide a comprehensive understanding of the discrete Fourier transform (DFT) and its relationship with the fast Fourier transform (FFT) algorithm.
7. Familiarize students with the principles of FIR and IIR filters and its applications, Introduce students to the design and analysis of digital signal processing algorithms for various applications.
8. Provide hands-on experience with designing and implementing practical digital signal processing algorithms

COURSE LEARNING OUTCOMES (CLO)

By the end of the course, students should be able to:

5. Understand the fundamental principles and concepts of digital signal processing and its importance in various engineering fields, analyse and interpret discrete-time signals and systems using mathematical techniques.
6. Understand the principles of the discrete Fourier transform (DFT), apply the fast Fourier transform (FFT) algorithm for efficient spectral analysis and Design and implement digital signal processing algorithms, such as convolution, correlation, and spectral estimation.
7. Analyse and interpret the spectral characteristics of signals using different signal processing techniques, design and implement digital filters (FIR & IIR) for specific signal processing applications
8. Work with simulation software and programming tools to design and implement practical digital signal processing algorithms and collaborate in teams to design and implement digital signal processing projects for specific engineering tasks and applications.

Mapping of CO's and CLO's: -

CLO / CO	CLO 1	CLO 2	CLO 3	CLO 4
CO 01				
CO 02				
CO 03				
CO 04				

COURSE CONTENTS

UNIT	CONTENTS	HOURS
UNIT-I:	**INTRODUCTION** Analog vs. Digital Signal Processing: Basic differences, advantages, and application domains, Classification of Systems: Continuous-time & discrete-time systems,– Linear vs. Non-linear, Causal vs. Non-causal, Static vs. Dynamic, Time-invariant vs. Time-variant, Recursive vs. Non-recursive, Stable vs. Unstable, Classification of Signals: Continuous and discrete signals , Energy and power signals, Mathematical Representation of Signals: Unit impulse, step, exponential, sinusoidal, Signal operations: shifting, scaling, folding, Spectral Density of Signals: Energy spectral density and power spectral density, Sampling and Quantization: Sampling theorem, Nyquist rate, Aliasing, anti-aliasing filters, Quantization techniques, quantization error, signal reconstruction	9
UNIT-II:	**DFT** Overview of Discrete Signals and Sampling Review, Introduction to DFT: DFT definition and comparison with CTFT & DTFT, Properties of DFT: Linearity, Time shifting, Frequency shifting, Conjugate symmetry, Circular convolution, Twiddle Factor and its Role in DFT: Circular and Linear Convolution, Graphical method, Matrix method, Overlap-add and overlap-save methods, Applications of DFT: Signal filtering, spectrum analysis.	9
UNIT-III:	**DISCRETE FOURIER TRANSFORM & COMPUTATION** Limitations of Direct DFT Computation : Need for FFT (Fast Fourier Transform),FFT Algorithm: Radix-2 Decimation-in-Time (DIT), Radix-2 Decimation-in-Frequency (DIF), Butterfly diagram structure, Magnitude and Phase Representation using FFT, Realization of Discrete-Time Systems, Direct Form I and II, Cascade form, Parallel form, Ladder and Lattice structures, Signal flow graphs and block diagrams	9
UNIT-IV:	**DESIGN OF FIR DIGITAL FILTERS** FIR vs. IIR Filters: Characteristics, stability, phase response, FIR Filter Realization Techniques: Direct, parallel, and cascade forms, Design of FIR Filters Using Window Techniques, Rectangular, Hamming, Hanning, Blackman, Kaiser windows, Trade-offs between main lobe width and side lobe attenuation, Linear Phase FIR Filters, Finite Word Length Effects, Quantization error, round-off error, Product round-off error, Limit cycle oscillations: zero-input and overflow-induced, Need for Scaling, Scaling to prevent overflow in DSP systems	9
UNIT-V:	**DESIGN OF IIR DIGITAL FILTER** Analog Filter Design Approaches: Butterworth approximation, Chebyshev approximation, IIR Filter Design from Analog Filters, Impulse invariant transformation, Bilinear transformation, Frequency warping and pre-warping techniques, Comparison between FIR and IIR filters, Digital Signal Processor (DSP) Architectures: General structure of DSP processors, Types of DSPs: Fixed-point vs. Floating-point, Features: MAC unit, pipelining, Harvard architecture, Evolution of DSP hardware: from early to modern architectures (e.g., TMS320, SHARC, ARM Cortex-M DSP extensions)	9

TEXT BOOKS

1. 1. J.G. Proakis and D.G. Manolakis, 'Digital Signal Processing Principles, Algorithms and Applications', Pearson Education, New Delhi, PHI. 2003.
2. S.K. Mitra, 'Digital Signal Processing – A Computer Based Approach', McGraw Hill Edu, 2013
3. Lonnie C.Ludeman ,"Fundamentals of Digital Signal Processing",Wiley,2013

REFERENCE:

1. Robert Schilling & Sandra L.Harris, Introduction to Digital Signal Processing using Matlab", Cengage Learning,2014.
2. B.P.Lathi, 'Principles of Signal Processing and Linear Systems', Oxford University Press, 2010 3. Taan S. ElAli, 'Discrete Systems and Digital Signal Processing with Mat Lab', CRC Press, 2009.

3. SenM.kuo, woonseng…s.gan, "Digital Signal Processors, Architecture, Implementations & Applications, Pearson,2013
4. DimitrisG.Manolakis, Vinay K. Ingle, applied Digital Signal Processing,Cambridge,2012.

		L	T	P	C
25EC301	**CONTROL SYSTEM**	**3**	**1**	**0**	**3**
	Prerequisite				
	Fundamental of Electronic Devices				

COURSE OBJECTIVES (CO)

1: Introduce students to the fundamental principles and concepts of instrumentation and control systems and Familiarize students with various instruments used for measurement in control systems and introduce students to the fundamental principles and concepts of Instruments.
2: Familiarize students with the different types of control systems and their applications in various engineering fields, enable students to understand the mathematical modelling of dynamic systems for control analysis and introduce the concept of feedback control and its role in regulating and stabilizing systems.
3: Provide a comprehensive understanding of control system components, such as controllers, sensors, and actuators and Introduce students to various control strategies, such as proportional, integral, and derivative (PID) control.
4: Explore the principles of frequency domain and time domain analysis of control systems.
5: Familiarize students with modern control techniques, such as state-space control and digital control and introduce students to control system design and optimization techniques and provide hands-on experience with designing, implementing, and analysing control systems using simulation software and practical experiments.

COURSE LEARNING OUTCOMES (CLO)

By the end of the course, students should be able to:

1: Understand the fundamental principles of instrumentation and control systems and their role in various engineering applications, Identify and select appropriate instrument for measuring different process variables in control systems and understand the fundamental principles of instrumentation systems and their importance in engineering applications.
2: Identify different types of control systems and their use in specific engineering fields. Formulate mathematical models of dynamic systems for control analysis and design.
3: Analyse and interpret the stability and performance of control systems using time domain and frequency domain methods, Design control systems to achieve desired performance specifications, such as transient response and steady-state error.
4: Design and implement feedback control systems using proportional, integral, and derivative (PID) control strategies and analyse the response of control systems to different inputs and disturbances.
5: Understand the concepts of state-space control and digital control and their advantages in modern control systems, apply control system design techniques for optimal performance and stability, work with simulation software to model and analyse control systems in various engineering applications and troubleshoot and identify potential issues in control systems and propose appropriate solutions.

MAPPING MATRIX OF CO AND CLO:-

CLO / CO	CLO 01	CLO 02	CLO 03	CLO 04	CLO 05
CO 01					
CO02					
CO 03					
CO 04					

CO 05					

COURSE CONTENTS

UNIT	CONTENTS	HOURS
UNIT-I	**TRANSFER FUNCTIONS** Introduction and Classification of Control Systems: Definition and significance of control systems in engineering, Classification: Linear vs., Nonlinear, Time-invariant vs. Time-varying, Continuous vs. Discrete, SISO vs. MIMO systems, Transfer Function Concept: Definition of transfer function for linear time-invariant (LTI) systems, Assumptions and limitations of transfer function approach, Mathematical Modelling of Physical Systems: Modelling of mechanical translational and rotational systems using Newton's and D'Alembert's laws, Modelling of electrical systems using Kirchhoff's laws, Mechanical–Electrical Analogies: Force-voltage and force-current analogies, Block Diagram Reduction Techniques : Series, parallel, feedback loops, and simplifying block diagrams, Signal Flow Graphs: Mason's Gain Formula for evaluating system transfer functions	9
UNIT-II	**TRANSIENT AND STEADY STATE ANALYSIS** Standard Test Signals: Unit step, unit ramp, unit impulse, parabolic input, Time Response of First-Order Systems, Mathematical derivation and graphical interpretation of response to step, ramp, impulse inputs, Time Response of Second-Order Systems: Natural frequency, damping ratio, Under-damped, critically damped, and over-damped system responses ,Step response characteristics, Time-Domain Specifications: Rise time, peak time, maximum overshoot, settling time, steady-state value, Steady-State Error Analysis: Static error constants (position, velocity, acceleration), System type and error coefficients.	9
UNIT-III	**STABILITY AND ROOT LOCUS TECHNIQUES** Stability of Control Systems: Concept of bounded input–bounded output (BIBO) stability, Characteristic equation and root location in the S-plane, Routh-Hurwitz Stability Criterion: Necessary and sufficient conditions for system stability, Routh array construction and interpretation, Relative stability and special cases (zero rows, sign changes),Root Locus Technique: Definition and importance in controller design, Basic rules for constructing root locus plots, Root locus for unity feedback systems, Impact of adding poles and zeros	9
UNIT-IV	**STABILITY ANALYSIS & FREQUENCY DOMAIN ANALYSIS** Frequency Response and Bode Plots: Frequency response for second-order systems, Magnitude and phase plots, Gain margin and phase margin, Polar Plots and Nyquist Plots,Plotting frequency response in polar form, Nyquist stability criterion: encirclement of critical point, Nichols Chart and Constant M and N Circles, Performance representation in frequency domain, Interpretation for gain/phase changes, Minimum Phase and Non-Minimum Phase Systems :Definition and behavior comparison	9
UNIT-V	**STATE-VARIABLE ANALYSIS** State-Space Representation: Vector-matrix form of state equations, Conversion from high-order differential equations to state space, State Transition Matrix and Equations: Definition and solution using matrix exponential, Homogeneous and non-homogeneous systems, Relationship Between State Equations and Transfer Functions: Deriving transfer function from state-space and vice versa, Similarity Transformation and Canonical Forms: Diagonalization and Jordan canonical forms, Controllable and observable canonical forms, Controllability and Observability, Kalman's tests and physical interpretation, Design implications and system design feasibility	9

TEXTBOOKS

1: Katsuhiko Ogata, "*Modern Control Engineering*" second edition, Prentice Hall of India Private Limited, New Delhi, 1995.

2: Nagrath, I J ,and Gopal, M., "*Control Systems Engineering*", 1st edition,Wiley and Sons, 1985.

REFERENCE

1: Benjamin C Kuo, "Automatic Control System", 7th edition, Prentice Hall of India Private Limited, New Delhi, 1993.

2: Gajic Z., Lelic M., "Modern Control System Engineering", Prentice Hall of India Private Limited, New Delhi, 1996.

3: Richard .C. Dorf and Robert. H. Bishop, "Modern Control System Engineering", Addison Wesley, 1999.

		L	T	P	C
25EPE321	**NEURAL NETWORK & FUZZY LOGIC**	**3**	**0**	**0**	**3**
	Prerequisite				

COURSE OBJECTIVES (CO)

1. Introduce students to the fundamental principles and concepts of neural networks and fuzzy logic, familiarize students with the basic structure and operation of artificial neural networks and enable students to understand the principles of Perceptron Algorithm and Feed Forward and Back Propagation Networks in neural networks.
2. Introduce the concept of fuzzy logic and its application in handling uncertainty and imprecision in decision-making and provide a comprehensive understanding of fuzzy membership functions and fuzzy rules.
3. Familiarize students with the design and implementation of fuzzy logic systems.
4. Introduce students to the concept of neural-fuzzy systems and their applications in intelligent control and decision-making.
5. Explore the principles of neural network training algorithms, such as back propagation and radial basis function (RBF) networks and provide hands-on experience with designing and implementing practical neural network and fuzzy logic systems.

COURSE LEARNING OUTCOMES (CLO)

By the end of the course, students should be able to:

1. Understand the fundamental principles and concepts of artificial neural networks and fuzzy logic, analyze and interpret the basic structure and operation of neural networks and apply supervised and unsupervised learning techniques in neural networks for pattern recognition and data clustering.
2. Understand the principles of fuzzy logic and apply fuzzy membership functions and fuzzy rules for handling uncertainty and imprecision and design and implement fuzzy logic systems for decision-making and control applications.
3. Analyse the principles of neural-fuzzy systems and apply them to intelligent control problems.
4. Design and implement neural networks for specific applications using appropriate training algorithms.
5. Work with simulation software and programming tools to design and implement practical neural network and fuzzy logic systems and collaborate in teams to design and implement neural network and fuzzy logic projects for specific engineering tasks and applications.

Mapping of CO's and CLO's :-

CLO / CO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CO 01					
CO 02					
CO 03					

CO 04					
CO 05					

COURSE CONTENTS

UNIT	CONTENTS	HOURS
UNIT-I	**INTRODUCTION TO DEEP LEARNING** Deep Learning Vs ML, Types of Neural Networks, History & Applications, Perceptron, Perceptron Loss, Hinge Loss, Cross-Entropy, MLP Notation, Forward Propagation, Deep Neural Networks (MLP), MNIST, Loss Functions in Deep Learning, Backpropagation (3 Parts), MLP Memorization, Gradient Descent (Batch, SGD, Mini-Batch), Vanishing/Exploding Gradient Problems	9
UNIT-II	**REGULARIZATION, OPTIMIZATION & HYPERPARAMETER TUNING** Performance Improvement Techniques: Early Stopping, Data Scaling, Dropout Layers, Regularization, Weight Decay. Activation Functions: Sigmoid, Tanh, ReLU, Leaky ReLU, ELU, SELU. Weight Initialization Xavier, He Initialization, Batch Normalization, Optimizers, SGD with Momentum, Nesterov Accelerated Gradient, AdaGrad, RMSProp, Adam and EWMA, and Hyperparameter Tuning	9
UNIT-III	**CONVOLUTIONAL NEURAL NETWORKS (CNNS)** CNN Introduction and History: CNN vs ANN, CNN vs Visual Cortex, Convolution Operation, Padding, Stride, Pooling (Max Pooling) and CNN Architecture – LeNet-5 CNN in Practice: CNN Backpropagation, Classification, Data Augmentation, Pretrained Models, ImageNet, Visualizing CNN Filters, Transfer Learning (Fine Tuning vs Feature Extraction)	9
UNIT-IV	**RECURRENT NEURAL NETWORKS (RNNS) AND SEQUENCE MODELLING** RNN Basics: basics and definition, RNN vs ANN, RNN Architecture & Forward Propagation, Sentiment Analysis Project using RNN, Types of RNN: Many-to-Many, One-to-Many, etc. and BPTT (Backpropagation Through Time) ,Advanced RNN Architectures: LSTM (3 Parts: What, How, Application), GRU, Deep RNNs, Stacked RNNs/LSTMs/GRUs, Bidirectional RNNs/LSTMs/GRUs, Encoder-Decoder Architecture, Seq2Seq Models with Attention and Bahdanau vs Luong Attention	9
UNIT-V	**TRANSFORMERS AND MODERN DEEP LEARNING ARCHITECTURES** Transformers Overview: History of LLMs, Self-Attention, Geometric, Scaled Dot-Product Attention, Multi-Head Attention, Positional Encoding and Layer Normalization. Transformer Architectures: Encoder Architecture, Masked Self-Attention, cross-attention, Decoder Architecture and Transformer Inference	9

TEXTBOOKS:

1. Ian Good Fellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2017.
2. Francois Chollet, “Deep Learning with Python”, Manning Publications, 2018.
3. Phil Kim, “Matlab Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence”, Apress , 2017.

REFERENCES:

1. Ragav Venkatesan, Baoxin Li, “Convolutional Neural Networks in Visual Computing”, CRC Press, 2018.
2. Navin Kumar Manaswi, “Deep Learning with Applications Using Python”, Apress, 2018.
3. Joshua F. Wiley, “R Deep Learning Essentials”, Packt Publications, 2016.

		L	T	P	C
25EPE322	INTRODUCTION TO MACHINE LEARNING	3	1	0	3
	Prerequisite				

COURSE OBJECTIVES (CO)

1. Introduce students to the fundamental principles and concepts of reinforcement learning (RL) and familiarize students with the components of RL, such as agents, environments, and rewards.
2. Enable students to understand different RL algorithms and their applications in solving sequential decision-making problems.
3. Introduce the concept of Markov Decision Processes (MDPs) and their use in modelling RL problems.
4. Provide a comprehensive understanding of various RL techniques, including value iteration, policy iteration, and Q-learning, familiarize students with exploration-exploitation trade-offs and their role in RL and introduce students to the concept of function approximation in RL.
5. Explore the principles of deep reinforcement learning and its applications in complex tasks and provide hands-on experience with implementing RL algorithms and solving RL problems.

COURSE LEARNING OUTCOMES (CLO)

By the end of the course, students should be able to:

1. Understand the fundamental principles and concepts of reinforcement learning and its significance in artificial intelligence and machine learning and analyse and interpret the components of reinforcement learning, including agents, environments, and rewards.
2. Apply different RL algorithms to solve sequential decision-making problems, such as dynamic programming and Monte Carlo methods.
3. Model and solve RL problems using Markov Decision Processes (MDPs). Design and implement RL algorithms, such as value iteration, policy iteration, and Q-learning, for specific applications.
4. Analyze the exploration-exploitation trade-offs in RL and apply appropriate strategies for different scenarios and use function approximation techniques to handle large state and action spaces in RL.
5. Analyze and implement deep reinforcement learning algorithms using neural networks for complex tasks, work with RL libraries and simulation environments to implement and test RL algorithms and collaborate in teams to design and implement RL projects for specific problem domains.

Mapping of CO's and CLO's :-

CLO / CO	CLO 1	CLO 2	CLO 3	CLO 4
CO 01				
CO 02				

CO 03				
CO 04				

COURSE CONTENTS

UNIT	CONTENTS	HOURS
UNIT-I	**INTRODUCTION TO MACHINE LEARNING AND TOOLS** What is Machine Learning, Difference between AI, ML, and DL,Types of Machine Learning, Offline vs Online Learning, Instance-Based vs Model-Based Learning, Challenges in Machine Learning, Applications of Machine Learning and Introduction to Tensors.	9
UNIT-II	**DATA ACQUISITION, PREPROCESSING, AND EXPLORATORY DATA ANALYSIS (EDA)** Working with CSV, JSON, SQL, Data Acquisition: APIs and Web Scraping, Data Understanding and Exploration, Exploratory Data Analysis (EDA): Univariate, Bivariate, Multivariate Pandas Profiling, Feature Engineering and Scaling, Encoding Categorical Variables, Column Transformer and Pipelines, Variable Transformation Techniques, Binning, Binarization, and Discretization Handling Special Data Types: Dates, Mixed Variables, Handling Missing Data, Outlier Detection and Treatment and Principal Component Analysis (PCA).	9
UNIT-III	**REGRESSION MODELS AND OPTIMIZATION TECHNIQUES** To study regression techniques, their mathematical foundations, performance metrics, and optimization methods. Simple Linear Regression, Multiple Linear Regression, Evaluation Metrics: MSE, MAE, RMSE, R^2, Model Bias-Variance Trade-off, Overfitting and Underfitting, Optimization: Gradient Descent , Batch, Stochastic, Mini-batch Variants, Polynomial Regression and Regularization Techniques	10
UNIT-IV	**CLASSIFICATION ALGORITHMS AND MODEL EVALUATION** Logistic Regression: Theory, Gradient Descent, Sigmoid, Cross Entropy, Softmax Regression, Polynomial Features in Classification, Decision Trees for Classification and Regression, Ensemble Learning Methods, Support Vector Machines (SVM), Naive Bayes Classifier, K-Nearest Neighbors (KNN), Evaluation Metrics and Handling Imbalanced Data.	9
UNIT-V	**CLUSTERING AND HYPERPARAMETER TUNING** K-Means Clustering,DBSCAN Clustering, Agglomerative Hierarchical Clustering, Feature Importance in Decision Trees and Forests, Hyperparameter Tuning Techniques, Grid Search CV, Randomized Search CV, OOB (Out-of-Bag) Score and Optuna for Bayesian Optimization	10

TEXTBOOKS

1. Andrew g. barto, Richard s. Sutton, A ***Reinforcement Learning: An Introduction (Adaptive Computation And Machine Learning Series***),2nd edition, The MIT Press Cambridge, Massachusetts London, England, 2018.

REFERENCE:

1. Alekh Agarwal, Nan Jiang and Sham M. Kakade, "Reinforcement Learning: Theory and Algorithms", in preparation
2. Csaba Szepesvari, "Algorithms for Reinforcement Learning", Morgan and Claypool, 2010.
3. Dimitri Bertsekas and John Tsitsiklis, "Neuro-dynamic programming", Athena Scientific, 1997.

		L	T	P	C
25EPE324	**ADVANCED WIRELESS COMMUNICATION**	**3**	**1**	**0**	**4**
	Prerequisite				
	21EC0502				

COURSE OBJECTIVES (CO)

1. Introduce students to the fundamental principles and concepts of wireless communication systems, familiarize students with the different wireless communication technologies and their applications and enable students to understand the basic concepts of radio frequency (RF) propagation and channel characteristics.
2. Provide a comprehensive understanding of multiple access techniques and their role in wireless networks and familiarize students with the principles of cellular communication systems and their design.
3. Introduce the concept of wireless modulation techniques and their use in data transmission.
4. Introduce students to the concept of wireless network protocols and architectures
5. Explore the principles of antenna design and beam-forming in wireless communication and provide hands-on experience with designing and analysing practical wireless communication systems.

COURSE LEARNING OUTCOME (CLO)

By the end of the course, students should be able to:

1. Understand the fundamental principles and concepts of wireless communication and its significance in modern communication systems, analyse and interpret different wireless communication technologies and their applications in various industries and analyse the radio frequency (RF) propagation and channel characteristics in wireless communication systems.
2. Analyse multiple access techniques and apply them to manage concurrent users in wireless networks.
3. Design and analyse wireless modulation techniques for efficient data transmission in wireless channels and design and analyse cellular communication systems and their coverage and capacity planning.
4. Understand the principles of wireless network protocols and architectures, such as Wi-Fi and cellular standards and
5. Design and analyse antenna systems and beamforming techniques for improved wireless communication performance, work with simulation software and measurement tools to model and test wireless communication systems and collaborate in teams to design and implement wireless communication projects for specific engineering tasks and applications.

Mapping of CO's and CLO's :-

CLO / CO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CO 01					
CO 02					
CO 03					

CO 04					
CO 05					

COURSE CONTENTS

UNIT	CONTENTS	HOURS
UNIT-I	**WIRELESS CHANNELS** Electromagnetic Wave Propagation Mechanisms - Reflection, Diffraction, Scattering Models– Large scale path loss – Path loss models: Free Space and Two-Ray models -Link Budget design – Small scale fading- Parameters of mobile multipath channels – Time dispersion parameters-Coherence bandwidth – Doppler spread & Coherence time, fading due to Multipath time delay spread – flat fading – frequency selective fading – Fading due to Doppler spread – fast fading – slow fading.	9
UNIT-II	**CELLULAR ARCHITECTURE** Multiple Access techniques - FDMA, TDMA, CDMA – Capacity calculations–Cellular concept-Frequency reuse - channel assignment- hand off- interference & system capacity trunking & grade of service – Coverage and capacity improvement.	9
UNIT-III	**MODULATION TECHNIQUES AND EQUALIZATION AND DIVERSITY** Digital Modulation – An Overview: Factors That Influence The Choice Of Digital Modulation, Linear Modulation Techniques: Minimum Shift Keying (MSK), Gaussian Minimum Shift Keying(GMSK), Spread Spectrum Modulation Techniques: Pseudo- Noise (PN) Sequences, Direct Sequence Spread Spectrum (DS-SS)- Modulation Performance In Fading And Multipath 91 Channels- Equalization, Diversity And Channel Coding: Introduction-Fundamentals Of Equalization-Diversity Techniques: Practical Space Diversity Considerations, Polarization Diversity, Frequency Diversity, Time Diversity.	9
UNIT-IV	**MULTIPLE ANTENNA TECHNIQUES** MIMO systems – spatial multiplexing -System model -Pre-coding - transmitter diversity, receiver diversity- Channel state information-capacity in fading and non-fading channels.	9
UNIT-V	**WIRELESS NETWORKING** Introduction: Difference Between Wireless And Fixed Telephone Networks, The Public Switched Telephone Network(PSTN), 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).	9

TEXTBOOKS

1. Rappaport, T.S., “Wireless communications”, Pearson Education, 3rd Edition, 2010.

2. Andreas.F. Molisch, “Wireless Communications”, John Wiley – India, 2ndEdition 2012.

REFERENCE ;

1. David Tse and PramodViswanath, “Fundamentals of Wireless Communication”, Cambridge University Press, 2005.
2. Upena Dalal, “Wireless Communication”, Oxford University Press, 2009.
3. Van Nee, R. and Ramji Prasad, “OFDM for wireless multimedia communications”, Artech House, 2000.
4. Simon Haykins& Michael Moher, “Modern Wireless Communications”, Pearson Education, 2007.
5. Vijay. K. Garg, “Wireless Communication and Networking”, Morgan Kaufmann Publishers, 2007.
6. Wireless Communication and Networks –William Stallings ,Pearson Education, Second Edition 2002.

		L	T	P	C
25EPE421	**NETWORK SECURITY**	**3**	**0**	**0**	**3**
	Prerequisite				

COURSE OBJECTIVES (CO)

1. Introduce students to the fundamental principles and concepts of network security, familiarize students with the threats and vulnerabilities in computer networks and communication systems and enable students to understand various cryptographic techniques and their applications in securing data and communication.
2. Introduce the concept of authentication, authorization, and access control mechanisms in network security and provide a comprehensive understanding of network security protocols and their role in securing network communication.
3. Familiarize students with network intrusion detection and prevention systems.
4. Introduce students to security policies and risk management in network environments.
5. Explore the principles of secure network design and implementation.

COURSE LEARNING OUTCOMES (CLO)

By the end of the course, students should be able to:

1. Understand the fundamental principles and concepts of network security and its importance in modern communication systems, identify and analyse the threats and vulnerabilities in computer networks and communication systems and apply cryptographic techniques to secure data transmission and protect sensitive information in network communication.
2. Design and implement authentication, authorization, and access control mechanisms to control network access.
3. Analyze and implement network security protocols, such as SSL/TLS and IPsec, to ensure secure communication.
4. Understand the principles of network intrusion detection and prevention systems and their role in detecting and mitigating network attacks.
5. Analyze and implement security policies and risk management strategies to protect network assets and design and implement secure network architectures and configurations to minimize security risks and threats.

Mapping of CO’s and CLO’s :-

CLO / CO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CO 01					
CO 02					

CO 03					
CO 04					
CO 05					

COURSE CONTENTS

UNIT	CONTENTS	HOURS
UNIT-I	**INTRODUCTION** Security trends - Legal, Ethical and Professional Aspects of Security, Need for Security at Multiple levels, Security Policies - Model of network security – Security attacks, services and mechanisms – OSI security architecture – Classical encryption techniques: substitution techniques, transposition techniques, steganography).- Foundations of modern cryptography: perfect security – information theory – product cryptosystem – cryptanalysis.	9
UNIT-II	**SYMMETRIC CRYPTOGRAPHY** MATHEMATICS OF SYMMETRIC KEY CRYPTOGRAPHY: Algebraic structures - Modular arithmetic-Euclid's algorithm- Congruence and matrices - Groups, Rings, Fields- Finite fields- SYMMETRIC KEY CIPHERS: SDES – Block cipher Principles of DES – Strength of DES – Differential and linear cryptanalysis - Block cipher design principles – Block cipher mode of operation – Evaluation criteria for AES – Advanced Encryption Standard - RC4 – Key distribution.	9
UNIT-III	**PUBLIC KEY CRYPTOGRAPHY** MATHEMATICS OF ASYMMETRIC KEY CRYPTOGRAPHY: Primes – Primality Testing – Factorization – Euler's totient function, Fermat's and Euler's Theorem - Chinese Remainder Theorem – Exponentiation and logarithm - ASYMMETRIC KEY CIPHERS: RSA cryptosystem – Key distribution – Key management – Diffie Hellman key exchange - ElGamal cryptosystem – Elliptic curve arithmetic- Elliptic curve cryptography.	9
UNIT-IV	**MESSAGE AUTHENTICATION AND INTEGRITY** Authentication requirement – Authentication function – MAC – Hash function – Security of hash function and MAC – SHA –Digital signature and authentication protocols – DSS- Entity Authentication: Biometrics, Passwords, Challenge Response protocols- Authentication applications - Kerberos, X.509	9
UNIT-V	**SECURITY PRACTICE AND SYSTEM SECURITY** Electronic Mail security – PGP, S/MIME – IP security – Web Security - SYSTEM SECURITY: Intruders – Malicious software – viruses – Firewalls.	9

TEXT BOOK:

1. William Stallings, Cryptography and Network Security: Principles and Practice, PHI 3rd Edition, 2006.

REFERENCES:

1. C K Shyamala, N Harini and Dr. T R Padmanabhan: Cryptography and Network Security, Wiley India Pvt.Ltd
2. BehrouzA. Foruzan, Cryptography and Network Security, Tata McGraw Hill 2007.
3. Charlie Kaufman, Radia Perlman, and Mike Speciner, Network Security: PRIVATE Communication in a PUBLIC World, Prentice Hall, ISBN 0-13-046019-2

		L	T	P	C
25EPE23	**DATA COMMUNICATION NETWORK**	**3**	**1**	**0**	**3**
	Prerequisite				
	Nil				

COURSE OBJECTIVES (CO)

1. Introduce students to the fundamental principles and concepts of data communication networks, familiarize students with the different network architectures and topologies used in data communication and enable students to understand the functions and components of data communication networks, including routers, switches, and protocols.
2. Introduce the concept of network protocols and their role in data transmission and error detection.
3. Provide a comprehensive understanding of the TCP/IP protocol suite and its applications in the Internet.
4. Familiarize students with the principles of network security and its importance in data communication.
5. Introduce students to the concept of network management and troubleshooting techniques and explore the principles of network performance analysis and optimization.

COURSE LEARNING OUTCOME (CLO)

By the end of the course, students should be able to:

1. Understand the fundamental principles and concepts of data communication networks and their significance in modern communication systems, Identify and analyse different network architectures and topologies for specific communication requirements.
2. Analyse the functions and components of data communication networks, including routers, switches, and other network devices and design and implement network protocols for efficient data transmission and error detection.
3. Analyse and interpret the TCP/IP protocol suite and its applications in the Internet and other communication systems.
4. Understand the principles of network security and apply appropriate measures to secure data communication and apply network management and troubleshooting techniques to ensure the smooth operation of data communication networks.
5. Analyse the performance of data communication networks and optimize their design for improved efficiency.

MAPPING OF CO'S AND CLO'S

CLO / CO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CO 01					
CO 02					
CO 03					
CO 04					

UNIT	CONTENTS	HOURS
UNIT-I	**DATA COMMUNICATION & NETWORKING BASICS** Data transfer modes - Telephone system - Protocols & standards -Multiplexing- Circuit switching - Message & packet switching - Introduction to LAN, MAN & WAN -IEEE standards for LAN – Network topologies.	9
UNIT-II	**OSI LOWER LAYERS** Network models – OSI layer architecture – Issues in data traffic over network – Physical layer standards – Data link control & protocol – ARQ schemes – HDLC protocol - VLAN	9
UNIT-III	**NETWORK LAYER** Need for Internetworking – Addressing – Routing Issues – Internet protocol (IPV4/V6) – Congestion & flow control mechanism – TCP/IP model - VPN	9
UNIT-IV	**OSI HIGHER LAYERS** Transport layer – TCP & UDP – Session layer issues – Presentation layer – Application layer.	9
UNIT-V	**APPLICATION & INTRODUCTION TO ISDN** Application layer: Email – FTP – HTTP–Compression Techniques – Firewalls – types of firewall – software based firewall- hardware based firewall – application level gateways	9

CO 05					

TEXT BOOKS

1. Behrouz A. Fehrouzan, “Data communication & Networking” Mc-Graw Hill, 3rd edition, 2004.
2. Andrew S. Tanenbaum, “Computer Networks”, 4th edition, Pearson education, 1999.

REFERENCE

1. W. Stallings, “Data & computer communication”, 2nd Edition, NY Pearson, 1988.
2. Rarnier Handel, N.Huber , Schroder, “ATM Networks Concepts ,Protocols Applications’’, Addison Welsey 1999

		L	T	P	C
25EPE425	**INTERNET OF THINGS (IOT) AND APPLICATIONS**	**3**	**0**	**0**	**3**
	Prerequisite				

COURSE OBJECTIVES (CO)

1. Introduce students to the fundamental principles and concepts of the Internet of Things (IoT), familiarize with the architecture and components of IoT systems and enable to understand the communication protocols and technologies used in IoT devices and networks.
2. Introduce the concept of IoT data analytics and its applications in extracting meaningful insights from IoT-generated data.
3. Provide a comprehensive understanding of IoT security and privacy challenges and their mitigation strategies.
4. Familiarize students with the design and implementation of IoT applications for various industries, such as smart homes, healthcare, and industrial automation.
5. Introduce students to the concept of IoT cloud platforms and their role in IoT applications and explore the principles of edge computing and its application in IoT systems.

COURSE LEARNING OUTCOMES (CLO)

By the end of the course, students should be able to:

1. Understand the fundamental principles and concepts of the Internet of Things and its significance in modern connected systems, Identify and analyse the architecture and components of IoT systems for specific application domains.
2. Analyse the communication protocols and technologies used in IoT devices and networks.
3. Design and implement IoT data analytics techniques to extract valuable insights from IoT-generated data and apply security and privacy measures to address the challenges in IoT systems.
4. Design and develop IoT applications for various industries, considering their unique requirements.
5. Work with IoT cloud platforms to deploy and manage IoT applications and analyse the principles of edge computing and apply it in IoT systems for efficient data processing and reduced latency.

Mapping of CO's and CLO's :-

CLO / CO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CO 01					
CO 02					

CO 03					
CO 04					
CO 05					

COURSE CONTENTS

UNIT	CONTENTS	HOURS
UNIT-I	**INTRODUCTION TO INTERNET OF THINGS** 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	9
UNIT-II	**COMPONENTS IN INTERNET OF THINGS** Functional Blocks of an IoT Ecosystem – Sensors, Actuators, and Smart Objects – Control Units - Communication modules (Bluetooth, Zigbee, Wifi, GPS, GSM Modules)	9
UNIT-III	**PROTOCOLS AND TECHNOLOGIES BEHIND IOT** IOT Protocols - IPv6, 6LoWPAN, MQTT, CoAP - RFID, Wireless Sensor Networks, Big Data Analytics, Cloud Computing, Embedded Systems.	9
UNIT-IV	**OPEN PLATFORMS AND PROGRAMMING** IOT deployment for Raspberry Pi /Arduino platform-Architecture –Programming – Interfacing – Accessing GPIO Pins – Sending and Receiving Signals Using GPIO Pins – Connecting to the Cloud.	9
UNIT-V	**IOT APPLICATIONS** 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.	9

TEXTBOOKS:

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

REFERENCES:

1. Perry Lea, “Internet of things for architects”, Packt, 2018
2. Olivier Hersent, David Boswarthick, Omar Elloumi , “The Internet of Things – Key applications and Protocols”, Wiley, 2012

		L	T	P	C
25EPE427	**INFORMATION THEORY AND CODING**	**3**	**0**	**0**	**3**
	Prerequisite				

COURSE OBJECTIVES (CO)

1. Introduce students to the fundamental principles and concepts of information theory, familiarize with the basics of entropy, information, and source coding and Enable students to understand the principles of channel capacity and channel coding.
2. Introduce the concept of error-correcting codes and their applications in data transmission and storage.
3. Provide a comprehensive understanding of data compression techniques and their role in efficient data representation.
4. Familiarize students with the principles of rate-distortion theory and its applications in multimedia communication.
5. Introduce students to the concept of source-channel coding and joint source-channel coding.

COURSE LEARNING OUTCOMES (CLO)

By the end of the course, students should be able to:

1. Understand the fundamental principles and concepts of information theory and its significance in various communication systems and analyse and interpret entropy, information, and source coding techniques for efficient data representation and calculate and analyse channel capacity and apply channel coding techniques for reliable data transmission.
2. Design and implement error-correcting codes for error detection and correction in data communication and storage.
3. Apply data compression techniques to reduce data redundancy and achieve efficient data representation.
4. Analyse and apply rate-distortion theory in multimedia communication for optimal data representation.
5. Design and implement joint source-channel coding techniques for error-resilient data transmission.

Mapping of CO's and CLO's :-

CLO / CO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CO 01					
CO 02					
CO 03					

CO 04					
CO 05					

COURSE CONTENTS

UNIT	CONTENTS	HOURS
UNIT-I	**SOURCE CODING** Mathematical Model of an Information Source: Concept of symbol generation from an information source, Statistical modelling of sources, Discrete Entropy and Mutual Information: Entropy as a measure of uncertainty, Mutual information as a measure of information gain between input and output, Joint and Conditional Entropies: Joint entropy for two random variable, Conditional entropy and its significance in communication, Entropy in the Continuous Case, Differential entropy and its interpretation for analogy sources, Source Coding Principles: Definition of unique decipherability and instantaneous codes, Kraft-McMillan inequality: conditions for codeword length validity, Shannon's Source Coding Theorem: Theoretical bounds for lossless compression.	9
UNIT-II	**NOISY CODING** Discrete Memoryless Channel (DMC):Definition and assumptions, Representation using transition matrices, Classification of Channels:– Noiseless, symmetric, asymmetric channels, binary symmetric channel (BSC), binary erasure channel (BEC), Z-channel, Channel Capacity:– Definition of capacity as the maximum mutual information, Calculation of capacity for symmetric channels, Shannon's Channel Coding Theorem: Capacity theorem for reliable transmission, Role of coding in approaching channel capacity, Fano's Inequality: Lower bound on error probability, Implication on reliability of codes, Capacity of Band-limited Gaussian Channels, Shannon-Hartley theorem, Impact of bandwidth and signal-to-noise ratio (SNR) on capacity.	9
UNIT-III	**CHANNEL CODING** Channel models: Binary Symmetric channels – Information capacity theorem – Implication of the information capacity theorem – Information capacity of coloured noise channel – Rate distortion theory – Data compression.	9
UNIT-IV	**ERROR CONTROL CODING** Linear block codes: – Cyclic codes, BCH Codes, RS codes, Golay codes, Burst error correcting codes, Interleaved codes, Convolutional codes : Convolutional encoder, code tree, state diagram, trellis diagram – Turbo codes.	9
UNIT-V	**DECODING OF CODES** Maximum likelihood decoding of convolutional codes - Sequential decoding of convolutional codes-Applications of Viterbi decoding.	9

TEXT BOOK:

1. Simon Haykin, “Communication Systems”, John Wiley & Sons, 5th Edition, 2009
2. John G. Proakis, “Digital Communications”, 5th Edition, McGraw Hill, 2018.
3. Shu Lin & Daniel J. Costello, “Error control coding Fundamentals and applications”, Prentice Hall, 1983.

REFERENCE:

1. P. Eugene Xavier, ‘’ Statistical Theory of Communication’’, New Age International Private Limited, 1st Edition, 1997.
2. Thomas M. Cover, Joy A. Thomas, “Elements of Information Theory”, Wiley, 2nd Edition, 2001.

		L	T	P	C
25EPE429	**NETWORK MODELLING USING REINFORCEMENT LEARNING**	**3**	**0**	**0**	**3**
	Prerequisite				

COURSE OBJECTIVES (CO)

1. Introduce students to advanced concepts of network modelling and optimization, familiarize with reinforcement learning (RL) algorithms and their applications in network optimization and
2. Enable to understand the fundamentals of Q-learning, Deep Q-Networks (DQNs), and other RL techniques.
3. Familiarize students with the integration of RL in software-defined networking (SDN) and network function virtualization (NFV) architectures.
4. Introduce the concept of network simulations and modelling using RL for performance evaluation and optimization. Introduce students to the concept of multi-agent RL and its applications in distributed network optimization.
5. provide a comprehensive understanding of how RL can be applied to solve various network design and management problems.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Understand the advanced concepts of network modelling and optimization using reinforcement learning and analyse and interpret different RL algorithms, including Q-learning and DQNs, and apply them to network problems and
2. Design and implement network simulations using RL to evaluate and optimize network performance and apply RL techniques to solve specific network design and management problems, such as routing, resource allocation,
3. Analyse the integration of RL in SDN and NFV architectures to enhance network flexibility and performance.
4. Apply multi-agent RL techniques to optimize network performance in distributed and complex environments and load balancing and
5. Work with simulation tools and RL frameworks to model and simulate advanced network scenarios and collaborate in teams to design and implement RL-based network modelling projects for specific engineering tasks and applications.

MAPPING OF CO’S AND CLO’S

CLO / CO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5

CO 01					
CO 02					
CO 03					
CO 04					
CO 05					

COURSE CONTENTS

UNIT	UNIT CONTENTS	HOURS
UNIT-I	**TEMPORAL-DIFFERENCE LEARNING:** TD Prediction, Advantages of TD Prediction, Methods, Optimality of TD(0) ,Sarsa: On-policy TD Control ,Q-learning: Off-policy TD Control , Expected Sarsa ,Maximization Bias and Double Learning Games, After states, and Other Special Cases.	9
UNIT-II	**BOOTSTRAPPING**: n-step TD Prediction-step Sarsa, n-step Off-policy Learning ,Per-decision Methods with Control Variates ,Off-policy Learning Without Importance Sampling: The n-step Tree Backup Algorithm ,A Unifying Algorithm: n-step Q(σ).	9
UNIT-III	**PLANNING AND LEARNING WITH TABULAR METHODS**: Models and Planning Dyna: Integrated Planning, Acting, and Learning, When the Model Is Wrong, Prioritized Sweeping, expected vs. Sample Updates, Trajectory Sampling, Real-time Dynamic Programming, Planning at Decision Time, Heuristic Search, Rollout Algorithms, Monte Carlo Tree Search	10
UNIT-IV	**ON-POLICY PREDICTION WITH APPROXIMATION**: Value-function Approximation ,The Prediction Objective (VE) ,Stochastic-gradient and Semi-gradient Methods ,Linear Methods ,Feature Construction for Linear Methods ,Polynomials , Fourier Coarse Coding ,Tile Coding ,Radial Basis Functions ,Selecting Step-Size Parameters Manually ,Nonlinear Function Approximation: Artificial Neural Networks ,Least-Squares TD , Memory-based Function ,Kernel-based Function Approximation , On-policy Control with Approximation ,Episodic Semi-gradient Control ,Semi-gradient n-step ,Average Reward, Deprecating the Discounted ,Differential Semi-gradient n-step Sarsa .	9
UNIT-V	**OFF-POLICY METHODS WITH APPROXIMATION**: Semi-gradient, Gradient Descent in the Bellman Error, Gradient-TD Methods, Emphatic-TD Methods, Reducing Variance	10

TEXTBOOKS

1. Andrew g. barto, Richard s. Sutton, A ***Reinforcement Learning: An Introduction (Adaptive Computation And Machine Learning Series***),2nd edition, The MIT Press Cambridge, Massachusetts London, England, 2018.

REFERENCE

1. Alekh Agarwal, Nan Jiang and Sham M. Kakade, "Reinforcement Learning: Theory and Algorithms", in preparation.
2. Csaba Szepesvari, "Algorithms for Reinforcement Learning", Morgan and Claypool, 2010.

3. Dimitri Bertsekas and John Tsitsiklis, "Neuro-dynamic programming", Athena Scientific, 1997.

		L	T	P	C
25EPE332	DATA SCIENCE	3	0	0	3
	Prerequisite				

COURSE OBJECTIVES (CO)

1. To provide an overview of an exciting field of Predictive Analytics.
2. To introduce the tools required For the Predictive Analytics.
3. To review and explore data to look at data distributions and to identify data problems, including missing values.
4. To enable students to have skills that will help them to solve complex real-world problems in for decision support.
5. To enable students to have skills that will help them to solve complex real-world problems in for decision support.

COURSE LEARNING OUTCOMES (CLO)

1. Explore the fundamental concepts of data science
2. Understand data analysis techniques for applications handling large data
3. Understand various machine learning algorithms used in data science process
4. Visualize and present the inference using various tools.
5. Learn to think through the ethics surrounding privacy, data sharing and algorithmic decision-making.

MAPPING OF CO'S AND CLO'S

CO \ CLO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CO 01					
CO 02					
CO 03					
CO 04					
CO 05					

COURSE CONTENTS

UNIT	UNIT CONTENTS	HOURS
UNIT-I	**Introduction to core concepts and technologies**: Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications, Mathematical Foundations for Data Science: linear algebra; Analytical and numerical solutions of linear equations; Mathematical structures, concepts and notations used in discrete mathematics. Introduction to Statistical Methods: basic and some advanced concepts of probability and statistics; Concepts of statistics in solving problems arising in data science.	9
UNIT-II	**Data collection and management**: Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, using multiple data sources	9
UNIT-III	**Data analysis:** Introduction, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance, Distribution properties and arithmetic, Samples/CLT, Basic machine learning algorithms, Linear regression, SVM, Naive Bayes.	10
UNIT-IV	**Data visualization:** Introduction, Types of data visualization, Data for visualization: Data types, Data encodings, Retinal variables, mapping variables to encodings, Visual encodings.	9
UNIT-V	**Computer science and engineering applications** Data mining, Network protocols, analysis of Web traffic, Computer security, Software engineering, Computer architecture, operating systems, distributed systems, Bioinformatics, Machine learning	10

TEXTBOOKS

2. Predictive Analytics Mesmerizing & fascinating by ERIC SIEGEL
3. Rich and K. Knight," Artificial Intelligence", Tata McGraw Hill.

REFERENCE

1. Nils J. Nilsson, Artificial Intelligence: A New Synthesis, Morgan-Kaufmann, 1998.
2. Biere, A., Heule, M., Van Maaren, H., Walsh, T., Handbook of Satisfiability, IOS Press, 2009.

		L	T	P	C
25EPE334	**AI and EXPERT Systems**	**3**	**0**	**0**	**3**
	Prerequisite				

COURSE OBJECTIVES (CO)

1. To learn the fundamentals of AI and role of agents in AI.
2. To understand the search which is the first building block of AI and its applications.
3. To understand and analyse the second building block of AI that is knowledge representation and handling uncertainty.
4. To understand the concepts of planning and learning to create smart applications.
5. To learn the applications of AI for NLP and Expert system designing.

COURSE LEARNING OUTCOMES (CLO)

6. Identify problems that are amenable to solution by AI methods, and which AI methods may be suited to solving a given problem.
7. Solve problems like constraint satisfaction search and optimization problem.
8. Deduce through logic and reasoning algorithms.
9. Understand the role of planning and learning in automated control and smart applications.
10. Formalize a given problem in the language/framework of different AI methods and Design and carry out an empirical evaluation of different algorithms on a problem formalization

MAPPING OF CO'S AND CLO'S

CLO / CO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CO 01					
CO 02					
CO 03					
CO 04					
CO 05					

COURSE CONTENTS

UNIT	UNIT CONTENTS	HOURS
UNIT-I	**Introduction:** Introduction to AI: Definitions, Historical foundations, Basic Elements of AI, Characteristics of intelligent algorithm, AI application Area**.** **Agents:** Definition of agents, Agent Environment, Agent architectures (e.g., reactive, layered, cognitive), Multi-agent systems- Collaborating agents, Competitive agents.	9
UNIT-II	**Problem solving:** State space search; Production systems, search space control: depth-first, breadth-first search, heuristic search - Hill climbing, best-first search, branch and bound. Problem Reduction, Constraint Satisfaction End, Means-End Analysis, Game Playing	9
UNIT-III	**Handling uncertainty:** Non-Monotonic Reasoning, Probabilistic reasoning, use of certainty factors, Basics of Fuzzy logic. **Knowledge Based Systems:** Proportional Logic, FOPL, Clausal Form, Resolution & Unification. Knowledge representation, acquisition, organization & Manipulation.	10
UNIT-IV	**Planning**-The blocks world, Components of Planning Systems, Goal stack Planning, Nonlinear planning, Hierarchical planning. **Learning**-Learning from example, Learning by advice, Explanation based learning, Learning in problem solving, Definition and examples of broad variety of machine learning tasks, Classification, Inductive learning, Simple statistical-based learning such as Naive Bayesian Classifier, decision trees, single layer & multiplayer Perceptions,	9
UNIT-V	**Natural Language Processing:** Language models, n-grams, Vector space models, Bag of words, Text classification, Information retrieval, Pagerank, Information extraction, Question-answering. **Expert Systems:** Need and justification for expert systems, Basic Components & architecture of Expert systems, ES-Shells, Representing & Using Domain Knowledge, Knowledge acquisition. **Case Studies:** IBM WATSON and CHATBOT, MYCIN,RI	10

TEXTBOOKS

4. Stuart Russell, Peter Norvig, Artificial Intelligence: A Modern Approach, Prentice Hall, Fourth edition, 2020.

5. Rich and K. Knight," Artificial Intelligence", Tata McGraw Hill.

REFERENCE

3. Nils J. Nilsson, Artificial Intelligence: A New Synthesis, Morgan-Kaufmann, 1998.
4. Biere, A., Heule, M., Van Maaren, H., Walsh, T., Handbook of Satisfiability, IOS Press, 2009.

		L	T	P	C
25EPE431	**DEEP LEARNING**	**3**	**0**	**0**	**3**
	Prerequisite				

COURSE OBJECTIVES (CO)

6. Introduce students to advanced concepts of network modelling and optimization, familiarize with reinforcement learning (RL) algorithms and their applications in network optimization and
7. Enable to understand the fundamentals of Q-learning, Deep Q-Networks (DQNs), and other RL techniques.
8. Familiarize students with the integration of RL in software-defined networking (SDN) and network function virtualization (NFV) architectures.
9. Introduce the concept of network simulations and modelling using RL for performance evaluation and optimization. Introduce students to the concept of multi-agent RL and its applications in distributed network optimization.
10. provide a comprehensive understanding of how RL can be applied to solve various network design and management problems.

COURSE LEARNING OUTCOMES (CLO)

By the end of the course, students should be able to:

6. Understand the advanced concepts of network modelling and optimization using reinforcement learning and analyse and interpret different RL algorithms, including Q-learning and DQNs, and apply them to network problems and
7. Design and implement network simulations using RL to evaluate and optimize network performance and apply RL techniques to solve specific network design and management problems, such as routing, resource allocation,
8. Analyse the integration of RL in SDN and NFV architectures to enhance network flexibility and performance.
9. Apply multi-agent RL techniques to optimize network performance in distributed and complex environments and load balancing and
10. Work with simulation tools and RL frameworks to model and simulate advanced network scenarios and collaborate in teams to design and implement RL-based network modelling projects for specific engineering tasks and applications.

MAPPING OF CO'S AND CLO'S

CLO / CO	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CO 01					
CO 02					
CO 03					
CO 04					
CO 05					

COURSE CONTENTS

UNIT	UNIT CONTENTS	HOURS
UNIT-I	**INTRODUCTION TO DEEP LEARNING** Deep Learning ML, Types of Neural Networks, History & Applications, Perceptron, Perceptron Loss, Hinge Loss, Cross-Entropy, MLP Notation, Forward Propagation, Deep Neural Networks (MLP), MNIST, Loss Functions in Deep Learning, Backpropagation (3 Parts), MLP Memorization, Gradient Descent (Batch, SGD, Mini-Batch), Vanishing/Exploding Gradient Problems	9
UNIT-II	**REGULARIZATION, OPTIMIZATION & HYPERPARAMETER TUNING** Performance Improvement Techniques: Early Stopping, Data Scaling, Dropout Layers, Regularization, Weight Decay. Activation Functions: Sigmoid, Tanh, ReLU, Leaky ReLU, ELU, SELU. Weight Initialization Xavier, He Initialization, Batch Normalization, Optimizers, SGD with Momentum, Nesterov Accelerated Gradient, AdaGrad, RMSProp, Adam and EWMA, and Hyperparameter Tuning	9
UNIT-III	**CONVOLUTIONAL NEURAL NETWORKS (CNNS)** CNN Introduction and History: CNN vs ANN, CNN vs Visual Cortex, Convolution Operation, Padding, Stride, Pooling (MaxPooling) and CNN Architecture – LeNet-5 CNN in Practice: CNN Backpropagation, Classification, Data Augmentation, Pretrained Models, ImageNet, Visualizing CNN Filters, Transfer Learning (Fine Tuning vs Feature Extraction)	10
UNIT-IV	**RECURRENT NEURAL NETWORKS (RNNS) AND SEQUENCE MODELING** RNN Basics: basics and definition, RNN vs ANN, RNN Architecture & Forward Propagation, Sentiment Analysis Project using RNN, Types of RNN: Many-to-Many, One-to-Many, etc. and BPTT (Backpropagation Through Time) ,Advanced RNN Architectures: LSTM (3 Parts: What, How, Application), GRU, Deep RNNs, Stacked RNNs/LSTMs/GRUs, Bidirectional RNNs/LSTMs/GRUs, Encoder-Decoder Architecture, Seq2Seq Models with Attention and Bahdanau vs Luong Attention	9
UNIT-V	**TRANSFORMERS AND MODERN DEEP LEARNING ARCHITECTURES** Transformers Overview: History of LLMs, Self-Attention, Geometric, Scaled Dot-Product Attention, Multi-Head Attention, Positional Encoding and Layer Normalization. Transformer Architectures: Encoder Architecture, Masked Self-Attention, cross-attention, Decoder Architecture and Transformer Inference	10

TEXTBOOKS

2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2016.
3. Bengio, Yoshua. "Learning deep architectures for AI." Foundations and trends in Machine Learning 2.1 (2009): 1127.

REFERENCE

1. N.D.Lewis, “Deep Learning Made Easy with R: A Gentle Introduction for Data Science”, January 2016.
2. Nikhil Buduma, “Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms”, O’Reilly publications.

		L	T	P	C
24AS404	**PROBABILITY & RANDOM PROCESS**	**3**	**1**	**0**	**4**
	Prerequisite				
	Nil				

COURSE OBJECTIVE (CO)

1. To familiarize the students with concepts of random variables, two dimensional random variables, distributions, random process and linear systems with random inputs that are used in many engineering problems.
2. To introduce basic Probability theory and Random variables, its types and concept of moments.
3. To equip the students with the knowledge of Discrete and continuous probability distributions with their applications.
4. To get exposed the students with the knowledge of two-dimensional Random variables and their transformations.
5. To extend the concept of random variable to random process and its basics that are applicable in engineering problems.

COURSE LEARNING OUTCOMES (CLO)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

1. Demonstrate knowledge of basic probability & random variables.
2. To understand techniques of developing discrete & continuous probability distributions and its applications.
3. Describe a random process in terms of its mean and correlation functions.
4. Gain knowledge in special processes like Poisson, Renewal processes.
5. Gain knowledge in spectral density, linear systems with random inputs.

MAPPING MATRIX OF CO AND CLO

CLO / CEO	01	02	03	04
01				
02				

03				
04				
05				

COURSE CONTENTS

UNIT	CONTENTS	HOURS
UNIT-I	**RANDOM VARIABLE** Random variables; probability mass functions; continuous random variables, probability density functions, Expectation, Moments - Moment generating function, Characteristics function.	9
UNIT-II	**DISCRETE PROBABILITY AND CONTINOUS PROBABILITY** Bernouli distribution, Binomial distribution, Poisson distribution, Geometric distribution, uniform Distribution, Exponential distribution, Normal distributions, functions of Random Variables, Chebyshev inequality	9
UNIT-III	**TWO-DIMENSIONAL RANDOM VARIABLE** Two dimensional Random Variables - Marginal and conditional distributions, Conditional mean and variance, covariance, correlation and Linear regression - Transformation of Random Variables - central limit theorem.	9
UNIT-IV	**RANDOM PROCESSES, COORELATION AND POWER SPECTRAL DENSITIES** Classification of Random processes - Stationarity - WSS and SSS processes, Random telegraph process, Ergodicity of Random Process, Poisson Random process, Autocorrelation function and its properties - Cross Correlation function and its properties. Spectral density function- Auto power spectral density and Cross power spectral density.	9
UNIT-V	**LINEAR SYSTEMS WITH RANDOM INPUTS** Linear time and invariant system, system transfer function. Linear system with random inputs. Auto correlation and cross correlation functions of input and output. System in the form of convolution - Unit Impulse Response of the System - Einstein - Weiner-Khinchine Relationship.	9

TEXTBOOKS

1. T. Veerarajan, "Probability, Statistics and Random Processes", Tata McGraw - Hill Publishing Company Limited, New Delhi, 2019.
2. Walpole R. E., Myers S. L., Ye K., Probability and Statistics for Engineers and Scientists, Pearson, 2017.
3. Moorthy M.B.K., Subramani K, Santha A. Probability and Random process. Scitech Publications, 7th edition 2018.

REFERENCE BOOKS

3. Trivedi K S, "Probability and Statistics with reliability, Queueing and Computer Science Applications", Wiley-Blackwell; 2nd edition, 2001.
4. Sheldon M Ross “Stochastic Process

		L	T	P	C
25EPE455	**DATA COMMUNICATION LAB**	**0**	**0**	**2**	**2**
	Prerequisite				
	Nil				

COURSE OBJECTIVES

To study the computer communication networks characteristics and to analyse the Date Link Layer, Network Layer, Transport Layer of the network and various routing protocol and Various MAC and routing layer Protocols.

COURSE OUTCOME

To know and understand computer communication networks Network Simulator (NS2) tool.

LIST OF EXPERIMENTS

1. Study and Implementation of Stop and Wait protocol.
2. Study and Implementation of Go Back N and Selective Repeat protocols.
3. Token Ring protocol: To create scenario and study the performance of Token Ring protocol through simulation.
4. Token Bus protocol: To create scenario and study the performance of Token Bus protocol through simulation.
5. Ethernet LAN protocol: To create Scenario and study the performance of network with CSMA/CD protocol through simulation.
6. Wireless LAN protocol: To create Scenario and study the performance of network with CSMA/CA protocol through
7. Simulation and compare with CSMA/CD protocol.
8. Study and Implementation of Distance Vector Routing Algorithm.
9. Study and Implementation of Link State Routing Algorithm.

Learning Resources	
Reference Book and other materials	Laboratory Manual Introduction to Network Simulator NS2, Teerwat Issariyakul, Ekram Hossain, Springer, 1st Edition, 2008