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. 2024-2025]

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	7
2	Engineering Sciences	ES	10
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	3
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			78

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	91
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	6
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		**183**

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	9							18	10
3.	Professional Core Courses	PC	-	-	12	14	14	11			51	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						6	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		25/22	25/22	25	25	25	25	24	12	183	100

PROGRAMME COURSES SRUCTURE SEMESTERWISE
BACHELOR OF TECHNOLOGY
(ELECTRONICS AND COMMUNICATION ENGINEERING)

SEMESTER – I

SL. No	Code	Category	Course Name	Hours per week				Credits
				L	T	P	Total Hours	
THEORY								
1	24AS101	(BAS)	Engineering Mathematics-I	3	1	0	4	4
2	24AS102/ 24AS103	(BAS)	Engineering Physics/ Engineering Chemistry	3	1	0	4	4
3	24EE101/ 24EC101	(ES)	Basic Electrical Engineering / Basic Electronics Engineering	3	0	0	3	3
4	23ME101/ 23CS101	(ES)	Engineering Mechanics / Fundamentals of Computer & C Programming	3	0	0	3	3
5	24HS101	(AEC)	Communicative English (*50% of students will be	2*	0	0	2*	2*
6	24HIN-101-I / 24FLGR101-I /	(AEC)	Hindi-I/German-I/French-I	2	0	0	2	2
7	23ESEB101/ 23VAC102	(VAC)	Environmental Bioengineering / Indian	2	0	0	2	2
Total Credits (Theory)				**16/18**	**2**	**0**	**18/20**	**18/20**
PRACTICAL								
8	24AS152/24AS153	(BAS)	Engineering Physics Lab/Engineering Chemistry Lab	0	0	2	2	1
9	23EE151/24EC151	(ES)	Basic Electrical Engineering Lab / Basic Electronics Engineering Lab	0	0	2	2	1
10	23ME151/23CS151	(ES)	Basic Mechanical Engineering Lab/ C	0	0	2	2	1
11	24ME152/24ME153	(ES)	Mechanical Workshop Lab/Engineering	0	0	2	2	1
12	24HS151*	(AEC)	Communicative English Lab (50% of students will be	0	0	2*	2*	1*
Total Credits (Practical)				**0**	**0**	**8/ 10**	**8/10**	**4/5**
TOTAL CREDITS (THEORY + PRACTICAL)				**16/18**	**2**	**8/ 10**	**26/30**	**22/25**

3 Week long Induction Programme right at the start of the 1st Semester. Normal class start only after the induction programme is over.

SEMESTER – II

SL. No	Code	Category	Course Name	Hours per week L	T	P	Total Hours	Credits
THEORY								
1	24AS201	(BAS)	Engineering Mathematics-II	3	1	0	4	4
2	24AS202/ 24AS203	(BAS)	Engineering Physics/ Engineering Chemistry	3	1	0	4	4
3	24EE201/ 24EC201	(ES)	Basic Electrical Engineering / Basic Electronics Engineering	3	0	0	3	3
4	23ME201/ 23CS201	(ES)	Engineering Mechanics / Fundamentals of Computer & C Programming	3	0	0	3	3
5	24HS201	(AEC)	Communicative English (*50% of students will be offered)	2*	0	0	2*	2*
6	24HIN-201-II / 24FLGR201-II/	(AEC)	Hindi-II/German-II/French-II	2	0	0	2	2
7	23ESEB201/2 3VAC 202	(VAC)	Environmental Bioengineering / Indian Constitution and Polity	2	0	0	2	2
Total Credits (Theory)				**16/18**	**2**	**0**	**18/20**	**18/20**
PRACTICAL								
8	24AS252/24AS253	(BAS)	Engineering Physics Lab/Engineering Chemistry Lab	0	0	2	2	1
9	23EE251/ 24EC251	(ES)	Basic Electrical Engineering Lab / Basic	0	0	2	2	1
10	23ME251/23CS251	(ES)	Basic Mechanical Engineering Lab/ C Programming Language Lab	0	0	2	2	1
11	24ME252/ 24ME253	(ES)	Mechanical Workshop Lab/Engineering Graphics & Design Lab	0	0	2	2	1
12	24HS251*	(AEC)	Communicative English Lab (50% of students will be offered)	0	0	2*	2*	1*
Total Credits (Practical)				**0**	**0**	**8/10**	**8/10**	**4/5**
Total Credits (Theory + Practical)				**16/18**	**2**	**8/10**	**26/30**	**22/25**

SEMESTER – III

S. No	Category	Code	Course	L	T	P	C
THEORY							
1	PC	23EC201	Fundamental of Electronics Devices	3	0	0	3
2	PC	24EC203	Digital Systems	3	0	0	3
3	PC	24EC205	Signals and Systems	3	0	0	3
4	PC	24EC207	Electromagnetic Field Theory	3	0	0	3
5	PE	24EPEXXX	Professional Elective-I	3	0	0	3
6	BAS	24AS301	Engineering Mathematics - III	3	1	0	4
7	VAC	23VAC103	Sports, Yoga and Fitness	1	0	2	2
TOTAL CREDITS (THEORY)				**20**	**1**	**1**	**21**
PRACTICAL							
8	P	23EC211	Electronics Devices Lab	0	0	2	1
9	P	24EC213	Digital Systems Lab	0	0	2	1
TOTAL CREDITS (PRACTICAL)				**0**	**0**	**4**	**2**
SKILL ENHANCEMENT							
10	SEC	23SS351	Effective Communication Skills	0	0	2	1
11	SEC	24CS0201A/24CS0201B/24CS0201C/24CS0201D	Data Structure and Algorithms using C or C++/Industry Automation Level-I/ Digital Marketing/Fundamentals of CAD for Engineers	0	0	2	1
TOTAL CREDITS (SKILL ENHANCEMENT)				**0**	**0**	**4**	**2**
TOTAL CREDITS (THEORY+PRACTICAL+SKILL ENHANCEMENT)				**20**	**1**	**9**	**25**

SEMESTER – IV

Sl. No	Category	Code	Course	L	T	P	C
THEORY							
1	PC	24EC208	Programming Using Python	3	0	0	3
2	PC	24EC202	Electronic Circuits	3	1	0	4
3	PC	24EC204	Linear Integrated Electronics	3	0	0	3
4	PC	24EC206	Transmission Lines and Waveguides	3	1	0	4
5	PE	24EPEXXX	Professional Elective -II	3	0	0	3
6	MDC	24MDC401	Multidisciplinary Elective-I	3	0	0	3
			TOTAL CREDITS (THEORY)	**18**	**2**	**0**	**20**
PRACTICAL							
7	P	23EC212	Electronic Circuits Lab	0	0	2	1
8	P	23EC214	Advance Simulation Lab	0	0	2	1
9	LP/SI	24LP202	#Live Projects and Industrial Visit	0	0	2	1
			TOTAL CREDITS (PRACTICAL)	**0**	**0**	**6**	**3**
SKILL ENHANCEMENT							
10	SEC	23SS452	Teamwork & Interpersonal Skills	0	0	2	1
11	SEC	24CS0202A/24CS0202B/24CS0202C	Introduction to SPSS Tool/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)	**18**	**2**	**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	23EC303	Analog and Digital Communication	3	1	0	4
2	PC	24EC305	Antenna and Wave Propagation	3	1	0	4
3	PC	24EC307	Microprocessors and Interfacing	3	0	0	3
4	PC	24EC301	Machine Learning using Python	3	0	0	3
5	PE	24EPEXXX	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	23EC311	Microprocessors Lab	0	0	2	1
8	P	23EC313	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/24CS0301D/24CS0301E	Wearable Technology/Big Data Analytics, Tools and Techniques/Machine Learning using Python/Industry Automation Level-II/RCC Structure Drawing Training	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	24EC302	RF and Microwave Engineering	3	1	0	4
2	PC	23EC304	Optical Fibre Communication	3	1	0	4
3	PC	24EC306	Digital VLSI Design	3	0	0	3
4	PE	24EPEXXX	Professional Elective -IV	3	0	0	3
5	PE	24EPEXXX	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	23EC312	Microwave and Optical Communication Lab	0	0	2	1
8	P	24EC314	Digital VLSI Design Lab	0	0	2	1
9	LP/SI	24LP302	#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/24CS0302B/24CS0302C/24CS0302D	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**	24EPEXXX	Professional Elective -VI	3	0	0	3
2	**PE**	24EPEXXX	Professional Elective -VII	3	0	0	3
3	**PE**	24EPEXXX	Professional Elective -VIII	3	0	0	3
4	**PE**	24EPEXXX	Professional Elective -IX	3	0	0	3
5	**PE**	24EPEXXX	Professional Elective – X	**3**	**0**	**0**	**3**
TOTAL CREDITS (THEORY)				**15**	**0**	**0**	**15**
PRACTICAL							
6	P	24EPEXXX	PE Lab	0	0	2	1
7	P	24EPEXXX	PE Lab	0	0	2	1
8	LP	24LP411	# Live Projects & Summer Internship	0	0	2	1
9	LP	24LP413	**Minor Project	0	0	8	4
TOTAL CREDITS (PRACTICAL)				**0**	**0**	**9**	**7**
SKILL ENHANCEMENT							
10	SEC	23SS755	Interpersonal Skills: Strategies	0	0	2	1
11	SEC	24CS0401A/24CS0401B/24CS0401C/24CS0401D	Building information modelling/PLC Programming/ 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**	**13**	**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	24LP402	*Major Project (Industrial Internship)	0	0	24 (6)**	12

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

****Teaching Load**

L : Lecture **T : Tutorials** **P: Practical**	**BAS : Basic Applied Sciences** **ES : Engineering Sciences** **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	24EPE211	Circuit Analysis & Synthesis	3	0	0	3
2.	II	PE	24EPE212	Digital Signal Processing	3	0	0	3
3.	III	PE	24EPE311	Solid-State Device Modelling/ Instrumentation and Control Engineering	3	0	0	3
4.	IV	PE	23EPE312	Embedded System Design using Microcontrollers	3	0	0	3
5.	V	PE	23EPE314	Mixed Signal System Design	3	0	0	3
6.	VI	PE	23EPE411	VLSI Fabrication Technology	3	0	0	3
7.	VII	PE	23EPE413	HDL Programming and System Design	3	0	2	4
8.	VIII	PE	23EPE415	ASIC and FPGA system design	3	0	2	4
9.	IX	PE	23EPE417	VLSI Testing	3	0	0	3
10.	X	PE	23EPE419	Low power VLSI Design	3	0	0	3

Note: Students may opt one course in 6th semester and one course in 7th 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	24EPE211	Circuit Analysis & Synthesis	3	0	0	3
2.	II	PE	24EPE212	Digital Signal Processing	3	0	0	3
3.	III	PE	24EPE321	Neural Network and Fuzzy logic/ Instrumentation and Control Engineering	3	0	0	3
4.	IV	PE	24EPE322	Introduction to Machine Learning	3	0	0	3
5.	V	PE	24EPE324	Advanced Wireless Communication	3	0	0	3
6.	VI	PE	23EPE421	Network Security	3	0	0	3
7.	VII	PE	24EPE423	Data Communication and Network	3	0	2	4
8.	VIII	PE	23EPE425	Internet of Things (IoT) and Applications	3	0	2	4
9.	IX	PE	23EPE427	Information Theory and Coding	3	0	0	3
10.	X	PE	23EPE429	Network Modelling using Reinforcement Learning	3	0	2	4

Note: Students may opt one course in 6th semester and one course in 7th 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	24EPE211	Circuit Analysis & Synthesis	3	0	0	3
2.	II	PE	24EPE212	Digital Signal Processing	3	0	0	3
3.	III	PE	24EPE311	Solid-State Device Modelling	3	0	0	3
			24EPE321	Neural Network and Fuzzy logic	3	0	0	3
			24EPE331	Instrumentation and Control Engineering	3	0	0	3
4.	IV	PE	23EPE312	Embedded System Design using Microcontrollers	3	0	0	3
			24EPE322	Introduction to Machine Learning	3	0	0	3
			23EPE332	Data Science	3	0	0	3
5.	V	PE	23EPE314	Mixed Signal System Design	3	0	0	3
			24EPE324	Advanced Wireless Communication	3	0	0	3
			23EPE334	AI and Expert Systems	3	0	0	3
6.	VI	PE	23EPE411	VLSI Fabrication Technology	3	0	0	3

			23EPE421	Network Security	3	0	0	3
			23EPE431	Deep Learning	3	0	0	3
7.	VII	PE	23EPE413	HDL Programming and System Design	3	0	2	4
			24EPE423	Data Communication and Network	3	0	2	4
8.	VIII	PE	23EPE415	ASIC and FPGA system design	3	0	2	4
			23EPE425	Internet of Things (IoT) and Applications	3	0	2	4
9.	IX	PE	23EPE417	VLSI Testing	3	0	0	3
			23EPE427	Information Theory and Coding	3	0	0	3
10.	X	PE	23EPE419	Low power VLSI Design	3	0	0	3
			23EPE429	Network Modelling using Reinforcement Learning	3	0	0	3

Note: Students may opt one course in 6th semester and one course in 7th 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	24EPE451	Embedded System Design Lab	0	0	2	1
II	P	24EPE453	ASIC and FPGA system design Lab	0	0	2	1
III	P	24EPE455	Data Communication Lab	0	0	2	1
IV	P	24EPE457	AI and Expert Systems Lab	0	0	2	1
V	P	24EPE459	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/24CS0201B/24CS0201C/24CS0201D	Data Structure and Algorithms using C or C++/Industry Automation Level-I/ Digital Marketing/Fundamentals of CAD for Engineers	0	0	2	1
SEC	24CS0202A/24CS0202B/24CS0202C	Introduction to SPSS Tool/Design Thinking and Augmented Virtual Reality/Programming Using Python for Engineers	0	0	2	1
SEC	24CS0301A/24CS0301B/24CS0301C/24CS0301D/24CS0301E	Wearable Technology/Big Data Analytics, Tools and Techniques/Machine Learning using Python/Industry Automation Level-II/RCC Structure Drawing Training	0	0	2	1
SEC	24CS0302A/24CS0302B/24CS0302C/24CS0302D	Artificial Intelligence and Machine Learning/MATLAB for Engineers/ Structural Analysis using FEM-based Tools/Data Analytics Tools	0	0	2	1
SEC	24CS0401A/24CS0401B/24CS0401C/24CS0401D	Building information modeling/PLC Programming/ 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	2	3
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

VALUE ADDED COURSES (VAC)

Total: 6 (2*3) Credits						
Code	**Category**	**Course**	**L**	**T**	**P**	**C**
23ESEB101/24ESEB201	(VAC)	Environment Bioengineering	2	0	0	2
23VAC101/24VAC201	(VAC)	Environment Protection and Sustainable Development	2	0	0	2
23VAC102/24VAC202	(VAC)	Indian Constitution and Polity	2	0	0	2
23VAC103	(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.						

NAAC ACCREDITED A+ GRADE

SRM UNIVERSITY DELHI-NCR, SONEPAT

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 (COMMON TO ALL BRANCHES EXCEPT BIO MEDICAL ENGINEERING)	
Course Code:24AS101	**Continuous Evaluation:** 40 Marks
Credits: 4	**End Semester Examination:** 60 Marks
L T P : 3 1 0	
Prerequisite:12^{th} Mathematics	

COURSE OBJECTIVES (COs)

1. To introduce the concept of Matrices and its applications
2. To introduce the concept of Differentiation-Ordinary & Partial differentiation and their applications.
3. To understand the calculation of Multiple Integrals with their Applications.
4. To get the knowledge that illustrate the concepts of Vector Calculus to understand solenoidal and irrotational vectors with inter dependence of line, surface and volume integral.
5. To familiarize with the concept of sequence & series and their convergence.

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 to compute inverse, eigenvalues and eigenvectors.
2. Apply the knowledge of differentiation, partial differentiation, Maxima and minima of two variables for analyzing engineering problems.
3. Apply the multiple integrals in engineering applications.
4. Understand differentiation and integration of vectors with knowledge of Green's, Gauss divergence and Stroke's theorems.
5. Demonstrate the convergence of sequence & series.

MAPPING BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

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

COURSE CONTENTS

Unit-1 : Matrices

Introduction, 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, Diagonalization of Matrices, Simple applications.

Unit – 2: Differentiation

Successive differentiation, nth order derivatives of standard functions, Leibnitz's theorem, 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.

Unit-3: Multiple Integral
Introduction, 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, Simple Applications of Multiple Integrals – Area (Cartesian Coordinates). Beta and Gamma functions and their properties.

Unit-4: Vector Calculus
Introduction, 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), Simple Applications.

Unit-5: Sequence and Series
Introduction, 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.

TEXT BOOKS/ REFERENCE BOOKS

1. Grewal B.S, Higher Engineering Mathematics, Khanna Publications, 44th Edition, 2017.
2. Jain R. K., Iyengar S. R. K., Advanced Engineering Mathematics, 6th Edition, Narosa Publishing House, 2019.
3. Kreyszig. E, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons. Singapore, 2015.
4. Bali N.P., Goyal M, Advanced Engineering Mathematics, Laxmi Publications, New Delhi, 2018.
5. Dass H. K., Advanced Engineering Mathematics, Sultan Chand Publication, Delhi, 2018.

Elementary Mathematics-I (For BME only)	
Course Code:24AS104	Continuous Evaluation: 40 Marks
Credits: 2	End Semester Examination:60 Marks
L T P : 2 0 0	
Prerequisite: Nil	

COURSE OBJECTIVES (COs)

1. To introduce the concept of Matrices and Determinants.
2. To introduce the concept of Differentiation.
3. To introduce the concept of Integration.
4. To get the knowledge that 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 computer science.
3. Apply the integrals in computer applications.
4. Understand the differential equations and their simple applications.

MAPPING BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CO \ CLO	CLO-01	CLO-02	CLO-03	CLO-04
CO-01	✓			
CO-02		✓		
CO-03			✓	
CO-04				✓

COURSE CONTENTS

Unit-1: Matrices and determinants **(6 Lectures)**

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,

Unit-2: Differential Calculus **(6 Lectures)**

Introduction, Continuity, Differentiability-Chain Rule, Derivatives of implicit functions, Derivatives of Trigonometric functions and Inverse trigonometric functions, Derivatives of Exponential and Logarithmic functions.

Unit-3: Integral Calculus **(6 Lectures)**

Introduction, Elementary Properties, Integration by method of Substitution, Integration using trigonometric identities, Integration by Partial fractions, Integration by parts.

Definite Integrals, Properties, Evaluation of definite Integrals.

Unit-4: Ordinary Differential Equations **(6 Lectures)**

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.

TEXT BOOKS/ REFERENCE BOOKS

1. Grewal B.S, Higher Engineering Mathematics, Khanna Publications, 44th Edition, 2017.
2. Jain R. K., Iyengar S. R. K., "Advanced Engineering Mathematics", 6th Edition, Narosa Publishing House, 2019.
3. Kreyszig. E, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons. Singapore, 2015.
4. Bali N.P., Goyal M, Advanced Engineering Mathematics, Laxmi Publications, New Delhi, 2018.
5. Dass H. K., Advanced Engineering Mathematics, Sultan Chand Publication, Delhi, 2018.

ELEMENTARY BIOLOGY (For BME only)	
Course Code: 24AS105	**Continuous Evaluation:** 40 Marks
Credits: 2	**End Semester Examination:** 60 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.

MAPPING MATRIX OF COURSE OBJECTIVES (CO) & COURSE LEARNING OUTCOMES (CLO)

COURSE OBJECTIVES	COURSE LEARNING OUTCOMES					
	CLO1	CLO2	CLO3	CLO4	CLO5	CLO6
CO1	✓					
CO2	✓	✓				
CO3		✓	✓			
CO4				✓	✓	
CO5				✓	✓	
CO6					✓	✓

COURSE CONTENTS:

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.

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.

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.

UNIT IV: PHYSIOLOGY
Animal Physiology: Hormones and their mode of action, types of asexual and sexual reproduction, stages of embryogenesis.

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

ENGINEERING PHYSICS	
Course Code: 24AS102/24AS202	**Continuous Evaluation:** 40 Marks
Credits: 4	**End Semester Examination:** 60 Marks
L T P : 3 1 0	
Prerequisite: Nil	

COURSE OBJECTIVES

1. To provide students with the knowledge of variety of important concepts of Physics and their applications in Engineering and Technology
2. To enhance the understanding of the concepts found in Mechanics, Harmonic Oscillations, wave Optics, Lasers, Fiber Optics.
3. To familiarize the quantum mechanical approach and its application in engineering.
4. To develop necessary understand on semiconductors and their applications in devices; Apply theory learnt to correlate with the environmental issues such as the use of solar cells

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. The student is expected to be familiar with broader areas of Physics such as mechanics of solids, optics, mechanical and electromagnetic waves oscillations and their relevance in Engineering.
2. An understanding of Physics also helps engineers understand the working and limitations of existing devices and techniques, which eventually leads to new innovations and improvements.
3. The student would be able to learn the fundamental concepts on Quantum behavior of matter in its micro state.
4. The course also helps the students to be exposed to the phenomena of electromagnetism and also to have exposure on semiconductor devices such as solar cell.

Mapping between Course Objectives and Course Learning Outcomes:

Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
CO1	x		x	
CO2	x	x		
CO3			x	
CO4				x

COURSE CONTENTS

Unit-1

WAVES AND OSCILLATIONS:

Oscillations: Simple Harmonic Motion (SHM), Differential Equation of SHM and its Solutions, Conservation of Energy. Mass-string System. Damped Harmonic Oscillator-Overdamped, Critically Damped, Under Damped motions, Relaxation Time, Forced vibrations. Resonance & Quality Factor.

Unit-2

OPTICS AND LASER:

Interference: Superposition Principle, Division of Amplitude-Interference in Thin Films, Application: Interference in Wedge shaped Film, Application: Newton's Ring.

Diffraction: Fraunhofer Vs Fresnel Diffractions, Fraunhofer Diffraction in Single & Multiple slits/Grating, Resolving power & Dispersive power of grating and prism.

Laser: Spontaneous and stimulated emission, Einstein's coefficients, Characteristics of laser, Ruby Laser**.**

Unit-3

ELECTROMAGNETIC THEORY AND FIBER OPTICS:

Mathematical Background: Gradient, Divergence, curl (Physical Significance), Irrotational & Solenoidal Field, Gauss Divergence and Stoke's Theorem, Maxwell's Equation in Integral & Differential forms. Wave equation for Electromagnetic (EM) Waves-Propagation in free space, Characteristic Impedance, Poynting theorem (only definition).

Fiber optics: Structure of optical Fiber, Principle of propagation and numerical aperture, acceptance angle and classification of optical fiber (single mode and multimode).

Unit-4

STATISTICAL MECHANICS AND QUANTUM MECHANICS:

Qualitative treatment of Maxwell-Boltzman, Fermi-Dirac and Bose-Einstein statistics**,** Black body problem, Photoelectric effect and Compton scattering (For concept), de Broglie Hypothesis of matter waves, de-Broglie waves-Phase & Group Velocities, Davison Germer experiment, Uncertainty Principle, Application of Uncertainty Principle, Significance of Wave Functions, Postulates of Quantum Mechanics**,** Schrodinger equation-Time dependent and time independent equation Application: Particle in a box (1-D).

Unit-5

OPTOELECTRONICS DEVICES

Fermi level in intrinsic and extrinsic semiconductors, effect of temperature and carrier concentration (qualitative), Direct and indirect bandgap semiconductor, LED, Photodiode, LDR, Semiconductor laser, Photo-Multiplier Tube, Hall Effect: Hall coefficient and its applications, Photovoltaic effect and Solar Cell.

TEXT BOOKS

1. Beiser A, Concepts of Modern Physics, 5th Ed., McGraw Hill International, 2003.
2. AjoyGhatak, Optics, 5th Ed., Tata McGraw Hill, 2012.
3. David J. Griffiths, Introduction to Electrodynamics, Pearson Education Limited, London, 2015.
4. Principles of Physics, 10ed, David Halliday, Robert Resnick Jearl Walker , Wiley
5. Electricity, Magnetism, and Light, Wayne M. Saslow, Academic Press
6. Engineering Mechanics (SIE), S. Timoshenko, D.H. Young, J.V. Rao, Sukumar Pati , McGraw Hill

REFERENCE BOOKS

1. Arumugam, M., Engineering Physics, 2^{nd} edition, Anuradha Publishers, Kumba Konam, 2003.
2. Gaur and Gupta, Engineering Physics, 7^{th} edition, Dhandapani and Sons, New Delhi, 1997.
3. N. Subrahmanyam and Brij Lal, Waves and Oscillations.
4. David J. Griffiths, , Introduction to Quantum Mechanics, Pearson Education Limited.

ENGINEERING CHEMISTRY	
Course Code: 24AS103 /24AS203	**Continuous Evaluation:** 40 Marks
Credits: 4	**End Semester Examination:** 60 Marks
L T P : 3 1 0	
Prerequisite: Nil	

COURSE OBJECTIVES (COs)

1. The knowledge of water quality parameters and the treatment of water.
2. Explain states of matter, phase diagram and related applications.
3. To learn various types of fuels and their properties, and to understand the basics of spectroscopy.
4. To understand the fundamental concepts of corrosion chemistry.
5. To learn an introductory idea about new materials.

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 to identify the quality of water and how to improve the quality of water.
2. Explain states of matter, phase diagram, related applications and polymers.
3. Analyze the quantitative aspects of fuel combustion, spectroscopy
4. Explain the mechanism of corrosion.
5. Get preliminary understanding on introductory idea about nano materials.

MAPPING BETWEEN COURSE OBJECTIVES AND COURSE LEARNING OUTCOMES:

COURSE LEARNING OUTCOME / COURSE OBJECTIVES	CLO 01	CLO 02	CLO 03	CLO 04	CLO 05
CO 01					
CO 02					
CO 03					
CO 04					
CO 05					

COURSE CONTENTS

Unit-0 : General Introduction: Importance and scope of Chemistry:
Atomic and molecular masses, mole concept and molar mass, percentage composition, redox reactions, Chemical and ionic equilibrium; Acid & bases.

Unit-1 : 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.

Unit-2: 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 component system-Eutectic, Pb-Ag system.
Polymer: Terminologies, Classification of polymer, Preparation of special polymer-Nylon 6, 6, Polyethylene, Polystyrene, Teflon, Polymethyl-methacrylate, Bakelite.

Unit-3 : **Fuels:**
Classification of fuels, calorific value. G.C.V. and N.C.V., Solid fuels, Analysis of coal. Liquid fuels: Classification of petroleum, refining of petroleum, Cracking, Knocking and anti-knocking, cetane and octane numbers.

UV Spectroscopy: Lambert Beer's Law, Principles and applications of UV-Visible Molecular Absorption Spectroscopy; Chromophores, effect of conjugation on chromophores.

Unit-4: 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.

Unit-5: New Materials:
Introduction to nanomaterials, 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.

TEXT BOOKS

1. Engineering Chemistry (NPTEL web-book) by B. L. Tembe, Kamaludddin and M. S. Krishan.
2. Fundamentals of Molecular Spectroscopy by Banwell, Tata McGraw Hill Education.
3. Textbook of nanoscience and Nanotechnology, McGraw Hill Education (India) Pvt. Ltd., 2012.
4. Engineering Chemistry by Jain and Jain, DhanpatRai Publication.
5. Engineering Chemistry by Prasanta Rath, Cenage Learning India Private Ltd., 2015.
6. A text book of Engineering Chemistry by Shashi Chawla, DhanpatRai& Co. 2020
7. Inorganic Chemistry by Donald A. Tarr, 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 Univesity Press, 6th edition.
2. Advanced Engineering Chemistry by M. R. Senapati, University Science Press, India.
3. A Text book of Engineering Chemistry by S.S. Dara, 10th Edition, S. Chand & Company Ltd., NewDelhi, 2003

BASIC ELECTRICAL ENGINEERING	
Course Code: 24EE101/24EE201	**Continuous Evaluation:** 40 Marks
Credits: 3	**End Semester Examination:** 60 Marks
L T P : 3 0 0	
Prerequisite: Nil	

COURSE OBJECTIVES (COs)

The objective of this Course is to provide the students with an introductory and broad treatment of the field of Electrical Engineering.

1. Students will gain knowledge regarding the various laws and principles associated with electrical systems.
2. Students will gain knowledge regarding electrical machines and apply them to practical problems.
3. Students will acquire knowledge in using the concepts in the field of electrical engineering.

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. To explain the strong basics of electrical engineering and practical implementation of electrical fundamentals.
2. To identify different applications of commonly used electrical machinery.
3. To define various renewable resources available in the power generation.
4. To understand the basic concept of a poly-phase system.

Mapping Matrix of Course Objectives (CO) and Course Learning Outcomes (CLO)

SEM	SUB CODE	Course Name	Course Objectives	CLO1	CLO2	CLO 3	CLO4
I/II	**24EE 101/201**	BASIC ELECTRICAL ENGINEERING	CO1	x			
			CO2			x	
			CO3		x	x	x

<u>**COURSE CONTENTS**</u>

Unit-1: DC CIRCUITS AND ELECTROMAGNETISM (8 Hrs.)

Ohm's Law and Kirchhoff's Laws, Analysis of Series, parallel, and series-parallel circuits excited by independent voltage sources, Thevenin's theorem, Norton's theorem, Superposition theorem, Maximum power transfer theorem. Faradays Laws, Lenz's Law, Fleming's Rules, Statically and dynamically induced EMF; Concepts of self-inductance, mutual inductance, and coefficient of coupling; Energy stored in magnetic fields

Unit-2: Single Phase A.C. Circuits:

Sinusoidal signal, instantaneous and peak values, RMS and average values, crest and peak factor, Concept of phase, representation-polar & rectangular, exponential and trigonometric forms, Analysis with phasor diagrams of R, L, C, RL, RC and RLC circuits; Real power, reactive power, apparent power and power factor, series, parallel and series-parallel circuits.

Unit-3: Transformers:
Principle of operation and construction of single-phase transformers (core and shell types). EMF equation, losses, efficiency, and voltage regulation.

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.

Unit-4: Three-Phase Induction Motors:

Concept of rotating magnetic field; Principle of operation, types and constructional features, Slip and its significance; Applications of squirrel cage and slip ring motors; Necessity of a starter, star-delta starter.

Unit-5: Renewable Sources:
Sources of Electrical Power, Introduction to Wind, Solar, Fuel cell, Tidal, Geothermal, Hydroelectric, Thermal-steam, diesel, gas, nuclear power plants; Concept of cogeneration, and distributed generation, Introduction to Earthing

TEXT BOOKS

1. Fundamental of Electric Circuits by Charles K Alexander and Matthew N. O.Sadiku, TMH Publication.
2. Electrical Engineering Fundamentals by Vincent Del Toro, PHI Publication.
3. Basic Electrical Engineering by V N Mittal & Arvind Mittal, TMH Publication.
4. Basic Electrical Technology by A.E. Fitzgerald, McGraw Hill Publication.

REFERENCE BOOKS

1. Kothari D P and Nagrath I J, “Basic Electrical Engineering “, Tata McGraw Hill, 1991

BASIC ELECTRONICS ENGINEERING	
Course Code: 24EC101/24EC201	**Continuous Evaluation:** 40 Marks
Credits: 3	**End Semester Examination:** 60 Marks
L T P : 3 0 0	
Prerequisite: Nil	

COURSE OBJECTIVES (COs)

1. To impart the knowledge of the passive and active electronic components
2. To understand the basic characteristics of Field Effect Transistors
3. To introduce the MOS devices
4. To gain knowledge of integrated circuit fabrication techniques
5. To introduce the digital logic gates and systems
6. To understand the principle of microprocessors

COURSE LEARNING OUTCOMES (CLOs)

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

1. To learn the fundamental concepts of semiconductor devices
2. An ability to apply the concept of diode in clipper and clamper circuits
3. Acquire the skills of constructing the different transistor configurations
4. To learn the basic concepts of integrated circuits
5. To Compile the different building blocks in digital electronics using logic gates and implement simple logic functions using basic universal gates
6. To acquire the knowledge of microprocessors.

Mapping Matrix of Course Objectives (CO) and Course Learning Outcomes (CLO)

SEM	SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5	CLO 6
I/II	24EC101/201	Basic Electronics Engineering	CO1	x	x				
			CO2		x	x			
			CO3			x	x		
			CO4			x	x		
			CO5					x	
			CO6						x

COURSE CONTENTS

Unit – 1: Semiconductor Diodes and Applications: p-n junction diode, Characteristics and Parameters, Half-wave rectifier, Full-wave rectifier, center tap and Bridge rectifier, and clipper, clamper, Zener diode voltage regulators: Regulator circuit with no load, Loaded Regulator and Numerical examples as applicable.

Unit –2: Bipolar Junction Transistor: Transistor Operation, Current Equation in n-p-n & amplifier; p-n-p transistors, CB, CE, CC Configurations and their Characteristics, Load line Analysis, BJT as Switch and amplifier, DC Biasing (Fixed bias and Voltage Divider), stability Factor.

Unit –3: Field Effect Transistor: JFET-types and their parameters, Operations, and their Characteristics, MOSFETs- types, Operations and their Characteristics, Secondary effects in MOSFET operation and Numerical.

Unit –4: Introduction to Operational Amplifiers: Ideal OPAMP, Inverting, and Non-Inverting OPAMP circuits, OPAMP applications: voltage follower, addition, subtraction, integration, differentiation; Numerical examples as applicable.

Unit –5: Digital Electronic Principles: Introduction, Binary digits, Logic levels and Digital waveforms, Introduction to basic Logic operation, Number system, Decimal numbers, Binary numbers, Decimal-to-Binary conversion, Simple binary arithmetic, Logic Gates, Boolean algebra and Combinational Logic Circuits: Boolean operations and expressions, Laws and Rules of Boolean algebra, DeMorgan's theorem, Boolean analysis of logic circuits, Standard forms of Boolean expressions, Boolean expression and truth table. Basic combinational logic circuits, Implementation of combinational logic, the universal properties of NAND and NOR gates, Half Adder adders, and full Adder.

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. Muthusubramanian.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

ENGINEERING MECHANICS	
Course Code: 23ME101/23ME201	**Continuous Evaluation:** 40 Marks
Credits: 3	**End Semester Examination:** 60 Marks
L T P : 3 0 0	
Prerequisite: Nil	

COURSE OBJECTIVES (COs)

1. To familiarize students with basic concepts of force and moments in equilibrium.
2. To impart students with the knowledge of mechanics for structural analysis.
3. To familiarize students with the centroids and MOI.
4. To make students aware of rigid body kinetics and kinematics.
5. To acquaint students with mechanics of deformable bodies.

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 concepts of force and moments in equilibrium.
2. Apply principles of mechanics to real engineering problems.
3. Understand the basics of Centroids and MOI.
4. Grasp the elements of rigid body kinematics and kinetics.
5. Understand the mechanics of deformable bodies.

Mapping Matrix of Course Objectives (CO) and Course Learning Outcomes (CLO)

SEM	SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
I/II	23ME101/201	ENGINEERING MECHANICS	CO1	x				
			CO2		x			
			CO3			x		
			CO4				x	
			CO5					x

COURSE CONTENTS

UNIT-I FORCE SYSTEMS:

• Basic concepts: Definitions, Basic assumptions, Scalar & Vector quantities, Free, Forced and fixed vectors.

• Force System: Force, Classification & Representation, Force as a Vector, Composition of forces, Parallelogram Law, Resolution, Principle of Transmissibility of forces

• Moment of a force, Vector representation, Moment for coplanar force system, Varignon’s theorem

• Couple, Vector representation, Resolution of a force into a force and a couple.

• Force Systems: Coplanar Concurrent Force system and Coplanar Non-Concurrent force systems, Resultant of coplanar force system.

• Equilibrium of coplanar force system, Free body diagrams, Determination of reactions, Equilibrium of a body under three forces, Lami’s theorem.

FRICTION:

• Introduction, Wet and Dry friction, Theory of Dry friction, Angle of friction, Angle of Repose, Cone of friction, Coulomb’s laws of friction.

UNIT –II: BASIC STRUCTURAL ANALYSIS

• Plane Truss, Difference between truss and frame, Perfect and imperfect truss, Assumptions and Analysis of Plane Truss, Method of joints, Method of section, Zero force members.

UNIT –III- CENTROID AND MOMENT OF INERTIA:

• Center of Gravity, Center of Mass and Centroid of curves, areas, volumes, Determination of centroid by integration, Centroid of composite bodies.

• Definition of Moment of inertia of area, Perpendicular axis theorem and Polar moment of Inertia, Parallel axis theorem, Moment of inertia of simple areas by integration, Moment of Inertia of Composite Areas.

• Moment of Inertia of masses, Parallel axis theorem for mass moment of inertia, Mass moment of inertia of simple bodies by integration, Mass moment of inertia of composite bodies.

UNIT –IV- KINEMATICS OF RIGID BODY:

• Introduction, Absolute motion, Plane rectilinear motion of rigid body, Plane curvilinear Motion of rigid body, x-y and n-t components, Rotation of rigid bodies, Relative Motion, Plane Motion of rigid bodies, Instantaneous center of zero velocity

UNIT- V - KINETICS OF RIGID BODY:

• Introduction, Force, Mass and Acceleration, Newton's law of motion, D'Alembert's Principles and Dynamic Equilibrium, Laws of motion applied to planar translation, rotation and plane motion.

• Work and Energy, Kinetic energy, Principle of work and energy, Conservative forces, Law of conservation of energy,

• Linear Impulse and Momentum, Conservation of linear momentum.

TEXT BOOKS

1. Engineering Mechanics : Statics and Dynamics", R. C. Hibbler, Pearson
2. Engineering Mechanics " , Thimoshenko & Young , 4ed, Tata McGraw Hill
3. Engineering Mechanics : Statics and Dynamics", Shames and Rao, Pearson
4. Engineering Mechanics " , Bhavikatti , New Age

FUNDAMENTALS OF COMPUTER & C PROGRAMMING	
Course Code: 23CS101/23CS201	**Continuous Evaluation:** 40 Marks
Credits: 3	**End Semester Examination:** 60 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 analyse 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's that help in developing of 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.

Mapping Matrix of Course Objectives (CO) and Course Learning Outcomes (CLO)

Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4	CLO5	CLO6
CO1	x	x				
CO2		x	x			
CO3			x	x		
CO4					x	
CO5						x

COURSE CONTENTS

UNIT-1: 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.

UNIT-2: 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.

UNIT-3 : BASICS OF ‘C’ LANGUAGE

C Fundamentals, Basic data types, variables and scope, operators and expressions, formatted input/ output, expressions, selection statements, loops and their applications.

UNIT-4: ARRAY & FUNCTION

Arrays, functions, recursive functions, pointers and arrays. Strings literals, arrays of strings; applications. Storage Classes and Pre-processor Directives.

UNIT-5 : STRUCTURE & FILE SYSTEM

Structures, Declaring a Structure, Accessing Structure Elements, Storing Structure elements, Array of Structures, Unions and Enumerations.

File Input/Output, Data 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, 2010, New Delhi.
4. Let Us C, Yashwant Kanetkar, 14th Edition, BPB Publications.
5. Computer Fundamentals and Programming in C, Reema Theraja, Oxford

REFERENCE BOOKS

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

COMMUNICATIVE ENGLISH	
Course Code: 24HS101/24HS201	**Continuous Evaluation:** 40 Marks
Credits: 2	**End Semester Examination:** 60 Marks
L T P : 2 0 0	
Prerequisite: Nil	

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 competence and boost their confidence.
3. To enable the students to properly communicate and express themselves in writing.
4. 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.
5. To study, understand and implement each unit according to National Education Policy 2020 and Bloom's Taxonomy.

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.

MAPPING MATRIX OF COURSE OBJECTIVES & COURSE LEARNING OUTCOMES

Course Objective	Course Learning Outcomes				
	CLO 1	**CLO 2**	**CLO 3**	**CLO 4**	**CLO 5**
CO 1	✓	✓	✓		
CO 2		✓		✓	
CO 3					
CO 4				✓	✓
CO 5					✓

COURE CONTENTS

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

Unit-II: Workplace Communication

- Communication Challenges in 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 Power Point Presentation.

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 with respect to technical writing

Unit-IV: Business Writing at Work

- Cover Letters and Applications
- Writing notices and circulars
- Email Writing and Memorandum
- Writing reports

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.

HINDI -I	
Course Code: 24HIN-101- I	**Continuous Evaluation:** 40 Marks
Credits: 2	**End Semester Examination:** 60 Marks
L T P : 2 0 0	
Prerequisite: Nil	

Course Description:

विश्वविद्यालय ने वर्ष 2024-25 सत्र से स्नातक स्तर पर हिन्दी विषय का पाठ्यक्रम तैयार किया है। हिन्दी विषय के प्रश्न पत्र की सामग्री में ज्ञान तथा शिक्षा के बदलते परिदृश्य को ध्यान में रखा गया है। | व्याकरण की विभिन्न कोटियों तथा भाषा के सम्प्रेषण से हिन्दी का प्रचार-प्रसार होगा। संचार कौशल के द्वारा छात्रों का ज्ञान परिमार्जित होगा। साहित्येतर छात्रों के ज्ञानवर्धनए भाषायी क्षमता एवम् अभिवृद्धि भी इस पाठ्यक्रम का लक्ष्य है।

(Course Content)

(Unit-A)
इस इकाई में हिंदी भाषा के बुनियादी पहलुओं को सम्मिलित किया गया हैं।

वर्ण , शब्द , पद और वाक्य

(Unit-B)

इस इकाई में हिंदी भाषा की व्याकरणिक कोटियों को सम्मिलित किया गया हैं।

संज्ञा, सर्वनाम, विशेषण, क्रिया और क्रिया विशेषण

(Unit-C)

इस इकाई में हिंदी भाषा की शब्द सम्पदा को सम्मिलित किया गया हैं।

पर्यायवाची शब्द, लिंग, वचन, वर्तनी और विलोम शब्द

(Unit-D)
यह इकाई संचार कौशल से सम्बन्धित है|

(i) हिंदी के प्रमुख मुहावरे और लोकोक्तियाँ

(ii) आत्म परिचय (self-introduction), साक्षात्कार कौशल (interview skills),

कार्यक्रम संचालन/मंच प्रबंधन (event management)

Course Outcomes:-
पाठ्यक्रम परिणाम
(1.Knowledge Outcome)
1 ज्ञान का परिणाम
(At the end of the course, the student should be able to)

पाठ्यक्रम के अंत में छात्र सक्षम होना चाहिए
-हिंदी भाषा के बुनियादी पहलुओं का ज्ञान होगा|
- शब्दों को लिखने,पढने और समझने में छात्र सक्षम होंगे|
.हिंदी व्याकरण के अध्ययन से छात्रों की शब्द सम्पदा बढेगी |
(2.Skill Outcome)
कौशल का परिणाम
(At the end of the course, the student should be able to)
पाठ्यक्रम के अंत में छात्र सक्षम होना चाहिए
.हिंदी भाषा का परिचय छात्र प्राप्त को प्राप्त होगा|
- छात्रों को हिंदी के अनेक शब्दों का ज्ञान होगा |
-व्याकरण के ज्ञान के साथ -साथ शब्दों के उच्चारण के बोध से भी छात्र अवगत होंगे।
(Methodology)
)पद्धति(
- कक्षा व्याख्यान
-व्याकरण के माध्यम से हिंदी शब्दों का उच्चारण व लेखन का अभ्यास किया जाएगा |
-समय-समय पर छात्रों को प्रदत्त कार्य दिया जाएगा |
-साप्ताहिक प्रश्नावली |
(Required Books and Materials)
आवश्यक पुस्तकें और सामग्री
-भाषा विज्ञान, डॉ. भोलानाथ तिवारी ,किताब महल इलाहाबाद |
-हिंदी व्याकरण, कामता प्रसाद गुरु, प्रभात प्रकाशन दिल्ली |

GERMAN-I	
Course Code: 24FLGR101- I	**Continuous Evaluation:** 40 Marks
Credits: 2	**End Semester Examination:** 60 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 develop an ability for discussions, debates, research ventures, etc. Overall, the objective is to facilitate comprehension of the legal concepts better and develop the ability to write effective propositionsin legal contexts.

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.

COURSE LEARNING OUTCOMES (CLOs):

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

1. Read and write short, simple texts.
2. Have Fluency in reading and writing.
3. Understand the dialogue between two native speakers and to take part in short, simple conversations using the skills acquired.
4. Know the culture of the countries where the German language is spoken.

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

COURSE OBJECTIVES	Course Learning Outcome			
	CLO 01	CLO 02	CLO 03	CLO 04
CO 01	✓			
CO02		✓	✓	
CO 03			✓	
CO 04				✓

COURSE CONTENTS

UNIT 1

- Information über Deutschland
- Buchstaben, Regeln der Aussprache, Wochentage, Monate
- Grüße, sich vorstellen, Einige nützliche Ausdrücke des Alltagslebens, Zahlen bis 100

UNIT 2

- Zahlen, Über Personen sprechen (Name, Herkunft, Adresse, Telefonnummer, Alter, Beruf, Familie)

- Länder und Städte, Sprachen, Berufe, Bezeichnungen für Personen, Familienmitglieder
- Personalpronomen, Konjugation von Verben (heißen, wohnen, kommen, machen,lernen, arbeiten, studieren, sein)

UNIT 3

- Nomen (Genus, Singular-Plural), Bestimmter Artikel, Unbestimmter Artikel, Negation, W-Frage, Ja-Nein-Frage
- Über Sachen sprechen
- Sachen des Alltagslebens, Haushaltswaren, Adjektive, Gegenteile
- Satz Struktur

UNIT 4

- Akkusativ, Artikel und Personalpronomen im Akkusativ, Verben und Präpositionen mit Akkusativ,Konjugation und Verwendung von Verben (haben, kaufen, sehen, lieben, lesen, kennen, hören, verstehen, usw.)
- Kleidung, Farben, Wetter, Lebensmittel

TEXT BOOKS:

- Netzwerk Neu A1 (Kursbuch+Arbeitsbuch)

Dengler, Stefanie, et al. Netzwerk neu: A1. Ernst Klett Sprachen., 2019.

REFERENCE BOOKS:

- Rusch, Paul, Helen Schmitz, and Humorvolle Zeichnungen. "Einfach Grammatik." *Übungsgrammatik Deutsch A1 bis B* 1 (2012): 329-330.Einfach Gramatik, Paul Rusch
- Carlson, Antje. "Lemcke, Christiane, Lutz Rohrmann, and Theo Scherling. Berliner Platz 1 Neu--German for Beginners." *Die Unterrichtspraxis/Teaching German* 44.1 (2011): 46-49.
- Dallapiazza, Rosa-Maria, Eduard Von Jan, and Sabine Dinsel. *Tangram: Deutsch als Fremdsprache. Lehrerbuch*. Vol. 1. Hueber Verlag, 1998.
- Wolfgang Hieber: Lernziel Deutsch, Teil 1,Max HueberVerlag, 1984.

WEBSITE PAGES:

- https://www.nthuleen.com/teach.html

FRENCH-I	
Course Code: 24FLFR101-I	**Continuous Evaluation:** 40 Marks
Credits: 2	**End Semester Examination:** 60 Marks
L T P : 2 0 0	
Prerequisite: Basics of English Language	

COURSE OBJECTIVE (COs)

1. To develop **listening, speaking, reading, and writing** requisites of a language.
2. To develop the ability **to construct sentences** and **frame questions**.
3. To equip the students with **cultural elements and communication strategies** that will help them **communicate in varied situations.**
4. To familiarize the students with the **French and Francophone culture.**

COURSE LEARNING OUTCOMES (CLOs)

1. After completion of this course, the student will be able **to express and interact in French** used in daily conversations.
2. The student will be able **to write short and simple texts.**
3. The student will be able to **initiate, understand and respond to the queries of cultural significance in various settings.**
4. The student can demonstrate **knowledge and understanding** of French and Francophone culture.

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

COURSE OBJECTIVES	Course Learning Outcome			
	CLO 01	CLO 02	CLO 03	CLO 04
CO 01	✓			
CO02		✓	✓	
CO 03			✓	
CO 04				✓

S. No	Unités	Objectifs de Communication	Grammaire	Lexique
1	**La Salutation et l'Introduction**	Saluer. Entrer en Contact. S'Excuser. Remercier. Se Présenter/Présenter Quelqu'un.	Les Pronoms Personnels Sujets. L'Alphabet. Les Articles Indéfinis. Les Verbes en -ER au Présent.	Salutations, Les Nombres. Les Objets de la Classe. La Nationalité.

2	**On Partage des Renseignements**	Demander de Se Présenter. Donner des Renseignements Personnels.	Etre et Avoir au Présent. Les Verbes en -ER au Présent. Les Adjectifs de Nationalités. L'Interrogation.	Les Adjectifs de Nationalité, Métiers et Secteurs Professionnels, L'Expression des Goûts et Intérêts
3	**Ma Ville et Mon Quartier**	Décrire et Qualifier une Ville ou un Quartier. Localiser. Demander et Donner la Directions.	Le Verbe Vivre. Les Articles Définis. Il y a/ Il n'y a pas. Les Prépositions. Les Adjectifs Qualificatifs. L'Impératif.	Les Prépositions de Localisation. Le Lexique des Sites. Etablissements et Service d'une Ville.
4	**Mes Intérêts et Goûts**	Parler de Ses Goûts et de Ses Loisirs. Donner Son Impression sur le Caractère de Quelqu'un.	Le Présent des Verbes en -ER, et du Verbe Faire. La Négation, Les Adjectifs Possessifs.	Avoir l'air. Loisirs. L'Expression des Goûts. Faire du/ de la. Ma Famille.

ENVIRONMENTAL BIOENGINEERING	
Course Code: 23ESEB101/23ESEB201	**Continuous Evaluation:** 40 Marks
Credits: 2	**End Semester Examination:** 60 Marks
L T P : 2 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.

MAPPING COURSE OBJECTIVES (COs) & COURSE LEARNING OUTCOMES (CLOs)

	COURSE LEARNING OUTCOMES (CLOs)			
COURSE OBJECTIVES (COs)	**CLO1**	**CLO2**	**CLO3**	**CLO4**
CO1	√			
CO2		√		
CO3			√	
CO4				√

COURSE CONTENTS

Unit-1: 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.

Unit-2: 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 gardening.

Unit-3: 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.

Unit 4: 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.

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 Erach Bharucha, 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.

INDIAN CONSTITUTION & POLITY	
Course Code: 23VAC102/23VAC202	**Continuous Evaluation:** 40 Marks
Credits: 2	**End Semester Examination:** 60 Marks
L T P : 2 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.

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

SEM	SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
I/II	23VAC102/202	INDIAN CONSTITUTION & POLITY	CO1	x	x	x	
			CO2		x		x
			CO3			x	x
			CO4				x

COURSE CONTENTS

UNIT 1 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

UNIT 2 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

UNIT 3 LOCAL GOVERNMENT AND ADMINISTRATION:

- Panchayati Raj System
- Rural and Urban administration
- Social and Economic Justice for the marginalized
- Directive Principles of State Policy

UNIT 4 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

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).

ENGINEERING PHYSICS LAB	
Course Code: 24AS152/24AS252	**Continuous Evaluation:** 60 Marks
Credits: 1	**End Semester Examination:** 40 Marks
L T P : 0 0 2	
Prerequisite: Nil	

COURSE OBJECTIVES

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. Apply the analytical techniques and graphical analysis to the experimental data

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. 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

MAPPING BETWEEN COURSE OBJECTIVES AND COURSE LEARNING OUTCOMES:

Course Objectives	CLO 1	CLO 2	CLO 3
CO1	x	x	
CO2		x	
CO3			x

LIST OF EXPERIMENTS

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

Experiment 1: To determine the moment of inertia of the disc and rigidity modulus of the wire by torsional pendulum.

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 the attenuation, numerical aperture and acceptance angle of the given optical fiber.

Experiment 5: To study the resonance characteristics of LCR series circuit.

Experiment 6: To determine Planck's constant.

Experiment 7: To study the I-V characteristics of a PN junction diode.

Experiment 8: To determine the energy band gap by four-probe method.

Experiment 9: To determine the Hall coefficient of the given n-type or p-type semiconductor.

Experiment 10: To study the solar cell characteristic.

Experiment 11: To determine the dispersive power of a given prism.

Experiment 12: To determine the width of a single slit by diffraction.

Experiment 13: To study the characteristic of LDR and finding the dark resistance.

Experiment 14: To determine the acceleration due to gravity by bar pendulum.

Experiment 15: To verify the laws of vibration of string using sonometer.

Experiment 16: To study the resonance characteristics of LCR parallel circuit

<u>TEXT BOOKS</u>

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.

<u>REFERENCE BOOKS</u>

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).

ENGINEERING CHEMISTRY LAB	
Course Code: 24AS153/24AS253	**Continuous Evaluation:** 60 Marks
Credits: 1	**End Semester Examination:** 40 Marks
L T P : 0 0 2	
Prerequisite: Nil	

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 KMnO4 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 amount of sodium hydroxide and sodium carbonate in a mixture.
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.

BASIC ELECTRICAL ENGINEERING LAB	
Course Code: 23EE151/23EE251	**Continuous Evaluation:** 60 Marks
Credits: 1	**End Semester Examination:** 40 Marks
L T P : 0 0 2	
Prerequisite: Nil	

COURSE OBJECTIVES (CO)

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 (CLO)

The syllabus has been prepared in alignment with National Education Policy (NEP). After completion of 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

Mapping Matrix of Course Objectives (CO) and Course Learning Outcomes (CLO)

SEM	SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
I/II	23EE151/251	Basic Electrical Engineering Lab	CO1	x	x		x
			CO2	x			x
			CO3	x	x	x	x

COURSE CONTENTS

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.

BASIC ELECTRONICS ENGINEERING LAB	
Course Code: 24EC151/24EC251	**Continuous Evaluation:** 60 Marks
Credits: 1	**End Semester Examination:** 40 Marks
L T P : 0 0 2	
Prerequisite: Nil	

COURSE OBJECTIVES (COs)

1. To study the different types of electronic components and equipment
2. To observe the characteristics of electronic devices
3. To acquire the basic knowledge of digital logic levels and application of knowledge

COURSE LEARNING OUTCOMES (CLOs)

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

1. Measure the voltage, frequency, and phase of any waveform using CRO.
2. Generate sine, square, and triangular waveforms with required frequency and amplitude using function generator.
3. Analyze the characteristics of different electronic devices such as diodes, transistors, and operational amplifiers
4. To develop skills to build and verify digital circuits.

Mapping Matrix of Course Objectives (CO) and Course Learning Outcomes (CLO)

SEM	SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
I/II	24EC151/251	Basic Electronics Engineering Lab	CO1	x	x		
			CO2			x	
			CO3				x

LIST OF EXPERIMENTS

1. (a). To study active and passive electronic components and function generators.
   (b). To study the Digital Cathode Ray Oscilloscope (CRO) and operation of multi-meters.
2. Study of the V-I characteristics of P-N junction diode & Calculate DC & AC resistance.
3. Study of the V-I characteristics of Zener diode.
4. Construction of half-wave rectifier (with & without filter) and calculation of efficiency and ripple factor.
5. Construction of full wave rectifier circuits (with & without filter) and calculation of efficiency and ripple factor.
6. Design of inverting amplifiers using Op-Amp for a given gain with the help of a breadboard and distinct components.
7. Design of non-inverting amplifiers using Op-Amp for a given gain with the help of breadboard

and distinct components.

8. Design of summer amplifiers using Op-Amp for a given gain with the help of a breadboard and distinct components.

9. Study of the input and output characteristics of Transistor.

10. Study and realization of digital logic gates with truth table verification

TEXT BOOKS

1. “Electronics Lab Manual”, K.A. Navas ,Volume 1, Fifth Edition. 2015 by PHI Learning Private Limited, Delhi.

REFERENCE BOOKS

1. Electronic Devices and Circuit Theory - by Rober L. Boylestad 11th Edition, Pearson Publication, 2014
2. Millman J., Halkias C.C., Jit S., “Electronic Devices and Circuits”, Tata McGraw-Hill, 2nd 2007 Edition

BASIC MECHANICAL ENGINEERING LAB	
Course Code: 23ME151/23ME251	**Continuous Evaluation:** 60 Marks
Credits: 1	**End Semester Examination:** 40 Marks
L T P : 0 0 2	
Prerequisite: Nil	

COURSE OBJECTIVES (COs)

1. To acquaint students with the laws of parallelogram and equilibrium of forces acting on anobject.
2. To make students understand the concepts and principles of friction.
3. To apply engineering sciences through learning-by-doing project work.
4. To provide a framework to encourage creativity and innovation. To develop team work and communication skills through group-based activity.

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 demonstrate:

1. The principle of equilibrium of forces and parallelogram.
2. The effects of friction on the motion.
3. The working and application of engineering components.
4. Develop group working, including task sub-division and integration of individual contributions from the team.

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

COURSE OBJECTIVES	COURSE LEARNING OUTCOMES			
	CLO1	CLO2	CLO3	CLO4
CO1			✓	
CO2	✓			
CO3				✓
CO4		✓		

LIST OF EXPERIMENTS

1. To verify the law of parallelogram of forces.
2. To study the equilibrium of a body under three forces.
3. To find reaction at the supports of a simply supported beam with different types of loading using Computation method.
4. To determine the co-efficient of friction between wood and various surface (like Leather, Wood, Aluminum) on an inclined plane.
5. To study functioning of belt pulley systems.
6. To find the coefficient of friction between belt and pulley using belt pulley system.
7. To find forces in members of a truss for different load conditions.

8. To determine the mass moment of inertia of a rotating disc
9. To find center of gravity of different geometrical objects using computation method.
10. To verify the law of conservation of energy.
11. Demonstration for centrifugal forces.
12. Engineering Design Project- Students in groups of 4/5 will do a project related to the course.

Note: At least ***8 experiments*** must be carried out.

TEXT BOOKS

1. Laboratory Manual

REFERENCE BOOKS

1. Strength of Materials. Thimoshenko & Young
2. Engineering Mechanics: Statics and Dynamics, R. C. Hibbler, Pearson
3. Mechanics of Solids, A. Mubeen, Pearson

C PROGRAMMING LAB	
Course Code: 23CS151/23CS251	**Continuous Evaluation:** 60 Marks
Credits: 1	**End Semester Examination:** 40 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 real world.
5. Employ good programming practices such as incremental development, data integrity checking and adherence to style guidelines.

Mapping Matrix of Course Objectives (CO) and Course Learning Outcomes (CLO)

SEM	SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
I/II	23CS151/ 251	C Programming Lab	CO1	x				
			CO2		x	x		
			CO3				x	
			CO4					x

<u>LIST OF EXPERIMENTS</u>

1. Write a program to find the largest of three numbers. (if-then-else)
2. Write a program to find the largest number out of ten numbers (for-statement)
3. Write a program to find the average mail height & average female heights in the class (input is in form of sex code, height).
4. Write a program to find roots of quadratic equation using functions and switch statements.
5. Write a program using arrays to find the largest and second largest no. out of given 50 nos.
6. Write a program to multiply two matrices.
7. Write a program to sort numbers using the sorting Algorithm.
8. Represent a deck of playing cards using arrays.
9. Write a program to check that the input string is a palindrome or not.
10. Write a program to read a string and write it in reverse order.

11. Write a program to concatenate two strings.
12. Write a program which manipulates structures (write, read, and update records).
13. Write a program which creates a file and writes into it supplied input.

Write a program which manipulates structures into files (write, read, and update records).
Note: At least 5 to 10 more exercises to be given by the teacher concerned.

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, 2010, New Delhi.

REFERENCE BOOKS

1. Let Us C, Yashwant Kanetkar, 14th 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.

MECHANICAL WORKSHOP LAB	
Course Code: 24ME152/24ME252	**Continuous Evaluation:** 60 Marks
Credits: 1	**End Semester Examination:** 40 Marks
L T P : 0 0 2	
Prerequisite: Nil	

COURSE OBJECTIVES (COs)

1. Study and practice on machine tools and their operations.
2. Practice on manufacturing of components using workshop trades includingfitting,
3. To study basics of carpentry, foundry and welding.
4. Identify and apply suitable tools for machining processes including turning, facing.

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 different manufacturing (Fitting, carpentry, sheet metal, welding, smithy working etc.) processes required to manufacture a product from the raw materials.
2. Use different measuring, marking, cutting tools used in the workshop.
3. Be aware of the safety precautions while working in the workshop.

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

COURSE OBJECTIVES	COURSE LEARNING OUTCOMES		
	CLO1	CLO2	CLO3
CO1	✓	✓	✓
CO2	✓	✓	✓
CO3	✓	✓	
CO4			✓

LIST OF EXPERIMENTS

Fitting Practice:

Use of hand tools in fitting, preparing a male and female joint of M.S. or making a paperweight of M.S.

Carpentry Practice:

Study of Carpentry Tools, Equipment and different joints.

Practice of Cross Half lap joint, Half lap Dovetail joint and Mortise Tenon Joint

Smithy

Tools and Equipments –Simple exercises base on smithy operations such as upsetting, drawing down, punching, bending, fullering & swaging, Making simple parts like hexagonal headed bolt, chisel

Welding Practice (Basic Theory to be explained prior topractice):

Gas Welding& Electric Arc welding Practice.

A joint such as a Lap joint, a T-joint or a Butt joint is to be prepared or to make furniture.

Machining (Basic Theory to be explained prior to practice):
(i) Stepped cylindrical Turning of a job and Thread-cutting in lathe. (ii) Shaping (iii) Milling

TEXT BOOKS

1. Laboratory Manual
2. Gopal, T.V., Kumar, T., and Murali, G., “A first course on workshop practice –Theory, practice and workbook”, Suma Publications, 2005

REFERENCE BOOKS

1. Kannaiah,P. & Narayanan,K.C. ―Manual on Workshop Practice”, Scitech Publications, Chennai, 1999.
2. Venkatachalapathy, V.S. ―First year Engineering Workshop Practice”, Ramalinga Publications, Madurai, 1999

ENGINEERING GRAPHICS & DESIGN LAB	
Course Code: 24ME153/24ME253	**Continuous Evaluation:** 60 Marks
Credits: 1	**End Semester Examination:** 40 Marks
L T P : 0 0 2	
Prerequisite: Nil	

COURSE OBJECTIVES (COs)

1. Draw orthographic projections of lines, planes and solids.
2. Construct isometric scale, isometric projections and views.
3. Draw sections of solids including cylinders, cones, prisms and pyramids.
4. 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 AutoCAD.
2. Imagine and convert isometric view into orthographic projections and vice versa.
3. Should be able to understand the simple machine components and draw its projections
4. Familiarize with projections of lines, planes, solids, isometric projections.

Mapping Matrix of Course Objectives (CO) and Course Learning Outcomes (CLO)

SEM	SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO4
I/II	23ME153/252	Engineering Graphics & Design Lab	CO1	x			
			CO2		x		
			CO3			x	
			CO4				x

COURSE CONTENTS:

S.No	LIST OF EXPERIMENTS
1	**Introduction**: **Auto CAD** Drawing Instruments and their uses, BIS conventions, Lettering, Dimensioning Line Conventions layout of the software, standard tool bar/menus and description of most commonly used toolbars, navigational tools. Co-ordinate system and reference planes. Definitions of HP, VP, RPP &LPP. Creation of 2D/3D environment. Selection of drawing size and scale. Commands and creation of Lines, Coordinate points, axes, poly lines, square, rectangle, polygons, splines, circles, ellipse, text, move, copy, off-set, mirror,rotate, trim, extend, break, chamfer, fillet, curves, constraints. 2 – Sheets
2	**Orthographic Projections:** Introduction, Definitions - Planes of projection, reference line and conventions employed, Projections of points in all the four quadrants, Projections of straight lines (located in First quadrant/first angle only), True and apparent lengths, True and apparent inclinations to reference planes.2 – Sheets

3	**Orthographic Projections of Plane Surfaces (First Angle Projection Only):** Introduction,Definitions–projections of plane surfaces–triangle, square, rectangle, rhombus, pentagon, hexagon and circle, planes in different positions by change of position method, **only 1-Sheet**
4	**Projections of Solids (First Angle Projection Only):** Introduction, Definitions – Projections of right regular tetrahedron, hexahedron (cube),prisms, pyramids, cylinders and cones in different positions. 2-Sheets
5	**Sections and Development of Lateral Surfaces of Solids** Introduction, Section planes, Sections, Section views, Sectional views, Apparent shapes and True shapes of Sections of right regular prisms, pyramids, cylinders and cones resting with base on HP. 2 – Sheet
6	**Isometric Projection (Using Isometric Scale Only):** Introduction, Isometric scale, Isometric projection of simple plane figures, Isometricprojection of tetrahedron, hexahedron(cube), right regular prisms, pyramids, cylinders, cones, spheres, cut spheres. 2-Sheets

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. Gopalakrishna, Subash Publishers Bangalore.
2. Graphics for Design and Production-Luzadder Warren J., Duff John M., EasternEconomy Edition, Prentice-Hall of India Pvt. Ltd., New Delhi.
3. Computer Aided Engineering drawing, Prof. M. H. Annaiah, New Age InternationalPublisher, New Delhi

REFERENCE BOOKS

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

COMMUNICATIVE ENGLISH LAB	
Course Code: 24HS151/24HS251	**Continuous Evaluation:** 60 Marks
Credits: 1	**End Semester Examination:** 40 Marks
L T P : 0 0 2	
Prerequisite: Nil	

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. 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.

MAPPING MATRIX OF COURSE OBJECTIVES & COURSE LEARNING OUTCOMES

Course Objective	Course Learning outcomes				
	CLO 1	**CLO 2**	**CLO 3**	**CLO 4**	**CLO 5**
CO 1	✓	✓	✓		
CO 2		✓		✓	
CO 3			✓	✓	
CO 4				✓	
CO 5					✓

COURSE CONTENTS

Unit-1

- Listening and Speaking
- Practicing Sounds of English
- Accent in speech (British and American)

Unit-2

- Role-play
- Extempore
- Public Speaking and Rhetoric

Unit-3

- Presentations
- Interview Simulations
- Group Discussions and Debates

Unit-4

- Guided composition
- Free-writing
- Reading comprehension practice: Technical and General text

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,
2. Oxford University Press.
3. Communication skill by Sanjay Kumar & Puspa Lata, Oxford University Press. 2nd Edition.
4. Business Communication Today by Courtland L Bovee and Thill, Pearson

SEMESTER II

ENGINEERING MATHEMATICS-II (COMMON TO ALL BRANCHES EXCEPT BIO MEDICAL ENGINEERING)	
Course Code: 24AS201	**Continuous Evaluation:** 40 Marks
Credits: 4	**End Semester Examination:** 60 Marks
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 familiarise the students for the Special function-Series Solutions, Bessel's & Legendre's Differential Equations and their properties.
3. To describe Laplace and inverse Laplace transforms with their properties.
4. To understand Analytic functions, Construction of Analytic Functions and Conformal Mapping.
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. Demonstrate various physical models through higher order differential equation and solve such linear ordinary differential equation.
2. Obtain series solution of differential equation and explain applications of Bessel's and Legendre's Differential Equations.
3. Apply Laplace transforms to find the solution of initial value and boundary value problems.
4. Demonstrate the concept of Analytic functions & its constructions, Conformal Mapping
5. Evaluate Complex Integration, Taylor's and Laurent's Expansion, Singularities and Residues.

MAPPING BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

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

COURSE CONTENTS

Unit-1: Linear Differential Equations

Linear differential equation with constant Coefficient , Complimentary Functions, Particular Integrals, Euler – Cauchy differential equations, Second order linear differential equations –One part of CF is known, Reduction to Normal form, Variation of Parameters & Method of undetermined coefficient.

Unit-2: Series Solutions

Power series method, validity of series method, Frobenius Method. Bessel’s Equation, Bessel’s function, Generating Function, Recurrence Relations, Orthogonal properties of Bessel’s functions, Transformation of Bessel’s Equation., Legendre’s Equation, Legendre Polynomials, Generating Function, Recurrence Relations, Rodrigue’s formula, Orthogonal properties of Legendre’s polynomials.

Unit-3: Laplace Transforms

Laplace Transforms, Existence theorem, Standard Properties, Laplace transforms of Derivatives and Integrals, Unit Step Function, Laplace Transform of Periodic functions, Inverse Laplace Transforms, Convolution theorem, Simple Applications of Laplace transforms for solving IVP.

Unit-4: Complex Variable - I

Introduction, Limit, continuity, Differentiability and Analyticity of functions, Cauchy-Riemann Equations (Cartesian and polar), Harmonic functions, Construction of Analytic Function, Determination of Harmonic conjugate, Milne-Thomson's method.

Unit-5: Complex Variable - II

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 and Simple Applications.

TEXT BOOKS/REFERENCE BOOKS

1. Grewal B.S, Higher Engineering Mathematics, Khanna Publications, 44th Edition, 2017
2. J.W. Brown and R.V. Churchill, Complex Variables and Applications, McGraw Hill, 9th edition, 2013.
3. E. Kreyszig, Advanced Engineering Mathematics, Wiley-India, 10th Edition, 2017
4. Kandasamy P et al. Engineering Mathematics, S. Chand & Co., New Delhi, revised edition.
5. Dass H. K., Advanced engineering Mathematics, Sultan Chand Publication, Delhi, 2013.

ELEMENTARY MATHEMATICS-II (For BME only)	
Course Code:24AS204	**Continuous Evaluation:** 40 Marks
Credits: 4	**End Semester Examination:** 60 Marks
L T P : 3 1 0	
Prerequisite: Elementary Mathematics-I	

COURSE OBJECTIVES (COs)

1. To introduce the concept of Differentiation of several variables.
2. To introduce the concept of Vector Calculus, Gradient, Divergence and Curl.
3. To introduce the concept of Second order differential equations and their applications.
4. To get the knowledge that illustrate the complex numbers.
5. To familiarize with the concept of complex variables.

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 differentiation of several variables.
2. Apply the knowledge of vector calculus in real life applications.
3. Apply the knowledge of Second order differential equations in solving simple problems.
4. Understand the complex number system and their uses.
5. Apply the knowledge to construct analytic functions.

MAPPING BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CO \ CLO	CLO-01	CLO-02	CLO-03	CLO-04	CLO-05
CO-01	✓				
CO-02		✓			
CO-03			✓		
CO-04				✓	
CO-05					✓

COURSE CONTENTS

Unit-1: Complex Numbers
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.

Unit-2: Successive Differentiation
Successive differentiation, n^{th} order derivatives of standard functions, Leibnitz theorem (without proof).

Unit-3: Differential Calculus of Several Variables
Introduction, Limit & Continuity, Partial derivatives, Homogeneous functions and Euler's theorem, Total derivatives, Jacobians, Properties of Jacobians.

Unit-4: Vector Calculus
Introduction, Scalar and vector point functions, differentiation formulae, Level surface, Gradient, Divergence, Curl, Directional derivatives, Simple Applications.

Unit-5: Linear Differential Equations
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.

TEXT BOOKS/ REFERENCE BOOKS

1. Grewal B.S, Higher Engineering Mathematics, Khanna Publications, 44th Edition, 2017.
2. Jain R. K., Iyengar S. R. K., "Advanced Engineering Mathematics", 6th Edition, Narosa Publishing House, 2019.
3. Bali N.P., Goyal M, Advanced Engineering Mathematics, Laxmi Publications, New, Delhi.2018.
4. Dass H. K., Advanced Engineering Mathematics, Sultan Chand Publication, Delhi, 2018.

HINDI-II	
Course Code:24HIN201-II	**Continuous Evaluation:** 40 Marks
Credits: 2	**End Semester Examination:** 60 Marks
L T P : 2 0 0	
Prerequisite: Nil	

Course Description:

विश्वविद्यालय ने वर्ष 2024-25 सत्र से स्नातक स्तर पर हिंदी विषय का पाठ्यक्रम तैयार किया है | हिंदी विषय के प्रश्न पत्र की सामग्री निर्धारण में ज्ञान तथा शिक्षा के बदलते परिप्रेक्ष्य को ध्यान में रखा गया है| इस सत्र में हिंदी लघु कथाओं को सम्मिलित किया गया है| छात्रों की मौखिक अभिव्यक्ति की क्षमता का विकास करने में निहित मूल्यों का महत्वपूर्ण योगदान होता है , इससे विद्यार्थियों की कल्पना शक्ति के विकास के साथ-साथ मनोरंजन भी होता है| संचार कौशल में मुहावरे, लोकोक्तियां, पत्र लेखन और अपठित गद्यांश की समझ के द्वारा हिंदी का प्रचार-प्रसार होगा| इस प्रकार साहित्य के ज्ञान की अभिवृद्धि वैश्वीकरण के संदर्भ में प्रासंगिकता और उपयोगिकता सिध्द करती है |

Course Content

सेमेस्टर 2: सुनना, पढ़ना और वाचन

इकाई 1: हिंदी सीखने की मूल बातें

• परिचय और दायरा
मात्रा और वर्णमाला
भाषण के अंग
व्याकरण

इकाई 2: कथन और आवाज़

प्रत्यक्ष-अप्रत्यक्ष, सक्रिय-निष्क्रिय
मुहावरे और वाक्यांश, भाषण के अलंकार
उपमा-रूपक

इकाई 3: हिंदी में आम गलतियाँ

- अपनी भाषा को स्वाभाविक कैसे बनाएँ
- कोलोकेशन
- वाक्यांश क्रियाएँ
- सामान्य त्रुटियाँ। व्याकरण और वाक्यविन्यास

इकाई 4: • लेखन कौशल

• विराम चिह्न

- सही विराम चिह्नों का महत्व विराम चिह्न
- पैराग्राफ़ के तत्व और पैराग्राफ़-लेखन अभ्यास
- रचना

GERMAN-II	
Course Code: 24FLGR201- II	**Continuous Evaluation:** 40 Marks
Credits: 2	**End Semester Examination:** 60 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 courseintends to develop an ability for discussions, debates, research ventures, etc. Overall, the objective is to facilitate comprehension of the legal concepts better and develop the ability to write effective propositionsin legal contexts.

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.

COURSE LEARNING OUTCOMES (CLOs):

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

1. Read and write short, simple texts.
2. Have Fluency in reading and writing.
3. Understand the dialogue between two native speakers and to take part in short, simple conversations using the skills acquired.
4. Know the culture of the countries where the German language is spoken.

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

COURSE OBJECTIVES	Course Learning Outcome			
	CLO 01	CLO 02	CLO 03	CLO 04
CO 01	✓			
CO02		✓	✓	
CO 03			✓	
CO 04				✓

COURSE CONTENTS

UNIT- 1

- Zeit-Ausdrücke, Tagesteile, Uhrzeit
- Präpositionen mit Akkusativ/Dativ, Ordinalzahlen
- Wegbeschreibung, Reisen, Verkehrsmittel
- Das Haus

UNIT- 2

- Modalverben
- Essen und Trinken, Mahlzeiten, Tagesablauf, Messeinheiten, Einkaufen
- Körperteile und Krankheiten
- Futur

UNIT- 3

- Dativ, Artikel und Personalpronomen im Dativ, Verben und Präpositionen mit Dativ, Konjugation und Verwendung von Verben (geben, kaufen, schenken, gratulieren, gehören, gefallen, gehen, fahren, fliegen, usw.)
- Possessiv-Artikel
- Trennbare Verben, Untrennbare Verben

UNIT 4

- Perfekt
- E- Mail Schreiben/ SMS Schreiben
- Vergangenheit erzählen, Das Wochenende, Lebenslauf

TEXT BOOKS :

- Netzwerk Neu A1 (Kursbuch+Arbeitsbuch)
  Dengler, Stefanie, et al. Netzwerk neu: A1. Ernst Klett Sprachen., 2019.

REFERENCE BOOKS:

- Rusch, Paul, Helen Schmitz, and Humorvolle Zeichnungen. "Einfach Grammatik." Übungsgrammatik Deutsch A1 bis B 1 (2012): 329-330.Einfach Gramatik, Paul Rusch
- Carlson, Antje. "Lemcke, Christiane, Lutz Rohrmann, and Theo Scherling. Berliner Platz 1 Neu--German for Beginners." Die Unterrichtspraxis/Teaching German 44.1 (2011): 46-49.
- Dallapiazza, Rosa-Maria, Eduard Von Jan, and Sabine Dinsel. Tangram: Deutsch als Fremdsprache. Lehrerbuch. Vol. 1. Hueber Verlag, 1998.
- Wolfgang Hieber: Lernziel Deutsch, Teil 1,Max HueberVerlag, 1984.

WEBSITE PAGES:

- https://www.nthuleen.com/teach.html

FRENCH-II	
Course Code: 24FLFR201-II	**Continuous Evaluation:** 40 Marks
Credits: 2	**End Semester Examination:** 60 Marks
L T P : 2 0 0	
Prerequisite: French-I	

COURSE OBJECTIVE (COs)

1. To develop **listening, speaking, reading and writing** requisites of a language.
2. To develop the ability **to construct sentences** and **frame questions**.
3. To equip the students with **cultural elements and communication strategies** which will help them **communicate in varied situations.**
4. To familiarise the students with the **French and Francophone culture.**

COURSE LEARNING OUTCOMES (CLOs)

1. After completion of this course, the student will be able **to express and interact in French** used in daily conversations.
2. The student will be able **to write short and simple texts.**
3. The student will be able to **initiate, understand and respond to the queries of cultural significance in various settings.**
4. The student can demonstrate **knowledge and understanding** of French and Francophone culture.

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

COURSE OBJECTIVES	Course Learning Outcome			
	CLO 01	CLO 02	CLO 03	CLO 04
CO 01	✓			
CO02		✓	✓	
CO 03			✓	
CO 04				✓

COURSE CONTENT

S. No	Unités	Objectifs de Communication	Grammaire	Lexique
1	**Journée Typique**	Parler de Nos Habitudes, Exprimer l'Heure, S'Informer sur l'Heure, le Moment et la Fréquence.	Les Verbes Pronominaux au Présent. Les Verbes Aller et Sortir	L'Heure, Les Moments de la Journée. Les Activités Quotidiennes. Les Adverbs. La Météo.
2	**Achats**	S'informer sur un Produit. Acheter et Vendre un Produit. Donner Son Avis. Parler du Temps qu'il Fait	Les Adjectifs Interrogatifs. Les Adjectifs Démonstratifs. Le Genre et le Nombre. Le Verbe Prendre.	Les Vêtements. Les Couleurs. Les Fruits et Les Légumes.
3	**Alimentation**	Parler des Plats et des Aliments. Commander un Menu dans un Restaurant. Situer une Action dans le Futur	Le Future Proche: Aller +Infinitif. Les Partitifs. Les Pronoms COD. Le Future.	Les Aliments. Le Lexique des Quantités.
4	**expérience vécue**	Parler de faits passés. Parler de Nos expériences. Parler de ce que nous savons faire.	Le Passé Composé. L'Imparfait.	Les Verbes Savoir, Pouvoir et Connaître. Les Adjectifs Qualificatifs. Le Lexique des Savoirs et Compétences. Le Récit de Vie.

TEXT BOOK

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

REFERENCE BOOKS

- Alter Ego 1, Livre d'élève, Berthet A. & Hugo C. & Kizirian M. V. & Sampsonis B. & Waendendries M., éd Hachette, Paris, 2006.

- Connexions 1, Loiseau Y. & Mérieux R., éd. Didier, Paris, 2004.
- Le Nouveau Sans Frontiers, Vol. 1, P. Dominique, J. Girardet et al, CLE International, Paris, 2013.
- Le Robert & Nathan Conjugation, Paperback, Le Robert Nathan, 2011.

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	**Fourier series** 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	9
UNIT-II	**Partial Differential Equations** 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.	9
UNIT-III	**Applications of Partial Differential Equations** Classification of Partial Differential Equations, Method of Separation of Variables, Solution of One Dimensional Wave Equation, Solution of One Dimensional Heat Equation.	9
UNIT-IV	**Fourier Transforms** 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.	9
UNIT-V	**Z – Transform** 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.	9

TEXT BOOKS/REFERENCE BOOKS

1. Grewal B.S., Higher Engineering Mathematics, 44th Edition, Khanna Publishers, 2019
2. Raisinghania, M.D., Advanced Differential Equations, S. Chand Publishing, 2018
3. Ramana B.V., Higher Engineering Mathematics, TMH, New Delhi, 11th reprint, 2010.
4. Churchill, R.V. and Brown, J.: Fourier series and Boundary Value Problems, McGraw-Hill Book Company 8th Edition-2017.
5. Kreyszig, E., Advanced Engineering Mathematics, Wiley-India, 10th Edition, 2017.

FUNDAMENTALS OF ELECTRONIC DEVICES	
Course Code:23EC201	Continuous Evaluation: 40 Marks
Credits: 3	End Semester Examination:60 Marks
L T P : 3 1 0	
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 BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLOs / COs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

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** **Field Effect transistors:** Transistor Operation – The junction FET, construction, operation and V-I characteristics, FET parameters, application of FET and voltage variable resistor.	9
UNIT-V	**Metal-Oxide-Semiconductor Field Effect transistors (MOSFET):** Dynamic Effects in MOS Capacitors, construction and working of n-channel and p-channel MOSFET, V-I Characteristics-Linear and saturation region, secondary effects in MOSFETs. Practical application of MOSFET in real scenario and validation using simulation/physical setup.	9

TEXT BOOKS/REFERENCE BOOKS

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

DIGITAL SYSTEMS	
Course Code: 24EC203	Continuous Evaluation: 40 Marks
Credits: 3	End Semester Examination:60 Marks
L T P : 3 0 0	
Prerequisite:	

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 BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLOs / COs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

COURSE CONTENTS

UNIT	CONTENTS	HOURS
UNIT-I	**DIGITAL INTEGRATED CIRCUITS AND PROGRAMMABLE LOGIC** Introduction – Special Characteristics – Bipolar-Transistor Characteristics – Fan Out, Fan in, Noise Margin; RTL and DTL Circuits – TTL – ECL - MOS – CMOS – CMOS Transmission Gate Circuits.	9
UNIT-II	**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-III	**GATE LEVEL MINIMIZATION & COMBINATIONAL LOGIC** Two level implementation – NAND & NOR Implementations – EXOR Functions. Combinational Circuits – Analysis and design procedure – Binary adder - Subtractor – Decimal Adder – Binary Multiplier – Magnitude Comparator – Multiplexers, Demultiplexer, Decoders – Encoders.	9
UNIT-IV	**SYNCHRONOUS SEQUENTIAL LOGIC** Sequential circuits - Latches – Flip-Flops - Analysis of Clocked Sequential Circuits – State Reduction and Assignment – Design Procedure. Registers – Shift Registers – Ripple counters – Synchronous Counters – Other counters: Johnson & Ring Counter.	9
UNIT-V	**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. Memory – Introduction –classification, initialization, Random-Access Memory – Memory Decoding – Read-only memory, Programmable Logic Array – Programmable Array Logic - Sequential Programmable Devices.	9

TEXT BOOKS/REFERENCE 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.
4. D. P. Kothari and J. S Dhillon, —Digital Circuits and Design, Pearson, 2016,
5. Morris Mano, —Digital Design, Prentice Hall of India, Third Edition.
6. K. A. Navas, —Electronics Lab Manual, Volume I, PHI, 5th Edition, 2015.

SIGNALS AND SYSTEMS	
Course Code: 24EC205	Continuous Evaluation: 40 Marks
Credits: 3	End Semester Examination:60 Marks
L T P : 3 0 0	
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 BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLOs / COs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					

					✓

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 – Properties of Continuous time Fourier series – Parseval's relation –Frequency spectrum – Power density spectrum –Band limited signals – complex analytic signals. System modeling: Differential equation – impulse response – Frequency response – Convolution – Analysis and characterization of LTI system using Fourier methods.	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

TEXT BOOKS/REFERENCE BOOKS

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

ELECTROMAGNETIC FIELD THEORY	
Course Code: 24EC207	Continuous Evaluation: 40 Marks
Credits: 3	End Semester Examination:60 Marks
L T P : 3 0 0	
Prerequisite: Nil	

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 BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLOs / COs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

COURSE CONTENTS

UNIT	CONTENTS	HOURS
UNIT-I	**COORDINATE SYSTEMS AND TRANSFORMATION:** Cartesian coordinates, cylindrical coordinates and spherical coordinates system. Vector analysis: Differential length, area and volume, line surface and volume integrals, del operator, gradient of a scalar, divergence of a vector and divergence theorem, curl of a vector and Stake's theorem, Laplacian operator.	9
UNIT-II	**STATIC ELECTRIC** Coulomb's law. Electric field intensity. Field due to different types of charges. Electric Flux density. Gauss law: It's applications to symmetrical charge distributions. Boundary conditions. Electric potential. Potential field due to different types of charges. Electric field due to dipole. Energy density in electrostatic field.	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 Magnetic Potential and Vector Magnetic Potential and its Properties - Vector Magnetic Potential due to Simple Configuration	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

TEXT BOOKS/REFERENCE BOOKS

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

ELECTRONICS DEVICES LAB	
Course Code: 23EC211	Continuous Evaluation: 40 Marks
Credits: 1	End Semester Examination:60 Marks
L T P : 0 0 2	
Prerequisite: Nil	

COURSE OBJECTIVES (CO)

1. To study experimentally the characteristics of diodes, BJT's and FET's.
2. To verify practically, the response of various special-purpose electron devices.

COURSE LEARNING OUTCOMES (CLO)

1. To verify practically, the fundamental characteristics of Electron Devices.

MAPPING BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLOs / COs	CLO1
CO1	✓
CO2	✓

LIST OF EXPERIMENTS

1. Characteristics of PN junction and Zener diode.
2. Input, Output and Transfer characteristics of CE and CC Amplifier.
3. Characteristics of LDR, Photo-diode and Phototransistor.
4. Transfer characteristics of JFET.
5. Transfer characteristics of MOSFET (with depletion and enhancement mode)
6. Characteristics of LED with three different wavelengths.
7. Half wave rectifier.
8. Full wave rectifier with 2 diodes.
9. Full wave rectifier with 4 diodes (Bridge rectifier).
10. Series Voltage Regulator.
11. Shunt Voltage Regulator.
12. Characteristics of Thermistor.

REFERENCE: LABORATORY MANUAL

DIGITAL SYSTEM LAB	
Course Code: 24EC213	Continuous Evaluation: 40 Marks
Credits: 1	End Semester Examination:60 Marks
L T P : 0 0 2	
Prerequisite: Nil	

COURSE OBJECTIVES (CO)

1. To verify the operation of logic gates and flip-flops. To design and construct digital circuits

COURSE LEARNING OUTCOMES (CLO)

1. To understand, the logical behaviours of digital circuits and apply them in appropriate applications.

MAPPING MATRIX OF CO AND CLO

CLOs / COs	CLO1
CO1	✓
CO2	✓

LIST OF EXPERIMENTS

1. Study of Gates & Flip-flops.
2. Half Adder and Full Adder.
3. Magnitude Comparator (2-Bit).
4. Encoders and Decoders.
5. Multiplexer and De-multiplexer.
6. Code Converter.
7. Synchronous Counters.
8. Ripple Counter.
9. Mod – N Counter.
10. Shift Register – SISO & SIPO.
11. Flip flop SR
12. Flip flop JK
13. Flip flop T
14. Decade Counter

REFERENCE: LABORATORY MANUAL

SRM UNIVERSITY
DELHI-NCR, SONEPAT

PROGRAMMING USING PYTHON	
Course Code: 24EC208	Continuous Evaluation: 40 Marks
Credits: 4	End Semester Examination:60 Marks
L T P : 3 1 0	
Prerequisite: Nil	

COURSE OBJECTIVES (CO)

1. To study the basic taxonomy, terminology and components of the python programming.
2. To study about the control flow and different type of functions in python programming language.
3. To study the different data types and their usage in python programming language.
4. To study different modules and libraries associated with python programming.
5. To study the visualization and plotting functions provided by python programming language.

COURSE LEARNING OUTCOMES (CLO)

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

1. Demonstrate the usage of basic programs of python programming.
2. Demonstrate the usage of loops, control flow and different functions.
3. Classify the different data types and their application in different scenarios.
4. Develop advanced programs in python programming using the libraries.
5. Use various visualization tools to develop graphs for data analysis.

MAPPING BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLOs / COs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

COURSE CONTENTS

UNIT	UNIT CONTENTS	HOURS
UNIT-I	**OVERVIEW OF PYTHON** Introduction to programming languages – Machine language, Assembly language, High level language, Software development, History of Python, Thrust areas of Python, Parts of Python programming language – Identifiers, Keywords, Statements and Expressions, Variables, Operators, Precedence and associativity, Data types, Indentation, Comments, Reading Input, Print Output.	9
UNIT-II	**FUNCTIONS AND CONTROL FLOW** Type of Control Flow statements; loops; exception handling; Functions – Built-In Functions, Commonly Used Modules, Function Definition and Calling the Function, The return Statement and void Function, Scope and Lifetime of Variables, Default Parameters, Keyword Arguments, *args and **kwargs, Command Line Arguments; Type conversion functions - int(), float(), str(), chr(),complex(), ord(), hex(), oct();Functional Programming – lambda, iterators and generators; Strings.	9
UNIT-III	**PYTHON DATA STORAGE FORMATS** Lists – Creating Lists, Basic List Operations, Indexing and Slicing in Lists, Built-In Functions Used on Lists, List Methods, The del Statement; Dictionaries – Creating Dictionary, Accessing and Modifying key, Built-In Functions, Dictionary Methods; Tuples and Sets – Creating Tuples, Tuple Operations, Indexing and Slicing in Tuples, Built-In Functions, Tuple Methods, Sets, Set Methods, Set Traversal, Frozen Set, Relation between Tuples and Dictionary, Relation between Tuples and Lists.	10
UNIT-IV	**FILES AND REGULAR EXPRESSIONS** Files – Types of Files, Creating and Reading Text Data, File Methods to Read and Write Data, Reading and Writing Binary Files, The Pickle Module, Reading and Writing CSV Files, Python os and os.path Modules; Regular Expression – RE Operations, Using Special Characters, Regular Expression Methods, Named Groups in Python Regular Expressions, Regular Expression with glob Module.	9
UNIT-V	**Visualizing Data** NumPy with Python; Pandas series and dataframe; Altair; Matplotlib – graphs and plots, appearance, axis, labels, annotations, legends; plotting pie-chart, histogram, bar charts, box plot, scatterplot; Introduction to Machine learning and essential packages: Scikit, SciPy, BeautifulSoup, statsmodel, IPython ;	10

TEXT BOOKS/REFERENCE BOOKS

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

ELECTRONIC CIRCUITS	
Course Code: 24EC202	Continuous Evaluation: 40 Marks
Credits: 4	End Semester Examination:60 Marks
L T P : 3 1 0	
Prerequisite: Nil	

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 BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLOs / COs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

COURSE CONTENTS

UNIT	CONTENTS	HOURS
UNIT-I	**BIASING METHODS AND SMALL SIGNAL MODELS (BJT)** DC & AC Load Lines-Operating Point-Q- Point variation-various Biasing Methods- Small signal equivalent - Calculation of voltage gain, current gain, power gain, input impedance and output impedance and re model. Small Signal analysis of BJT, Cascade amplifier- Cascade amplifier- Darlington Bootstrap amplifier- Differential amplifier. Large signal model (BJT).	9
UNIT-II	**BIASING METHODS AND SMALL SIGNAL MODELS (JFET, AND MOSFET)** Calculation of voltage gain, current gain, power gain, input impedance and output impedance and remodel. Small Signal analysis of BJT, Cascade amplifier- Cascade amplifier-Darlington Bootstrap amplifier- Differential amplifier. Large signal model (FET)	9
UNIT-III	**FEEDBACK AMPLIFIERS AND OSCILLATORS** Concept of feedback- Types of feedback- Analysis of voltage & current feedback amplifiers, Barkhausen criterion for oscillation – mechanism for start of oscillation & stabilization of amplitude –Analysis of RC & LC oscillators and crystal oscillator.	9
UNIT-IV	**LARGE SIGNAL AND TUNED AMPLIFIERS** Class-A CE amplifier – Q point placement – Power calculation – Maximum dissipation Hyperbola – Transformer coupled Amplifier – Class-B push pull amplifier – Class-AB operation-– Direct coupled push pull amplifier – Amplifier using complementary symmetry- Heat sink. Single Tuned Amplifiers –Double tuned & synchronously tuned amplifiers	9
UNIT-V	**FREQUENCY RESPONSE AND WAVE SHAPING CIIRCUITS** Low frequency and High frequency response of BJT and FET amplifier. **Nonlinear wave shaping circuits:** Triggering of multivibrators, **Astable** - Bistable – Monostable Multivibrators. Schmitt Trigger - Time Base Generators	9

TEXT BOOKS/REFERENCE BOOKS

1. Robert l. Boylsted, Louis Nashelsky," *Electronic Devices and circuit Theory*", Pearson, 1997. 2.G K Mithal, "*Electronic Devices & Circuits*", Khanna Publishers, 1993.
2. David A Bell, "*Electronic Devices and Circuits*", Prentice Hall of India, 1998.
3. JacobMillman, Christos C Halkias, "*Electron Devices and Circuits*", Tata McGraw Hill, Edition 1991 Donald L Schilling, Charles Belove, "*Electronic Circuits*", 3rd edition, 1989.
4. Stanley G. Burns , Paul R,Bond, " *Principles of Electronic Circuits* " ,Galgottia publishers.

LINEAR INTEGRATED CIRCUITS

Course Code: 24EC204	Continuous Evaluation: 40 Marks
Credits: 3	End Semester Examination:60 Marks
L T P : 3 0 0	
Prerequisite: Nil	

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 BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLOs / COs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

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 AND VOLTAGE REGULATOR** Filter Fundamentals: Filter types-Filter order and poles-Filter class or alignment (Butterworth, Bessel, Chebyshev or Cauer) Voltage Regulators-Need for Regulation-Linear Regulators- Monolithic IC Regulators (78xx,79xx,LM 317,LM 337,723)-Switching Regulators	9
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	9

TEXT BOOKS/REFERENCE BOOKS

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

TRANSMISSION LINES AND WAVEGUIDES	
Course Code: 24EC206	Continuous Evaluation: 40 Marks
Credits: 3	End Semester Examination:60 Marks
L T P : 3 0 0	
Prerequisite: Nil	

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.

MAPPING BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLOs / COs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

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, Design and analyse of Microstrip and CPW.	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

TEXT BOOKS/REFERENCE BOOKS

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

ELECTRONIC CIRCUITS LAB	
Course Code: **23EC212**	Continuous Evaluation: 40 Marks
Credits: 1	End Semester Examination:60 Marks
L T P : 0 0 2	
Prerequisite: Nil	

COURSE OBJECTIVES (CO)

1. To study experimentally the working of amplifiers, regulators and analyze their behaviour by plotting graphs.

COURSE LEARNING OUTCOMES (CLO)

1. To train the students to analyze electronic circuits and understand their functionality.

CLOs / COs	CLO1
CO1	✓

LIST OF EXPERIMENTS

Group 1: (Using only discrete components)

1. Frequency response of RC coupled amplifier using BJT or FET.
2. Colpitts Oscillator.
3. Efficiency of Class-A or Class AB Amplifier.
4. Frequency response of Single Tuned Amplifier.
5. Frequency response of a BJT amplifier with and without feedback.

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

1. Differential and Summing Amplifier.
2. Integrator and Differentiator.
3. Wein Bridge and RC Phase Shift oscillator.
4. Astable Multivibrator
5. Monostable Multivibrator
6. Bistable Multivibrator

Group 3: Simulation experiments (Using PSPICE and LABVIEW)

1. Active filters: Band pass filter and Notch filter.
2. Digital to Analog converter (any one method)
3. Analog to Digital converter (any one method)
4. Ramp Generator

REFERENCE: LAB MANUAL

SEMESTER – V

ANALOG AND DIGITAL COMMUNICATION	
Course Code: 23EC303	Continuous Evaluation: 40 Marks
Credits: 3	End Semester Examination:60 Marks
L T P : 3 0 0	
Prerequisite: Nil	

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. Analyze 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 BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLOs / COs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

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

TEXT BOOKS/REFERENCE BOOKS

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

ANTENNA AND WAVE PROPAGATION

Course Code: 24EC0305	Continuous Evaluation: 40 Marks
Credits: 3	End Semester Examination:60 Marks
L T P : 3 0 0	
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 BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLOs / COs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

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, A comparison Between Parabolic and Corner Reflectors, The Paraboloid Reflector.	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 BOOKS/REFERENCE BOOKS

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

MICROPROCESSOR AND INTERFACING	
Course Code: 24EC307	Continuous Evaluation: 40 Marks
Credits: 3	End Semester Examination:60 Marks
L T P : 3 0 0	
Prerequisite: Nil	

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 BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

COs \ CLOs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

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

SRM UNIVERSITY
DELHI-NCR, SONEPAT

MICROPROCESSOR LAB	
Course Code: 24EC311	Continuous Evaluation: 40 Marks
Credits: 1	End Semester Examination:60 Marks
L T P : 0 0 2	
Prerequisite: Nil	

COURSE OBJECTIVES

1. To practice assembly language programming on 8085 & 8086.
2. To practice fundamentals of interfacing/programming various peripheral devices with Microprocessor.

COURSE LEARNING OUTCOME

The students will be able to

1. Develop assembly language programs for problem solving using software interrupts and various assembler directives.
2. Implement interfacing of various I/O devices to the microprocessor/microcontroller through assembly language programming.

MAPPING BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLOs / COs	CLO1
CO1	✓
CO2	✓

LIST OF EXPERIMENTS

PART I-8086 MICROPROCESSOR

1. 16 bit Addition , Subtraction, Multiplication and Division
2. Largest and Smallest number
3. Ascending and Descending numbers and Sum of Series

PART II-INTERFACING

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

PART III-8051 MICROCONTROLLER

1. Addition , Subtraction, Multiplication and Division
2. One's and two's complement
3. Word disassembly
4. Decimal to Hexa decimal Conversion

PART IV –DSP PROCESSOR

1. 8bit/16bit addition subtraction using immediate direct and indirect addressing modes.
2. 8bit/16bit multiplication and division using immediate, direct and indirect addressing.
3. Linear evaluation
4. Wave form generation

REFERENCE: MANUAL LAB

COMMUNICATION LAB	
Course Code: **24EC313**	Continuous Evaluation: 40 Marks
Credits: 1	End Semester Examination:60 Marks
L T P : 0 0 2	
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

6. for modulation schemes like BFSK, BPSK, and QPSK.

MAPPING BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLOs / COs	CLO1	CLO2	CLO3	CLO4
CO1	✓			
CO2		✓		
CO3			✓	
CO4				✓

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

RF AND MICROWAVE ENGINEERING	
Course Code: 24EC302	Continuous Evaluation: 40 Marks
Credits: 3	End Semester Examination:60 Marks
L T P : 3 0 0	
Prerequisite: Nil	

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 BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLOs / COs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

COURSE CONTENTS

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

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

OPTICAL FIBER COMMUNICATION	
Course Code: 23EC304	Continuous Evaluation: 40 Marks
Credits: 3	End Semester Examination:60 Marks
L T P : 3 0 0	
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:

1. 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.
2. Analyse the principles of light propagation in optical fibres, including attenuation, dispersion, and nonlinearity effects,
3. Understand the operation and characteristics of optical sources, detectors, and amplifiers used in optical communication systems.
4. 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.
5. 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 BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLOs / COs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

COURSE CONTENTS

UNIT	CONTENTS	HOURS
UNIT-I	**INTRODUCTION OF OPTICAL FIBERS** Introduction, Total internal reflection, acceptance angle, numerical aperture, electromagnetic wave nature, modes in planar guide, phase and group velocity, mode coupling, step index Fiber and graded index Fiber.	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

TEXT BOOKS/REFERENCE BOOKS

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

DIGITAL VLSI DESIGN

Course Code: 23EC306	Continuous Evaluation: 40 Marks
Credits: 3	End Semester Examination:60 Marks
L T P : 3 0 0	
Prerequisite: Nil	

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 BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLOs / COs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

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 to single and two stage op-amp design, Introduction Hardware description Language (HDL)- Verilog & 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

TEXT BOOKS/REFERENCE BOOKS

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

MICROWAVE AND OPTICAL COMMUNICATION LAB	
Course Code: 23EC312	Continuous Evaluation: 40 Marks
Credits: 1	End Semester Examination:60 Marks
L T P : 0 0 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 BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLOs / COs	CLO1
CO1	✓
CO2	✓

3.

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.

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.

SPICE SIMULATION

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

REFERENCE: LABORATORY MANUAL

DIGITAL VLSI DESIGN LAB	
Course Code: 24EC314	Continuous Evaluation: 40 Marks
Credits: 1	End Semester Examination:60 Marks
L T P : 0 0 2	
Prerequisite: Nil	

COURSE OBJECTIVES

To gain expertise in design and development and simulation of digital circuits with VHDL.

COURSE OUTCOME

To know and understand VHDL and design circuits using it.

MAPPING BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLOs / COs	CLO1
CO1	✓

LIST OF EXPERIMENTS

1. Verification of Logics Gate
2. Design of Inverters
3. Design of Combinational Circuits
4. Design of Counters and Shift Registers
5. Design of Multipliers
6. Design of ALU
7. Design of RAM
8. Design of FIFO
9. Control Logic Design

REFERENCE: LABORATORY MANUAL

SEMESTER VII

MINOR PROJECT	
Course Code: 24LP413	Continuous Evaluation: 40 Marks
Credits: 4	End Semester Examination:60 Marks
L T P : 0 0 8	
Prerequisite: Nil	

COURSE OBJECTIVES (COs)

1. To develop the ability of design and implement a project by applying Engineering knowledge:
2. To apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
3. To enhance the 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.

COURSE LEARNING OUTCOME (CLO)

1. Student will be able to design and implement a major project by applying Engineering knowledge:
2. Will be able to apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
3. Will be able to solve the 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

MAJOR PROJECT	
Course Code: 24LP402	Continuous Evaluation: 40 Marks
Credits: 12	End Semester Examination:60 Marks
L T P : 0 0 24	
Prerequisite: Nil	

COURSE OBJECTIVES (COs)

1. To develop the ability of design and implement a project by applying Engineering knowledge:
2. To apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
3. To enhance the 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.

COURSE LEARNING OUTCOME (CLO)

1. Student will be able to design and implement a major project by applying Engineering knowledge:
2. Will be able to apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
3. Will be able to solve the 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.

CIRCUIT ANALYSIS & SYNTHESIS

Course Code: 24EPE211	Continuous Evaluation: 40 Marks
Credits: 3	End Semester Examination: 60 Marks
L T P : 3 0 0	
Prerequisite:	

COURSE OBJECTIVES (COs)

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 (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 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 BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLOs / COs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

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.	9
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	9
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	9
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	9

TEXTBOOKS/ REFERENCE BOOKS/NPTEL RESOURCES

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

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DIGITAL SIGNAL PROCESSING	
Course Code: 24EPE212	Continuous Evaluation: 40 Marks
Credits: 3	End Semester Examination: 60 Marks
L T P : 3 0 0	
Prerequisite:	

COURSE OBJECTIVES (COs)

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 (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 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 BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLOs / COs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

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COURSE CONTENTS

UNIT	CONTENTS	HOURS
UNIT-I:	**INTRODUCTION** Analog signal processing – Digital signal processing -Classification of systems: Continuous, discrete, linear, causal, stability, dynamic, recursive, time variance; classification of signals: continuous and discrete, energy and power; mathematical representation of signals; spectral density; sampling techniques, quantization, quantization error, Nyquist rate, aliasing effect.	9
UNIT-II:	**DFT** Overview of discrete signals, sampling theorem, DFT- Properties of DFT-time shifting, frequency shifting, interpolation, etc., twiddle factor, linear convolution, circulation convolution-graphical method, matrix method and Application	9
UNIT-III:	**DISCRETE FOURIER TRANSFORM & COMPUTATION** Discrete Fourier Transform- properties, magnitude and phase representation - Computation of DFT using FFT algorithm – DIT &DIF using radix 2 FFT – Butterfly structure. , Realization of structures for discrete time systems – Direct form-I & II, Cascade, Parallel forms, Ladder structure and Lattice structure.	9
UNIT-IV:	**DESIGN OF FIR DIGITAL FILTERS** FIR & IIR filter realization – Parallel & cascade forms. FIR design: Windowing Techniques – Need and choice of windows – Linear phase characteristics. Fixed point arithmetic –effect of quantization of the input data due to Finite word length. Product round off – need for scaling – Zero input limit cycle oscillations - Limit cycle oscillations due to overflow of adders.	9
UNIT-V:	**DESIGN OF IIR DIGITAL FILTER** Analog filter design – Butterworth and Chebyshev approximations; IIR Filters, digital design using impulse invariant and bilinear transformation Warping, pre-warping-Digital signal processors-types-architectures-evolution of Digital signal processors	9

TEXTBOOKS/ REFERENCE BOOKS/NPTEL RESOURCES

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
4. Robert Schilling & Sandra L.Harris, Introduction to Digital Signal Processing using Matlab", Cengage Learning,2014.
5. 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.
6. SenM.kuo, woonseng…s.gan, "Digital Signal Processors, Architecture, Implementations & Applications, Pearson,2013
7. DimitrisG.Manolakis, Vinay K. Ingle, applied Digital Signal Processing, Cambridge,2012

SOLID STATE DEVICE MODELLING	
Course Code: 23EPE311	Continuous Evaluation: 40 Marks
Credits: 3	End Semester Examination: 60 Marks
L T P : 3 1 0	
Prerequisite:	

COURSE OBJECTIVES (COs)

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)

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 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 BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLOs / COs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

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**

TEXTBOOKS/ REFERENCE BOOKS/NPTEL RESOURCES

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.

INSTRUMENTATION & CONTROL ENGINEERING

Course Code: 24EC301	Continuous Evaluation: 40 Marks
Credits: 3	End Semester Examination: 60 Marks
L T P : 3 1 0	
Prerequisite:	

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)

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.
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 BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

COs \ CLOs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

COURSE CONTENTS

UNIT	CONTENTS	HOURS
UNIT-I	**MEASUREMENT ERRORS & INDICATING INSTRUMENTS** Measurement Errors: Gross error, systematic error, absolute error and relative error, accuracy, precision, resolution and significant figures, Measurement error combination, basics of statistical analysis. PMMC instrument, Galvanometer, DC ammeter, DC voltmeter, series ohm meter. Indicating Instruments (Moving Iron instruments, electrodynamometer instrument.	9
UNIT-II	**TRANSFER FUNCTIONS** Introduction and classification of control systems-linear, nonlinear, time varying, time in-variant, continuous, discrete, SISO and MIMO systems – definitions. Transfer function – Mathematical modelling of mechanical (translation and rotational), Electrical systems- mechanical-electrical analogies– Block Diagram reduction technique and Signal flow graphs.	9
UNIT-III	**TRANSIENT AND STEADY STATE ANALYSIS** Transient and steady state response-definitions-mathematical expression for standard test signals-type and order of systems-step, ramp and impulse response of first order and second order under damped systems - Step response of second order critically damped and over damped systems - Time domain specifications of second order under damped systems - Steady state error analysis.	9
UNIT-IV	**STABILITY AND ROOT LOCUS TECHNIQUES** Stability analysis – characteristic equation – location of roots in S-plane for stability -Routh's stability criterion-relative stability analysis-root locus technique-construction of root loci for negative feed-back systems. **STABILITY ANALYSIS & FREQUENCY DOMAIN ANALYSIS** Frequency response analysis-frequency domain specifications of second order systems-Bode plots and stability (gain and phase) margins- minimum phase& non-minimum phase systems - polar plots-constant M and N circles-Nichols chart - Nyquist stability criterion	9
UNIT-V	**STATE-VARIABLE ANALYSIS** State-Variable Analysis: Vector matrix representation of state equation, state transition matrix, state-transition equation, relationship between state equations and high-order differential equations, relationship between state equations and transfer functions. Similarity Transformation, Decomposition of transfer functions, Controllability and observability.	9

TEXTBOOKS/ REFERENCE BOOKS/NPTEL RESOURCES

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", 1stedition,Wiley and Sons, 1985.
3. Benjamin C Kuo, "Automatic Control System", 7th edition, Prentice Hall of India Private Limited, New Delhi, 1993.
4. Gajic Z., Lelic M., "Modern Control System Engineering", Prentice Hall of India Private Limited, New Delhi, 1996.
5. Richard .C. Dorf and Robert. H. Bishop, "Modern Control System Engineering", Addison Wesley, 1999.

EMBEDDED SYSTEM DESIGN USING MICROCONTROLLER

Course Code: 23EPE312	Continuous Evaluation: 40 Marks
Credits: 3	End Semester Examination: 60 Marks
L T P : 3 1 0	
Prerequisite:	

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 (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 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 BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLOs / COs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

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/ REFERENCE BOOKS/NPTEL RESOURCES

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

MIXED SIGNAL SYSTEM DESIGN

MIXED SIGNAL SYSTEM DESIGN	
Course Code: 23EPE314	Continuous Evaluation: 40 Marks
Credits: 3	End Semester Examination: 60 Marks
L T P : 3 1 0	
Prerequisite:	

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 (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 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 BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLOs / COs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

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/ REFERENCE BOOKS/NPTEL RESOURCES

1. CMOS Mixed Signal Circuit Design by R.Jacob Baker, Wiley India, IEEE Press, reprint 2008.
2. Design of Analog CMOS Integrated Circuits by Behzad Razavi, McGraw Hill, 33rd Re- print, 2016.
3. CMOS Circuit Design, Layout and Simulation by R.Jacob Baker, Wiley India, IEEE Press, Second Edition, reprint 2009.

VLSI FABRICATION TECHNOLOGY

Course Code: 23EPE314	Continuous Evaluation: 40 Marks
Credits: 3	End Semester Examination: 60 Marks
L T P : 3 1 0	
Prerequisite:	

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 (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 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 BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLOs / COs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

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**

TEXTBOOKS/ REFERENCE BOOKS/NPTEL RESOURCES

1. Peter Van Zant, “Microchip Fabrication: A Practical Guide to Semiconductor Processing”, McGraw- Hill Professional, Sixth Edition, 2014.
2. Marc J. Madou, “Fundamentals of Microfabrication and Nanotechnology – Volume II”, CRC Press, Third Edition, 2011.
3. James D. Plummer, Michael D. Deal, Peter B. Griffin, “Silicon VLSI Technology: Fundamentals, Practice and Modelling”, Prentice Hall India Private Limited, 2000.
4. Stephen Campbell, “Science of Microelectronic Fabrication”, Oxford University Press, 2001.
5. Gary. S. May and S. M. Sze, “Fundamentals of semiconductor fabrication”, John Wiley, First Edition, 2003.

HDL PROGRAMMING AND SYSTEM DESIGN	
Course Code: 23EPE413	Continuous Evaluation: 40 Marks
Credits: 3	End Semester Examination: 60 Marks
L T P : 3 1 0	
Prerequisite:	

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 (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 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 BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLOs / COs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

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**

TEXTBOOKS/ REFERENCE BOOKS/NPTEL RESOURCES

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.
3. Stephen Brown and Zvonko Vranesic - Fundamentals of Digital Logic with Verilog, 2nd Edition, TMH, 2008.
4. Z Navabi - Verilog Digital System Design, 2nd Edition, McGraw Hill, 2005.

SRM UNIVERSITY
DELHI-NCR, SONEPAT

ASIC AND FPGA SYSTEM DESIGN	
Course Code: 23EPE415	Continuous Evaluation: 40 Marks
Credits: 3	End Semester Examination: 60 Marks
L T P : 3 1 0	
Prerequisite:	

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 (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 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 BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLOs / COs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

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**

TEXTBOOKS/ REFERENCE BOOKS/NPTEL RESOURCES

1. M.J.S .Smith, "Application Specific Integrated Circuits, Addison -Wesley Longman Inc.,199FPGA-Based
2. System Design book by Wayne Wolf
3. S. Trimberger, Field Programmable Gate Array Technology, Edr, Kluwer Academic Publications, 1994.
4. John V.Oldfield, Richard C Dore, Field Programmable Gate Arrays, Wiley Publications1995.
5. P.K.Chan & S. Mourad, Digital Design Using Field Programmable Gate Array, Prentice Hall, 1994.

SRM UNIVERSITY
DELHI-NCR, SONEPAT

VLSI TESTING	
Course Code: 23EPE417	Continuous Evaluation: 40 Marks
Credits: 3	End Semester Examination: 60 Marks
L T P : 3 1 0	
Prerequisite:	

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 (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 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 BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLOs / COs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

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/ REFERENCE BOOKS/NPTEL RESOURCES

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

LOW POWER VLSI DESIGN

Course Code: 23EPE419	Continuous Evaluation: 40 Marks
Credits: 3	End Semester Examination: 60 Marks
L T P : 3 1 0	
Prerequisite:	

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 (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 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 BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLOs / COs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

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/ REFERENCE BOOKS/NPTEL RESOURCES

1. Gary K. Yeap, “Practical Low Power Digital VLSI Design”, KAP, 2002
2. Rabaey, Pedram, “Low Power Design Methodologies” Kluwer Academic
3. Kaushik Roy, Sharat Prasad, “Low-Power CMOS VLSI Circuit Design” Wiley, 2000
4. Yeo, “CMOS/BiCMOS ULSI Low Voltage Low Power” Pearson Education

CIRCUIT ANALYSIS & SYNTHESIS

Course Code:24EPE211	Continuous Evaluation: 40 Marks
Credits: 3	End Semester Examination: 60 Marks
L T P : 3 0 0	
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 (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 principles and concepts of electrical network analysis and synthesis, interpret the behaviour and characteristics and apply network theorems to simplify and analyze complex circuits.
2. Analyze 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. Analyze 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 BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLOs / COs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

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/ REFERENCE BOOKS/NPTEL RESOURCES

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

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DIGITAL SIGNAL PROCESSING	
Course Code:24EPE212	Continuous Evaluation: 40 Marks
Credits: 3	End Semester Examination: 60 Marks
L T P : 3 0 0	
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)

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 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 BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLOs / COs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

COURSE CONTENTS

UNIT	CONTENTS	HOURS
UNIT-I:	**INTRODUCTION** Analog signal processing – Digital signal processing -Classification of systems: Continuous, discrete, linear, causal, stability, dynamic, recursive, time variance; classification of signals: continuous and discrete, energy and power; mathematical representation of signals; spectral density; sampling techniques, quantization, quantization error, Nyquist rate, aliasing effect.	9
UNIT-II:	**DFT** Overview of discrete signals, sampling theorem, DFT- Properties of DFT-time shifting, frequency shifting, interpolation, etc., twiddle factor, linear convolution, circulation convolution-graphical method, matrix method and Application	9
UNIT-III:	**DISCRETE FOURIER TRANSFORM & COMPUTATION** Discrete Fourier Transform- properties, magnitude and phase representation - Computation of DFT using FFT algorithm – DIT &DIF using radix 2 FFT – Butterfly structure. , Realization of structures for discrete time systems – Direct form-I & II, Cascade, Parallel forms, Ladder structure and Lattice structure.	9
UNIT-IV:	**DESIGN OF FIR DIGITAL FILTERS** FIR & IIR filter realization – Parallel & cascade forms. FIR design: Windowing Techniques – Need and choice of windows – Linear phase characteristics. Fixed point arithmetic –effect of quantization of the input data due to Finite word length. Product round off – need for scaling – Zero input limit cycle oscillations - Limit cycle oscillations due to overflow of adders.	9
UNIT-V:	**DESIGN OF IIR DIGITAL FILTER** Analog filter design – Butterworth and Chebyshev approximations; IIR Filters, digital design using impulse invariant and bilinear transformation Warping, pre-warping-Digital signal processors-types-architectures-evolution of Digital signal processors	9

TEXTBOOKS/ REFERENCE BOOKS/NPTEL RESOURCES

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
4. Robert Schilling & Sandra L.Harris, Introduction to Digital Signal Processing using Matlab", Cengage Learning,2014.
5. 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.
6. SenM.kuo, woonseng…s.gan, "Digital Signal Processors, Architecture, Implementations & Applications, Pearson,2013
7. DimitrisG.Manolakis, Vinay K. Ingle, applied Digital Signal Processing,Cambridge,2012.

INSTRUMENTATION & CONTROL ENGINEERING	
Course Code:24EC301	Continuous Evaluation: 40 Marks
Credits: 3	End Semester Examination: 60 Marks
L T P : 3 0 0	
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.

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 BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLOs / COs	CLO1	CLO2	CLO3	CLO4
CO1	✓			
CO2		✓		
CO3			✓	
CO4				✓

COURSE CONTENTS

UNIT	CONTENTS	HOURS
UNIT-I	**MEASUREMENT ERRORS & INDICATING INSTRUMENTS** Measurement Errors: Gross error, systematic error, absolute error and relative error, accuracy, precision, resolution and significant figures, Measurement error combination, basics of statistical analysis. PMMC instrument, Galvanometer, DC ammeter, DC voltmeter, series ohm meter. Indicating Instruments (Moving Iron instruments, electrodynamometer instrument.	9
UNIT-II	**TRANSFER FUNCTIONS** Introduction and classification of control systems-linear, nonlinear, time varying, time in-variant, continuous, discrete, SISO and MIMO systems – definitions. Transfer function – Mathematical modelling of mechanical (translation and rotational), Electrical systems- mechanical-electrical analogies– Block Diagram reduction technique and Signal flow graphs.	9
UNIT-III	**TRANSIENT AND STEADY STATE ANALYSIS** Transient and steady state response-definitions-mathematical expression for standard test signals-type and order of systems-step, ramp and impulse response of first order and second order under damped systems - Step response of second order critically damped and over damped systems - Time domain specifications of second order under damped systems - Steady state error analysis.	9
UNIT-IV	**STABILITY AND ROOT LOCUS TECHNIQUES** Stability analysis – characteristic equation – location of roots in S-plane for stability -Routh's stability criterion-relative stability analysis-root locus technique-construction of root loci for negative feed-back systems. **STABILITY ANALYSIS & FREQUENCY DOMAIN ANALYSIS** Frequency response analysis-frequency domain specifications of second order systems-Bode plots and stability (gain and phase) margins- minimum phase& non-minimum phase systems - polar plots-constant M and N circles-Nichols chart - Nyquist stability criterion	9
UNIT-V	**STATE-VARIABLE ANALYSIS** State-Variable Analysis: Vector matrix representation of state equation, state transition matrix, state-transition equation, relationship between state equations and high-order differential equations, relationship between state equations and transfer functions. Similarity Transformation, Decomposition of transfer functions, Controllability and observability.	9

TEXTBOOKS/ REFERENCE BOOKS/NPTEL RESOURCES

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*", 1stedition,Wiley and Sons, 1985.
3. Benjamin C Kuo, "Automatic Control System", 7th edition, Prentice Hall of India Private Limited, New Delhi, 1993.
4. Gajic Z., Lelic M., "Modern Control System Engineering", Prentice Hall of India Private Limited, New Delhi, 1996.
5. Richard .C. Dorf and Robert. H. Bishop, "Modern Control System Engineering", Addison Wesley, 1999.

NEURAL NETWORK & FUZZY LOGIC

Course Code: 24EPE321	Continuous Evaluation: 40 Marks
Credits: 3	End Semester Examination: 60 Marks
L T P : 3 0 0	
Prerequisite: NIL	

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)

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 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 BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLOs / COs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

COURSE CONTENTS

UNIT	CONTENTS	HOURS
UNIT-I	**BASICS OF NEURAL NETWORKS** Basic concept of Neurons – Perceptron Algorithm – Feed Forward and Back Propagation Networks.	9
UNIT-II	**INTRODUCTION TO DEEP LEARNING:** Feed Forward Neural Networks – Gradient Descent – Back Propagation Algorithm – Vanishing Gradient problem – Mitigation – RelU Heuristics for Avoiding Bad Local Minima – Heuristics for Faster Training – Nestors Accelerated Gradient Descent – Regularization – Dropout.	9
UNIT-III	**CONVOLUTIONAL NEURAL NETWORKS:** CNN Architectures – Convolution – Pooling Layers – Transfer Learning – Image Classification using Transfer Learning	9
UNIT-IV	**DEEP LEARNING ARCHITECTURES**: LSTM, GRU, Encoder/Decoder Architectures – Autoencoders – Standard- Sparse – Denoising – Contractive- Variational Autoencoders – Adversarial Generative Networks – Autoencoder and DBM	9
UNIT-V	**APPLICATIONS OF DEEP LEARNING**: Image Segmentation – Object Detection – Automatic Image Captioning – Image generation with Generative Adversarial Networks – Video to Text with LSTM Models – Attention Models for Computer Vision – Case Study: Named Entity Recognition – Opinion Mining using Recurrent Neural Networks – Parsing and Sentiment Analysis using Recursive Neural Networks – Sentence Classification using Convolutional Neural Networks – Dialogue Generation with LSTMs.	9

TEXTBOOKS/ REFERENCE BOOKS/NPTEL RESOURCES

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.
4. Ragav Venkatesan, Baoxin Li, "Convolutional Neural Networks in Visual Computing", CRC Press, 2018.
5. Navin Kumar Manaswi, "Deep Learning with Applications Using Python", Apress, 2018.
6. Joshua F. Wiley, "R Deep Learning Essentials", Packt Publications, 2016.

INTRODUCTION TO MACHINE LEARNING	
Course Code: 24EPE322	Continuous Evaluation: 40 Marks
Credits: 3	End Semester Examination: 60 Marks
L T P : 3 0 0	
Prerequisite: NIL	

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)

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 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 BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLOs / COs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

COURSE CONTENTS

UNIT	CONTENTS	HOURS
UNIT-I	**INTRODUCTION:** Reinforcement Learning, Early History of Reinforcement Learning, Elements of Reinforcement Learning, Limitations and Scope, Tic-Tac-Toe	9
UNIT-II	**Tabular Solution Methods:** Multi-armed Bandit, A k-armed Bandit Problem, Action-value Methods, the 10-armed Testbed, Incremental Implementation, Tracking a Nonstationary Problem, Optimistic Initial Values, Upper-Confidence-Bound Action Selection, Bandit Algorithms Associative Search (Contextual Bandits)	9
UNIT-III	**Finite Markov Decision Processes**: The Agent–Environment Interface, Goals and Rewards, Returns and Episodes, Unified Notation for Episodic and Continuing Tasks, Policies and Value Functions, Optimal Policies and Optimal Value Functions, Optimality and Approximation	10
UNIT-IV	**Dynamic Programming**: Policy Evaluation (Prediction), Policy Improvement, Policy Iteration, Value Iteration, Asynchronous Dynamic Programming, Generalized Policy and Efficiency of Dynamic Programming	9
UNIT-V	**Monte Carlo Methods:** Monte Carlo Prediction, Carlo Control, Off-policy Prediction via Importance sampling, Incremental Implementation, ff-policy Monte Carlo Per-decision Importance Sampling	10

TEXTBOOKS/ REFERENCE BOOKS/NPTEL RESOURCES

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

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ADVANCED WIRELESS COMMUNICATION	
Course Code: 24EPE324	Continuous Evaluation: 40 Marks
Credits: 3	End Semester Examination: 60 Marks
L T P : 3 0 0	
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)

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 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 BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLOs / COs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

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/ REFERENCE BOOKS/NPTEL RESOURCES

1. Rappaport, T.S., "Wireless communications", Pearson Education, 3rd Edition, 2010.
2. Andreas.F. Molisch, "Wireless Communications", John Wiley – India, 2ndEdition 2012.
3. David Tse and PramodViswanath, "Fundamentals of Wireless Communication", Cambridge University Press, 2005.
4. Upena Dalal, "Wireless Communication", Oxford University Press, 2009.
5. Van Nee, R. and Ramji Prasad, "OFDM for wireless multimedia communications", Artech House, 2000.
6. Simon Haykins& Michael Moher, "Modern Wireless Communications", Pearson Education, 2007.
7. Vijay. K. Garg, "Wireless Communication and Networking", Morgan Kaufmann Publishers, 2007.
8. Wireless Communication and Networks –William Stallings ,Pearson Education, Second Edition 2002.

SRM UNIVERSITY
DELHI-NCR, SONEPAT

NETWORK SECURITY	
Course Code: 23EPE421	Continuous Evaluation: 40 Marks
Credits: 3	End Semester Examination: 60 Marks
L T P : 3 0 0	
Prerequisite: NIL	

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)

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 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 BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

COs \ CLOs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

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

TEXTBOOKS/ REFERENCE BOOKS/NPTEL RESOURCES

1. William Stallings, Cryptography and Network Security: Principles and Practice, PHI 3rd Edition, 2006.
2. C K Shyamala, N Harini and Dr. T R Padmanabhan: Cryptography and Network Security, Wiley India Pvt.Ltd
3. BehrouzA. Foruzan, Cryptography and Network Security, Tata McGraw Hill 2007.
4. Charlie Kaufman, Radia Perlman, and Mike Speciner, Network Security: PRIVATE Communication in a PUBLIC World, Prentice Hall, ISBN 0-13-046019-2

SRM UNIVERSITY DELHI-NCR, SONEPAT

DATA COMMUNICATION NETWORK	
Course Code: 24EPE23	Continuous Evaluation: 40 Marks
Credits: 3	End Semester Examination: 60 Marks
L T P : 3 0 0	
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)

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 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 BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLOs / COs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

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

TEXTBOOKS/ REFERENCE BOOKS/NPTEL RESOURCES

1. Behrouz A. Fehrouzan, "Data communication & Networking" Mc-Graw Hill, 3rd edition, 2004.
2. Andrew S. Tanenbaum, "Computer Networks", 4th edition, Pearson education, 1999.
3. W. Stallings, "Data & computer communication", 2nd Edition, NY Pearson, 1988.
4. Rarnier Handel, N.Huber , Schroder, "ATM Networks Concepts ,Protocols Applications'', Addison Welsey 1999

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INTERNET OF THINGS (IOT) AND APPLICATIONS	
Course Code: 23EPE425	Continuous Evaluation: 40 Marks
Credits: 3	End Semester Examination: 60 Marks
L T P : 3 0 0	
Prerequisite: NIL	

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)

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 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.

6. **MAPPING BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)**

CLOs / COs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

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/ REFERENCE BOOKS/NPTEL RESOURCES

1. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, “IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things”, CISCO Press, 2017
2. Samuel Greengard, The Internet of Things, The MIT Press, 2015
3. Perry Lea, “Internet of things for architects”, Packt, 2018
4. Olivier Hersent, David Boswarthick, Omar Elloumi , “The Internet of Things – Key applications and Protocols”, Wiley, 2012

INFORMATION THEORY AND CODING	
Course Code: 23EPE427	Continuous Evaluation: 40 Marks
Credits: 3	End Semester Examination: 60 Marks
L T P : 3 0 0	
Prerequisite: NIL	

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)

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 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 BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLOs / COs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

COURSE CONTENTS

UNIT	CONTENTS	HOURS
UNIT-I	**SOURCE CODING** Mathematical model for information source: - Mutual Information – Discrete Entropy-Definition and properties–Joint and conditional entropies – Entropy in the continuous case – Unique decipherability and instantaneous codes – Kraft inequality.	9
UNIT-II	**NOISY CODING** Discrete memoryless channel – Classification of channels & channel capacity – Calculation of channel capacity–Decoding schemes – Fano's inequality – Shannon's fundamental theorem– Capacity of a band limited Gaussian channel.	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

TEXTBOOKS/ REFERENCE BOOKS/NPTEL RESOURCES

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

NETWORK MODELLING USING REINFORCEMENT LEARNING

Course Code: 23EPE429	Continuous Evaluation: 40 Marks
Credits: 3	End Semester Examination: 60 Marks
L T P : 3 0 0	
Prerequisite: NIL	

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 BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

COs \ CLOs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

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/ REFERENCE BOOKS/NPTEL RESOURCES

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

DATA SCIENCE	
Course Code: 23EPE332	Continuous Evaluation: 40 Marks
Credits: 3	End Semester Examination: 60 Marks
L T P : 3 0 0	
Prerequisite: NIL	

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)

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

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 BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLOs / COs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

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/ REFERENCE BOOKS/NPTEL RESOURCES

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

SRM UNIVERSITY
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AI AND EXPERT SYSTEMS	
Course Code: 23EPE334	Continuous Evaluation: 40 Marks
Credits: 3	End Semester Examination: 60 Marks
L T P : 3 0 0	
Prerequisite: NIL	

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)

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

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 BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLOs / COs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

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/ REFERENCE BOOKS/NPTEL RESOURCES

2. Stuart Russell, Peter Norvig, Artificial Intelligence: A Modern Approach, Prentice Hall, Fourth edition, 2020.
3. Rich and K. Knight," Artificial Intelligence", Tata McGraw Hill.
4. Nils J. Nilsson, Artificial Intelligence: A New Synthesis, Morgan-Kaufmann, 1998.
5. Biere, A., Heule, M., Van Maaren, H., Walsh, T., Handbook of Satisfiability, IOS Press, 2009.

SRM UNIVERSITY
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DEEP LEARNING	
Course Code: 23EPE431	Continuous Evaluation: 40 Marks
Credits: 3	End Semester Examination: 60 Marks
L T P : 3 0 0	
Prerequisite: NIL	

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)

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would 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 BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLOs / COs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

COURSE CONTENTS

UNIT	UNIT CONTENTS	HOURS
UNIT-I	Introduction To Deep Learning: Basics: Biological Neuron, Idea Of Computational Units, Artificial Neuron Model- Operations Of Artificial Neuron- Types Of Activation Functions, ANN Architectures, Classification Taxonomy Of ANN, Learning Strategy, Learning Rules.	9
UNIT-II	Feedforward Networks: Multilayer Perceptron, Gradient Descent, Backpropagation, Empirical Risk Minimization, Regularization, Autoencoders.	9
UNIT-III	Convolutional Networks: The Convolution Operation - Variants Of The Basic Convolution Function - Structured Outputs - Data Types - Pooling Layers- Efficient Convolution Algorithms - Random Or Unsupervised Features- LeNet, AlexNet.	10
UNIT-IV	Recurrent Neural Networks: Bidirectional RNNs - Deep Recurrent Networks Recursive Neural Networks - The Long Short-Term Memory And Other Gated RNNs .	9
UNIT-V	Deep Generative Models: Boltzmann Machines - Restricted Boltzmann Machines - Gradient Computations In RBMs - Deep Belief Networks. Applications: Large-Scale Deep Learning - Computer - Speech Recognition - Natural Language Processing - Other Applications	10

TEXTBOOKS/ REFERENCE BOOKS/NPTEL RESOURCES

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

PROBABILITY & RANDOM PROCESS

Course Code: 24AS404	Continuous Evaluation: 40 Marks
Credits: 3	End Semester Examination: 60 Marks
L T P : 3 0 0	
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 BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLOs / COs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

SRM UNIVERSITY
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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/ REFERENCE BOOKS/NPTEL RESOURCES

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

DATA COMMUNICATION LAB	
Course Code: 24EPE455	Continuous Evaluation: 40 Marks
Credits: 3	End Semester Examination: 60 Marks
L T P : 3 0 0	
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

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

6. 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

SKILL ENHANCEMENT COURSES (SEC)

SOFT SKILLS COURSES

Category	Course Code	Course Name	L	T	P	Credits
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

SEMESTER – III

Programme	**Faculty of Engineering & Technology**		
Year / Semester	**2 / 3**	**Course Category**	**SEC**
Course Code	**23SS351**	**Course Title**	**Effective Communication Skills**
Continuous Evaluation: 70		**End Term Examination: 30**	
Prerequisite: Nil		**L T P: 0 0 2**	**Credits: 1**

Training Objectives (TO): -

- TO1. To define and understand communication and its process.
- TO2. To make student practice on communication skills via LSRW approach via instructing, engaging, assessing and re engaging.
- TO3. To enhance the confidence and motivation of a student by honing his communication skills.

Training Learning Outcomes (TLO): -

After the completion of the training, the student will have ability:

- TLO1. To communicate effectively and interact with people with confidence.
- TLO2. To demonstrate and differentiate between various forms of communication.
- TLO3. To apply effective communication skills confidently which a student need to get ahead in job and life.

Mapping Matrix of Training Objectives (TO) & Training Learning Outcomes (TLO)			
TRAINING LEARNING OUTCOMES (TLO) → TRAINING OBJECTIVES (TO) ↓	TLO1	TLO2	TLO3
TO1			
TO2			
TO3			

Unit	Course Contents	Student Engagement Activity

Unit-I	**Verbal Communication Skills** • Communication Process & its importance • 7 C's of Communication • Formal & Informal Conversation • Requirements of effective verbal communication	Conversation Cards Activity
Unit-II	**Nonverbal Communication Skills** • Importance of nonverbal skills in effective communication • Types of nonverbal (body language) skills • Barriers to nonverbal communication	Power of Body Language Activity
Unit-III	**Listening Skills** • Role of listening skills in effective communication • Barriers to listening • Overcoming listening barriers • Empathetic listening & avoiding selective listening	Chinese Whisper Activity
Unit-IV	**Reading & Writing Skills** • Types of reading strategies to enhance improve reading skills • Types of written communication	The What IF Activity
Unit- V	**Visual Communication** • Types of visual communication • Importance of visual communication • Picture narration/description technique	Interpret The Picture Activity

Learning Resources	
Text Book	***Communication Skills*** by Sanjay Kumar & Pushp Lata: Oxford University Press, 2019.
Suggested Reference Book	***Personality Development & Communication Skills-1*** by C B Gupta: Scholar Tech Press,2019.

Pedagogy

- The training will be based on the concept of learning by practice.
- The training will involve 30% of the training time on briefing and demonstration & the remaining 70% will be focusing on student's engagement in training activities.
- The training will follow a circular approach where students are engaged, evaluated, given feedback and then re engaged.

Internal (Continuous Assessment & Evaluation) & End Term (Assessment & Evaluation) for Effective Communication Skills Course

Unit No.	Unit Name	Internal Assessment Parameter	Internal Marks (70)	End Term Assessment Parameters	End Term Marks (30)
I	Verbal Communication Skills	Speech Activity	15	Written Test	10
II	Non Verbal Communication Skills	Role Play	15		
III	Listening Skills	Oral Assessment / Written Assessment	10		
IV	Reading & Writing Skills		20	Viva	20
V	Visual Communication		10		

SEMESTER –IV

Programme	Faculty of Engineering & Technology		
Year / Semester	**2 / 4**	**Course Category**	**SEC**
Course Code	**23SS452**	**Course Title**	**Teamwork & Interpersonal Skills**
Continuous Evaluation: 70		**End Term Examination: 30**	
Prerequisite: Nil		**L T P: 0 0 2**	**Credits: 1**

Training Objectives (TO): -

- TO1. To make the students learn & demonstrate effective teamwork, leadership & interpersonal skills.
- TO2. To equip the students with capability of handling stress and utilization of work time effectively.
- TO3. To make the students understand the importance and application of Emotional Quotient, Critical Thinking & Problem Solving Skills.

Training Learning Outcomes (TLO): -

After the completion of the training, the student will have ability:

- TLO1. To be confident working in a team and leading it as well.
- TLO2. To categorize the work and achieve expected performance within the time frame & will be able to adapt himself to work under various kinds of stress and re-energies himself to bounce back from such situations.
- TLO3. To get benefitted from Emotional Quotient in building stronger professional relationships and achieving career and personal goals.
- TLO4. To face complex problems and effectively deal with it in the job due to Critical Thinking & Problem Solving Skills.

Mapping Matrix of Training Objectives (TO) & Training Learning Outcomes (TLO)

Training Learning Outcomes (TLO)→ Training Objectives(TO)↓	TLO1	TLO2	TLO3	TLO4
TO1				
TO2				
TO3				

Unit	Course Contents	Student Engagement Activity
Unit - I	**Team Management** • Team communication & team conflict resolution • Role of a team leader • Team goal setting & understanding team development • Team dynamics & multicultural team activity • Johari Window Model	Collaborative Working Game Activity
Unit-II	**Time Management** • Time management matrix • Pareto Principle (80/20 rule) • Development process of plan of action	What You Did Yesterday Activity
Unit-III	**Leadership** • Difference between leadership & management • Types of leadership style • Core leadership skills	Lead The Blindfolded Activity
Unit-IV	**Stress Management** • Sign of stress & its impact • Types of stress • Techniques of handling stress	Keeping Cool Activity
Unit - V	**Emotional Intelligence** • Emotional intelligence & emotional competence • Components & behavioral skills of emotional intelligence	Guess The Emotion Game Activity
Unit - VI	**Critical Thinking** • Types of thinking & Characteristics • Critical thinking standards • Barriers to critical thinking	Think Pair Share Activity

Learning Resources	
Text Book	***Communication Skills*** by Sanjay Kumar & Pushp Lata: Oxford University Press, 2019.
Suggested Reference Book	***Personality Development & Communication Skills-1*** by C B Gupta: Scholar Tech Press, 2019.(ISBN No. – 9382209131)

Pedagogy

- The training will be based on the concept of learning by practice.
- The training will involve 30% of the training time on briefing and demonstration & the remaining 70% will be focusing on student's engagement in training activities.
- The training will follow a circular approach where students are engaged, evaluated, given feedback and then re engaged.

Internal (Continuous Assessment & Evaluation) & End Term (Assessment & Evaluation) for Teamwork & Interpersonal Skills

Unit No.	Unit Name	Internal Assessment Parameter	Internal Marks (70)	End Term Assessment Parameters	End Term Marks (30)
I	Team Management	Role Play / Group Activity	10	Written Test	10
II	Time Management		10		
III	Leadership		10		
IV	Stress Management	Assignment	10	Viva	20
V	Emotional Intelligence	Written Test	10		
VI	Critical Thinking		20		

SEMESTER – V

Programme	**Faculty of Engineering & Technology**		
Year / Semester	**3 / 5**	**Course Category**	**SEC**
Course Code	**23SS553**	**Course Title**	**Presentation Skills**
Continuous Evaluation: 70		**End Term Examination: 30**	
Prerequisite: Nil		**L T P: 0 0 2**	**Credits: 1**

Training Objectives (TO):-

- TO1. To develop the public speaking skills in the student.
- TO2. To make the students learn and adapt to the necessary etiquettes required working and growing in corporate culture.
- TO3. To make the students learn to speak in a debate session by putting his arguments and making others accept his viewpoint convincingly.

Training Learning Outcomes (TLO): -

After the completion of the training, the student will have ability:

- TLO1. To be confident in presenting himself in front of audience.
- TLO2. To become professional in his approach towards work culture.
- TLO3. To enhance the level communication skills while interacting with others.

Mapping Matrix of Training Objectives (TO) & Training Learning Outcomes (TLO)			
Training Learning Outcomes (TLO)➔ **Training Objectives(TO)🡻**	TLO1	TLO2	TLO3
TO1			
TO2			
TO3			

Unit	Course Contents	Student Engagement Activity
Unit-I	**Importance of Presentation Skills** • 4 P's of presentation skills – plan, prepare, practice & present • Guidelines for effective presentation	PPT Presentation Activity
Unit-II	**Storytelling Skills** • 4 P's of storytelling skills – people, place, plot & purpose • Types of storytelling techniques • Importance of storytelling skills	Start From Where I Stopped Activity
Unit-III	**Corporate Culture Etiquettes** • Importance of professional behavior at work place • Understand & implementation of etiquettes at work place • Importance of values & ethics • Types of professional / corporate etiquettes	Etiquettes Role Play Activity
Unit-IV	**Debate / Extempore** • Difference between debate, extempore & group discussion • Learning argument /counter argument in debate	Current Affair Topic Speech Activity
Unit-V	**Art of Creating Impression** • Importance of creating first impression • 6 ways to master the art of creating impression	Speech Activity
Unit-VI	**Problem Solving** • Types of problems & its solutions Problem solving process & tools	Think Pair Share Activity

Learning Resources	
Text Book	***Communication Skills*** by Sanjay Kumar & Pushp Lata: Oxford University Press, 2019.
Suggested Reference Book	***Personality Development & Communication Skills-1*** by C B Gupta: Scholar Tech Press, 2019.(ISBN No. – 9382209131)

Pedagogy

- The training will be based on the concept of learning by practice.
- The training will involve 30% of the training time on briefing and demonstration & the remaining 70% will be focusing on student's engagement in training activities.
- The training will follow a circular approach where students are engaged, evaluated, given feedback and then re engaged.

Internal (Continuous Assessment & Evaluation) & End Term (Assessment & Evaluation) for Presentation Skills

Unit No.	Unit Name	Internal Assessment Parameter	Internal Marks (70)	End Term Assessment Parameters	End Term Marks (30)
I	Importance of Presentation Skills	Presentation Activity	20	Written Test	10
II	Storytelling Skills	Speech Activity	15		
III	Corporate Culture Etiquettes	Assignment	10		
IV	Debate/Extempore	Speech Activity / Written Activity	15	Viva	20
V	Art of Creating Impression		10		
VI	Problem Solving				

SEMESTER – VI

Programme	**Faculty of Engineering & Technology**		
Year / Semester	**3 / 6**	**Course Category**	**SEC**
Course Code	**23SS654**	**Course Title**	**Professional Skills**
Continuous Evaluation: 70		**End Term Examination: 30**	
Prerequisite: Nil		**L T P: 0 0 2**	**Credits: 1**

Training Objectives (TO): -

- TO1. To encourage students to learn and apply the effective writing skills.
- TO2. To make the students learn various types of business correspondence letters, cover letters & resume.
- TO3. To encourage students to learn as to how to talk and convince people in GD & interview.
- TO4. To make the students learn to build rapport for building positive relationships professionally at workplace.

Training Learning Outcomes (TLO): -

After the completion of the training, the student will have ability:

- TLO1. To understand the importance of professional writing required in workplace.
- TLO2. To explore different formats in resume, cover letters & other business related letters.
- TLO3. To develop knowledge, skills and understanding people in-group and individually.
- TLO4. To apply communication strategies either in-group or one on one basis and will be confident to lead the discussion among them.

Mapping Matrix of Training Objectives (TO) & Training Learning Outcomes (TLO)

Training Learning Outcomes (TLO) ➔ Training Objectives(TO)🡻	TLO1	TLO2	TLO3	TLO4
TO1				
TO2				

TO3				
TO4.	-	-	-	

Unit	Course Contents	Student Engagement Activity
Unit-I	**Email Writing** • Importance of email communication skills • Basic rules of effective email writing • Structure of email – address, subject, message text, attachments, signature	Email Practice Activity
Unit-II	**Resume Writing** • Difference between Resume, CV & Bio data • Guidelines of resume writing • Resume preparation of the student	Resume Making Activity
Unit-III	**Letter Writing** • Types of Letter Writing – Application, Leave, etc. • Cover letter	Letter Writing Activity
Unit--IV	**Group Discussion (GD)** • Characteristics of GD & subject knowledge • Do's & Don'ts in GD • Strategies of GD • Types of GD	Group Discussion Practice Activity
Unit-V	**Interview Skills** • Preparation of the interview & company details information • Do's & Don'ts in interview • Types of Interviews • Strategies of interview	Mock Interview Practice Activity
Unit-VI	**Negotiation Skills** • Importance of negotiation skills • Four phases of negotiation skills • Barriers to negotiation & overcoming it • Win-win negotiation	Win-Win Activity

Learning Resources	
Text Book	***Communication Skills*** by Sanjay Kumar & Pushp Lata: Oxford University Press, 2019.
Suggested Reference Book	***Personality Development & Communication Skills-1*** by C B Gupta: Scholar Tech Press, 2019.(ISBN No. – 9382209131)

Pedagogy

- The training will be based on the concept of learning by practice.
- The training will involve 30% of the training time on briefing and demonstration & the remaining 70% will be focusing on student's engagement in training activities.
- The training will follow a circular approach where students are engaged, evaluated, given feedback and then re engaged.

Internal (Continuous Assessment & Evaluation) & End Term (Assessment & Evaluation) for Professional Skills

<table>
<tr><th>Unit No.</th><th>Unit Name</th><th>Internal Assessment Parameter</th><th>Internal Marks (70)</th><th>End Term Assessment Parameters</th><th>End Term Marks (30)</th></tr>
<tr><td>I</td><td>Email Writing</td><td rowspan="3">Written Assignment</td><td>10</td><td rowspan="3">Written Test</td><td rowspan="3">10</td></tr>
<tr><td>II</td><td>Resume Writing</td><td>10</td></tr>
<tr><td>III</td><td>Letter Writing</td><td>10</td></tr>
<tr><td>IV</td><td>Group Discussion</td><td>Group Discussion Activity</td><td>15</td><td rowspan="3">Viva</td><td rowspan="3">20</td></tr>
<tr><td>V</td><td>Interview Skills</td><td>Mock Interview Activity</td><td>15</td></tr>
<tr><td>VI</td><td>Negotiation Skills</td><td>Role Play</td><td>10</td></tr>
</table>

SEMESTER – VII

Programme	**Faculty of Engineering & Technology**		
Year / Semester	**4 / 7**	**Course Category**	**SEC**
Course Code	**23AR755**	**Course Title**	**Aptitude & Reasoning**
Continuous Evaluation: 70		**End Term Examination: 30**	
Prerequisite: Nil		**L T P: 0 0 2**	**Credits: 1**

Training Objectives (TO): -

- TO1. To understand the basic concepts of quantitative ability and logical reasoning.
- TO2. To make student practice on the concepts of quantitative ability and logical reasoning.
- TO3. To prepare the students for aptitude and reasoning round in placement selection process & other competitive exams.

Training Learning Outcomes (TLO): -

After the completion of the training, the student will have ability:

- TLO1. To understand the basic concepts of quantitative ability.
- TLO2. To solve campus placements aptitude papers covering Quantitative Ability.
- TLO3. To Compete in various competitive exams like CAT, CMAT, GATE, GRE, GATE, UPSC, GPSC etc.

Mapping Matrix of Training Objectives (TO) & Training Learning Outcomes (TLO)			
TRAINING LEARNING OUTCOMES (TLO) → TRAINING OBJECTIVES (TO) ↓	TLO1	TLO2	TLO3
TO1			
TO2			
TO3			

A-Quantitative Ability

UNIT - I

- Number System

- Percentage
- Profit, Loss and Discount
- Simple Interest and Compound Interest

UNIT – II

- Allegation and Mixture
- Average
- Ratio, Proportion and Variation, Problem on Ages and Numbers
- Time and Work
- Time, Speed and Distance

UNIT – III

- Permutation and Combination
- Probability
- Data Interpretation
- Geometry and Menstruations
- Sequence, Series & Progression and Logarithmic

B- Logical Reasoning

UNIT - IV

- Number Series and Alphabet Series
- Direction Sense Test
- Coding -Decoding
- Blood Relation

UNIT – V

- Syllogism
- Dice, Cube and Cuboids
- Seating Arrangement

UNIT – VI

- Clock and Calendar
- Critical Reasoning
- Order and Ranking, Ven diagram, Analogy
-

Learning Resources	
Text Books	***Quantitative Aptitude for Competitive Examinations*** by R S Aggarwal: S Chand Publishing, 2022.
	A Modern Approach to Logical Reasoning by R S Aggarwal: S Chand Publishing, 2022.

Pedagogy-

- The training will be based on the concept of learning by doing and practice.
- The training will involve 50% of the training time on teaching the concepts and the remaining 50% will be focusing on practice.
- The training will follow a circular approach where students are taught, evaluated and given the feedback.

Internal (Continuous Assessment & Evaluation) & End Term (Assessment & Evaluation) for Aptitude & Reasoning

Unit No.	Unit Name	Internal Assessment Parameter	Internal Marks (70)	End Term Assessment Parameters	End Term Marks (30)
I	Quantitative Ability	Written Assignment	10	Written Test	30
II			10		
III			10		
IV	Logical Reasoning		15		
V			15		
VI			10		

SKILL ENHANCEMENT COURSES (SEC)
IT SKILLS COURSES

Category	Course Code	Course Name	L	T	P	Credits
Technical Training						
SEC	24CS0201A/24ME0201/24CS0201B/24CE0201	Data Structure and Algorithms using C++/Industrial Automation Level-I/ Digital Marketing/Fundamentals of CAD for Engineers	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	Wearable Technology/Big Data Analytics, Tools and Techniques/Machine Learning using Python/Industrial Automation Level-II/RCC Structural Drawing Training	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 modeling/ FPGA for Embedded Systems/Essentials of Blockchain and IoT	0	0	2	1

	Data Structures and Algorithm using C++	L	T	P	C
Course Code:	23CS0201A	0	0	2	1
Course Type:	**SC**				
Pre-Requisite	**Basic Programming Knowledge**				

TRAINING OBJECTIVES

1. To understand object-oriented programming and advanced C++ concepts.
2. Be able to explain the difference between object-oriented programming and procedural programming.
3. To understand the basic concepts of data structure and their implementation through C++
4. To understand basic concepts about stacks, queues, lists.
5. To understand concepts about searching and sorting techniques.
6. To learn and understand the applications of basic data structures.

TRAINING LEARNING OUTCOMES (CLO)

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

1. Prepare object-oriented design for small/medium scale problems.
2. Demonstrate the differences between traditional imperative design and object-oriented design
3. To explain class structures as fundamental, modular building blocks, to understand the role of inheritance, polymorphism, dynamic binding and generic structures in building reusable code
4. For a given algorithm student will able to analyze the algorithms to determine the time and computation complexity and justify the correctness.
5. For a given problem of Stacks, Queues and linked list student will able to implement it and analyze the same to determine the time and computation complexity.
6. For a given Search problem (Linear Search and Binary Search) student will able to implement it.
7. Design and identify how to select the appropriate data structure according to the problem.

Mapping Matrix of Course Objectives (CO) and Course Learning Outcomes (CLO)

SEM	SUB CODE	Course name	TRAINING Objectives	TLO 1	TLO 2	TLO 3	TLO 4	TLO 5	TLO 6	TLO 7
III	23CS0401	Data Structures and Algorithm using C++	TO1	x						
			TO2		x	x				
			TO3				x			
			TO4					x		
			TO5						x	
			TO6							x

MODULE	TRAINING CONTENTS	HOURS
I	**INTRODUCTION TO C++ AND OBJECT ORIENTED CONCEPTS** Introduction to Objects and Object Oriented Programming, Encapsulation (Information Hiding), Access Modifiers: Controlling access to a class, method, or variable (public, protected, private, package), Other Modifiers, Polymorphism: Overloading, Inheritance, Overriding Methods, Abstract Classes, Reusability, Class's Behaviors. Basics of a Typical C++ Environment, Pre-processors Directives, illustrative Simple C++ Programs. Header Files and Namespaces, library files, Constructor and Destructor.	3
II	**INTRODUCTION TO DATA STRUCTURES** Dynamic aspects of operations on data, Characteristics of data structures, Creation and manipulation of data structures, Operations on data structures, Types of data structures – linear and nonlinear Linked lists: types of linked lists – singly, doubly and circularly linked lists, operations on linked lists.	3
III	**STACKS & QUEUE** Stacks: Implementation of stacks– array and linked list, operations on stacks, Applications of Stacks. Queues: Implementation of queues– array and linked list, operations on queues, Types of queues – queue, double ended queue and priority queue.	3
IV	**Searching:** Linear search, Binary search and Hashing. Algorithms and data structures for sorting: Insertion Sort, Bubble sort, Selection Sort, Merge sort, Quick Sort, Heap sort.	3
V	**HANDS ON ACTIVITY** a) Design an application in C++ for undo operation. b) Design an application in C++ for job scheduling. c) Design an application in C++ to display the student's record. Also include the previous and next options to view the previous and next record in the list.	3

TEXT BOOKS

1. Seymour Lipschutz, "*Data Structures with C*", McGraw Hill Education, Special Indian Edition, 2014.

REFERENCE BOOKS

2. Cormen, T. H. (2009). Introduction to Algorithms, 3rd Edition (The MIT Press) (3rd ed.) MIT Press.

Industrial Automation Level-I	
Course Code: 24ME0201	**L T P : 0 0 2**
Credits: 1	
Prerequisite: None	

COURSE OBJECTIVES (CO)

1. To acquaint students with the principles and objectives of Industrial Automation
2. To familiarize students with the actuators and sensors
3. To acquaint students with the process of PLC programming
4. To make students understand the basic concepts of HMI and MPS
5. To familiarize students with Industrial Robots

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 demonstrate:

1. The understanding of Industrial Automation
2. The principles of sensors and their outputs
3. The process of PLC programming
4. The understanding of concepts of HMI and MPS
5. The operation of Industrial Robotics

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

COURSE OBJECTIVES	COURSE LEARNING OUTCOMES				
	CLO1	CLO2	CLO3	CLO4	CLO5
CO1					
CO2					
CO3					
CO4					
CO5					

COURSE CONTENTS

Basic Level-1 Experiments

1. Aim: To learn the Basics of Servo Motor
    - Methodology: Understand the basic principles of servo motors, wire and program a servo motor, and observe its controlled movements.
2. Aim: To learn the Pneumatics Fundamentals
    - Methodology: Set up simple pneumatic circuits, operate pneumatic valves and actuators, and analyze their behavior under different conditions.
3. Aim: To learn the Basics of Hydraulic Systems
    - Methodology: Assemble a basic hydraulic circuit, operate hydraulic cylinders, and measure the force and displacement produced.
4. Aim: To learn the Sensor Technology Basics
    - Methodology: Connect various sensors (e.g., proximity, temperature) to a microcontroller, program them to read data, and analyze sensor outputs.
5. Aim: To learn the Object Detection Using Sensors
    - Methodology: Implement a simple object detection system using infrared sensors, detect objects, and respond with an LED indicator.

6. Aim: To learn the Basics of PLC Programming
    - Methodology: Write and upload a basic PLC program to control a simple process, such as turning on a light when a button is pressed.

6. Aim: To learn the Human-Machine Interfaces (HMI) Basics
    - Methodology: Create a basic HMI screen to display and control a simple process, such as monitoring and controlling the status of a motor.
7. Aim: To learn the Basics of MPS Station
    - Methodology: Set up a basic manufacturing process on the MPS station, operate it, and understand the role of each component.
8. Aim: To learn the Robotics Basics
    - Methodology: Learn the fundamental concepts of robotics, assemble a simple robotic arm, and program it to perform basic tasks.

Text and Reference Books:

- ACMA Handouts and course materials

DIGITAL MARKETING	
Course Code: 24CS0201B	**L T P : 0 0 2**
Pre-Requisite : NIL	
Credits: 2	

TRAINING OBJECTIVES(TOs)

1. To provide a foundational understanding of digital marketing concepts and strategies.
2. To explain the principles and practices of Search Engine Optimization (SEO).
3. To explore the role and strategies of social media marketing.
4. To examine digital advertising tools and methods for optimizing ad performance.
5. To design marketing strategy.

TRAINING LEARNING OUTCOMES (TLO's)

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

1. Explain the importance and components of digital marketing.
2. Understand how search engines work and apply SEO techniques to improve website visibility.
3. Develop strong social media profiles and create effective social media marketing strategies.
4. Utilize digital advertising tools and measure the performance of digital advertising campaigns.
5. Analyze and design marketing strategy for a given application or domain.

TRAINING LEARNING OUTCOMES (TLOs)-TRAINING OBJECTIVES (TOs) MAPPING

CLO / CO	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

COURSE CONTENTS

UNIT NUMBER	TRAINING CONTENTS	ACTIVITY
UNIT-I	**INTRODUCTION TO DIGITAL MARKETING & MARKETING ANALYSIS:** Introduction To Online Digital Marketing, Importance Of Digital Marketing, Traditional Vs. Digital Marketing, Types of Digital Marketing, Market Research, Keyword Research And Analysis	Use keyword planner tools to identify high-potential keywords for their industry.
UNIT-II	**SEARCH ENGINE OPTIMIZATION(SEO):** Introduction to SEO, How Search engine works, SEO Phases, History Of SEO, How SEO Works, , Types Of SEO technique, Keywords, Keyword Planner tools	**Review the SEO history and current status of a real-world website**
UNIT-III	**SOCIAL MEDIA MARKETING:** Introduction to Social Media Networks, Types of Social Media Websites and their Marketing strategies. Creating Strong Social Media Profiles.	**Develop a social media strategy for a startup, focusing on creating strong profiles and engaging content.**
UNIT-IV	**ADVERTISING TOOLS and OPTIMIZATION:** Advertising & its importance, Digital Advertising, Different Digital Advertisement, Performance of Digital Advertising, Display Advertising Media, Digital metrics.	Analyze the digital advertising strategy of a major e-commerce platform
UNIT-V	**CASE STUDY/HANDS-ON:** Googlebot (Google Crawler) /You-tube advertising/ Develop a social media strategy for a startup, focusing on creating strong profiles and engaging content/ Design a digital advertising campaign for a local business and measure its performance using digital metrics.	

TEXT BOOKS
• Digital Marketing –Kamat and Kamat-Himalaya • Marketing Strategies for Engaging the Digital Generation, D. Ryan
REFERENCE BOOKS
• Digital Marketing, V. Ahuja, Oxford University Press • Digital Marketing, S.Gupta, McGraw-Hill • Quick win Digital Marketing, H. Annmarie , A. Joanna, Paperback edition

Course Name: Fundamentals of CAD for Engineers	
Course Code: 24CE0201	**L T P : 0 0 2**
Credits: 01	
Prerequisite: None	

COURSE OBJECTIVES (COs)

1. The objective of this lab is to teach the student usage of Auto cad, basic drawing fundamentals in various civil engineering applications, especially in building drawing.
2. The objective of this course is to teach students the basic commands and tools necessary for professional 2D drawing, 3D drawing and drafting using AutoCAD.
3. Students able to learn to sketch and take field dimensions.
4. Students able to learn to take data and transform it into graphic drawings.
5. Students able to learn basic engineering drawing formats.

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 CAD software and basic functions.
2. Evaluate plans of Single storied building & multistoried buildings.
3. Develop different sections at different elevations.
4. Detailing of building components like doors, windows roof trusses.
5. Develop section and elevation for single and multistoried buildings using CAD software.

MAPPING BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLOs / COs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

COURSE CONTENTS

1. Introduction to computer aided drafting & coordinate system.
2. Introduction to computer aided drafting commands.
3. Exercise on Draw & Modify tool bars.
4. Exercise on Layer, Dimension, Texting & Block etc.
5. Drawing a plan of Building and dimensioning using layers.
6. Drawing a plan of Single storied buildings.
7. Drawing a plan of Multi storied buildings.
8. Developing sections and elevations for Single storied buildings
9. Developing sections and elevations for multistoried buildings.
10. Drawing of building components like walls, lintels, Doors, and Windows.

TEXTBOOKS/ REFERENCE BOOKS/NPTEL RESOURCES

1. Laboratory Manual

	Design Thinking and Augmented Virtual Reality	L	T	P	C
Course Code:	24CS0202A	0	0	2	1
Course Type:	SEC				
Pre-Requisite	None				

COURSE OBJECTIVES

1. To recognize the importance of DT.
2. To explain the phases in the DT process.
3. To familiarize the students with the Augmented Virtual Reality Environment.
4. To establish and cultivate a broad and comprehensive understanding of this rapidly evolving and commercially viable field of Computer Science

COURSE LEARNING OUTCOMES (CLO)

After the completion of TRAINING the students will be able to:

1. Understand and critically apply the concepts and methods of business processes.
2. Understand and analyzing design thinking history and its various concepts.
3. Understand, analyzing and create models with user's collaboration to apply design thinking concepts.
4. Understands the role and importance of graphics in VR, AR and MR.
5. Understand the technical and experiential design foundation required for the implementation of immersive environments in current and future virtual, augmented and mixed reality platforms.

Mapping Matrix of Course Objectives (CO) and Course Learning Outcomes (CLO)

SEM	SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
V	23CS0301	Design Thinking and Augmented Virtual Reality	CO1	x				
			CO2		x	x		
			CO3				x	
			CO4					x

MODULE	TRAINING CONTENT	STUDENTS ENGAGEMENT ACTIVITY
I	**INTRODUCTION TO DT** Recognize the importance of Design Thinking, Identify the steps in the DT process, Recognize the steps in the empathize phase of DT, Identify the steps required to conduct an immersion activity	Product that you loved and hated activity.
II	**DEFINE PHASE OF DT** Conduct an immersion activity and fill up the DT question template, Recognize the steps to create personas in the define phase of DT, Recognize the steps to create problem statements in the define phase of DT, Define the problem statements in the define phase of DT.	Interview people and fill the DT Question template
III	**IDEATE PAHSE OF DT** Recognize the steps in the ideate phase of DT, Apply the steps in the ideate phase of DT, Recognize how doodling can help to express ideas, Recognize the importance storytelling in presenting ideas and protypes, Recognize the importance of the prototype phase in DT.	Ideate a solution for a Given problem.
IV	**INTRODUCTION TO VR and AR** Historical Overview, Current Trends and Future applications of Immersive Technologies, Best practices in VR, AR and Mixed Reality (MR), Categorization of VR and AR techniques, Input and Output devices used in AR and VR. Case Study : Google Lens, ARCore	To study various AR and VR based existing applications.
V	**HANDS ON ACTIVITY** This activity will help the students to identify the importance of an innovative approach: a) Discuss about a product that you like or dislike and identify what they need in a bad product to make it good. b) Design a prototype how AR and VR can be used in Education.	Designing of Solution to the Problem.

TEXT BOOKS

1. Kelly S. Hale (Editor), Kay M. Stanney (Editor). 2014. Handbook of Virtual Environments: Design, Implementation, and Applications, Second Edition (Human Factors and Ergonomics) ISBN-13: 978-1466511842.

2. Michael Madary and Thomas K. Metzinger. 2016. Real Virtuality: A Code of Ethical Conduct. Recommendations for Good Scientific Practice and the Consumers of VR-Technology. Frontiers in Robotics and AI 3, February: 1–23. http://doi.org/10.3389/frobt.2016.00003

3. Jason Jerald. 2015. The VR Book: Human-Centered Design for Virtual Reality. Association for Computing Machinery and Morgan & Claypool Publishers. http://doi.org/10.1145/2792790.

REFERENCE BOOKS

1. Hooked by Nir Eyal
2. The Art of Creative Thinking by Rod Judkins
3. Start Up nation by Dan Senor and Saul singer
4. Start with Why by Simon Sinek

Programming using Python for Engineers	
Course Code: 24CS0202B	**L T P : 0 0 2**
Prerequisite: NIL	
Credits: 1	

TRAINING OBJECTIVES (CO)
1. To understand the fundamental structure of Python programs and the installation process.
2. To demonstrate proficiency with Python data types, variables, control statements, and debugging techniques.
3. To develop and test functions, including the use of identifiers, keywords, and various operators.
4. To create Python programs incorporating input/output statements and built-in data structures.
5. To apply Python programming concepts to implement a functional contact management system.

TRAINING LEARNING OUTCOMES (TLOS) After the completion of TRAINING the students will be able to:
1. Outline the basic structure of a Python program and discuss its components.
2. Practice variable assignments, perform operations with integers and floats, and utilize control statements effectively.
3. Design and implement functions, using appropriate identifiers, keywords, and operators.
4. Write programs that take user input and display output, utilizing built-in data structures like strings, lists, sets, tuples, and dictionaries.
5. Develop a functional contact management system incorporating all learned concepts, demonstrating comprehensive Python programming skills.

TRAINING LEARNING OUTCOME (TLO)-TRAINING OBJECTIVE (TO) MAPPING

	TLO1	TLO2	TLO3	TLO4	TLO5
TO1	✓				
TO2		✓			
TO3			✓		
TO4				✓	
TO5					✓

TRAINING CONTENTS

MODULE	TRAINING CONTENT	STUDENTS ENGAGEMENTACTIVITY
I	Introduction to Programming using Python: Structure of a Python Program, Python Overview, Modes of Programming in Python, installing Python, Algorithms and Flowcharts.	Divide students into small groups and ask them to outline the basic structure of a Python program. Each group presents their structure, and the class discusses similarities and differences.
II	Data Types & Variables: Statements & Expressions, Variables, Integers & Floats. Control statements:-branching, looping, Exit function, break, continue and pass, mutable and immutable structures. Testing and debugging a program.	Demonstrate variable assignment, operations with integers and floats, and control statements (if-else, loops). Students will practice these concepts by writing and testing simple code snippets.
III	Functions, Interpreter shell, Indentation. Identifiers and keywords, Literals, Basic operators (Arithmetic operator, Relational operator, Logical or Boolean operator, Assignment Operator, Bit wise operator). Building blocks of Python: Standard libraries in Python, notion of class, object and method.	Students will design and implement their own functions, including defining parameters and return values. They will test their functions and use identifiers, keywords, and operators appropriately within their functions.
IV	Creating Python Programs: Input and Output Statements Built-in data structures: Strings, Strings Slicing, lists, Sets, Tuples and Dictionary and associated operations, Indexing & Slicing.	Students will write a small program that takes user input and displays output, incorporating built-in data structures (strings, lists, sets, tuples, dictionaries) and using custom modules. For example, a simple contact management system or a quiz game.
V	Hands on Activity: • Apply Python programming concepts: data types, control statements, functions, and data structures. • Implement a functional contact management system.	Implement a python program that includes all the concepts.

LEARNING RESOURCES

1. “Python Programming: A Modern Approach”, Vamsi Kurama, Pearson
2. “PythonProgramming”,Oxford,ReemaThareja,June2017
3. “Learning Python”, Mark Lutz, Orielly
4. “Think Python”, Allen Downey, Green Tea Press
5. “Python Cookbook” by David Beazley and Brian K.Jones
6. “Python for Data Analysis” by Wes McKinney

WEARABLE Technology	
Course Code: 24CS0301A	L T P :0 0 2
Pre-Requisite : NIL	
Credits: 1	

TRAINING OBJECTIVES (TO's)
1. To know the hardware requirement of wearable systems 2. To understand the communication and security aspects in the wearable devices 3. To know the applications of wearable devices in the field of medicine

TRAINING LEARNING OUTCOMES (TLO's)
The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to: 1. Describe the concepts of wearable system. 2. Explain the energy harvestings in wearable device. 3. Use the concepts of BAN in health care. 4. Compare the various wearable devices in healthcare system

TRAINING LEARNING OUTCOME (CLO)-TRAINING OBJECTIVE (CO) MAPPING

TLO / **TO**	TLO1	TLO2	TLO3	TLO4
TO1	✓	✓		
TO2		✓	✓	
TO3			✓	✓

TRAINING CONTENTS

UNIT NUMBER	**TRAINING CONTENTS**
UNIT-I	**INTRODUCTION TO WEARABLE SYSTEMS AND SENSORS** Wearable Systems- Introduction, Need for Wearable Systems, Drawbacks of Conventional Systems for Wearable Monitoring, Applications of Wearable Systems, Types of Wearable Systems, Components of wearable Systems. Sensors for wearable systems-Inertia movement sensors, Respiration activity sensor, Impedance plethysmography, Wearable ground reaction force sensor.

UNIT-II	**SIGNAL PROCESSING AND ENERGY HARVESTING FOR WEARABLE DEVICES** Wearability issues -physical shape and placement of sensor, Technical challenges - sensor design, signal acquisition, sampling frequency for reduced energy consumption, Rejection of irrelevant information. Power Requirements- Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles.
UNIT-III	**WIRELESS HEALTH SYSTEMS** Need for wireless monitoring, Definition of Body area network, BAN and Healthcare, Technical Challenges- System security and reliability, BAN Architecture – Introduction, Wireless communication Techniques.
UNIT-IV	**APPLICATIONS OF WEARABLE SYSTEMS** Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, neural recording, Gait analysis, Sports Medicine.

TEXT BOOKS

- Annalisa Bonfiglo and Danilo De Rossi, Wearable Monitoring Systems, Springer, 2011
- Zhang and Yuan-Ting, Wearable Medical Sensors and Systems,Springer, 2013
- Edward Sazonov and Micheal R Neuman, Wearable Sensors: Fundamentals, Implementation and Applications, Elsevier, 2014
- Mehmet R. Yuce and JamilY.Khan, Wireless Body Area Networks Technology, Implementation applications,Pan Stanford Publishing Pte.Ltd, Singapore, 2012

REFERENCE BOOKS / RESOURCES

- Sandeep K.S, Gupta, Tridib Mukherjee and Krishna Kumar Venkatasubramanian, Body Area Networks Safety, Security, and Sustainability, Cambridge University Press, 2013.
- Guang-Zhong Yang, Body Sensor Networks, Springer, 2006.

	BIG DATA ANALYTICS, TOOLS AND TECHNIQUES	L	T	P	C
Course Code:	24CS0301B	0	0	2	1
Course Type:	**SEC**				
Pre-Requisite	**None**				

TRAINING OBJECTIVES

1. To provide an overview of an exciting field of big data analytics.
2. To introduce the tools required to manage and analyze big data like Hadoop, NoSQL MapReduce
3. To learn the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability.

TRAINING LEARNING OUTCOMES (TLO)

After completion of TRAINING, students would be able to:

1. Understand the vision of Big Data from a global context.
2. To understand and apply Hadoop in Market perspective of Big Data.
3. To evaluate the application of Big Data in Industrial and Commercial Building Automation, evaluating.
4. To reduce Big Data performance using MapReduce and Real-World Design Constraints.

Mapping Matrix of Training Objectives (TO) and Training Learning Outcomes (TLO)

SEM	SUB CODE	Course name	TRAINING Objectives	TLO 1	TLO 2	TLO 3	TLO 4
VI	24CS0301B	BIG DATA ANALYTICS, TOOLS AND TECHNIQUES	TO1	x			
			TO2		x	x	
			TO3				x

MODULE	TRAINING CONTENTS	STUDENTS ENGAGEMENT ACTIVITY
I	**BIG DATA** Definition with Real Time Examples, How Big Data is generated with Real Time Generation, Use of Big Data-How Industry is utilizing Big Data, Future of Big Data.	Real life examples illustrated with discussion on Significance of Big Data

MODULE	TRAINING CONTENTS	STUDENTS ENGAGEMENT ACTIVITY
II	**HADOOP** Why Hadoop? What is Hadoop? Hadoop vs RDBMS, Hadoop vs BigData, Anatomy of a Hadoop cluster.	Students are trained on how to work on Hadoop
III	**MAPREDUCE** Theory, Data Flow (Map – Shuffle - Reduce), MapRed vs MapReduce APIs	Evaluating the application of Big Data in Industrial and Commercial Building Automation, evaluating Big Data performance using MapReduce and Real-World Design Constraints.
IV	**HIVE AND PIG** Architecture, Installation, Configuration, Hive vs RDBMS, Why Pig, Use case of Pig, Pig Components, Data Model.	Building and create state of the art architecture in Big Data. Hadoop, Creating projects and research activities based on Pig& Hive

TEXT BOOKS

1. Gelman, Andrew, and Jennifer Hill. Data Analysis Using Regression and Multilevel/Hierarchical Models. 1st ed. Cambridge, UK: Cambridge University Press, 2006. ISBN: 9780521867061.

2. Gelman, Andrew, John B. Carlin, Hal S. Stern, and Donald B. Rubin. Bayesian Data Analysis. 2nd ed. New York, NY: Chapman & Hall, 2003. ISBN: 9781584883883

REFERENCE BOOKS/RESOURCES

1. Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data” by EMC Education Services
2. Analytics: Data Science, Data Analysis and Predictive Analytics for Business” by Daniel Covington.
3. Machine Learning for Big Data: Hands-On for Developers and Technical Professionals” by Jason Bell.

Machine Learning with Python	
Course Code: 24CS0301C	**L T P : 0 0 2**
Prerequisite: Nill	
Credits: 1	

TRAINING OBJECTIVES (CO)
6. To understand the fundamental concepts of python programming.
7. To apply machine learning concepts and processes using Python libraries.
8. To analyze datasets to perform regression analysis and evaluate models.
9. To assess the performance of classification models using various metrics such as precision, recall, and F1 scored.
10. To design and Implement SVM for classification and regression tasks.

TRAINING LEARNING OUTCOMES (TLOS) After the completion of TRAINING the students will be able to:
6. Articulate the basic syntax, data structures, and control flow in Python.
7. Implement basic machine learning algorithms and processes using libraries such as Scikit-Learn.
8. Conduct exploratory data analysis (EDA), perform regression analysis, and evaluate the performance of regression models using appropriate metric.
9. Evaluate classification models by calculating and interpreting performance metrics like precision, recall, and F1 score.
10. Create and deploy Support Vector Machines (SVM) for classification and regression tasks, including the use of different kernels and hyperparameter tuning.

TRAINING LEARNING OUTCOME (TLO)-TRAINING OBJECTIVE (TO) MAPPING

	TLO1	TLO2	TLO3	TLO4	TLO5
TO1	✓				
TO2		✓			
TO3			✓		
TO4				✓	
TO5					✓

TRAINING CONTENTS

MODULE	TRAINING CONTENT	STUDENTS ENGAGEMENTACTIVITY
I	Introduction to Python, python basics, Data Preprocessing techniques, Reading CSV Data into Memory, Loading data from Seaborn, Visualization.	Analyzing a dataset: Load, clean, and visualize data.
II	Introduction to Machine Learning, Python for Machine Learning.	1. Identify real-world problems for ML solutions. 2. Implementing a simple ML model.
III	Regression: Introduction to Regression, Linear regression with scikit-Learn, Model Evaluation: EDA, Evaluation metrics, Multiple Linear Regression.	Lab: Conduct EDA and implement linear and multiple linear regression models.
IV	Classification: Introduction to Classification, Performance Measures: Confusion matrix, precision, recall, F1 score, Stratified k-fold cross-validation.	Lab: Implement classification algorithms and performance evaluation.
V	Support Vector Machine (SVM): SVM Concepts, Linear SVM Classification, Polynomial Kernel. Support Vector Regression (SVR): Introduction to SVR, Applications and implementation using Scikit-Learn.	Lab: Implement SVM for classification and regression, Explore hyperparameter tuning and optimization.

LEARNING RESOURCES
7. "Python Machine Learning" by Sebastian Raschka and Vahid Mirjalili 8. "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow” by Aurélien Géron 9. "Machine Learning with Python Cookbook" by Chris Albon 10. "Introduction to Machine Learning with Python: A Guide for Data Scientists" by Andreas C. Müller and Sarah Guido 11. "Machine Learning Yearning" by Andrew Ng

Industrial Automation Level-II	
Course Code: 24ME0301	**L T P : 0 0 2**
Credits: 1	
Prerequisite: None	

COURSE OBJECTIVES (CO)

1. To acquaint students with the electrical connections for Industrial Automation
2. To familiarize students with the connections of multiple actuators and sensors
3. To acquaint students with the process of advanced PLC programming
4. To make students understand the basic concepts of HMI
5. To familiarize students with Industrial Robots and its scope in Industry 4.0

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 demonstrate:

1. The understanding of advances of Industrial Automation
2. The principles of sensors and their outputs to control multiple actuators
3. The process of PLC programming
4. The understanding of concepts of HMI
5. The operation of Industrial Robotics and Industry 4.0

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

COURSE OBJECTIVES	COURSE LEARNING OUTCOMES				
	CLO1	CLO2	CLO3	CLO4	CLO5
CO1					
CO2					
CO3					
CO4					
CO5					

COURSE CONTENTS

Level-2 Experiments

1. Aim: To learn Electrical Circuit Construction for industrial automation
   - Methodology: Construct basic electrical circuits using breadboards, resistors, LEDs, and power sources, and measure current and voltage.
2. Aim: To learn formation of Complex Pneumatic Systems containing multiple actuators
   - Methodology: Design and build complex pneumatic circuits with multiple actuators and sequence control, and troubleshoot common issues.
3. Aim: To learn Hydraulic Control Systems
   - Methodology: Implement proportional control in hydraulic systems, use proportional valves, and analyze the system response.
4. Aim: To learn Sensor Integration Techniques
   - Methodology: Integrate multiple sensors into a single system, program data fusion techniques, and analyze combined sensor data for decision-making.
5. Aim: To learn Advanced Object Detection
   - Methodology: Implement an object detection system using a camera and image processing software, and program it to identify and track objects.
6. Aim: To learn Advanced PLC Programming for Automation
   - Methodology: Write complex PLC programs for automating multi-step processes, use timers and counters, and implement fault detection.
7. Aim: To learn Advanced HMI Design
   - Methodology: Develop dynamic HMI screens with real-time data display and control, implement user interactions, and handle alarms and events.
8. Aim: To learn Robotics Teaching
   - Methodology: Program a robotic arm for complex tasks, implement motion planning algorithms, and integrate sensors for enhanced functionality.
9. Aim: To get acquainted with Industry 4.0
   - Methodology: Learn the key concepts of Industry 4.0, explore a simple simulation of an Industry 4.0 system, and discuss its applications.

Text and Reference Books:

- ACMA Handouts and course materials.

Course Name: RCC Structural Drawing Training	
Course Code: 24CE0301	**L T P : 0 0 2**
Credits: 01	
Prerequisite: None	

COURSE OBJECTIVES (COs)

1. The objective of this lab is to teach the student usage of RCC, with the help of Auto CAD basic drawing fundamentals in various civil engineering applications, especially in RCC member drawing.
2. The objective of this course is to teach students the basic commands and tools necessary for professional 2D drawing, 3D drawing and drafting using Auto CAD.
3. Students able to learn to sketch and take field dimensions.
4. Students able to learn to take data and transform it into graphic drawings.
5. Students able to learn basic engineering drawing for RCC members formats.

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 CAD and STAAD Pro. Software and basic functions.
2. Evaluate plans of Cantilever Beam and with given data regarding the size of the beam and the reinforcement
3. Develop different sections at different elevations.
4. Detailing of RCC components like singly and Doubly Reinforced section, roof trusses.
5. Develop section and elevation for RCC Columns and RCC Beam using CAD and STAAD Pro. Software.

MAPPING BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLOs / Cos	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					

					✓

COURSE CONTENTS

1. Details of reinforcement in a simply supported RCC beam for singly reinforced with the given design data regarding the size and number of bars.
2. Details of reinforcement in a simply supported RCC beam for singly reinforced with the given design data regarding the stirrups their size and spacing.
3. Details of reinforcement in a simply supported RCC beam for doubly reinforced with the given design data regarding the size and number of bars.
4. Details of reinforcement in a simply supported RCC beam for doubly reinforced with the given design data regarding the stirrups their size and spacing.
5. Details of reinforcement for a RCC square and circular column with isolated square footing.
6. Details of reinforcement for a cantilever beam with given data regarding the size of the beam and the reinforcement.

NOTE: Exercises on bar bending schedules for each of the three above items will be prepared.

7. Details of reinforcement in plan for a simply supported RCC One way slab with intermediate support and two-way slabs from the given data.
8. Details of reinforcement in section for a simply supported RCC Tow way slab with intermediate support and two-way slabs from the given data.
9. Details of reinforcement in a two storied RCC internal and corner column. In this, the details of reinforcement at the junction with beams must be shown from the given design data.
10. Details of reinforcement of the junction of a secondary beam with the main beam with the given data.

TEXTBOOKS/ REFERENCE BOOKS/NPTEL RESOURCES

2. Laboratory manual
3. IS 962 (1989): Code of practice for architectural and building drawings [CED 51: Planning, Housing and pre-fabricated construction]
4. IS 456 (2000): Plain and Reinforced Concrete - Code of Practice [CED 2: Cement and Concrete]
5. R. C. C. DESIGN & DRAWING [4TH EDITION] BY NEELAM SHARMA, Publisher- Kataria, S. K., & Sons
6. R.C.C. Design And Drawing by Dr. M.L. Ohri, Publisher- Satya Prakashan.

	Artificial Intelligence and Machine Learning	L	T	P	C
Course Code:	24CS0302A	0	0	2	1
Course Type:	**SEC**				
Pre-Requisite	**None**				

COURSE OBJECTIVES

1. To understand the need of AI
2. To describe AI algorithms (e.g., standard search algorithms).
3. To learn about one of the learning methods of AI that is Machine Learning.
4. To identify potential application domains of AI and machine learning in practice.

COURSE LEARNING OUTCOMES (CLO)

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

1. Identify problems that are amenable to solution by AI methods.
2. Understand the basics and need of AI and Machine learning in a global view.
3. Apply the supervised learning techniques.
4. Implement the different applications using the concepts of AI and ML

Mapping Matrix of Course Objectives (CO) and Course Learning Outcomes (CLO)

SEM	SUB CODE	Course name	Course Objectives	CLO 1	CLO 2		CLO 3	CLO 4
IV	24CS0302A	Artificial Intelligence and Machine Learning	CO1	x				
			CO2		x			
			CO3		x		x	
			CO4				x	x

MODULE	TRAINING CONTENTS	STUDENTS ENGAGEMENT ACTIVITY
I	**INTRODUCTION:** Introduction to AI: Definitions, Historical foundations, Basic Elements of AI, Characteristics of intelligent algorithm, AI application Area.	Classification of AI Problems into AI task Domains
II	**PROBLEM SOLVING:**	Solving manually constraint satisfaction problem

MODULE	TRAINING CONTENTS	STUDENTS ENGAGEMENT ACTIVITY
	Depth-first, breadth-first search, Problem Reduction, Constraint Satisfaction, Means-End Analysis.	
III	**INTRODUCTION TO MACHINE LEARNING** Machine Learning Basics, Need of Machine Learning, Application Domains, Basic Learning Techniques.	Identification of ML Model based on Application
IV	**CLASSIFICATION PROBLEM** Machine learning Algorithms for classification problem: Decision Trees, K-NN, SVM.	Design decision trees and apply K-NN algorithm
V	**HANDS ON ACTIVITY:** Students will apply the methods learnt to design applications for a) Constraint Satisfaction Problem b) Robot Traversal c) Classification problems like COVID Detection, Spam classification etc.	Implement the given activity.

TEXT BOOKS

1. Introduction to Machine Learning, E. Alpaydin. MIT Press
2. Machine Learning, T.M. Mitchell, Mc-Graw Hill

REFERENCE BOOKS

1. Stuart Russell, Peter Norvig, Artificial intelligence: A Modern Approach, Prentice Hall, Fourth edition, 2020.
2. Rich and K. Knight," Artificial Intelligence", Tata McGraw Hill.

MATLAB FOR ENGINEERS

Course Code: 24EC0302	**L T P** : 0 0 2
Credits: 3	
Prerequisite: Nil	

COURSE OBJECTIVES (CO)

1. To learn features of MATLAB as a programming tool.
2. To promote new teaching model that will help to develop programming skills and technique to solve mathematical problems.
3. To understand MATLAB graphic feature and its applications.
4. To use MATLAB as a simulation tool.

COURSE LEARNING OUTCOMES (CLO)

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

1. Develop the understanding about the features of MATLAB as a programming tool.
2. Develop programming skills and technique to solve mathematical problems.
3. Understand MATLAB graphic feature and its applications.
4. Apply the MATLAB as a simulation tool.

MAPPING BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLOs / COs	CLO1	CLO2	CLO3	CLO4
CO1	✓			
CO2		✓		
CO3			✓	
CO4				✓

COURSE CONTENTS

UNIT	CONTENTS	HOURS
UNIT-I	The MATLAB Environment MATLAB Basics – Variables, Numbers, Operators, Expressions, Input and output. Vectors, Arrays – Matrices	9
UNIT-II	Built-in Functions User defined Functions	9
UNIT-III	Files and File Management – Import/Export Basic 2D, 3D plots Graphic handling	9

UNIT-IV	Conditional Statements, Loops MATLAB Programs – Programming and Debugging. Applications of MATLAB Programming.	9
UNIT-V	Algebraic equations Basic Symbolic Calculus and Differential equations Numerical Techniques and Transforms	9

TEXT BOOKS/REFERENCE BOOKS

1. "A Guide to MATLAB - for Beginners and Experienced Users", 2nd Ed., Brian R. Hunt, Ronald L. Lipsman, Jonathan M. Rosenberg, Cambridge University Press, (2006).
2. "Essentials of MATLAB Programming", 2nd Ed., Stephen J. Chapman, Cengage Learning, (2009).
3. "MATLAB Demystified", David McMahon, The McGraw-Hill Companies, (2007).
4. "MATLAB® for Engineers", 3rd Ed., Holly Moore, Pearson Education, Inc., (2012).
5. "Engineering computation with MATLAB", 2nd Ed., David M. Smith, Pearson Education, Inc., (2010).

Structural Analysis Using FEM-based Tools	
Course Code: 24CE0302	**L T P : 0 0 2**
Credits: 2	
Prerequisite: Nil	

COURSE OBJECTIVES (COs)

1. Utilize the analysis software to create geometry, discretize, and apply boundary conditions to solve stress-related problems on bars, Trusses, and plates for different loading conditions
2. Demonstrate the deflection of beams subjected to point, uniformly distributed, and varying loads further to use the available of results to draw shear force and bending moment diagram
3. Analysis of Framed Structure.
4. Analyze the given problem by applying basic principles to solve and demonstrate 1D and 2D heat transfer with conduction and convection boundary conditions

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 bar, truss, and plate problems for different loading conditions.
2. Calculate deflection and Draw BMD & SFD of Beam subjected to different loading conditions.
3. Analyze Framed Structure.
4. Demonstrate 1D and 2D heat transfer with conduction and convection boundary conditions.

MAPPING BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLOs / COs	CLO1	CLO2	CLO3	CLO4
CO1	✓			
CO2		✓		
CO3			✓	
CO4				✓

COURSE CONTENTS

Unit-1: Introduction

Introduction to FEM, Getting Started with FEM Tools, Steps in FEM.

Unit-2: Modeling (Pre-Processing)

Modeling of Bar, Truss, Plate, Beam, and Framed Structures, Applying Boundary Conditions, and Applying Loads.

Unit-3: Analysis (Post-Processing)

Static analysis of Structures and visualization of Results.

REFERENCE BOOK/RESOURCES

1. FE based Software Manual

Data Analytics Tools	
Course Code: 24CS0302B	**L T P :0 0 2**
Pre-Requisite : NIL	
Credits: 1	

COURSE OBJECTIVE

1. To provide an understanding of the fundamental concepts and processes of data analytics.
2. To introduce students to R and R-Studio, and teach basic data types and structures in R.
3. To equip students with skills for importing, exporting, and performing exploratory data analysis (EDA) in R.
4. To familiarize students with report generation tools like Google Data Studio and Tableau, focusing on creating interactive dashboards.
5. To enable students to apply their knowledge through hands-on activities and case studies, enhancing their practical skills in data analytics.

COURSE LEARNING OUTCOMES (CLO's)

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

1. Demonstrate an understanding of the basic principles and processes of data analytics.
2. Utilize R and R-Studio to handle basic data types and structures, and perform fundamental operations.
3. Import, export, and clean data in R, and conduct exploratory data analysis (EDA) using descriptive statistics and data visualization techniques.
4. Create interactive reports and dashboards using Google Data Studio and Tableau, effectively visualizing data insights.
5. Apply data analytics tools and techniques to real-world datasets through hands-on projects, presenting and interpreting their findings accurately.

COURSE LEARNING OUTCOMES (CLO)-COURSE OBJECTIVES (CO) MAPPING

CLO / **CO**	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**Introduction to Data Analytics** Overview of Data Analytics: Definition and importance, Types of data analytics, Applications and examples; Data Analytics Process: Steps in the data analytics process, Key concepts; Introduction to Data Analytics Tools: Overview of tools, Comparison of tools
UNIT-II	**Foundations of R and Data Structures** Introduction to R and RStudio: Installation and setup, RStudio interface; Basic R Syntax and Operations: Writing and executing R commands, Basic arithmetic and logical operations, Understanding variables and assignments; Data Types and Structures in R: Vectors, matrices, and arrays, Data frames and lists, Factors and strings
UNIT-III	**Data Handling and Exploratory Analysis in R** File Import and Export in R: Reading data from CSV, Excel, Writing data to CSV and Excel, Handling different file types; Exploratory Data Analysis (EDA) with R: Descriptive statistics, Data visualization using `ggplot2`, Data manipulation using `dplyr`, Case study
UNIT-IV	**Interactive Data Visualization Tools : Google Data Studio / Tableau / Any other** Introduction, Creating an account/installation, Connecting to data sources, Building basic visualizations, Creating interactive dashboards;
UNIT-V	**Hands-On Activity / Case Study** Mini Project with R: Choose a dataset, Perform data manipulation, visualization, and analysis, Present findings; Mini Project with Google Data Studio / Tableau: Choose a dataset, Create visualizations and dashboard, Present the dashboard and insights

TEXT BOOKS

- Grolemund, G., & Wickham, H. (2017). R for Data Science: Import, Tidy, Transform, Visualize, and Model Data. O'Reilly Media.
- Matloff, N. (2011). The Art of R Programming: A Tour of Statistical Software Design. No Starch Press.
- Murray, D. (2016). Tableau Your Data!: Fast and Easy Visual Analysis with Tableau Software. John Wiley & Sons.
- Devey, B. (2020). Google Data Studio for Beginners: A Step by Step Guide to Building Better Data Visualizations and Business Intelligence with Google Data Studio. Independently Published

REFERENCE BOOKS / RESOURCES

- Shmueli, G., Patel, N. R., & Bruce, P. C. (2010). Data Mining for Business Intelligence: Concepts, Techniques, and Applications in Microsoft Office Excel with XLMiner. John Wiley & Sons.
- Adler, J. (2010). R in a Nutshell: A Desktop Quick Reference. O'Reilly Media.
- Few, S. (2013). Information Dashboard Design: Displaying Data for At-a-Glance Monitoring. Analytics Press.
- Google. (n.d.). Google Data Studio Help Center. Retrieved from https://support.google.com/datastudio/answer/6283323?hl=en
- Google. (n.d.). Introduction to Data Studio. Coursera. Retrieved from https://www.coursera.org/learn/google-data-studio

Building Information Modelling	
Course Code: 24CE0401	**L T P : 0 0 2**
Credits: 2	
Prerequisite: None	

COURSE OBJECTIVES (COs)

5. Provide familiarity with current BIM technologies and understanding of the shift from 2D representation to 3D simulation
6. Provide an understanding of new means of coordination and collaboration of design and construction
7. Provide understanding for linking and maintaining continuity of existing and designed BIM information and other vital information, such as vendors for specific materials, location of details, and quantities required for estimation, bidding, and scheduling, into the model
8. Provide an understanding of new project delivery systems and technologies for 'integrated practice
9. Provide an outlook on how innovative technologies could be integrated into the current AEC practices.

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:

5. Extract and analyze data from site topography and Create basic building models using structural grids and support systems.
6. Design basic building components including levels, floors, roofs, etc.
7. Employ parametric modeling in 3D design and incorporate the building systems into the 3D building model.
8. Produce the building details and documentation.
9. Create high-quality and annotated building section drawings and renderings

MAPPING BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLOs / COs	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

COURSE CONTENTS

Unit-1: Introduction

Definition of BIM, history of BIM. BIM on the architecture and engineering disciplines, introduction & modeling, interface, and navigation. 3D drafting: basic model building, Structural grids, support.

Unit-2: Modeling

Levels, floors, roofs, ceilings, windows, doors. navigation: ribbon, sketch mode, general interface. Basic dimensions, building sections, plans and elevations, circulation, and families.

Unit-3: Detailing, Documentation, and Rendering

Construction details, detail views, sheet organization, title block, annotation, rendering, and panorama.

REFERENCE BOOK/RESOURCES

2. AEC Technology – AECbytes - http://www.aecbytes.com/
3. Building Smart Alliance - http://www.buildingsmartalliance.org/
4. National BIM Standard (NIBS) - https://www.nationalbimstandard.org/
5. BIM Forum - http://www.bimforum.org/
6. BIM and Integrated Design - http://bimandintegrateddesign.com/
7. Revit Wiki On-line Help – http://wikihelp.autodesk.com/Revit/enu/2013
8. Revit City – http://www.revitcity.com/index.php
9. The Revit Kid – http://therevitkid.blogspot.com
10. BIM Boom/ Revit 3D – http://bimboom.blogspot.com
11. Tips and Tricks Series by AECbytes – http://www.aecbytes.com/tipsandtricks/index.htm
12. Wing, Eric. Autodesk Revit Architecture 2017: No Experience Required. Indianapolis: John Wiley & Sons, 2016.
13. Kim, Marcus, Lance Kirby, and Eddy Krygiel. Mastering Autodesk Revit 2017 for architecture. 1st ed. INpolis, IN: John Wiley & Sons, 2016.
14. Garber, Richard. BIM Design: Realizing the Creative Potential of Building Information Modeling. AD Smart 02. Chichester, U.K.: Wiley, 2004.
15. Pressman, Andy. Designing Relationships: The Art of Collaboration in Architecture. New York: Routledge, 2014.

FPGA FOR EMBEDDED SYSTEM	
Course Code: 24EC0401	**L T P : 3 1 0**
Credits: 1	
Prerequisite: NIL	

COURSE OBJECTIVES (CO)

This course covers the advanced design and analysis of digital circuits with HDL. The primary goal is to provide in depth understanding of system design. The course enables students to apply their knowledge for the design of advanced digital hardware systems with help of FPGA tools.

1. Understand Digital system design using HDL.
2. Know FPGA architecture, interconnect and technologies.
3. Know different FPGA's and implementation methodologies.
4. Understand configuring and implementing digital embedded system, microcontrollers, microprocessors, DSP algorithm on FPGA.

COURSE LEARNING OUTCOMES (CLO)

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

1. Design and optimize complex combinational and sequential digital circuits
2. Model Combinational and sequential digital circuits by Verilog HDL
3. Design and model digital circuits with Verilog HDL at behavioural, structural, and RTL Levels
4. Develop test benches to simulate combinational and sequential circuits.

MAPPING BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLOs / COs	CLO1	CLO2	CLO3	CLO4
CO1	✓			
CO2		✓		
CO3			✓	
CO4				✓

COURSE CONTENTS

UNIT	CONTENTS	HOURS
UNIT-I	Basic about Electronics, Digital Circuit Design, Logic Gates, Boolean Algebra, Microprocessor Fundamentals of FPGA Architecture, Logic Blocks	9
UNIT-II	Timers & Counters, FPGA Vs CPLDs, FPGA Developmental Process - in Xilinx Software Vivado Design Flow & it tools, RTL Analysis	9

UNIT-III	Hardware Description Language, Verilog HDL - Code Structure, VHDL - Code Structure, VHDL - Dataflow Modelling Styles, VHDL - Behaviourial Modelling Style, VHDL - Structural Modelling Style	9
UNIT-IV	Basic Programming in FPGA, Simulation Tools, LCD Display Interfacing with FPGA, ADC Interfacing with FPGA	9
UNIT-V	IOT using FPGA, Live Project with FPGA, Session Overview about Microcontrollers	9

TEXT BOOKS/REFERENCE BOOKS

1. M.J.S. Smith, "Application Specific Integrated Circuits", Pearson, 2000.
2. Peter Ashenden, "Digital Design using VHDL", Elsevier, 2007.
3. Peter Ashenden, "Digital Design using Verilog", Elsevier, 2007.
4. W. Wolf, "FPGA based system design", Pearson, 2004. 4. Clive Maxfield, "The Design Warriors's Guide to FPGAs", Elsevier, 2004
5. Samir Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis" Prentice Hall, Second Edition, 2003.

ESSENTIALS OF BLOCKCHAIN & IOT –LEVEL-I	
Course Code: 24CS0401	**L T P : 0 0 2**
Pre-Requisite : NIL	
Credits: 1	

TRAINING OBJECTIVES

1. To familiarise the students with functional/operational aspects of cryptocurrency ECOSYSTEM.
2. To understand emerging abstract models for Block chain Technology.
3. To learn various protocols of IoT.

TRAINING LEARNING OUTCOMES (TLOS)

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

1. Understand how bitcoin and other coins work in real world.
2. Analyse the properties of Block Chain models.
3. Understand the vision of IoT and communication protocols from a global context.
4. Design portable IoT using appropriate boards.

TRAINING LEARNING OUTCOME (TLO)-TRAINING OBJECTIVE (TO) MAPPING

	TLO1	**TLO2**	**TLO3**	**TLO4**
TO1	✓			
TO2		✓		
TO3			✓	✓

TRAINING CONTENTS

MODULE	TRAINING CONTENT	STUDENTS ENGAGEMENT ACTIVITY
I	**CONSENSUS** The consensus problem, Abstract Models for BLOCKCHAIN : GARAY model, RLA Model, liveness and fairness, Proof of Stake (PoS) based Chains, Hybrid models (PoW + PoS)	Perform Mapping of coins and Blockchain Models
II	**BITCOIN** Bitcoin Introduction, Wallet - Blocks - Merkley Tree - hardness of mining - transaction verifiability - anonymity - forks - double spending - mathematical analysis of properties of Bitcoin.	To identify the type of wallet used in a specific application.
III	**Introduction to IoT:** Definition, Characteristics, Applications, Connectivity Layers, Addressing, Networking, Sensing: Sensors and Transducers, Sensor Classes, Sensor Types, Actuation: Actuator Basics, Actuator Types. **Connectivity Technologies:** ZigBee, 6LoWPAN, RFID, HART, NFC, Bluetooth, ISA100.11a.	To identify the types and characteristics of Sensors
IV	**Introduction to Arduino**: Basic Concepts of Arduino Platform, Examples of Arduino Programming, Integration of Sensors and Actuators with Arduino,	To design a simple application of LED lightning
V	**HANDS ON ACTIVITY** The students will design an application for smart irrigation system, smart healthcare system. In this activity students will identify the major components required for building a smart application and design the architecture and application accordingly.	Complete the Assigned Activity

LEARNING RESOURCES

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press, 2016.
2. Honbo Zhou, ”The Internet of Things in the Cloud:A Middleware Perspective” – – CRC Press-2012
3. Arshdeep Bahga, Vijay Madisetti, “Internet of Things (A Hands-On-Approach)”, VPT, 2014.
4. https://eprint.iacr.org/2014/349.pdf
5. https://eprint.iacr.org/2012/718.pdf
6. https://github.com/ElementsProject/lightning/blob/master/doc/deployable-lightning.pdf
7. https://www.hyperledger.org/use/tutorials
8. https://docs.soliditylang.org/en/latest
9. https://github.com/ethereum/wiki/wiki/White-Paper
10. http://gavwood.com/paper.pdf
11. Raspberry Pi Cookbook, Software and Hardware Problems and solutions, Simon Monk, O'Reilly (SPD), 2016, ISBN 7989352133895
12. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014, ISBN: 9789350239759.

ABILITY ENHANCEMENT COURSES (AEC)

Total: 6 (3*2) Credits						
Common to all B.Tech Programs						
Code	**Category**	**Course**	**L**	**T**	**P**	**C**
24HS101/24HS201	(AEC)	Communicative English	2	0	0	2
24HIN-101-I / 24FLGR101-I / 24FLFR101-I	(AEC)	Hindi-I/German-I/French-I (Phase-I)	2	0	0	2
24HIN-201-II / 24FLGR201-II/ 24FLFR201-II	(AEC)	Hindi-II/German-II/French-II (Phase-II)	2	0	0	2
24HS151/24HS251	(AEC)	Communicative English Laboratory	0	0	2	1

COMMUNICATIVE ENGLISH	
Course Code: 24HS101/24HS201	**Continuous Evaluation:** 40 Marks
Credits: 2	**End Semester Examination:** 60 Marks
L T P : 2 0 0	
Prerequisite: Nil	

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 competence and boost their confidence.
3. To enable the students to properly communicate and express themselves in writing.
4. 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.
5. To study, understand and implement each unit according to National Education Policy 2020 and Bloom's Taxonomy.

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.

MAPPING MATRIX OF COURSE OBJECTIVES & COURSE LEARNING OUTCOMES

Course Objective	Course Learning Outcomes				
	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CO 1	✓	✓	✓		
CO 2		✓		✓	
CO 3					

CO 4				✓	✓
CO 5					✓

COURE CONTENTS

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

Unit-II: Workplace Communication

- Communication Challenges in 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 Power Point Presentation.

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 with respect to technical writing

Unit-IV: Business Writing at Work

- Cover Letters and Applications
- Writing notices and circulars
- Email Writing and Memorandum
- Writing reports

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.

HINDI -I	
Course Code: 24HIN-101- I	**Continuous Evaluation:** 40 Marks
Credits: 2	**End Semester Examination:** 60 Marks
L T P : 2 0 0	
Prerequisite: Nil	

Course Description:

विश्वविद्यालय ने वर्ष 2024-25 सत्र से स्नातक स्तर पर हिन्दी विषय का पाठ्यक्रम तैयार किया है। हिन्दी विषय के प्रश्न पत्र की सामग्री में ज्ञान तथा शिक्षा के बदलते परिदृश्य को ध्यान में रखा गया है। | व्याकरण की विभिन्न कोटियों तथा भाषा के सम्प्रेषण से हिन्दी का प्रचार-प्रसार होगा। संचार कौशल के द्वारा छात्रों का ज्ञान परिमार्जित होगा। साहित्येतर छात्रों के ज्ञानवर्धन, भाषायी क्षमता एवम् अभिवृद्धि भी इस पाठ्यक्रम का लक्ष्य है।

(Course Content)

(Unit-A)

इस इकाई में हिंदी भाषा के बुनियादी पहलुओं को सम्मिलित किया गया हैं।

वर्ण , शब्द , पद और वाक्य

(Unit-B)

इस इकाई में हिंदी भाषा की व्याकरणिक कोटियों को सम्मिलित किया गया हैं।

संज्ञा, सर्वनाम, विशेषण, क्रिया और क्रिया विशेषण

(Unit-C)

इस इकाई में हिंदी भाषा की शब्द सम्पदा को सम्मिलित किया गया हैं।

पर्यायवाची शब्द, लिंग, वचन, वर्तनी और विलोम शब्द

(Unit-D)

यह इकाई संचार कौशल से सम्बन्धित है|

(i) हिंदी के प्रमुख मुहावरे और लोकोक्तियाँ

(ii) आत्म परिचय (self-introduction), साक्षात्कार कौशल (interview skills), कार्यक्रम संचालन/मंच प्रबंधन (event management)

Course Outcomes :-

पाठ्यक्रम परिणाम

(1.Knowledge Outcome)

1 ज्ञान का परिणाम

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

पाठ्यक्रम के अंत में छात्र सक्षम होना चाहिए

-हिंदी भाषा के बुनियादी पहलुओं का ज्ञान होगा|

- शब्दों को लिखने,पढने और समझने में छात्र सक्षम होंगे|

-हिंदी व्याकरण के अध्ययन से छात्रों की शब्द सम्पदा बढेगी |

(2.Skill Outcome)

कौशल का परिणाम

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

पाठ्यक्रम के अंत में छात्र सक्षम होना चाहिए

-हिंदी भाषा का परिचय छात्र प्राप्त को प्राप्त होगा|

- छात्रों को हिंदी के अनेक शब्दों का ज्ञान होगा |

-व्याकरण के ज्ञान के साथ -साथ शब्दों के उच्चारण के बोध से भी छात्र अवगत होंगे।

(Methodology)

(पद्धति)

- कक्षा व्याख्यान

-व्याकरण के माध्यम से हिंदी शब्दों का उच्चारण व लेखन का अभ्यास किया जाएगा |

-समय-समय पर छात्रों को प्रदत्त कार्य दिया जाएगा |

-साप्ताहिक प्रश्नावली |

(Required Books and Materials)

आवश्यक पुस्तकें और सामग्री

-भाषा विज्ञान, डॉ. भोलानाथ तिवारी ,किताब महल इलाहाबाद |

-हिंदी व्याकरण, कामता प्रसाद गुरु, प्रभात प्रकाशन दिल्ली |

GERMAN-I	
Course Code: 24FLGR101- I	**Continuous Evaluation:** 40 Marks
Credits: 2	**End Semester Examination:** 60 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 courseintends to develop an ability for discussions, debates, research ventures, etc. Overall, the objective is to facilitate comprehension of the legal concepts better and develop the ability to write effective propositionsin legal contexts.

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.

COURSE LEARNING OUTCOMES (CLOs):

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

1. Read and write short, simple texts.
2. Have Fluency in reading and writing.
3. Understand the dialogue between two native speakers and to take part in short, simple conversations using the skills acquired.
4. Know the culture of the countries where the German language is spoken.

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

COURSE OBJECTIVES	Course Learning Outcome			
	CLO 01	CLO 02	CLO 03	CLO 04
CO 01	✓			
CO02		✓	✓	
CO 03			✓	
CO 04				✓

COURSE CONTENTS

UNIT 1

- Information über Deutschland
- Buchstaben, Regeln der Aussprache, Wochentage, Monate
- Grüße, sich vorstellen, Einige nützliche Ausdrücke des Alltagslebens, Zahlen bis 100

UNIT 2

- Zahlen, Über Personen sprechen (Name, Herkunft, Adresse, Telefonnummer, Alter, Beruf, Familie)
- Länder und Städte, Sprachen, Berufe, Bezeichnungen für Personen, Familienmitglieder
- Personalpronomen, Konjugation von Verben (heißen, wohnen, kommen, machen, lernen, arbeiten, studieren, sein)

UNIT 3

- Nomen (Genus, Singular-Plural), Bestimmter Artikel, Unbestimmter Artikel, Negation, W-Frage, Ja-Nein-Frage
- Über Sachen sprechen
- Sachen des Alltagslebens, Haushaltswaren, Adjektive, Gegenteile
- Satz Struktur

UNIT 4

- Akkusativ, Artikel und Personalpronomen im Akkusativ, Verben und Präpositionen mit Akkusativ,Konjugation und Verwendung von Verben (haben, kaufen, sehen, lieben, lesen, kennen, hören, verstehen, usw.)
- Kleidung, Farben, Wetter, Lebensmittel

TEXT BOOKS:

- Netzwerk Neu A1 (Kursbuch+Arbeitsbuch)

  Dengler, Stefanie, et al. Netzwerk neu: A1. Ernst Klett Sprachen., 2019.

REFERENCE BOOKS:

- Rusch, Paul, Helen Schmitz, and Humorvolle Zeichnungen. "Einfach Grammatik." *Übungsgrammatik Deutsch A1 bis B* 1 (2012): 329-330.Einfach Gramatik, Paul Rusch
- Carlson, Antje. "Lemcke, Christiane, Lutz Rohrmann, and Theo Scherling. Berliner Platz 1 Neu--German for Beginners." *Die Unterrichtspraxis/Teaching German* 44.1 (2011): 46-49.
- Dallapiazza, Rosa-Maria, Eduard Von Jan, and Sabine Dinsel. *Tangram: Deutsch als Fremdsprache. Lehrerbuch*. Vol. 1. Hueber Verlag, 1998.
- Wolfgang Hieber: Lernziel Deutsch, Teil 1,Max HueberVerlag, 1984.

WEBSITE PAGES:

- https://www.nthuleen.com/teach.html

FRENCH-I	
Course Code: 24FLFR101-I	**Continuous Evaluation:** 40 Marks
Credits: 2	**End Semester Examination:** 60 Marks
L T P : 2 0 0	
Prerequisite: Basics of English Language	

COURSE OBJECTIVE (COs)

1. To develop **listening, speaking, reading, and writing** requisites of a language.
2. To develop the ability **to construct sentences** and **frame questions**.
3. To equip the students with **cultural elements and communication strategies** that will help them **communicate in varied situations.**
4. To familiarize the students with the **French and Francophone culture.**

COURSE LEARNING OUTCOMES (CLOs)

1. After completion of this course, the student will be able **to express and interact in French** used in daily conversations.
2. The student will be able **to write short and simple texts.**
3. The student will be able to **initiate, understand and respond to the queries of cultural significance in various settings.**
4. The student can demonstrate **knowledge and understanding** of French and Francophone culture.

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

COURSE OBJECTIVES	**Course Learning Outcome**			
	CLO 01	CLO 02	CLO 03	CLO 04
CO 01	✓			
CO02		✓	✓	
CO 03			✓	
CO 04				✓

S. No	Unités	Objectifs de Communication	Grammaire	Lexique
1	**La Salutation et l'Introduction**	Saluer. Entrer en Contact. S'Excuser. Remercier. Se Présenter/Présenter Quelqu'un.	Les Pronoms Personnels Sujets. L'Alphabet. Les Articles Indéfinis. Les Verbes en -ER au Présent.	Salutations, Les Nombres. Les Objets de la Classe. La Nationalité.
2	**On Partage des Renseignements**	Demander de Se Présenter. Donner des Renseignements Personnels.	Etre et Avoir au Présent. Les Verbes en -ER au Présent. Les Adjectifs de Nationalités. L'Interrogation.	Les Adjectifs de Nationalité, Métiers et Secteurs Professionnels, L'Expression des Goûts et Intérêts
3	**Ma Ville et Mon Quartier**	Décrire et Qualifier une Ville ou un Quartier. Localiser. Demander et Donner la Directions.	Le Verbe Vivre. Les Articles Définis. Il y a/ Il n'y a pas. Les Prépositions. Les Adjectifs Qualificatifs. L'Impératif.	Les Prépositions de Localisation. Le Lexique des Sites. Etablissements et Service d'une Ville.
4	**Mes Intérêts et Goûts**	Parler de Ses Goûts et de Ses Loisirs. Donner Son Impression sur le Caractère de Quelqu'un.	Le Présent des Verbes en -ER, et du Verbe Faire. La Négation, Les Adjectifs Possessifs.	Avoir l'air. Loisirs. L'Expression des Goûts. Faire du/ de la. Ma Famille.

HINDI-II	
Course Code:24HIN201-II	**Continuous Evaluation:** 40 Marks
Credits: 2	**End Semester Examination:** 60 Marks
L T P : 2 0 0	
Prerequisite: Nil	

Course Description:

विश्वविद्यालय ने वर्ष 2024-25 सत्र से स्नातक स्तर पर हिंदी विषय का पाठ्यक्रम तैयार किया है | हिंदी विषय के प्रश्न पत्र की सामग्री निर्धारण में ज्ञान तथा शिक्षा के बदलते परिप्रेक्ष्य को ध्यान में रखा गया है| इस सत्र में हिंदी लघु कथाओं को सम्मिलित किया गया है| छात्रों की मौखिक अभिव्यक्ति की क्षमता का विकास करने में निहित मूल्यों का महत्वपूर्ण योगदान होता है , इससे विद्यार्थियों की कल्पना शक्ति के विकास के साथ-साथ मनोरंजन भी होता है| संचार कौशल में मुहावरे, लोकोक्तियां, पत्र लेखन और अपठित गद्यांश की समझ के द्वारा हिंदी का प्रचार-प्रसार होगा| इस प्रकार साहित्य के ज्ञान की अभिवृद्धि वैश्वीकरण के संदर्भ में प्रासंगिकता और उपयोगिकता सिध्द करती है |

Course Content

सेमेस्टर 2: सुनना, पढ़ना और वाचन

इकाई 1: हिंदी सीखने की मूल बातें

- परिचय और दायरा

मात्रा और वर्णमाला

भाषण के अंग

व्याकरण

इकाई 2: कथन और आवाज़

प्रत्यक्ष–अप्रत्यक्ष, सक्रिय–निष्क्रिय

मुहावरे और वाक्यांश, भाषण के अलंकार

उपमा–रूपक

इकाई 3: हिंदी में आम गलतियाँ

- अपनी भाषा को स्वाभाविक कैसे बनाएँ
- कोलोकेशन
- वाक्यांश क्रियाएँ
- सामान्य त्रुटियाँ। व्याकरण और वाक्यविन्यास

इकाई 4: • लेखन कौशल

• विराम चिह्न

• सही विराम चिह्नों का महत्व विराम चिह्न

• पैराग्राफ़ के तत्व और पैराग्राफ़–लेखन अभ्यास

• रचना

GERMAN-II	
Course Code: 24FLGR201- II	**Continuous Evaluation:** 40 Marks
Credits: 2	**End Semester Examination:** 60 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 courseintends to develop an ability for discussions, debates, research ventures, etc. Overall, the objective is to facilitate comprehension of the legal concepts better and develop the ability to write effective propositionsin legal contexts.

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.

COURSE LEARNING OUTCOMES (CLOs):

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

1. Read and write short, simple texts.
2. Have Fluency in reading and writing.
3. Understand the dialogue between two native speakers and to take part in short, simple conversations using the skills acquired.
4. Know the culture of the countries where the German language is spoken.

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

COURSE OBJECTIVES	Course Learning Outcome			
	CLO 01	CLO 02	CLO 03	CLO 04
CO 01	✓			
CO02		✓	✓	
CO 03			✓	
CO 04				✓

COURSE CONTENTS

UNIT- 1

- Zeit-Ausdrücke, Tagesteile, Uhrzeit
- Präpositionen mit Akkusativ/Dativ, Ordinalzahlen
- Wegbeschreibung, Reisen, Verkehrsmittel

- Das Haus

UNIT- 2

- Modalverben
- Essen und Trinken, Mahlzeiten, Tagesablauf, Messeinheiten, Einkaufen
- Körperteile und Krankheiten
- Futur

UNIT- 3

- Dativ, Artikel und Personalpronomen im Dativ, Verben und Präpositionen mit Dativ, Konjugation und Verwendung von Verben (geben, kaufen, schenken, gratulieren, gehören, gefallen, gehen, fahren, fliegen, usw.)
- Possessiv-Artikel
- Trennbare Verben, Untrennbare Verben

UNIT 4

- Perfekt
- E- Mail Schreiben/ SMS Schreiben
- Vergangenheit erzählen, Das Wochenende, Lebenslauf

TEXT BOOKS :

- Netzwerk Neu A1 (Kursbuch+Arbeitsbuch)
  Dengler, Stefanie, et al. Netzwerk neu: A1. Ernst Klett Sprachen., 2019.

REFERENCE BOOKS:

- Rusch, Paul, Helen Schmitz, and Humorvolle Zeichnungen. "Einfach Grammatik." Übungsgrammatik Deutsch A1 bis B 1 (2012): 329-330.Einfach Gramatik, Paul Rusch
- Carlson, Antje. "Lemcke, Christiane, Lutz Rohrmann, and Theo Scherling. Berliner Platz 1 Neu--German for Beginners." Die Unterrichtspraxis/Teaching German 44.1 (2011): 46-49.
- Dallapiazza, Rosa-Maria, Eduard Von Jan, and Sabine Dinsel. Tangram: Deutsch als Fremdsprache. Lehrerbuch. Vol. 1. Hueber Verlag, 1998.
- Wolfgang Hieber: Lernziel Deutsch, Teil 1,Max HueberVerlag, 1984.

WEBSITE PAGES:

- https://www.nthuleen.com/teach.html

FRENCH-II	
Course Code: 24FLFR201-II	**Continuous Evaluation:** 40 Marks
Credits: 2	**End Semester Examination:** 60 Marks
L T P : 2 0 0	
Prerequisite: French-I	

COURSE OBJECTIVE (COs)

1. To develop **listening, speaking, reading and writing** requisites of a language.
2. To develop the ability **to construct sentences** and **frame questions**.
3. To equip the students with **cultural elements and communication strategies** which will help them **communicate in varied situations.**
4. To familiarise the students with the **French and Francophone culture.**

COURSE LEARNING OUTCOMES (CLOs)

1. After completion of this course, the student will be able **to express and interact in French** used in daily conversations.
2. The student will be able **to write short and simple texts.**
3. The student will be able to **initiate, understand and respond to the queries of cultural significance in various settings.**
4. The student can demonstrate **knowledge and understanding** of French and Francophone culture.

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

COURSE OBJECTIVES	Course Learning Outcome			
	CLO 01	CLO 02	CLO 03	CLO 04
CO 01	✓			
CO02		✓	✓	
CO 03			✓	
CO 04				✓

COURSE CONTENT				
S. No	**Unités**	**Objectifs de Communication**	**Grammaire**	**Lexique**
1	**Journée Typique**	Parler de Nos Habitudes, Exprimer l'Heure, S'Informer sur l'Heure, le Moment et la Fréquence.	Les Verbes Pronominaux au Présent. Les Verbes Aller et Sortir	L'Heure, Les Moments de la Journée. Les Activités Quotidiennes. Les Adverbs. La Météo.
2	**Achats**	S'informer sur un Produit. Acheter et Vendre un Produit. Donner Son Avis. Parler du Temps qu'il Fait	Les Adjectifs Interrogatifs. Les Adjectifs Démonstratifs. Le Genre et le Nombre. Le Verbe Prendre.	Les Vêtements. Les Couleurs. Les Fruits et Les Légumes.
3	**Alimentation**	Parler des Plats et des Aliments. Commander un Menu dans un Restaurant. Situer une Action dans le Futur	Le Future Proche: Aller +Infinitif. Les Partitifs. Les Pronoms COD. Le Future.	Les Aliments. Le Lexique des Quantités.
4	**expérience vécue**	Parler de faits passés. Parler de Nos expériences. Parler de ce que nous savons faire.	Le Passé Composé. L'Imparfait.	Les Verbes Savoir, Pouvoir et Connaître. Les Adjectifs Qualificatifs. Le Lexique des Savoirs et Compétences. Le Récit de Vie.

TEXT BOOK

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

REFERENCE BOOKS

- Alter Ego 1, Livre d'élève, Berthet A. & Hugo C. & Kizirian M. V. & Sampsonis B. & Waendendries M., éd Hachette, Paris, 2006.
- Connexions 1, Loiseau Y. & Mérieux R., éd. Didier, Paris, 2004.

- Le Nouveau Sans Frontiers, Vol. 1, P. Dominique, J. Girardet et al, CLE International, Paris, 2013.
- Le Robert & Nathan Conjugation, Paperback, Le Robert Nathan, 2011.

COMMUNICATIVE ENGLISH LAB	
Course Code: 24HS151/24HS251	**Continuous Evaluation:** 60 Marks
Credits: 1	**End Semester Examination:** 40 Marks
L T P : 0 0 2	
Prerequisite: Nil	

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. 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.

MAPPING MATRIX OF COURSE OBJECTIVES & COURSE LEARNING OUTCOMES

Course Objective	Course Learning outcomes				
	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
CO 1	✓	✓	✓		
CO 2		✓		✓	

CO 3			✓	✓	
CO 4				✓	
CO 5					✓

COURSE CONTENTS

Unit-1

- Listening and Speaking
- Practicing Sounds of English
- Accent in speech (British and American)

Unit-2

- Role-play
- Extempore
- Public Speaking and Rhetoric

Unit-3

- Presentations
- Interview Simulations
- Group Discussions and Debates

Unit-4

- Guided composition
- Free-writing
- Reading comprehension practice: Technical and General text

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,
2. Oxford University Press.

3. Communication skill by Sanjay Kumar & Puspa Lata, Oxford University Press. 2nd Edition.
4. Business Communication Today by Courtland L Bovee and Thill, Pearson

VALUE ADDED COURSES (VAC)

Total: 6 (2*3) Credits						
Code	**Category**	**Course**	**L**	**T**	**P**	**C**
23ESEB101/23ESEB201	(VAC)	Environment Bioengineering	2	0	0	2
23VAC101/23VAC201	(VAC)	Environmental Protection, Sustainable Development & Living	2	0	0	2
23VAC102/23VAC202	(VAC)	Indian Constitution and Polity	2	0	0	2
23VAC103	(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.						

ENVIRONMENTAL BIOENGINEERING	
Course Code: 23ESEB101/23ESEB201	**Continuous Evaluation:** 40 Marks
Credits: 2	**End Semester Examination:** 60 Marks
L T P : 2 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.

MAPPING COURSE OBJECTIVES (COs) & COURSE LEARNING OUTCOMES (CLOs)

	COURSE LEARNING OUTCOMES (CLOs)			
COURSE OBJECTIVES (COs)	**CLO1**	**CLO2**	**CLO3**	**CLO4**
CO1	√			
CO2		√		
CO3			√	
CO4				√

COURSE CONTENTS

Unit-1: 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.

Unit-2: 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 gardening.

Unit-3: 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.

Unit 4: 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.

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 Erach Bharucha, 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.

Environmental Protection, Sustainable development

& Living	
Course Code: 23ESEB101/23ESEB201	**Continuous Evaluation:** 40 Marks
Credits: 2	**End Semester Examination:** 60 Marks
L T P : 2 0 0	
Prerequisite: Nil	

COURSE 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 gain the knowledge of climate change and the contemporary issues

COURSE LEARNING OUTCOMES (CLO)

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

1. Demonstrate to safeguard the Earth's environment and its resources.
2. Explain sustainable development, its goals, challenges, and global strategies.
3. Analyse the environmental pollution and sensitize themselves to adverse health impacts of pollution.
4. Appraise the concept of climate change, its science and response measures.

Mapping Matrix of Course Objectives (CO) and Course Learning Outcomes (CLO)

SEM	SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
I/II	23VAC101/23VAC201	Environmental Protection & Sustainable development	CO1	x			
			CO2		x	x	
			CO3			x	
			CO4				x

UNIT	COURSE CONTENTS	HOURS
UNIT-I	**Human and Environment:** Introduction to earth environment, Scope and importance. Components of environment: Lithosphere, Hydrosphere, Biosphere, Atmosphere. The man- environment interaction, Population growth and natural resource exploitation, Industrial revolution, and impact on the environment, Global environmental challenges at global, regional and local level.	4

UNIT-II	**Natural Resources, Sustainable Development & Sustainable living:** Overview of natural resources: Definition of resource; Classification of natural resources-, renewable, and non-renewable. Resources: Forests, wetlands, Status and challenges. Water resources: Types of water resources, issues and challenges; Soil and mineral resources: Important minerals; Environmental problems due to extraction of minerals, Soil as a resource and its degradation. Energy resources: renewable and non-renewable sources of energy. 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 gardening.	4
UNIT-III	**Conservation of Biodiversity and Ecosystems:** Biodiversity and its distribution: Biodiversity as a natural resource; Levels and types of biodiversity; Biodiversity in India and the world; Biodiversity hotspots; Major ecosystem types in India and their basic characteristics, forests, wetlands, grasslands, agriculture, coastal and marine; Ecosystem services- classification and their significance. Threats to biodiversity and ecosystems. Major conservation policies: in-situ and ex-situ conservation approaches; Major protected areas; National and International instruments for biodiversity conservation: The role of traditional knowledge, community-based conservation. Major International Environmental Agreements: Convention on Biological Diversity (CBD); Cartagena Protocol on Biosafety, Ramsar Convention on Wetlands of International Importance, The Wildlife (Protection) Act, 1972, The Biological Diversity Act, 2002.	4
UNIT-IV	**Environmental Pollution and Health:** Understanding of pollutant and pollution; Types of Pollution, Air pollution: Sources of air pollution; Primary and secondary pollutants; Criteria pollutants, Indoor air pollution; Adverse health impacts of air pollutants, National Ambient Air Quality Standards. Water pollution: Sources of water pollution; River, lake and marine pollution, groundwater pollution; water quality Water quality parameters and standards; adverse health impacts of water pollution on human and aquatic life. Soil pollution and solid waste: Soil pollutants and their sources; Solid and hazardous waste; Impact on human health. Noise pollution: Definition of noise; Unit of measurement of noise pollution; Sources of noise pollution; Noise standards; adverse impacts of noise on human health. Thermal and Radioactive pollution: Sources and impact on human health and ecosystems.	4
UNIT-V	**Climate Change: Impacts, Adaptation and Mitigation:** Understanding climate change: Natural variations in climate, Anthropogenic climate change from greenhouse gas emissions– past, present and future; Projections of global climate change with special reference to temperature, rainfall, climate variability and extreme events, Climate change projections for the Indian sub-	2

	continent. Observed impacts of climate change on ocean and land systems; Sea level rise, changes in marine and coastal ecosystems; Impacts on forests and natural ecosystems; Impacts on animal species, agriculture, health. the concept of vulnerability, adaptation and resilience, Synergies between adaptation and mitigation measures, Concept of carbon neutrality, net zero targets, Carbon capture and storage, National climate action plan and Intended Nationally Determined Contributions (INDCs).	
UNIT-VI	**Case Studies and Field Work:** The students are expected to be engaged in one of the following or similar identified activities. Field visits to identify local issues, make observations including data collection and prepare a brief report, or Documentation of campus biodiversity or Campus environmental management activities such as solid waste disposal.	2

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 Erach Bharucha, UGC New Delhi

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/

INDIAN CONSTITUTION & POLITY	
Course Code: 23VAC102/23VAC202	**Continuous Evaluation:** 40 Marks

Credits: 2	**End Semester Examination:** 60 Marks
L T P : 2 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.

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

SEM	SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
I/II	23VAC102/202	INDIAN CONSTITUTION & POLITY	CO1	x	x	x	
			CO2		x		x
			CO3			x	x
			CO4				x

COURSE CONTENTS

UNIT 1 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

UNIT 2 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

UNIT 3 LOCAL GOVERNMENT AND ADMINISTRATION:

- Panchayati Raj System
- Rural and Urban administration
- Social and Economic Justice for the marginalized
- Directive Principles of State Policy

UNIT 4 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

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).

Sports, Yoga & Fitness	
Course Code: 23VAC103	**Continuous Evaluation:** 40 Marks

Credits: 2	**End Semester Examination:** 60 Marks
L T P : 2 0 0	
Prerequisite: Nil	

COURSE OBJECTIVES

1. To know about the physical body
2. To discuss about improve range of motion, mobility and coordination in body
3. To understand the ways to improve strength, balance and flexibility.
4. To grasp the significance of yoga and sports in fitness
5. To construct environment for individual and community health.

COURSE LEARNING OUTCOMES (CLO)

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

1. Explain the role of yoga and fitness in life.
2. Apply the rules of healthy and fit life
3. Analyse the ways and methods of yoga and sports
4. Recommend the practices of Asanas and different sports
5. Integrate the concept of yoga and sports in all round development of students and beings.

Mapping Matrix between Course Objectives and Course Learning Outcomes:

SEM	SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
III	**23 VAC 103**	Sports , Yoga & Fitness	CO1	x				
			CO2		x	x		
			CO3			x		
			CO4				x	
			CO5					x

UNIT	COURSE CONTENTS	HOURS
UNIT-I	Health and Wellness: Meaning Definition and Importance of Health and Wellness, Dimensions of Health and Wellness, Role of Exercise in maintaining Health and Wellness, Stress and Its management through Exercise, Nutrition for Health and Wellness. Practical-Exercise for Health and Wellness: Warming –Up, Stretching Exercises, Strengthening Exercises, Cardiovascular Exercises, Flexibility and Agility Exercises, Limbering Down, Relaxation Techniques (IRT, QRT, DRT etc.)	6
UNIT-II	Yoga and Fitness: Importance of Yoga and Fitness, Types and Principles of Asanas, Fitness Components, Specific Exercises for Strength,Flexibility, Speed,Agility & Coordinative Abilities, Yoga, Fitness and Personality, General Specific Warm up, Aerobics / Zumba Dance, Asanas, Recreation for Fitness, Report preparation, Records and PPT	6
UNIT-III	Sports and Psychology: Definition of Sports Psychology, Adolescence-Problems related with Adolescence i.e.physical problems, Peer group Relationship, Career Selection,Drug Abuse, Psychological and Emotion problems, Importance of Sports Psychology	6
UNIT-IV	Sports and Recreation: Meaning Definition and Concept of Sports Fitness and Recreation, Objectives,Characteristics and principles of Sports Fitness and Recreation, Importance,Purpose, Benefits of Fitness and Recreation, Types of Recreation, Recreation through Sports and Games, Use of Leisure Time Activities and their educational values, Traditional, Folk and Indigenous Games, Three Days outdoor camp and Hiking, Cycling, tie up with District/State Associations, Visits to Recreational Clubs	6

TEXT BOOKS:

1. Foundations of Physical Education, Chales A. Bucher
2. Foundations of Physical Eduction, M.L.Kamlesh

3. History and Principles in Physical Education, Dr. Karan Singh
4. Essentials of Physical Education, Dr. Ajmer Singh
5. Foundations of Physical Education, Dr. A.K.Uppal
6. Physical Education, Manu Sood, New SP Books
7. Health the basis of life: Dr. John Maclay
8. Natural Health & Yoga, Brij Bhushan
9. Health Education, S.K.Mangal
10. Essential of Physical Education, Dr. Ajmer Singh & Dr. Bains

MULTI-DISCIPLINARY COURSES (MDC)

Total: 9 (3*3) Credits						
Code	**Category**	**Course**	**L**	**T**	**P**	**C**
23MDC101/24MDC101 A/24MDC101B/24MDC 101C/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.

STATISTICAL METHODS	
Course Code: 23MDC401	Internal Examination: 40 Marks
Credits: 3	External Examination: 60 Marks
L T P : 3 0 0	
Prerequisite: Engineering Mathematics-I & II	

COURSE OBJECTIVES

1. To introduce the basics of statistics and graphical representation of data
2. To equip the students with measures of central tendency and dispersion
3. To learn about correlation and regression analysis
4. To know about the probability in daily life

COURSE LEARNING OUTCOMES (CLO)

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

1. Understand the basics of statistics and explain data for graphical representation
2. Understand the concept of measures of central tendency and measures of dispersion
3. Understand the basics of correlation and regression
4. Understand the concept of probability in real life scenario

Mapping Matrix of Course Objectives (CO) and Course Learning Outcomes (CLO)

SEM	SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
IV	23MDC401	Statistical Methods	CO1	✓			
			CO2		✓		✓
			CO3			✓	
			CO4				✓

UNIT	COURSE CONTENTS	HOURS
UNIT-I	**Introduction to Statistics** Importance of statistics, concepts of statistical population and a sample, data collection methods, primary and secondary data, primary and secondary data. Designing a questionnaire, types of data– quantitative and qualitative data. Measurement scales –Nominal, Ordinal, Interval and Ratio. Classification and tabulation of data, Diagrammatic and Graphical representation of data.	8
UNIT-II	**Univariate Data Analysis**	8

	Measures of Central Tendency- mathematical and positional. Measures of Dispersion: range, quartile deviation, mean deviation, standard deviation, coefficient of variation, Skewness and Kurtosis.	
UNIT-III	**Bivariate Data Analysis** Bivariate Data, Scatter plot, Correlation, Karl Pearson's correlation coefficient, Rank correlation – Spearman's and Kendall's measures. Concept of errors, Principle of least squares, fitting of polynomial and exponential curves. Simple linear regression and its properties. Fitting of linear regression line and coefficient of determination.	8
UNIT-IV	**Probability** Probability: Introduction, random experiments, sample space, events, and algebra of events. Definitions of Probability – classical, statistical, and axiomatic. Conditional Probability, laws of addition and multiplication, independent events, theorem of total probability, Bayes' theorem, and its applications.	8
UNIT-V	**Practical/Lab Work to be performed in Computer Lab** The practical will be taught using Excel software and/or using some statistical software like R /SPSS. Students are encouraged to use resources available on open sources. · Graphical representation of data. · Practical based on measures of central tendency. · Practical based on measures of dispersion. · Practical based on combined mean and variance and coefficient of variation. · Practical based on moments, skewness, and kurtosis. · Fitting of polynomials, exponential curves. · Karl Pearson correlation coefficient. · Correlation coefficient for a bivariate frequency distribution. · Lines of regression, angle between lines and estimated values of variables. · Problems based on conditional probability and Baye's theorem	8

Text Books/Reference Books

1. Agresti, A. (2010): Analysis of Ordinal Categorical Data, 2nd Edition, Wiley
2. Goon A.M., Gupta M.K. and Dasgupta B. Fundamentals of Statistics, Vol. I & II, 8th Edn. The World Press, Kolkata, 2002
3. Fundamental of Mathematical Statistics by S.C. Gupta and V.K Kapoor, Saurabh Jain 2017
4. Hogg, R. V. McKean J. W. and Craig, A. T. (2012), Introduction to Mathematical Statistics, Pearson 7th Edition R for beginners by Emmanuel Paradis (Freely available) at https://cran.rproject.org/doc/contrib/Paradisrdebuts_en.pdf)

COMPUTER-BASED NUMERICAL AND STATISTICAL TECHNIQUES	
Course Code: 24MDC101A	Internal Examination: 40 Marks
Credits: 3	External Examination: 60 Marks
L T P : 3 0 0	
Prerequisite: Engineering Mathematics – III	

COURSE OBJECTIVES (COs)

1. To familiarize with different operators that are useful in Numerical Analysis and introduce the concept of interpolation.
2. To familiar with numerical solutions of algebraic, transcendental and simultaneous equations. Also, introduce numerical differentiation and integration with applications.
3. Familiarize with numerical solutions of ordinary differential equations.
4. To equip the students with the knowledge of basic probability, Random variables, discrete as sell as continuous distributions with their applications, correlation and regression.

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. Get exposed to finite differences and interpolation.
2. Get numerical solution of equations and find the numerical differentiation and integration.
3. Demonstrate the numerical solutions of ordinary differential equations by different methods.
4. Implement the probability concepts and the corresponding distributions and compute correlation coefficients and regression lines.

MAPPING BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CO \ CLO	CLO-01	CLO-02	CLO-03	CLO-04
CO-01	✓			
CO-02		✓		
CO-03			✓	
CO-04				✓

COURSE CONTENTS

Unit-I: Finite Differences and Interpolation

First and higher order differences - Forward differences and backward differences and Central Differences - Differences of a polynomial - Properties of operators - Factorial polynomials - Shifting operator E - Relations between the operators. Interpolation - Newton-Gregory Forward and Backward Interpolation formulae - Divided differences - Newton's Divided difference formula - Lagrange's Interpolation formula.

Unit-II: Numerical Solution of Equations, Differentiation and Numerical integration Bisection Method, Newton-Raphson method - Gauss Elimination method - Gauss Jacobi method - Gauss Seidel method. Numerical Differentiation and Integration: Newton's forward and backward differences formulae to compute first and higher order derivatives - The Trapezoidal rule - Simpson's one third rule and three eighth rule.

Unit-III: Numerical Solutions of Ordinary Differential Equations

Solution by Taylor's series - Euler's method, Modified Euler method - Runge-Kutta methods of second and fourth orders.

Unit-IV: Statistics

Introduction, Measures of Central tendency and dispersion, Moments - Skewness and kurtosis based on moments..

TEXT BOOKS/REFERNCE BOOKS

1. Grewal, B.S., Numerical Methods, Khanna Publishers, 6th edition,
2. Sastry, S.S., Introductory Methods of Numerical Analysis, PHI New Delhi , 2007
3. Balagurusamy, E. , Computer Oriented Statistical and Numerical Methods - TMH, 2000
4. Jain, M.K. Iyengar, S.R.K. and Jain, R.L., Numerical Methods for Scientific and Engineering Computation, Wiley Eastern Ltd., 1987
5. Gupta, S.C. and Kapoor,V.K., Fundamental of Mathematical Statistics, S. Chand, New Delhi, 2017

PROBABILITY & RANDOM PROCESS	
Course Code: 24MDC101B	Internal Examination: 40 Marks
Credits: 3	External Examination: 60 Marks
L T P : 3 0 0	
Prerequisite: Engineering Mathematics-III	

COURSE OBJECTIVE (COs)

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 (CLOs)

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 BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

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

COURSE CONTENTS

Unit-I: Random Variables & Probability Distributions

Random variables, Discrete Random Variables, probability mass functions; continuous random variables, probability density functions, Expectation, Moments - Moment generating function,

Bernouli distribution, Binomial distribution, Poisson distribution, Geometric distribution, uniform Distribution, Exponential distribution, Normal distributions,

Unit-II: Two Dimensional Random Variables

Two dimensional Random Variables - Marginal and conditional distributions, Coditional mean and variance, covariance, correlation and Linear regression - Transformation of Random Variables.

Unit-III: Random Processes, Correlation 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.

Unit-IV: Linear Systems with Random Inputs

Linear time and invariant system, system transfer function. Linear system with random inputs. System in the form of convolution - Unit Impulse Response of the System - Weiner-Khinchine Relationship.

TEXT BOOKS/ REFERENCE BOOKS

1. Veerarajan, T., Probability, Statistics and Random Processes, TMH, 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.
4. Trivedi K S, Probability and Statistics with reliability, Queueing and Computer Science Applications, Wiley-Blackwell; 2nd Edition, 2001.

BIOSTATISTICS

Course Code: 24MDC101C	ContinuousEvaluation:40 Marks
Credits:3	End Semester Examination:60 Marks
LTP:3 0 0	
Prerequisite: Nil	

COURSE OBJECTIVES (COs)

1. The objective of the course is to make the students familiar with basic of probability
2. The course is providing probability applications in biomedical engineering.
3. The basics of probability, conditional probability and Baye's theorem.
4. Understand the random variable and probability distributions.

COURSE LEARNING OUTCOMES (CLOs)

The syllabus as been prepared in accordance with National Education Policy (NEP-2020). After completion of course, students would be able to explain

1. All descriptive statistics
2. Basic statistical concepts of probability.
3. Correlation and Regression analysis.
4. Testing of hypothesis.

MAPPING BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUT COMES (CLOs)

CLO / CO	CLO-01	CLO-02	CLO-03	CLO-04
CO-01	✓			
CO-02		✓		
CO-03			✓	
CO-04				✓

COURSE CONTENTS

Unit-I: Graphical Representation and Descriptive Statistics

Quantitative and Qualitative Variables, Frequency Tables, Histograms, Bar Chart, Pie Chart, Box Plot, Measures of central tendency: Mean, Median and Mode, Measures of dispersion: Range, Standard Deviation and Variance, Measures of Position :Quartiles and Percentiles.

Unit-II: Probability Theory

Introduction of Probability, Mutually Exclusive Events, Independent vs Dependent events, Experiment, Outcomes, Events and Sample Space, Conditional Probability, Total Probability and Bayes' theorem.

Unit-III: Correlation and Regression

Introduction to Correlation and regression. Correlation model, correlation coefficient, multiple correlation. Simple linear regression, multiple regression.

Unit-IV: Testing of Hypothesis

Type I error and Type II error and power of test. Hypothesis testing for- population means, difference of two population means, population proportions, difference between two population proportions, population variance, ratio of two population variances. Chi-square test: test of goodness of fit, independence and heterogeneity.

TEXT BOOKS/REFERENCE BOOKS

1. Gupta, S.C. and Kapoor, V.K. , Fundamental of Mathematical Statistics, S Chand Publications, New Delhi 2017
2. Mann , P.S. ,Introductory Statistics, John Wiley& Sons, Global edition, 2017.
3. Daniel, W.W., Biostatistics- A foundation for analysis in health sciences, John Wiley &Sons;11th Edition, EMEA edition, 2019.
4. Lipschutz, Seymour and Schiller, John , Introduction to Probability and Statistics, Tata McGraw Hill,2017.
5. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, Keying Ye, Probability & Statistics for Engineers & Scientists,9th Edition, Prentice Hall,2017.

NUMERICAL METHODS	
Course Code: 24MDC101D	Internal Examination: 40 Marks
Credits: 3	External Examination: 60 Marks
L T P : 3 0 0	
Prerequisite: Engineering. Mathematics – II	

COURSE OBJECTIVEs (COs)

1. To have a clear perception of the power of numerical techniques, ideas.
2. To demonstrate the applications of these techniques to problems drawn from industry, management and other engineering fields.
3. To make familiar with error analysis and some numerical methods to solve equations which are not easily solved by algebraic methods**.**
4. To familiar with different operators which are useful in Numerical Analysis and introduce theconcept of interpolation

COURSE LEARNING OUTCOMES (CLOs)

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

1. Find solutions by various numerical methods to get approximation solutions of algebraic atranscendental, simultaneous linear equations.
2. Get interpolating values by different numerical methods.
3. Do differentiation and integrations of tabular data.
4. To find numerical solutions of ordinary and partial differential equations.

MAPPING BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CLO / CO	CLO-01	CLO-02	CLO-03	CLO-04
CO-01	✓			
CO-02		✓		
CO-03			✓	
CO-04				✓

COURSE CONTENTS

Unit-I: Error Analysis and Numerical Solution of Equations

Approximations and error in computation: Significant figures, approximate numbers, Errors: Round- off Errors, Truncation Errors, Absolute Relative and Percentage Errors, Error in approximation of a function and series, Solution of algebraic and transcendental equation: basic properties of equation, Bisection method, Newton-Raphson method. Solution of simultaneous equations: Gauss Elimination method, Gauss Jacobi method, Gauss Seidel method.

Unit-II: Differences and Interpolation

Finite differences - Forward differences and backward differences, shifting operator E - Difference tables, relation between operators, Differences of a polynomial - Factorial polynomials -. Interpolation with equal intervals: Newton- Forward and Backward Interpolation formulae, Interpolation with unequal interval: Divided differences - Newton's Divided difference formula - Lagrange's Interpolation formula.

Unit-III: Numerical Differentiation and Integration

Numerical Differentiation: Newton's forward and backward differences formulae to compute first and higher order derivatives, Numerical Integration: The Trapezoidal rule - Simpson's one third rule and Simpson's three eighth rule.

Unit-IV: Numerical Solutions of Ordinary and Partial Differential equations

Solution by Taylor's series - Euler's method - Improved and modified Euler method - Runge-Kutta methods of second and fourth orders (No proof).Classification of Partial differential equations of the second order - Difference quotients - Laplace's equation and its solution by Liebmann's process

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TEXT BOOKS/ REFERENCE BOOKS

1. B.S. Grewal, “Numerical Methods in engineering and science”, Khanna Publishers, 42nd Edition, 2015.
2. Steven Chapra and Raymond Canale, Numerical Methods for Engineers, 8th Edition, McGrawHill, 2020.
3. M.K. Venkataraman, Numerical Methods in Science and Engineering, NationalPublishing Co., 1999
4. Gerald C. F., Wheatley P. O., Applied Numerical Analysis, Pearson, 2011.
5. Arumugam S., Isaac A. T., Somasundaram A., Numerical Methods, ScitechPublications Pvt. Ltd, 2009.
6. S.S. Sastry, Introductory Methods of Numerical Analysis, 2012.
7. E. Balagurusamy, Computer Oriented Statistical and Numerical Methods-Laxmi Publications, 2009.

Environmental Geosciences& Disaster Management	
Course Code: 23MDC 102	Internal Examination: 40 Marks
Credits: 3	External Examination: 60Marks
L T P : 3 0 0	
Prerequisite: None	

COURSE OBJECTIVES (COs)

1. To know the fundamentals of earth origin.
2. Educate the students fundamentals of earth Processes.
3. To develop basic understanding of Disasters
4. To understand the basics of Disaster management.

COURSE LEARNING OUTCOMES (CLOs)

1. Able to explain the origin and Internal structure of earth.
2. Explain the Geological resources and geochemistry of minerals.
3. Gain a comprehensive understanding of disasters.
4. Insights for understanding disaster management.

Mapping Matrix of Course Objectives (CO) and Course Learning Outcomes (CLO)

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

COURSE CONTENTS

Unit-1

Origin & Structure of the Earth (11 hours)

Theories and hypothesis of the origin of earth- Oparin-Haldane hypothesis, Big bang theory, the material basis of life, geological time scale, evolution of earth's atmosphere and life through the geological time scale. Internal Structure of Earth. Formation of core, mantle, crust, atmosphere, hydrosphere, and biosphere. Convection in Earth's core and production of its magnetic field. Geothermal gradient and internal heat of the Earth

Unit-2

Fundamentals of Earth process (11 hours)

Earthquake and earthquake belts: seismic waves and internal constitution of the Earth. Volcanoes and volcanism, distribution of volcanoes. Concepts and Formation of rocks, types of rock (Igneous rock, Metamorphic Rocks, and Sedimentary rocks), Continental drift theory, Plate tectonic, sea floor spreading. Basic concepts of weathering, erosion, and deposition of earth materials by water wind and glaciers

Unit-3

Introduction to Disasters (11 hours)

Disaster introduction - Different typologies and classification of disasters, cataclysmic – slow-onset, natural- manmade etc- Critique of different classifications, Concept of Hazard. Types of Hazards, Characteristic of Hazards. Concept of Disaster, what magnitude constitutes a "disaster" for the government, Effects of hazards: Primary, secondary and tertiary

Unit-4

Disaster Management (12 hours)

Disaster management, capability vulnerability, risk, preparedness and mitigation. Disaster management cycle. Hazard zonation and mapping- risk reduction measures. Natural and man-made disasters. Role of geo-spatial technology in surveillance, monitoring, risk assessment, and disaster management Sendai Framework for Disaster Risk Reduction

RECOMMENDED TEXTBOOKS:

1. Mukherjee, S. (2004). Text Book of Environmental remote Sensing. Published by Macmillan India Limited New Delhi ISBN: 1403922357.
2. Keller, E.A. (1996). Introduction to Environmental Geology. Prentice Hall, Upper Saddle River, New Jersey.
3. Disaster management by R. Subramanian, Vikash Publishing house, ISBN 9352718704

REFERENCE BOOKS

1. Keller, E.A. (1996). Introduction to Environmental Geology. Prentice Hall, Upper Saddle River, New Jersey.
2. J.R Jensen, Remote Sensing of the Environment: An Earth Resource Perspective, 2012

IPR in Business	
Course Code: 23MDC301	Internal Examination: 40 Marks
Credits: 3	External Examination: 60 Marks
L T P : 3 0 0	
Prerequisite: None	

COURSE OBJECTIVES

The objective of this Multidisciplinary Course (MDC) is to familiarize the students with various types of IPR and its relevance to the businesses and their respective streams.

1: To provide students with a basic understanding of various types of IPR and its relevance for business.

2: To acquaint students with the strategies and management techniques associated with intellectual property assets, and the legal considerations and challenges involved.

3: To familiarize the students with the challenges and legal considerations related to intellectual property disputes.

4: To develop skills related to management of intellectual property in business.

COURSE LEARNING OUTCOMES (CLO)

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

1. Describe various types of IPR and its relevance for business
2. Discuss the adjudicating bodies and mechanisms under each of these IPRs
3. Analyze business disputes relating to IPR
4. Apply the learning to the real-life situations in business

Mapping Matrix of Course Objectives (CO) and Course Learning Outcomes (CLO)

SEM	SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4	CLO5
V	23MDC301	IPR in Business	CO1	√				
			CO2		√			
			CO3			√		
			CO4				√	
			CO5					√

UNIT	COURSE CONTENTS	HOURS
UNIT-I	**INTRODUCTION TO INTELLECTUAL PROPERTY AND BUSINESS:** Concept of IPR in business and its types, International Context - Introduction to the leading International Instruments concerning Intellectual Property Rights: the Berne Convention, Universal Copyright Convention, The Paris Convention, Patent Co-operation Treaty, TRIPS, The World Intellectual Property Organization (WIPO), World Trade Organization (WTO) and the UNESCO, Innovation as a Business Strategy and relevance of protecting the ideas legally, National IPR Policy	8
UNIT-II	**COPYRIGHT** Concept of Copyright and importance for businesses, Media business – protecting performer's rights, Performers' and Broadcasters' Rights Law, Assignment, Transmission, Licensing of Copyrights, Infringement of Copyrights and remedies,	8
UNIT-III	**TRADEMARKS** Trademark – value of and relevance for businesses, Protecting brand value- acquiring trademark nationally and internationally, Trade mark disputes – case studies	8
UNIT-IV	**PATENTS** Protecting innovation – acquiring patents nationally and internationally, Product and process patents, Assigning patents and its commercialization, Patent Disputes	8
UNIT-V	**INDUSTRIAL PROPERTIES** Industrial designs – protection - Procedure for Registration of Designs • Copyright under Design , Semiconductor Integrated Circuits Layout-Designs, Plant varieties – commercialization - Monsanto cases, Geographical Indications, Biotechnology and IPR	8

REGISTRATION AND ENFORCEMENT MECHANISMS

- Registration authorities of various IPRs
- IP Management and assertion of rights through declarations – use of copyright, trademark signs
- IP Litigation – Approach of courts – landmark cases

TEXT BOOKS:

- WIPO DL-101 General Course on Intellectual Property (online)

- Elizabeth Verkey and Jithin Saji Issac, *Intellectual Property*, Eastern Book Company 2021
- Anurag K. Agarwal, *Business and Intellectual Property: Protect your Ideas*, IIM Ahmedabad. Random
House India (2016)
- *Handbook on IP Commercialisation - Strategies for Managing IPRs and Maximising Value* Jakarta:
ASEAN Secretariat, November 2019

REFERENCES BOOKS:

- ICSI Study Material, Intellectual Property Rights: Law and Practice, A. Ramaiya, Guide to the
Companies Act, LexisNexis, 19th Ed. 2020 (in 6 volumes)
- WIPO, *Enterprising Ideas A Guide to Intellectual Property for Startups*, 2023
- Manuals published by Office of the Controller General of Patents, Designs & Trade (CGPDTM),
available at https://ipindia.gov.in/
- Guide Books by WIPO –Intellectual Property for Business, available
at https://www.wipo.int/publications/en/series/index.jsp?id=181

Library Information Science & Media Literacy	
Course Code: 23MDC302	Internal Examination: 40 Marks
Credits: 3	External Examination: 60 Marks
L T P : 3 0 0	
Prerequisite: None	

COURSE OBJECTIVES (COs)

The course is designed with the following objectives:

1: To know the library collection and its classifications.
2: To discuss the library information services.
3: To understand the importance of media
4: To grasp the significance of motive of media

COURSE LEARNING OUTCOMES (CLOs)

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

1: Explain the library collection and their classifications.
2: Analyse the library information services.
3: Analyse the media roles.
4: Analyse the motive of media.

Mapping Matrix of Course Objectives (CO) and Course Learning Outcomes (CLO)

SEM	SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
V	**23MDC302**	**Library Information Science & Media Literacy**	CO1	√			
			CO2		√		
			CO3			√	
			CO4				√

UNIT	COURSE CONTENTS	HOURS
UNIT-I	*Library Collection,* Type of Information Sources: Primary, Secondary and Tertiar, Reference Collection: Type of reference sources, Indexing and Abstracting Journals, Multimedia Collection, Arrangement of Information Sources: Classification	8
UNIT-II	Information Services Bibliography: Type of Bibliography, Reviews Literature, Citation Style, Citation Analysis: Web of Science and Scopus, Online Databases: Structure and Retrieval	8
UNIT-III	Media Literacy Introduction to Media Literacy, Type of media: Traditional versus social media, Bias in media.	8

UNIT-IV	*Motive of Media* Media tycoons and conditions in which media works, Research and Publication ethics	8

Recommended Books:

1. Richard E. Rubin & Rachel G. Rubin ,Foundations of Library and Information Science, 5th Edition. ISBN-9781783304776, Facet Publication, UK
2. https://en.unesco.org/themes/media-and-information-literacy/resources

Management Process & Organizational Behavior	
Course Code: 23MDC302	Internal Examination: 40 Marks
Credits: 3	External Examination: 60 Marks
L T P : 3 0 0	
Prerequisite: None	

COURSE OBJECTIVES (COs)

1. To understand the functions and responsibilities of managers.
2. To acquaint the students with the fundamentals of managing business.
3. To understand individual and group behaviour at work place so as to improve the effectiveness of an organization.
4. To analyse human behaviour in the organization setting in order to manage it in accordance to the intentions.

COURSE LEARNING OUTCOMES (CLOs)

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

1. Demonstrate the roles, skills and functions of management.
2. Analyse the causes and consequences of applying different business strategies.
3. Analyse and compare individual behaviour related to motivation and rewards.
4. Identify group behaviour, leadership styles and the role of leaders in a decision making process.

Mapping Matrix of Course Objectives (CO) and Course Learning Outcomes (CLO)

SEM	SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
IV	23MDC302	Principals of Management & Organizational Behaviour	CO1	√			
			CO2		√		
			CO3			√	
			CO4				√

UNIT	COURSE CONTENTS	HOURS
UNIT-I	**Introduction to the management** Management Concept, Nature, Process and significance, levels of management, managerial skills, functions of management, management and administration, evolution of management, Role of management and insights from Indian practices and ethos.	8
UNIT-II	**Functions of the management** Planning: Types of Plans & The planning process; Organizing: Common organisational structures; Staffing: features and necessity; Leading: types of leaders; Controlling: functions and types	8

UNIT-III	**Introduction to Organizational Behaviour** Meaning, importance and scope of OB; abilities: meaning and forms, attitudes: framework, work related attitudes, personality: types, assessment, perception: process, factors influencing perception, perceptual errors	8
UNIT-IV	**Foundation of Group Behaviour** Defining and classifying groups; need to join groups, stages of group development; group dynamics: group properties as roles, norms and size; group decision making techniques, conflict management	8

TEXT BOOKS

1. Stephen Robbins, Organizational Behavior, 16th edition (2012), Pearson Education.
2. K. Aswathappa, Organizational Behaviour, 13th edition (2016), Himalaya Publishing House.
3. Fred Luthans, Organizational Behavior, 14th edition (2017), McGraw-Hill.

SUGGESTED READINGS

1. Gregory Moorhead & Ricky W. Griffin, Organizational Behaviour, 11th edition (2009), Jaico
   Publication.
2. Tripathy PC and Reddy PN, Principles of Management, 6th edition (2011), McGraw-Hill.

Photonics	
Course Code: 23MDC103	Internal Examination: 40 Marks
Credits: 3	External Examination: 60 Marks
L T P : 3 0 0	
Prerequisite: None	

COURSE OBJECTIVES

1. To state the fundamental principles of photonics, including the behaviour and properties of light, its interaction with materials, and the basics of optical components.
2. To delve into the interaction of light with matter, including concepts like absorption, emission, and scattering, and how they are utilized in spectroscopy and laser technologies.
3. To demonstrate about various optoelectronic devices such as lasers, photodetectors, and modulators, their working principles, and applications in optical communication, sensing, and imaging.
4. To appraise the role of photonics in communication systems, including optical networking, fiber-optic transmission technologies.
5. To assess the use of photonics in imaging technologies (e.g., microscopy, holography) and sensing applications (e.g., biomedical sensing, environmental monitoring).

COURSE LEARNING OUTCOMES (CLO)

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

1. Describe the fundamental properties of light, the behaviour of photons, Polarization of light, Reflection, refraction, and dispersion, Interference, and diffraction phenomena
2. Apply the principles of light-matter interaction to explain absorption, emission, and scattering phenomena, and their relevance in different contexts.
3. Illustrate the operation of lasers, photodetectors, and modulators, and analyze their use in different applications.
4. Design and analyze optical waveguides, taking into account factors like propagation modes, dispersion, and confinement.
5. Critically assess the suitability of photonics techniques in various technological and scientific contexts, and propose innovative 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
V	23MDC103	Photonics	CO1	√			
			CO2		√		√
			CO3			√	
			CO4				√

UNIT	COURSE CONTENTS	HOURS
UNIT-I	ELECTROMAGNETIC WAVES AND OPTICS: Maxwell's equations and electromagnetic wave propagation, Polarization of light, Reflection, refraction, and dispersion, Interference, and diffraction phenomena, Holography, Plasmonics, metamaterial optics, transformation optics	8

UNIT-II	LIGHT SOURCES: Introduction to different light sources (lasers, light-emitting diodes, incandescent lamps, etc.) Interaction of Photons with atoms, theory of Laser amplification, pumping, types of lasers, pulsed laser, Nd YAG laser, CO2 laser, semiconductor laser	8
UNIT-III	PHOTO DETECTORS Integrated photonic Passive and active devices, fabrication, photo detectors, photo conductors, Light emitting diodes, Optical amplifiers, modulators, photonic integrated circuit technology: Silicon, III-V and beyond.	8
UNIT-IV	WAVE GUIDE Introduction of guided wave optics, coupling light in a wave guide, Planar slab waveguide, dispersion in wave guides, graded index waveguides, wave propagation in periodic media, photonic crystals, Coupled Mode Theory, and the Beam Propagation, Birefringent Media and Electrooptic Modulators, Nonlinear Effects and Loss Mechanisms in Waveguides.	8
UNIT-V	APPLICATIONS OF PHOTONICS: Laser applications in various fields: medical, industrial, research, Optical sensors, display, communication and imaging systems, LiDAR, photonic computing, Augmented reality etc.	8

Text Books

1. Fundamentals of Photonic, Bahaa E A Saleh, Malvin Carl Teich, third edition, Wiley 2019.

2. Optical Networks - A Practical Perspective - R Ramaswami and K N Sivarajan – Marcourt Asia (2000)

3. Photonic Switching Technology System and Networks- H T Mouftah, J M H Elmirghani – IEEE Press (1999)

Reference Books

1. Deploying Optical Networking Components - Oil Held, Mccraw Hill (2001)
2. Optical Interconnection-C Tocci, Hi Caulfield, Artech House (1999)

Chemistry & Society	
Course Code: 23MDC104	Internal Examination: 40 Marks
Credits: 3	External Examination: 60 Marks
L T P : 3 0 0	
Prerequisite: None	

COURSE OBJECTIVES (COs)

The course is designed to expand the literacy of chemistry among the non-chemistry student with the following objectives:

1. To know basic fundamental of chemistry and medicinal importance
2. To understand the role of chemistry in our heritage.
3. To grasp the significance of the role of Chemicals in Pollution and toxicity.
4. To analyse the current scenario and future requirement in Chemistry

COURSE LEARNING OUTCOMES (CLOs)

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

1. Increase the literacy of chemistry even in non-science students
2. Analyze the basic concept of general Chemistry.
3. Apply the principle and application of Chemistry in everyday Life.
4. Integrate the importance of chemistry and future requirement

Mapping Matrix of Course Objectives (CO) and Course Learning Outcomes (CLO)

SEM	SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
V	23MDC104	Chemistry & Society	CO1	√			
			CO2		√		√
			CO3			√	
			CO4				√

UNIT	COURSE CONTENTS	HOURS
UNIT-I	**Basic of chemistry and Chemistry in Life** Periodic table, Atom and molecules, chemical bonding, properties and chemical reactions with simple examples and illustration. Edible and non-edible molecules, biochemistry of foods and medicine with examples: Aspirin, Paracetamol. Ibuprofen and Penicillin, Cephalosporin, Chemistry for industry: Artificial sweeteners, Soaps and detergents and cosmetics, Polymer and Plastics: Uses and environmental issues.	8

UNIT-II	**Chemistry in Heritage** Extraction and uses of metals like iron and stone in ancient times, metals in ornaments, medicines, weapons and chemistry for preservatives, basics of preservation and few examples of preservatives.	8
UNIT-III	**Chemical pollution and Toxicity** Chemical source of water, air and soil pollution, bio magnification and metal toxicity with example and illustrations. Monitoring of air pollution.	8
UNIT-IV	**Future of Chemistry** Basics of green chemistry, Reuse and recycling of by-products, zero waste chemistry and Alternate fuel and energy providing chemicals: biodiesel, natural gas and hydrogen.	8
UNIT-V	**Practical/Hands-on Training:** 1. Determine the calcium and magnesium contents in water samples using EDTA methods. 2. Determine the organic contents and pH of soil sample. 3. Estimate the food adulterants in edible items 4. Demonstrate the conversion of PET into bottle into value added products. 5. Demonstrate the exothermic and endothermic reaction in laboratory 6. Compare the fuel efficiency of biodiesel and petrol. 7. Demonstrate the biodegradability of natural and synthetic plastics. 8. Demonstrate the protection of rusting of iron after surface spray coating. 9. Estimate the protein contents in edible samples using chemical methods. 10. Small working project on heritage chemistry like bio compatibility of metals and medicinal importance of metals like iron, gold and silver.	8

Text Books /Reference Books

1. Concise Inorganic Chemistry, J D Lee, Wiley India Pvt. Ltd.
2. Industrial chemistry, B K Sharma, Goel Publishing House, India
3. Analytical chemistry, Gary D. Christian, Purnendu K. Dasgupta, Kevin A. Schug, Wiley
4. A text book of Environmental chemistry, V. Subramanian, Wiley

Psychology and Emotional Intelligence	
Course Code: 23MDC303	Internal Examination: 40 Marks
Credits: 3	External Examination: 60 Marks
L T P : 3 0 0	
Prerequisite: None	

COURSE OBJECTIVES (COs)

1.To know the concepts in sociology relevant to the study of society.
2.To discuss classical sociological thoughts by sociologists.
3.To understand modern and post modern sociological thoughts.
4.To grasp the significance of sociological theories in understanding society
5.To construct the relation between individual and social structure in the society.

COURSE LEARNING OUTCOMES (CLOs)
At the end of the course, the student will be able to

1. Explain various sociological concepts important in the understanding of society.
2.Apply the critical conceptual understanding that is central to sociological investigations.
3. Analyze the social phenomena with respect to the theoretical understanding of society.
4.Interpret methodological understanding to generate authentic knowledge.
5. Combine the knowledge of social issues in society according to advanced, contemporary, interdisciplinary knowledge.

Mapping Matrix of Course Objectives (CO) and Course Learning Outcomes (CLO)

SEM	SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4	CLO5	CLO6
V	23MDC303	Psychology and Emotional Intelligence	CO1	√					
			CO2		√				
			CO3			√			
			CO4				√		
			CO5					√	√

UNIT	COURSE CONTENTS	HOURS
UNIT-I	**INTRODUCTION** Definition, Scope, Nature and Importance of Sociology, SOME BASIC CONCEPTS: Status & Role, Power & Authority, Social Structure & Function	8
UNIT-II	**SOCIETY AND SOCIAL BEHAVIOUR**: Society: Meaning & Characteristics, Culture, Socialization: Definition & Agencies, Social Mobility: Meaning & Types, Social Group: Meaning and Types	8
UNIT-III	**SOCIAL CONTROLS & SOCIAL BEHAVIOUR: MEANING AND NATURE OF SOCIAL CONTROL**: Social Controls & Social Behaviour: Types: Folkways, Mores, Norms, Values, Law **SOCIAL CONFORMITY AND DEVIANCE:** Meaning of Conformity & Deviance	8
UNIT-IV	**THEORETICAL PERSPECTIVES** **MACRO PERSPECTIVE:** Theoretical perspectives: Functionalism, Conflict, Structuralism **MICRO PERSPECTIVE:** Theoretical perspectives: Symbolic	8

	Interactionism, Exchange Theory, Labelling Theory	
UNIT-V	**CLASSICAL THEORISTS** **EMILE DURKHEIM:** Division of Labour in Society, Suicide **KARL MARX**: Historical Materialism, Class and Class Conflict, Alienation **MAX WEBER**: Authority, Social Action, Ideal Types	8
UNIT-VI	**THEORIES OF MODERNITY** Juggernaut of Modernity, McDonaldization, Risk Society **GLOBALIZATION AND INEQUALITY**: Global justice, Need for Global governance	8

TEXT BOOKS

1. Anthony Giddens, Sociology, Polity Press (2019)
2. Harlambos, M. Sociology: Themes and Perspectives, Oxford University Press
3. C.N. Shankar Rao, Sociology: Principles Of Sociology With An Introduction To Social Thoughts, S. Chand Publications, (2019)

REFERENCE BOOKS

1. Transformation: Theory and Society in India, Oxford University Press (2010)
2. Andre Beteille. Six Essays in Comparative Sociology, Oxford University Press
3. M. Francis, Abraham. Contemporary Sociology: An Introduction to Concepts and Theories, Oxford University Press (2014)
4. J.P.S. Uberoi. Mind and Society: From Indian Studies to General Sociology, Edited by Khalid Tyabji, Oxford University Press (2019)

Indian Economy	
Course Code: 23MDC304	Internal Examination: 40 Marks
Credits: 3	External Examination: 60 Marks
L T P : 3 0 0	
Prerequisite: None	

COURSE OBJECTIVES (COs)

1. To introduce about different demography terms and trends.
2. To make students familiar with growth and its distribution.
3. To discuss the major changes in agriculture sector over-time.

COURSE LEARNING OUTCOMES (CLOs)

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

1. Formulate major demographic indicators
2. Explain the concept of inequality
3. Analyse the agriculture sector

Mapping Matrix of Course Objectives (CO) and Course Learning Outcomes (CLO)

SEM	SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3
V	23MDC304	Indian Economy	CO1	√		
			CO2		√	
			CO3			√

UNIT	COURSE CONTENTS	HOURS
UNIT-I	**Population and Human Development** Demographic trends and issues; education; health and malnutrition. Demographic features of India's population	8
UNIT-II	**Growth and Distribution** Trends and policies in poverty; inequality and unemployment.	8
UNIT-III	**Agriculture** Importance of Agriculture; Causes of backwardness and low productivity; Land Reforms: Need, Implementation and Critical Evaluation	8

TEXT BOOKS

1. Jean Dreze and Amartya Sen, 2013. *An Uncertain Glory: Indiaand its Contradictions*, Princeton UniversityPress.
2. Pulapre Balakrishnan, 2007, The Recovery of India: Economic Growth in the Nehru Era, *Economic and Political Weekly*,November.
3. Rakesh Mohan, 2008,―Growth Record ofIndian Economy: 1950 2008. AStory of Sustained Savings and Investment, *Economic and Political Weekly*,May.
4. S.L. Shetty, 2007,―India's SavingsPerformancesincethe Advent of Planning,in K.L. Krishna and A. Vaidyanathan, editors, *Institutions and Markets in India's Development.*
5. Himanshu, 2010,―TowardsNew Poverty LinesforIndia, *Economic and Political Weekly*, January.

Creating Entrepreneurial Mind	
Course Code: 23MDC402	**Continuous Evaluation:** 40 Marks
Credits: 3	**End Semester Examination:** 60 Marks
L T P : 3-0-0	**Course Type:** MDC

COURSE OBJECTIVES (COs)

1. To disseminate knowledge about basics of entrepreneurship and forms of ownership.
2. To enlighten students regarding the relevance of creativity and innovation from an entrepreneurship point of view.
3. To give clarity to students regarding formulation of business plan.
4. To familiarize students with the upcoming trends in the entrepreneurship field.

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 basics of entrepreneurship and different types of ownerships.
2. Grasp relevance of creativity and innovation and its application in a business.
3. Acknowledge components of a business plan and ways to launch it.
4. Utilize conceptual building skills in interpreting trends for the entrepreneurs.

MAPPING BETWEEN COURSE OBJECTIVES AND COURSE LEARNING OUTCOMES

Course Objectives (COs)	Course Learning Outcomes (CLOs)			
	CLO 1	CLO 2	CLO 3	CLO 4
CO 1				
CO 2				
CO 3				
CO4				

COURSE CONTENTS

UNIT	CONTENTS
UNIT-I	**Basics of Entrepreneurship** Entrepreneur: Definition, characteristics, functions, types of an entrepreneur; Concept of Entrepreneurship, types, role of entrepreneurship in economic development, Factors affecting Entrepreneurship.
UNIT-II	**Entrepreneurial Development Programme** Entrepreneurial Development Programme (EDP): meaning & concept; The Role and Relevance of Entrepreneurial Development Program in India; Role of Government in Organizing EDP's Critical Evaluation; Women Entrepreneurship- Meaning, Reasons for Slow Growth, Problems faced by Women Entrepreneurs, Development of women Entrepreneurship.
UNIT-III	**Business Planning** Opportunity Identification and selection, Formulation of business plan, External Environmental Analysis - Economic, Social, financial, technological, competitive, and legal. Financing: Sources, venture capital, export finance.
UNIT-IV	**Entrepreneurial Trends in the Digital Age** Definition and significance of digital entrepreneurship; Brief overview of key digital trends impacting businesses; Disruptive Technologies; Promoting innovation and adaptability in a digital ecosystem

TEXT BOOKS

1. Burns, Entrepreneurship and small business, 4th edition (2016), Palgrave.
2. Norman M. Scarborough, Essentials of entrepreneurship and small business management, 9th edition (2018), Pearson.
3. Hisrich, R., & Peters, M., Entrepreneurship, 11th edition (2020), Tata McGraw Hill.
4. Prahalad, C. K. (2006). Fortune at the bottom of the pyramid, eradicating poverty through profits. Wharton school Publishing.
5. The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses, Eric Ries

SUGGESTED READINGS

1. Khandwalla, P., Corporate creativity, 7th edition (2017), Tata Mc. Graw Hill.
2. Mullins, J., New business road test, 4th edition (2013), Prentice Hall.

3. Drucker, P. F. (2006). Innovation and entrepreneurship: Practice and principles. USA: Elsevier.
4. Gersick, K. E., Davis, J. A., Hampton, M. M., & Lansberg, I. (1997). Generation to generation: Life cycles of the family business. Boston: Harvard Business School Press.
5. Holt, D. H. (2004). Entrepreneurship new venture creation. New Delhi: Prentice Hall of India.

NUMERICAL METHODS IN BME	
Course Code: 24MDC106A	Internal Examination: 40 Marks
Credits: 3	External Examination: 60 Marks
L T P : 3 0 0	
Prerequisite:	

COURSE OBJECTIVES (COs)

1. To have a clear perception of the power of numerical techniques, ideas.
2. To demonstrate the applications of these techniques to problems drawn from industry, management and other engineering fields.
3. To make familiar with error analysis and some numerical methods to solve equations which are not easily solved by algebraic methods.
4. To familiar with different operators which are useful in Numerical Analysis and introduce theconcept of interpolation

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. Find solutions by various numerical methods to get approximation solutions of algebraica transcendental, simultaneous linear equations.
2. Get interpolating values by different numerical methods.
3. Do differentiation and integrations of tabular data.
4. To find numerical solutions of ordinary and partial differential equations.

MAPPING BETWEEN COURSE OBJECTIVES AND COURSE LEARNING OUTCOMES

CLO / CO	CLO-01	CLO-02	CLO-03	CLO-04
CO-01	✓			
CO-02		✓		
CO-03			✓	
CO-04				✓

COURSE CONTENTS

Unit-I: Error in Computation and Numerical Solution of Equations

Approximations and error in computation: Significant figures ,approximate numbers, Errors: Round- off Errors, Truncation Errors ,Absolute Relative and Percentage Errors ,Solution of algebraic and Transcendental equation: basic properties of equation, Bisection method, Newton-Raphson method Solution of simultaneous equation: Gauss Elimination method , Gauss Jacobi method , Gauss Seidel method.

Unit-II: Interpolation with Equal and Unequal Interval

Finite differences - Forward differences and backward differences, difference tables, Interpolationwith equal intervals: Newton- Forward and Backward Interpolation formulae, Interpolation with unequal interval: Divided differences - Newton's Divided difference formula - Lagrange'sInterpolation formula.

Unit-III: Numerical Differentiation and Integration

Numerical Differentiation and Integration: Newton's forward and backward differences formulae to compute first and higher order derivatives - The Trapezoidal rule - Simpson's one third rule and three eighth rule.

Unit-IV: Numerical Solutions of Differential Equations

Solution by Taylor's series - Euler's method - Improved and modified Euler method - Runge-Kutta methods of fourth order (No proof).

TEXT BOOKS / REFERENCE BOOKS

1. B.S. Grewal, “Numerical Methods in engineering and science”, 11th Edition Mercury Learning and Information, 2018.
2. Steven Chapra and Raymond Canale, Numerical Methods for Engineers, McGraw-Hill Education, 8th edition 2020.
3. Gerald C. F., Wheatley P. O., Applied Numerical Analysis, Pearson, 2011.
4. Arumugam S., Isaac A. T., Somasundaram A., Numerical Methods, Scitech Publications Pvt.Ltd, 2010.
5. S.S. Sastry, Introductory Methods of Numerical Analysis, 5th Edition 2012
6. E. Balagurusamy, Computer Oriented Statistical and Numerical Methods - LaxmiPublications,2009.
7. M.K.Jain, SRK Iyengar and R.L.Jain, Numerical Methods for Scientific and EngineeringComputation, NEW AGE; 6th edition, 2019.
8. P.Kandasamy, Numerical Methods, S Chand & Company; Reprint Edition, 2006.

DISCRETE MATHEMATICS	
Course Code: 24MDC 106B	Internal Examination: 40 Marks
Credits: 3	External Examination: 60Marks
L T P : 3 0 0	
Prerequisite:	

COURSE OBJECTIVES (COs)

1. To introduce most of the basic terminologies for Logical and Mathematical maturity thatimpart analytical ability to describe, analyze and solving mathematical problems
2. To get idea about recurrence relation & algebraic systems.
3. To familiarize the students with Boolean algebra and its terminologies.
4. To solve practical problems to the respective branches of Engineering in a logical andsystematic fashion

COURSE LEARNING OUTCOMES (CLOs)

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

1. Write an argument using logical notation and determine if the argument is or is not valid.
2. Understand the basic principles of sets and operations in sets and prove basic set equalities.
3. Understanding recurrence relation and properties of algebraic structures such as groups, ringsand fields.
4. Get idea of Boolean algebra and its applications.

MAPPING BETWEEN COURSE OBJECTIVES AND COURSE LEARNING OUTCOMES

CO \ CLO	CLO-01	CLO-02	CLO-03	CLO-04
CO-01	✓			
CO-02		✓		
CO-03			✓	
CO-04				✓

COURSE CONTENTS

Unit-I: Mathematical Logic

Propositions and Logical operators - Truth tables and propositions generated by a set

-Equivalence and Implication - Tautologies - Laws of logic - Proofs in Propositional calculus -Direct proofs - Conditional conclusions - Indirect proofs - Propositions over a universe -Mathematical Induction -The existential and universal quantifiers - Predicate calculus including theory of inference.

Unit-II: Set Theory & Relations

Laws of Set theory - Partition of a set – Relations – Binary relation - Domain and range of a relation– Inverse relation – Composite relation – Equivalence relation – Equivalence classes – Partitions – Quotient set – Graphs of relations - Hasse diagram - Matrices of relations - Closure operations on relations -Warshall's algorithm

Unit-III: Recurrence Relation & Algebraic Systems

Recurrence relations - Solving a recurrence relation - Recurrence relations obtained from solutions - Generating functions - Solution of a recurrence relation using generating functions- Closed form expression for generating function. Groups - Cyclic groups and subgroups -Normal subgroups - Coding theory - Group codes.

Unit-IV: Boolean Algebra, Posets and lattices

Definitions and Basic Properties of Boolean Algebra, Boolean Expressions, Logic Gates and Circuits, Boolean Function - Method to find Truth Table of a Boolean Function – Disjunctive Normal Form or Canonical Form - Karanugh map. Posets– Hasse Diagram, Chain and anti-chain, Dual of a poset- Isomorphic posets. Lattices – Properties of Lattices, sub-lattices, well ordered set - complete order - Complete lattice - Lattice Homomorphism. Application of Boolean algebra to switching theory.

TEXT BOOKS / REFERENCE BOOKS

1. B. Kolman, R. Busby, and S. C. Ross., Discrete Mathematical Structure, 6^{th}edition.,Pearson'sPublication,2017.
2. Sarkar S. K., Discrete Mathematics, S Chand & Co Ltd2016. Prentice Hall India LearningPrivate Limited; Second edition, 2014.
3. Keneth H. Rosen, Discrete Mathematics and its application, Tata Mcgraw Hill, 7th edition,2017.
4. Bondy J. A., Murty U. S. R., Graph Theroy, Springer, 2013.
5. C.L. Liu, Elements of Discrete Mathematics, Tata McGraw Hill, 4^{th} edition,2017.
6. Yadav S. K., Discrete Mathematics with Graph Theory, Anne Books Pvt. Ltd., 2013.

Life Sciences and Public Health	
Course Code: 23MDC 105	Internal Examination: 40 Marks
Credits: 3	External Examination: 60Marks
L T P : 3 0 0	
Prerequisite:	

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

- Basic concepts of life science and public health.
- To recognize the factors causing environmental degradation and its outcome in form of increasing number of diseases leading to deterioration of public health.
- Analyze and debate therapeutic, diagnostic and preventive measures for communicable and non-communicable disease.

Course Learning Outcomes (CLO) –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:

• Familiarize with various aspects of environmental and biological risks and hazards.
• Be aware about the various factors impacting human health through case studies and modes of prevention.
• Learn about diagnosis, therapy and prevention of various diseases.
• Be sensitized about social health problems for betterment of human race and all living beings.

MAPPING BETWEEN COURSE OBJECTIVES AND COURSE LEARNING OUTCOMES

	COURSE LEARNING OUTCOMES (CLOs)			
COURSE OBJECTIVES (COs)	**CLO1**	**CLO2**	**CLO3**	**CLO4**
CO1	√			
CO2		√		
CO3			√	√

COURSE CONTENTS

Unit 1: Introduction to Public health and Hygiene

Significance of Public health and Hygiene, Nutrition and health, Classification of foods, Major nutritional Deficiency diseases- Protein Energy Malnutrition (Kwashiorkor and Marasmus), Vitamin deficiency disorders, Iron deficiency disorders, Iodine deficiency disorders.

Unit 2: Environment and Health hazards

Environmental degradation, Environmental Pollution – Air, water, soil and noise; Associated health hazards.

Unit 3: Communicable Diseases

Different types of communicable diseases and their control measures – Tuberculosis, Measles, Dengue, Leprosy.

Unit 4: Life Style Related Non-Communicable Diseases

Different types of Life style related non-communicable diseases - Hypertension, Coronary Heart diseases, Stroke, Diabetes mellitus, Obesity and Mental ill-health - their causes and prevention through dietary and lifestyle modifications.

Unit 5: Social Health Problems

Smoking, alcoholism, drug dependence and Acquired Immuno-Deficiency Syndrome (AIDS) - their causes, treatment and prevention.

Recommended Text Books:

• Park, K. (2017), Preventive and Social Medicine, B.B. Publishers
• Brownson, R. C., Baker, E.A., Leet T.L., and Follespie K.N. (2003) Evidence based Public Health, Oxford University Press. 64 Suggested Readings:
• Guyton A.C. and Hall J.E. Textbook of Medical Physiology, Saunders

Reference Books:

• Robbins and Cortan, Pathologic basis of Disease, VIII Edition, Saunders
• Engelkirk P.G. and Duben-Engelkirk J. (2015) Burton's Microbiology for the Health Sciences, 10th Edn. Wolters Kluwer Health.

Electoral Literacy in India	
Course Code: 23MDC 305	Internal Examination: 40 Marks
Credits: 3	External Examination: 60Marks
L T P : 3 0 0	
Prerequisite: None	

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

5. To know the meaning and nature of the electoral democracy in India
6. To discuss electoral institutions in India
7. To understand the procedural aspect of elections in India
8. To grasp the significance of elections and electoral aspects of democracy, the electoral model code of conduct, issues, and challenges in India's democracy.

Course Learning Outcomes (CLO) – The Syllabus has been prepared in accordance with the NEP-2020. Upon completion of this course, learners will be able to:

1. Understand the meaning, definition, and significance of elections in India.
2. Analyse the role of electoral institutions and functions in the conduct of free and fair elections.
3. Illustrate the party system of India.

Mapping Matrix between Course Objectives and Course Learning Outcomes:

Course Learning Objectives (Cos)	Course Learning Outcome (CLOs)				
	CLO1	CLO2	CLO3	CLO4	CLO5
CO1					
CO2					
CO3					
CO4					

COURSE CONTENTS:

UNIT-1: Elections in India

- Suffrage, Types, and Methods of Elections
- Parliamentary elections: Lok Sabha & Rajya Sabha
- Presidential Elections
- State Legislative Assembly Elections
- Local Body Elections

UNIT-2: Electoral Institutions

- Election Commission (EC)

- State Election Commission
- Constitution: Part-15

UNIT-3: Political Parties in India

- One-party, Two Party, Multi-party system
- Model Code of Conduct, Party Funding, and Campaign

UNIT-4: Elections: Issues and Challenges

RECOMMENDED TEXTBOOKS:

1. Subhash C. Kashyap, Our Political System, 2nd, National Book Trust, India, 2008, ISBN: 8123752520
2. D. D. Basu, Introduction to The Constitution Of India, 26th Edition, Lexis Nexis, ISBN: 978-9388548861
3. Bidyut Chakrabarty, Rajendra Kumar Pandey, Indian Government and Politics, Sage Text, ISBN: 8132100581

REFERENCE BOOKS:

1. Sanjay Kumar, Elections in India: An Overview, 1st, Routledge, ISBN: 9781032033136
2. https://eci.gov.in/
3. https://www.lokniti.org/
4. Websites of State Election Commission
5. NCERT, Chapter-3 Indian Constitution at Work

PERSONAL FINANCIAL PLANNING

Course Code: 23MDC403	**Continuous Evaluation**: 40
Credits: 03	**End Semester Examination**: 60
L T P : 3-0-0	
Prerequisite: Student should be aware about various saving schemes and their future benefits.	

COURSE OBJECTIVES

1. Build an understanding to familiarize different aspect of personal financial planning.
2. Analyze and compare different sources of savings and investment.
3. Develop a perspective to understand necessary knowledge and skills for effective Tax planning.
4. Develop skills to assess need for the insurance and retirement planning.

COURSE LEARNING OUTCOMES

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

1. Analyze the meaning and appreciate the relevance of financial planning
2. Analyze the Integration of various avenues of investment for future benefit.
3. Examine the scope and ways of personal tax planning.
4. Analyze the insurance and retirement planning with relevance.

MAPPING MATRIX COURSE OBJECTIVES & COURSE LEARNING OUTCOMES

CLO / CO	01	02	03	04
01				
02				
03				
04				

UNIT	Course contents
UNIT-I	**Introduction to Financial Planning** Financial goals, steps in financial planning, budgeting incomes and payments, time value of money. Introduction to savings, benefits of savings, management of spending & financial discipline, Setting alerts and maintaining sufficient funds for fixed commitments.
UNIT- II	**Investment Planning** Process and objectives of investment, concept and measurement of return & risk for various asset classes, measurement of portfolio risk and return, diversification & portfolio formation, Various Investment avenues
UNIT- III	**Personal Tax Planning** Tax structure in India for personal taxation, Scope of personal tax planning, exemptions and deductions available to individuals under different heads of income and gross total income.
UNIT- IV	**Insurance and Retirement Benefits Planning** Need for insurance. Life insurance, health insurance, property insurance, credit life insurance and professional liability insurance, Pension plans available in India

TEXT BOOKS

1. Halan, M. ―Let‘s Talk Money: You've Worked Hard for It, Now Make It Work for You‖ Harper Collins Publishers, 2020 New York.
2. Madura, J. ―Personal Finance, 2021,Pearson Publication
3. Indian Institute of Banking & Finance. ―Introduction to Financial Planning, Taxmann Publication, 2021, New Delhi.
4. Keown A.J. ―Personal Finance, Pearson Publication, 2021, New York.

REFERENCE BOOKS

1. Pandit, A. –The Only Financial Planning Book that You Will Ever Need, Network 18 Publications Ltd., Mumbai.
2. Sinha, M. –Financial Planning: A Ready Reckoner, McGraw Hill Education, New York.
3. Tripathi, V. –Fundamentals of Investment, Taxmann Publication, New Delhi.

Interior Design	
Course Code: 23MDC 404	Internal Examination: 40 Marks
Credits: 3	External Examination: 60Marks
L T P : 3 0 0	
Prerequisite: None	

COURSE OBJECTIVES (COs)

1. To explain and introduce to basics of Interior design and décor.
2. To explain and inform about elements and principles of design.
3. To explain the Importance of window and lightings in enhancing décor of the interiors.
4. To introduce and explain about the use of furniture and accessories in Interior décor and design.
5. To explain the use of different wall and floor finishes in enhancing the décor and design.

COURSE LEARNING OUTCOMES (CLO)

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

1. At the end of the first unit students would be able to understand the basics of Interior design and décor.
2. At the end of the Second unit students would be able to utilize elements and principles of design in décor enhancement.
3. At the end of the third unit students would be able to understand the Importance of window and lightings in enhancing décor of the interiors.
4. At the end of the fourth unit students would be able to explain and use furniture and accessories in Interior décor and design.
5. At the end of the fifth unit students would be able to use different wall and floor finishes in enhancing the décor and design.

Mapping Matrix of Course Objectives (CO) and Course Learning Outcomes (CLO)

SEM	SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4	CLO5
VI	23MDC404	Interior Design	CO1	√				
			CO2		√			
			CO3			√		
			CO4				√	
			CO5					√

UNIT	COURSE CONTENTS	HOURS
UNIT-I	**INTRODUCTION TO INTERIOR DESIGN AND DÉCOR**: Beauty, Expensiveness, Functionalism, Common terms used in décor	8
UNIT-II	**ELEMENTS AND PRINCIPLES OF DESIGN**: Line, form, texture and colour (basic elements), The concept of light, space and pattern as elements, Colour Associations, Understanding colour, The colour wheel, Properties of colour –Warm /Cool, Advancing/Receding, Heavy/Light, Earthy /Acid, Additive and Subtractive colour, Colour Perception, Physical and psychological effect of colour, Colour Balance, Colour Emphasis, Colour Contrast, Effect of light on colour, Choice of colours, Planning a colour scheme of a room, Harmony, Balance, Scale and Proportion, Rhythm, Emphasis	8
UNIT-III	**WINDOW AND LIGHTINGS**: The purpose of a window, Types of windows, The importance of suitable window treatments, Selecting fabrics for curtains (practical and visual), Curtain headings, Calculating fabric requirements, Types of window treatments. LIGHTINGS: Introduction to lighting Lighting, Levels- Lux and Lumen, Categories- Ambient, Task, Accent, Exterior and Emergency, The importance of a good lighting system, Artificial lighting -Tungsten, Fluorescent, Discharge, CFL, Halogen.., Types of light distribution-direct, semi direct, indirect, diffused, Methods of lighting- architectural and non-architectural, Lighting in various areas of the hotels, Light fittings, Selection of lighting systems and energy check list	8
UNIT-IV	**FURNITURE AND ASSESSORIES**: The functional aspect-furniture elements, structure, finish, upholstery, The decorative aspects- styles of furniture, Furniture items placed in the guestrooms, Standard sizes of furniture, Furniture arrangement—Guidelines. ACCESSORIES: Various types of accessories and their guidelines, Flower Arrangement as an accessory Indoor Plants as an accessory.	8
UNIT-V	**WALL AND FLOOR FINISHES:** Wall Finishes: Paint, Wallpaper, Fabric, Laminates Wood panelling, Ceramic Tiles, Glass, Textured. FLOOR FINISHES: Ceramic, Marble Terrazzo, Granite, Concrete, Wood, Resilient (Vinyl, Asphalt, Rubber, Linoleum), Carpets (Types and Maintenance)	8

Text Books

- **The Handbook of Interior Design by Jo Ann Asher Thompson, Nancy H.**

Reference Books

- The Interior Design Reference & Specification Book: Everything Interior Designers Need to Know
- Every Day, by Chris Grimley, Linda O'Shea, and Mimi Love
- The Interior Design Handbook by Frida Ramstedt
- Residential Interior Design: A Guide To Planning Spaces by Courtney Nystuen and Maureen Mitton

PROBABILITY AND STATISTICS	
Course Code: 24MDC107	Internal Examination: 40 Marks
Credits: 3	External Examination: 60Marks
L T P : 3 0 0	
Prerequisite: Nil	

COURSE OBJECTIVES (COs)

1. To apply the basis rules of probability and gain knowledge of theoretical distributions.
2. To apply the knowledge of Regression lines and analysis of variance.
3. Understand how to develop null and alternative hypothesis and draw conclusions using hypothesis tests.
4. Acquire the knowledge to solve the problem of process control.

COURSE LEARNING OUTCOMES (CLOs)

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

1. Implement the concept of probability and random variables and model them using various distributions.
2. Examine the regression lines and interpret the results in the analysis of variants.
3. Infer the results by using hypothesis testing on large and small samples.
4. Utilize quality control technique to solve real world problems.

MAPPING BETWEEN COURSE OBJECTIVES (COs) AND COURSE LEARNING OUTCOMES (CLOs)

CO \ CLO	CLO-01	CLO-02	CLO-03	CLO-04
CO-01	✓			
CO-02		✓		
CO-03			✓	
CO-04				✓

COURSE CONTENTS

Unit-I: Probability and Probability Distributions

Introduction, Conditional Probability, Baye’s Theorem and its applications, Random Variable, Discrete and Continuous random variables, Binomial, Poisson and Normal distributions.

Unit-II: Correlation, Regression and ANOVA

Correlation and its properties, Karl Pearson's Coefficient of correlation, Spearman's Rank Correlation Coefficient for repeated and non-repeated ranks, Linear regression lines and properties, Introduction to ANOVA, one way and two way classifications.

Unit-III: Testing of Hypothesis

Sampling distribution, Type-I and Type-II errors, large sample test, Test of significance for single proportion, difference of proportion, single mean and difference of means. Small sample test, t-test for single mean, for difference of means.

Unit-IV: Statistical Quality Control

Introduction, Process control, Control charts for variable, $\bar{X}$, R and S charts.

TEXT BOOKS / REFERENCE BOOKS

7. S.Ross, "A first Course in Probabilty", Pearson Education, India, 2010
8. Veera Rajan,T, "Probability and Statistics," TMH, New Delhi-2010
9. V.K.Rohatagi, A.K.Md. Ehsan's Saleh, "An Introduction to Probability and Statistics," Wiley, Oxford, 2^{nd} Ed. 2008.
10. S.C.Gupta and V.K. Kapoor, "Fundamental of Mathematical Statistics", S.Chand ,New Delhi, 2015.