CURRICULUM & SYLLABUS

CHOICE BASED CREDIT SYSTEM (CBCS)

FOR

BACHELOR OF TECHNOLOGY (B.Tech.)

(4 Year Undergraduate Degree Programme)

IN

ELECTRICAL & ELECTRONICS ENGINEERING

(In alignment with National Education Policy, 2020)

[w. e. f. 2025-26]

FACULTY OF ENGINEERING AND TECHNOLOGY

SRM UNIVERSITY DELHI-NCR, SONEPAT

Plot No.39, Rajiv Gandhi Education City, P.S. Rai, Sonepat Haryana-131029

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

ENGINEERING GRADUATES EMPLOYABILITY ATTRIBUTES (EGEAs):

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 modeling 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.

Effective Communication Skills:

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.

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.

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FACULTY OF ENGINEERING AND TECHNOLOGY

FACULTY OF ENGINEERING PROGRAM EDUCATIONAL OBJECTIVES (FEPEOs):

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 (FEPLOs):

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 PR OGRAM LEARNING OUTCOMES

FACULTY OF ENGINEERING PROGRAM EDUCATIONAL OBJECTIVES	FACULTY OF 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.

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NAAC ACCREDITED A+ GRADE

TABLE 1: MAPPING MATRIX OF FACULTY OF ENGINEERING PROGRAM EDUCATIONAL OBJECTIVES AND FACULTY OF ENGINEERING PROGRAM LEARNING OUTCOMES (TABULAR FORMAT)

MAPPING MATRIX	FEPLO1	FEPLO2	FEPLO3	FEPLO4	FEPLO5	FEPLO6	FEPLO7
FEPEO1	X	X					
FEPEO2		X	X				
FEPEO3			X	X			
FEPEO4				X	X	X	
FEPEO5						X	X

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ELECTRICAL AND ELECTRONICS ENGINEERING DEPARTMENT

ELECTRICAL AND ELECTRONICS ENGINEERING GRADUATE EMPLOYABILITY ATTRIBUTES (EEEGEAS):

The B. Tech program aims at providing a strong foundation in theoretical, practical and design aspects of Electrical and Electronics Engineering (EEE). 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 electrical and electronics engineering under the broad categories of power generation, transmission and distribution, communication and Electrical Machine Drives. The syllabus comprises of theory and laboratory courses. The theory course can be either a professional core (major) or professional elective course (minor). There are various specialized identified domains on 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 learnt 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 semesters are aimed at providing opportunities to the students, as well as guiding them to design electrical and electronic circuits or Electrical and Electronics software products and systems by using theoretical, practical and design knowledge learnt so for. The elective courses are aimed at imparting knowledge in the specialized and state of the art topics in the broad categories mentioned above. In addition, syllabus covers various Live Projects and skill enhancement courses. Thus the B. Tech program offered by the department provides an ample opportunity for the aspiring students to become Electrical and Electronics Engineer with sufficient knowledge to take up the Engineering profession. Employability Attributes pertaining to Electrical and Electronics Engineering Curriculum is as follows:

Sound Knowledge and Skills of Basic Sciences & Engineering Sciences	An Electrical and Electronics Engineering graduate should be able to apply the knowledge of applied basic sciences, engineering sciences, engineering fundamentals to the solution of complex engineering problems.
Problem formulation, analysis and solving	An electrical and electronics graduate 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 Solution	An electrical and electronics 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.

Investigation	An electrical and electronics 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.
Modern Tools Usage	An electrical and electronics graduate engineer should be able to create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
The Engineer and the Society	An electrical and electronics 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.
Effective Communication	An electrical and electronics 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.
Individual and Teamwork	An electrical and electronics graduate 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 electrical and electronics 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.
Environment and Sustainability	An electrical and electronics graduate 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 electrical and electronics graduate 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 electrical and electronics graduate 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.

Department of Electrical and Electronics Engineering

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1. To transform electrical and electronics engineering graduates to expert engineers so that they could comprehend, analyse, design and create novel products and solutions to problems in the area of Electrical and Electronics that are technically sound, economically feasible and socially acceptable.

PEO2. To produce competent electrical and Electronics engineering graduates with adequate knowledge and skills in the areas of Electrical and Electronics so as to excel in advanced level jobs in modern industry, teaching, higher education and research.

PEO3. To train electrical and electronics engineering graduates to exhibit professionalism, keep up ethics in their profession and relate engineering issues to address the technical and social challenges.

PEO4. To develop the ability to organize and present information and to write and speak effective English.

PEO5. To imbibe an attitude in the graduates for life-long Learning process.

PROGRAM LEARNING OUTCOMES (PLOs)

PLO1. Engineering Knowledge and Skill: Apply the knowledge of mathematics, science, electrical engineering fundamentals, and an electrical engineering specialization to the solution of complex electrical engineering problems.

PLO2. Problem Analysis: Identify, formulate, review research literature, and analyze complex electrical engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PLO3. Design and development of Solutions: Design solutions for complex electrical 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.

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

PLO8. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PLO9. 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.

PLO10. Environment and sustainability: Understand the impact of the professional electrical engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PLO11. Professional Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PLO12. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

TABLE 2: MAPPING MATRIX OF PROGRAM EDUCATIONAL OBJECTIVES (PEOs) AND PROGRAM LEARNING OUTCOMES (PLOs):

	Program Learning Outcomes (PLOs)											
Program Educational Objectives (PEOs)	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	PLO 11	PLO 12
PEO1	x		x		x	x			x	x		
PEO2			x	x		x				x	x	x
PEO3	x	x		x	x		x	x				
PEO4	x			x	x				x	x	x	
PEO5		x	x	x	x		x	x	x	x		

B. TECH (ELECTRICAL AND ELECTRONICS ENGINEERING) PROGRAMME STRUCTURE

The curriculum for Bachelor of Technology in Electrical and Electronics Engineering is tailor-made so that the graduate must have a strong foundation in the discipline and in-depth knowledge of the tools used to tackle both, conventional and new challenging problems. In order to earn a B. Tech. degree in Electrical and Electronics Engineering, a student should secure a minimum of 180 credits in the course of their study. The credit requirements for their program of study are comprised of the following Programme Structure:

- **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, and Chemistry in the mind of the learners so that they proceed to the 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 the 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 teamwork.
- **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 well equipped with the latest software to conduct practicals as per the requirement of the University Curriculum.
- **Professional Electives (PE) – Program-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 to enable the students to acquire and demonstrate core linguistic skills, including critical reading and academic writing skills. The focus is on imparting students with the necessary skills to articulate their arguments to 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 to Engineering Graduates of various disciplines with common nomenclature. The training is categorized into three categories: Elementary, Intermediate & Advanced keeping in view the 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 disciplines are introduced to inculcate Group Dynamics, teamwork & leadership traits by engaging students in interactive sessions through Role Play, Group Discussions, and improve their 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 are being introduced for all Engineering disciplines from 3rd semester onwards till 6th Semester to develop an ability in engineering graduates to apply skills and knowledge attained to solve real-life complex problems (One Credit each semester).
    - ❖ Apart from this, it will be mandatory to conduct at least 1 Industrial Visit each semester to provide students a proper industrial exposure.
- **Summer Internship (SI):**
    - ❖ Students will be monitored on a periodic basis, both by the Faculty Mentor from the Industry and the Faculty in 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 presentations to keep a check on the progress of the student.

- ❖ Students are provided with the internship/related document which helps them to prepare a report. In addition to this, it provides 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 to have a multidisciplinary approach.

TABLE 3: PROGRAM STRUCTURE FOR BACHELOR OF TECHNOLOGY (ELECTRICAL AND ELECTRONICS ENGINEERING) DEGREE COURSE

SL. No.	Course Category	Course Code	Number of Courses
1	Basic Applied Sciences	BAS	7
2	Engineering Sciences	ES	9
3	Professional Core	PC	15
4	Professional Electives -Program-Specific Specialized Elective Courses	PE	11
5	Ability Enhancement Courses	AEC	4
6	Skill Enhancement courses (Technical and Soft 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	8
10	Multidisciplinary (Humanities and Social Sciences Courses) Courses	MDC	**3**
TOTAL NUMBER OF COURSES			80

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TABLE 4: PROGRAM CREDIT STRUCTURE SEMESTERWISE FOR BACHELOR OF TECHNOLOGY (ELECTRICAL & ELECTRONICS ENGINEERING)

SL. No	Course Category	Course Code	Credits Per Semester								Total Credits	% AG E
			I	II	III	IV	V	VI	VII	VIII		
1	Basic Applied Sciences	BAS	9	9	4	-	-	-	-	-	22	12
2	Engineering Sciences	ES	8	9	-	-	-	-	-	-	17	10
3	Professional Core	PC	-	-	12	12	9	6	6	-	45	25
4	Professional Electives -Program Specific Specialized Elective Courses	PE	-	-	3	3	9	9	9	-	33	18
5	Ability Enhancement Courses	AEC	5	2	-	-	-	-	-	-	7	4
6	Skill Enhancement courses (Technical and Soft skills)	SEC	-	-	2	2	2	2	2	-	10	5
7	Value Added Courses	VAC	2	2	2	-	-	-	-	-	6	3
8	Practical / Workshop	P/W	-	-	2	3	2	2	1	-	10	5
9	Live Project & Industrial Visit and Summer Internship	LP/SI	-	-	-	1	2	1	6	12	22	12
10	Multidisciplinary (Humanities and Social Sciences Courses) Courses	MDC	-	-	-	3	3	3	-	-	9	5
TOTAL			24	22	25	24	27	23	24	12	181	100

PROGRAM COURSE'S CREDIT STRUCTURE SEMESTER WISE
SEMESTER-I

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

[L= Lecture, T = Tutorials, P = Practical's & C = Credits]

PROGRAM COURSE’S CREDIT STRUCTURE SEMESTER WISE
SEMESTER-II

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

[L= Lecture, T = Tutorials, P = Practical’s & C = Credits]

Semester-III

SL.No	Code	Category	Course Name	Hours per week				Credits
				L	T	P	Total Hours	
Theory								
1	24AS301	(BAS)	Engineering Mathematics-III	3	1	0	4	4
2	23EE0203	(PC)	Electrical Machines-I	3	0	0	3	3
3	23EE0205	(PC)	Electromagnetic Theory	3	0	0	3	3
4	23EE0207	(PC)	Digital System Design	3	0	0	3	3
5	24EEPEXX	(PE)	Professional Elective- I	3	0	0	3	3
6	23EE0209	(PC)	Network Analysis and Synthesis	3	0	0	3	3
Total Credits (Theory)				18	1	0	19	19
Practical								
7	23EE0253	(P)	Electrical Machines Laboratory-I	0	0	2	2	1
8	23EE0257	(P)	Digital System Design Lab	0	0	2	2	1
9	23VAC 103	(VAC)	Sports, Yoga & Fitness	1	0	2	3	2
Total Credits (Practical)				1	0	6	7	4
Skill Enhancement								
10	24CS0201A /24CS0201 B/24CS020 1C/24CS02 01D	(SEC)	Data Structure and Algorithmsusing C or C++/Industry Automation Level-I/ Digital Marketing/Fundamenta ls of CAD for Engineers	0	0	2	2	1
11	23SS351	(SEC)	Effective Communication Skills	0	0	2	2	1
Total Credits (Skill Enhancement)				0	0	4	4	2
Total Credits (Theory + Practical + Skill Enhancement)				19	1	10	30	25

[L= Lecture, T = Tutorials, P = Practical's & C = Credits]

Semester-IV

SL.No	Code	Category	Course	Hours per week				Credits
				L	T	P	Total Hours	
Theory								
1	24MDC401	(MDC)	Multidisciplinary Elective-I	3	0	0	3	3
2	23EEPE09	(PC)	Programming using	3	0	0	3	3
3	23EE0201	(PC)	Electrical Machines	3	0	0	3	3
4	23EE0206	(PC)	Control Engineering	3	0	0	3	3
5	23EE0208	(PC)	Linear Integrated Circuits	3	0	0	3	3
6	24EEPEXX	(PE)	Professional Elective - II	3	0	0	3	3
Total Credits (Theory)				18	0	0	18	18
Practical								
7	23EE0254	(P)	Electrical Machines Laboratory II	0	0	2	2	1
8	23EE0256	(P)	Electrical Measurement & Control	0	0	2	2	1
9	23EE0258	(P)	Linear Integrated Circuits Laboratory	0	0	2	2	1
10	23EE0260	(LP/SI)	#Live Project-I &	0	0	1	1	1
Total Credits (Practical)				0	0	7	7	4
Skill Enhancement								
11	23SS452	(SEC)	Teamwork & Interpersonal Skills	0	0	2	2	1
12	24CS0202A /24CS0202 B/24CS020 2C	(SEC)	Introduction to SPSS Tool/Design Thinking and Augmented Virtual Reality/Programming Using Python for Engineers	0	0	2	2	1
	Total Credits (Skill Enhancement)			0	0	4	4	2
Total Credits (Theory + Practical + Skill Enhancement)				18	0	11	29	24

#To be carried out after 3rd Semester during semester break. Evaluation to be carried out in 4th Semester.

Semester – V

SL.No	Code	Category	Course Name	Hours per week				Credits
				L	T	P	Total Hours	
Theory								
1	24MDC5XX	(MDC)	Multidisciplinary Elective-II	3	0	0	3	3
2	24EEXXX	(PC)	Machine Learning using Python	3	0	0	3	3
3	23EE0305	(PC)	Power Electronics	3	0	0	3	3
4	24EE0307	(PC)	Generation, Transmission and Distribution	3	0	0	3	3
5	*24EEPEXX	(PE)	Professional Elective - III	3	0	0	3	3
6	*24EEPEXX	(PE)	Professional Elective - IV	3	0	0	3	3
7	*24EEPEXX	(PE)	Professional Elective-V	3	0	0	3	3
Total Credits (Theory)				21	0	0	21	21
Practical								
8	23EE0355	(P)	Power Electronics Lab	0	0	2	2	1
9	23EE0357/ 23EE0363	(P)	Electrical Simulation and Programming Lab-II/ Computer Aided Manufacturing (CNC) Laboratory	0	0	2	2	1
10	23EE0359	(LP/SI)	Live Project II & Industrial Training	0	0	1	1	1
11	23EE0361	(LP/SI)	#Industrial Training-I	0	0	1	0	1
Total Credits (Practical)				0	0	6	5	4
Skill Enhancement								
12	23SS553	(SEC)	Presentation Skills	0	0	2	2	1
13	24CS0301B/ 24CS0301C/ 24CS0301D	(SEC)	Big Data Analytics, Tools and Techniques/Machine Learning using Python/Industry Automation Level-II	0	0	2	2	1
Total Credits (Skill Enhancement)				0	0	4	4	2
Total Credits (Theory + Practical + Skill Enhancement)				21	0	10	30	27

[L= Lecture, T = Tutorials, P = Practical's & C = Credits]

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

#To be carried out after 4th semester during semester break. Evaluation to be carried out in 5th Semester.

Semester – VI

SL.No	Code	Category	Course	Hours per week L	T	P	Total Hours	Credits
Theory								
1	24MDC6XX	(MDC)	Multidisciplinary Elective- III	3	0	0	3	3
2	24EE0306	(PC)	Power System Analysis	3	0	0	3	3
3	23EE0308	(PC)	Microprocessor and Microcontroller	3	0	0	3	3
4	*24EEPEXX	(PE)	Professional Elective- VI	3	0	0	3	3
5	*24EEPEXX	(PE)	Professional Elective-VII	3	0	0	3	3
6	*24EEPEXX	(PE)	Professional Elective-VIII	3	0	0	3	3
Total Credits (Theory)				18	0	0	18	18
Practic								
7	23EE0356	(P)	Power System Analysis Laboratory	0	0	2	2	1
8	23EE0358	(P)	Microprocessor and Microcontroller	0	0	2	2	1
9	23EE0360	(LP/SI)	#Live Project III & Industrial Visit	0	0	1	1	1
Total Credits (Practical)				0	0	5	5	3
Skill Enhancement								
10	23SS654	(SEC)	Professional Skills	0	0	2	2	1
11	24CS0302A /24CS0302B /24CS0302C /24CS0302D	(SEC)	Artificial Intelligence andMachine Learning/MATLAB for Engineers/ Structural Analysis using FEM- based Tools/Data Analytics	0	0	2	2	1
Total Credits (Skill Enhancement)				0	0	4	4	2
Total Credits (Theory + Practical + Skill Enhancement)				18	0	9	27	23

[L= Lecture, T = Tutorials, P = Practical's & C = Credits]

***The XX part of the course code will depend upon the elective chosen by the student**
#To be carried out after 5th semester during semester break. Evaluation to be carried out in 6th Semest

Semester – VII

SL.No	Code	Category	Course	Hours per week				Credits
				L	T	P	Total Hours	
Theory								
1	24EE0407	(PE)	Professional Elective -IX	3	0	0	3	3
2	24EE0409	(PE)	Professional Elective -X	3	0	0	3	3
3	*24EEPEXX	(PE)	Professional Elective -XI	3	0	0	3	3
4	23EE0405	(PC)	Solid State Electrical Drives and Control	3	0	0	3	3
5	24EE0411	(PC)	Power System Protection	3	0	0	3	3
Total Credits (Theory)				15	0	0	15	15
Practical								
6	23EE0455	(P)	Electric Drives and Renewable Energy Laboratory	0	0	2	2	1
7	23EE0457	(LP/SI)	**Minor Project	0	0	8(4) **	4	4
8	23EE0459	(LP/SI)	Live Project-IV & Industrial Visits	0	0	1	1	1
9	23EE0461	(LP/SI)	#Industrial Training-II	0	0	1	1	1
Total Credits (Practical)				0	0	8	8	7
Skill Enhancement								
10	23AR755	(SEC)	Aptitude and Reasoning	0	0	2	2	1
11	24CS0401D/24CS0401B	(SEC)	Essentials of Blockchain and IoT/PLC Programming	0	0	2	2	1
Total Credits (Skill Enhancement)				0	0	4	4	2
Total Credits (Theory + Practical + Skill Enhancement)				15	0	12	27	24

[L= Lecture, T = Tutorials, P = Practical's & C = Credits]

***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 carried out in 7th Semester

Semester – VIII

SL.No	Code	Category	Course	Hours per week				Credits
				L	T	P	Total Hours	
Practical								
1	23EE0430	(LP/SI)	*Major Project (Industrial Internship)	0	0	24	24(6) **	12
Total Credits (Practical)				0	0	24	24(6) **	12

* To Be Monitored at The Institute Level
** Teaching Load

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 andMachine 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: 7- (3*2) +1 Credits						
University Pool Common to all UG Programs						
Code	**Category**	**Course**	**L**	**T**	**P**	**C**
24HS101/24HS201 24HS151/24HS251	(AEC)	Communicative English// Communicative English Lab	2	0	2	3
24 HIN101-I/24FLGR-I/24FLFR-I	(AEC)	Hindi/ German/French (Phase-I)	2	0	0	2
24 HIN201-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
23VAC101/23VAC201	(VAC)	Environment Protection and Sustainable Development	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.						

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.

Department Elective Courses of Specialization in Major Degree of Electrical and Electronics Engineering Department

Professional Elective Courses

1. Specialization in Electrical and Electronics Engineering

SL.No	Code	Category	Course	L	T	P	C
Professional Elective-I							
1	23EEPE65	**(PE)**	Electrical & Electronics, Measurements and Instrumentation	3	0	0	3
2	23EEPE66	**(PE)**	Electron Devices and Circuits	3	0	0	3
3	23EEPE10	**(PE)**	Mechatronics	3	0	0	3
4	23EEPE64	**(PE)**	Computer-aided design and Manufacturing	3	0	0	3
Professional Elective-II							
1	23EEPE68	**(PE)**	Renewable Energy Sources	3	0	0	3
2	23EEPE42	**(PE)**	Modern Optimization Techniques	3	0	0	3
3	23EEPE04	**(PE)**	Wind and Solar Energy Systems	3	0	0	3
4	23EEPE02	**(PE)**	Instrumentation System	3	0	0	3
5	23EEPE06	**(PE)**	Solar Photovoltaic System	3	0	0	3
Professional Elective-III							
1	23EEPE15	**(PE)**	Design of Electrical Machines	3	0	0	3
2	23EEPE16	**(PE)**	Special Electrical Machines	3	0	0	3
3	23EEPE17	**(PE)**	Electrical Safety and Safety Management	3	0	0	3
Professional Elective-IV							
1	23EEPE52	**(PE)**	Digital Communication	3	0	0	3
2	23EEPE19	**(PE)**	Communication Systems	3	0	0	3
3	23EEPE67	**(PE)**	Discrete Transform and Signal Processing	3	0	0	3
4	23EEPE51	**(PE)**	Distributed System Planning and Automation	3	0	0	3
5	23EEPE39	**(PE)**	Energy Management and Audit	3	0	0	3
Professional Elective-V							
1	23EEPE54	**(PE)**	Mobile Communication	3	0	0	3
2	23EEPE20	**(PE)**	Wireless Communication Systems	3	0	0	3
3	23EEPE69	**(PE)**	Modern Control Systems	3	0	0	3
4	23EEPE58	**(PE)**	Embedded Systems Design	3	0	0	3
5	23EEPE33	**(PE)**	Power Quality	3	0	0	3
6	23EEPE43	**(PE)**	Soft Computing	3	0	0	3
Professional Elective-VI							
1	23EEPE46	**(PE)**	Smart Grid Technologies & IoT	3	0	0	3
2	23EEPE37	**(PE)**	Substation Design	3	0	0	3
3	23EEPE08	**(PE)**	PLC, DCS and SCADA	3	0	0	3
4	23EEPE01	**(PE)**	Data acquisition and Telemetry	3	0	0	3
5	23EEPE22	**(PE)**	Power Converter Analysis and Design	3	0	0	3
Professional Elective-VII							
1	23EEPE53	**(PE)**	Optical Fiber Communication	3	0	0	3
2	23EEPE07	**(PE)**	Design of Hydro Power Station	3	0	0	3
3	23EEPE03	**(PE)**	Sensors and Transducers	3	0	0	3
4	23EEPE11	**(PE)**	Advanced Topics in Electrical Insulation	3	0	0	3
5	23EEPE34	**(PE)**	Power System Optimization	3	0	0	3
Professional Elective-VIII							
1	23EEPE55	**(PE)**	Data Communication Networks	3	0	0	3
2	23EEPE29	**(PE)**	Micro Grid	3	0	0	3
3	23EEPE18	**(PE)**	Electrical Systems Design for Building	3	0	0	3
4	23EEPE38	**(PE)**	Hybrid Electric Vehicles	3	0	0	3

Professional Elective-IX							
1	23EEPE56	**(PE)**	Wireless Communication	3	0	0	3
2	23EEPE30	**(PE)**	Power System Deregulation	3	0	0	3
3	23EEPE21	**(PE)**	Switched Mode Power Conversion	3	0	0	3
4	23EEPE63	**(PE)**	Biomedical Engineering	3	0	0	3
5	23EEPE50	**(PE)**	Real-Time Control of Power Systems and Energy Management	3	0	0	3
6	23EEPE48	**(PE)**	Infrastructure For Smart Cities	3	0	0	3
Professional Elective-X							
1	23EEPE57	**(PE)**	Satellite Communication	3	0	0	3
2	23EEPE14	**(PE)**	Electrical Power Utilization and Illumination	3	0	0	3
3	23EEPE32	**(PE)**	High Voltage Engineering	3	0	0	3
4	23EEPE35	**(PE)**	Energy Storage Technology	3	0	0	3
5	23EEPE45	**(PE)**	Cyber Security	3	0	0	3
6	23EEPE40	**(PE)**	Power System operation and Control	3	0	0	3
Professional Elective-XI							
1	23EEPE59	**(PE)**	Radar and Imaging systems	3	0	0	3
2	23EEPE12	**(PE)**	Reactive Power control & FACT Devices	3	0	0	3
3	23EEPE25	**(PE)**	Power System Harmonics	3	0	0	3
4	23EEPE60	**(PE)**	Virtual Instrumentation	3	0	0	3
5	23EEPE47	**(PE)**	Distributed Generation and Microgrids	3	0	0	3

Note: *** The department can adopt professional elective courses from 2023-24 academic regulation of Electrical & Electronics Engineering program.

2. Minor Specialization in Data Science & Artificial Intelligence

Sem	Course Code	Course	Category	L	T	P	C
Professional Elective-I							
3	24EEPEXX	Computer Architecture & Organization	PE	3	1	0	4
Professional Elective-II							
4	24EEPEXX	Theory of Computation	PE	3	1	0	4
Professional Elective-III							
4	24EEPEXX	Analysis and Design of Algorithms	PE	3	0	0	3
Professional Elective-III							
5	24EEPEXX	Compiler Design	PE	3	1	0	4
Professional Elective-IV-V							
5	24EEPEXX	Computer Networks	PE	3	1	0	4
5	24EEPEXX	Machine Learning Using R	PE	3	0	0	3
Professional Elective-VI							
6	24EEPEXX	Software Engineering	PE	3	0	0	3

Professional Elective- VII-VIII							
6	24EEPEXX	Neural Networks & Fuzzy Logic	PE	3	1	0	4
6	24EEPEXX	Business Intelligence	PE	3	1	0	4
6	24EEPEXX	Cyber Security	PE	3	1	0	4
6	24EEPEXX	NASSCOM Associate Analytics – II	PE	3	1	0	4
6	24EEPEXX	Software Project Management	PE	3	1	0	4
6	24EEPEXX	Object Oriented Analysis & Design	PE	3	1	0	4
6	24EEPEXX	Design Thinking	PE	3	1	0	4
6	24EEPEXX	Distributed Operating System	PE	3	1	0	4
6	24EEPEXX	Grid Computing	PE	3	1	0	4
6	24EEPEXX	Internet of Things	PE	3	1	0	4
Professional Elective-IX-XI							
7	24EEPEXX	Data Warehousing & Data Mining	PE	3	1	0	4
7	24EEPEXX	NASSCOM Associate Analytics – III	PE	3	1	0	4
7	24EEPEXX	Network Security & Cryptography	PE	3	1	0	4
7	24EEPEXX	Software Testing	PE	3	1	0	4
7	24EEPEXX	Open Source Software	PE	3	1	0	4
7	24EEPEXX	Wireless Adhoc and Sensor Network	PE	3	1	0	4
7	24EEPEXX	Advanced Java Programming	PE	3	1	0	4
7	24EEPEXX	Mobile Computing	PE	3	1	0	4

3. Specialization in Electric Vehicles

Professional Elective-I							
SL. No	**Code**	**Category**	**Course**	**L**	**T**	**P**	**C**
1	23EEPE65	**(PE)**	Electrical & Electronics, Measurements and Instrumentation	3	0	0	3
2	23EEPE66	**(PE)**	Electron Devices and Circuits	3	0	0	3
3	23EEPE10	**(PE)**	Mechatronics	3	0	0	3
4	23EEPE64	**(PE)**	Computer-aided design and Manufacturing	3	0	0	3
Professional Elective-II							
1	23EEPE68	**(PE)**	Renewable Energy Sources	3	0	0	3
2	23EEPE42	**(PE)**	Modern Optimization Techniques	3	0	0	3
3	23EEPE04	**(PE)**	Wind and Solar Energy Systems	3	0	0	3
4	23EEPE02	**(PE)**	Instrumentation System	3	0	0	3
5	23EEPE06	**(PE)**	Solar Photovoltaic System	3	0	0	3

Professional Elective-III							
1	23EEPE15	**(PE)**	Design of Electrical Machines	3	0	0	3
2	23EEPE16	**(PE)**	Special Electrical Machines	3	0	0	3
3	23EEPE17	**(PE)**	Electrical Safety and Safety Management	3	0	0	3
Professional Elective-IV							
1	23EEPE52	**(PE)**	Digital Communication	3	0	0	3
2	23EEPE19	**(PE)**	Communication Systems	3	0	0	3
3	23EEPE67	**(PE)**	Discrete Transform and Signal Processing	3	0	0	3
4	23EEPE51	**(PE)**	Distributed System Planning and Automation	3	0	0	3
5	23EEPE39	**(PE)**	Energy Management and Audit	3	0	0	3
Professional Elective-V							
1	23EEPE54	**(PE)**	Mobile Communication	3	0	0	3
2	23EEPE20	**(PE)**	Wireless Communication Systems	3	0	0	3
3	23EEPE69	**(PE)**	Modern Control Systems	3	0	0	3
4	23EEPE58	**(PE)**	Embedded Systems Design	3	0	0	3
5	23EEPE33	**(PE)**	Power Quality	3	0	0	3
6	23EEPE43	**(PE)**	Soft Computing	3	0	0	3
Professional Elective-VI							
1	24EEPEXX	**(PE)**	Electric & Hybrid Vehicles	3	0	0	3
2	23EEPE01	**(PE)**	Data acquisition and Telemetry	3	0	0	3
3	23EEPE22	**(PE)**	Power Converter Analysis and Design	3	0	0	3
Professional Elective-VII							
1	24EEPEXX	**(PE)**	Energy Storage System and Management System	3	0	0	3
2	23EEPE03	**(PE)**	Sensors and Transducers	3	0	0	3
Professional Elective-VIII							
1	24EEPEXX	**(PE)**	Electric Drives and Controls for Electric Vehicles	3	0	0	3
2	23EEPE38	**(PE)**	Hybrid Electric Vehicles	3	0	0	3
Professional Elective-IX							
1	24EEPEXX	**(PE)**	Electro-Chemistry of Fuel Cells	3	0	0	3
2	23EEPE50	**(PE)**	Real-Time Control of Power Systems and Energy Management	3	0	0	3
3	23EEPE48	**(PE)**	Infrastructure For Smart Cities	3	0	0	3
Professional Elective-X							
1	24EEPEXX	**(PE)**	Modeling and Simulation of EHV	3	0	0	3
2	23EEPE35	**(PE)**	Energy Storage Technology	3	0	0	3
3	23EEPE45	**(PE)**	Cyber Security	3	0	0	3
Professional Elective-XI							
1	24EEPEXX	**(PE)**	Testing and Certification of Electric Hybrid Vehicles	3	0	0	3

4. Specialization in Hybrid Electric Vehicle and Energy Management

SL.No	Code	Category	Course	L	T	P	C
1	23EEPE38	**(PE)**	Hybrid Electric Vehicles	3	0	0	3
2	23EEPE35	**(PE)**	Energy Storage Technology	3	0	0	3
3	23EEPE49	**(PE)**	Electric Vehicle Machines and Drives.	3	0	0	3
4	23EEPE26	**(PE)**	Vehicular Power Systems	3	0	0	3
5	23EEPE18	**(PE)**	Electrical Systems Design for Building	3	0	0	3

6	23EEPE21	**(PE)**	Switched Mode Power Conversion	3	0	0
7	23EEPE39	**(PE)**	Energy Management and Audit	3	0	0
8	23EEPE64	**(PE)**	Computer Aided Design and Manufacturing	3	0	0
9	23EEPE17	**(PE)**	Electrical Safety and Safety Management	3	0	0
10	23EEPE05	**(PE)**	Python Programming	3	0	0
11	23EEPE42	**(PE)**	Modern Optimization Techniques	3	0	0
12	23EEPE48	**(PE)**	Energy Management for Smart cities	3	0	0
13	23EEPE50	**(PE)**	Real-Time Control of Power Systems and Energy Management	3	0	0
14	23EEPE65	**(PE)**	Electronic Measurements and Instrumentation	3	0	0
15	23EEPE66	**(PE)**	Electron Device s and Circuits	3	0	0
16	23EEPE67	**(PE)**	Discrete Transform and Signal Processing	3	0	0
17	23EEPE60	**(PE)**	Virtual Instrumentation	3	0	0

5. Specialization in Renewable & Sustainable Energy Engineering

SL.No	**Code**	**Category**	**Course**	**L**	**T**	**P**	**C**
1	23EEPE06	**(PE)**	Solar Photovoltaic System	3	0	0	3
2	23EEPE07	**(PE)**	Design of Hydro Power Station	3	0	0	3
3	23EEPE04	**(PE)**	Wind and Solar Energy Systems	3	0	0	3
4	23EEPE35	**(PE)**	Energy Storage Technology	3	0	0	3
5	23EEPE36	**(PE)**	Power Electronics for Renewable Energy Systems	3	0	0	3
6	23EEPE42	**(PE)**	Modern Optimization Techniques	3	0	0	3
7	23EEPE50	**(PE)**	Real-Time Control of Power Systems and Energy Management	3	0	0	3
8	23EEPE05	**(PE)**	Solar Energy system and Maintenance	3	0	0	3
9	23EEPE68	**(PE)**	Renewable Energy Sources	3	0	0	3
10	23EEPE48	**(PE)**	Python Programming	3	0	0	3
11	23EEPE50	**(PE)**	Programming with JAVA	3	0	0	3
12	23EEPE47	**(PE)**	Distributed Generation and Microgrids	3	0	0	3
13	23EEPE28	**(PE)**	Smart Grid	3	0	0	3
14	23EEPE49	**(PE)**	Electric Vehicle Machines and Drives.	3	0	0	3
15	23EEPE65	**(PE)**	Electronic Measurements and	3	0	0	3

			Instrumentation				
16	23EEPE66	**(PE)**	Electron Devices and Circuits	3	0	0	3
17	23EEPE67	**(PE)**	Discrete Transform and Signal Processing	3	0	0	3
18	23EEPE60	**(PE)**	Virtual Instrumentation	3	0	0	3

6. Specialization in IoT based Industrial Automation & Smart Grid

SL.No	Code	Category	Course	L	T	P	C
1	23EEPE44	**(PE)**	Introduction to Robotics & Industrial Automation	3	0	0	3
2	23EEPE46	**(PE)**	Smart Grid Technologies & IoT	3	0	0	3
3	23EEPE48	**(PE)**	Energy Management for Smart cities	3	0	0	3
4	23EEPE10	**(PE)**	Mechatronics	3	0	0	3
5	23EEPE18	**(PE)**	Electrical Systems Design for Building	3	0	0	3
6	23EEPE51	**(PE)**	Distributed System Planning and Automation	3	0	0	3
7	23EEPE42	**(PE)**	Modern Optimization Techniques	3	0	0	3
8	23EEPE43	**(PE)**	Python Programming	3	0	0	3
9	23EEPE45	**(PE)**	Programming with JAVA	3	0	0	3
10	23EEPE47	**(PE)**	Industrial Power System	3	0	0	3
11	23EEPE33	**(PE)**	Power Quality	3	0	0	3
12	23EEPE29	**(PE)**	Micro Grid	3	0	0	3
13	23EEPE50	**(PE)**	Real-Time Control of Power Systems and Energy Management	3	0	0	3
14	23EEPE65	**(PE)**	Electronic Measurements and Instrumentation	3	0	0	3
15	23EEPE66	**(PE)**	Electron Devices and Circuits	3	0	0	3
16	23EEPE67	**(PE)**	Discrete Transform and Signal Processing	3	0	0	3
17	23EEPE60	**(PE)**	Virtual Instrumentation	3	0	0	3

List of Professional Electives offered under academic regulation 2023-2024 in Electrical and Electronics Engineering

SL.No	Code	Category	Course	L	T	P	C
1	23EEPE01	(PE)	Data acquisition and Telemetry	3	0	0	3
2	23EEPE02	(PE)	Instrumentation System	3	0	0	3
3	23EEPE03	(PE)	Sensors and Transducers	3	0	0	3
4	23EEPE04	(PE)	Wind and Solar Energy Systems	3	0	0	3
5	23EEPE05	(PE)	Python Programming	3	0	0	3
6	23EEPE06	(PE)	Solar Photovoltaic System	3	0	0	3
7	23EEPE07	(PE)	Design of Hydro Power Station	3	0	0	3
8	23EEPE08	(PE)	PLC, DCS and SCADA	3	0	0	3
9	23EEPE09	(PE)	Programming with Java	3	0	0	3
10	23EEPE10	(PE)	Mechatronics	3	0	0	3
11	23EEPE11	(PE)	Advanced Topics in Electrical Insulation	3	0	0	3
12	23EEPE12	(PE)	Reactive Power control & FACT Devices	3	0	0	3
13	23EEPE13	(PE)	Micro Electro Mechanical Systems	3	0	0	3
14	23EEPE14	(PE)	Electrical Power Utilization and Illumination	3	0	0	3
15	23EEPE15	(PE)	Design of Electrical Machines	3	0	0	3
16	23EEPE16	(PE)	Special Electrical Machines	3	0	0	3
17	23EEPE17	(PE)	Electrical Safety and Safety Management	3	0	0	3
18	23EEPE18	(PE)	Electrical Systems Design for Building	3	0	0	3
19	23EEPE19	(PE)	Communication Systems	3	0	0	3
20	23EEPE20	(PE)	Wireless Communication Systems	3	0	0	3
21	23EEPE21	(PE)	Switched Mode Power Conversion	3	0	0	3
22	23EEPE22	(PE)	Power Converter Analysis and Design	3	0	0	3
23	23EEPE23	(PE)	Advanced Control Theory	3	0	0	3
24	23EEPE24	(PE)	Aircraft Electronic Systems	3	0	0	3
25	23EEPE25	(PE)	Power System Harmonics	3	0	0	3
26	23EEPE26	(PE)	Vehicular Power Systems	3	0	0	3
27	23EEPE27	(PE)	Industrial Power System	3	0	0	3
28	23EEPE28	(PE)	Smart Grid	3	0	0	3
29	23EEPE29	(PE)	Micro Grid	3	0	0	3
30	23EEPE30	(PE)	Power System Deregulation	3	0	0	3
31	23EEPE31	(PE)	Modern Power System Analysis	3	0	0	3
32	23EEPE32	(PE)	High Voltage Engineering	3	0	0	3
33	23EEPE33	(PE)	Power Quality	3	0	0	3
34	23EEPE34	(PE)	Power System Optimization	3	0	0	3
35	23EEPE35	(PE)	Energy Storage Technology	3	0	0	3
36	23EEPE36	(PE)	Power Electronics for Renewable Energy Systems	3	0	0	3
37	23EEPE37	(PE)	Substation Design	3	0	0	3
38	23EEPE38	(PE)	Hybrid Electric Vehicles	3	0	0	3
39	23EEPE39	(PE)	Energy Management and Audit	3	0	0	3
40	23EEPE40	(PE)	Power System operation and Control	3	0	0	3
41	23AS701	(PE)	Operation Research	3	0	0	3
42	23EEPE42	(PE)	Modern Optimization Techniques	3	0	0	3
43	23EEPE43	(PE)	Soft Computing	3	0	0	3
44	23EEPE44	(PE)	Production to Robotics & Industrial Automation	3	0	0	3
45	23EEPE45	(PE)	Cyber Security	3	0	0	3
46	23EEPE46	(PE)	Smart Grid Technologies & IoT	3	0	0	3
47	23EEPE47	(PE)	Distributed Generation and Microgrids	3	0	0	3
48	23EEPE48	(PE)	Infrastructure For Smart Cities	3	0	0	3
49	23EEPE49	(PE)	Electric Vehicle Machines and Drives.	3	0	0	3

50	23EEPE50	(PE)	Real-Time Control of Power Systems and Energy Management	3	0	0	3
51	23EEPE51	(PE)	Distributed System Planning and Automation	3	0	0	3
52	23EEPE52	(PE)	Digital Communication	3	0	0	3
53	23EEPE53	(PE)	Optical Fiber Communication	3	0	0	3
54	23EEPE54	(PE)	Mobile Communication	3	0	0	3
55	23EEPE55	(PE)	Data Communication Networks	3	0	0	3
56	23EEPE56	(PE)	Wireless Communication	3	0	0	3
57	23EEPE57	(PE)	Satellite Communication	3	0	0	3
58	23EEPE58	(PE)	Embedded Systems Design	3	0	0	3
59	23EEPE59	(PE)	Radar and Imaging systems	3	0	0	3
60	23EEPE60	(PE)	Virtual Instrumentation	3	0	0	3
61	23EEPE61	(PE)	Microelectronics	3	0	0	3
62	23EEPE62	(PE)	Computer Architecture and very large-scale Integration	3	0	0	3
63	23EEPE63	(PE)	Biomedical Engineering	3	0	0	3
64	23EEPE64	(PE)	Computer Aided Design and Manufacturing	3	0	0	3
65	23EEPE65	(PE)	Electrical & Electronics, Measurements and Instrumentation	3	0	0	3
66	23EEPE66	(PE)	Electron Device s and Circuits	3	0	0	3
67	23EEPE67	(PE)	Discrete Transform and Signal Processing	3	0	0	3
68	23EEPE68	(PE)	Renewable Energy Sources	3	0	0	3
69	23EEPE69	(PE)	Modern Control Systems				

SEMESTER-I

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

COURSE OBJECTIVES (COs)

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

COURSE LEARNING OUTCOMES (CLOs)

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

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

COURSE CONTENTS

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

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

TEXT BOOKS

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

REFERENCE BOOKS

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

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

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

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

COURSE OBJECTIVES (COs)

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

COURSE LEARNING OUTCOMES (CLOs)

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

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

COURSE CONTENTS

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

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

TEXT BOOKS

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

REFERENCE BOOKS

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

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

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

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

COURSE OBJECTIVES (COs)

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

COURSE LEARNING OUTCOMES (CLOs)

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

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

LIST OF EXPERIMENTS

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

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

TEXT BOOKS

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

REFERENCE BOOKS

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

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

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

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

COURSE OBJECTIVES (COs)

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

COURSE LEARNING OUTCOMES (CLOs)

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

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

COURSE CONTENTS

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

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

TEXT BOOKS

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

REFERENCE BOOKS

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

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

SEM	SUBCODE	Course Name	Course Objectives	CLO1	CLO2	CLO3	CLO4	CLO5
I/II	25AS105 /25AS208	Applied Chemistry	CO1	x				
			CO2	x	x			
			CO3			x		
			CO4				x	
			CO5					x

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

COURSE OBJECTIVES (COs)

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

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

COURSE LEARNING OUTCOMES (CLOs)

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

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

LIST OF EXPERIMENTS

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

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

TEXT BOOKS

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

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

REFERENCE BOOKS

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

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

3. Department Laboratory Manual.

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

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

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

COURSE OBJECTIVES (COs)

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

COURSE LEARNING OUTCOMES (CLOs)

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

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

COURSE CONTENTS

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

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

TEXT BOOKS

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

REFERENCE BOOKS

1. KothariDPandNagrathIJ,“BasicElectricalEngineering“,TataMcGrawHill, 1991.

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

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

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

COURSE OBJECTIVES (COs)

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

COURSE LEARNING OUTCOMES (CLOs)

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

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

LIST OF EXPERIMENTS

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

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

TEXT BOOKS

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

REFERENCE BOOKS

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

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

(CLOs)

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

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

COURSE OBJECTIVES (COs)

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

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

COURSE LEARNING OUTCOMES (CLOs)

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

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

COURSE CONTENTS

UNIT	COURSE CONTENTS	HOURS
UNIT-I	**DIODE THEORY AND APPLICATIONS:** Overview of p-n junction diode structure, Basic idea of forward and reverse biasing in diodes, VI characteristics of p-n junction diode under various biasing conditions, Ideal diode characteristics and assumptions, Second approximation (with cut-in voltage), Third approximation (including forward resistance and reverse leakage current), Structure and working principle of Zener diode, VI characteristics of Zener diode in breakdown region, Zener diode as a voltage regulator, half and Full Wave Rectifier: Circuit diagram, operation, and waveform analysis, Calculation of average and RMS output voltage, Ripple factor and efficiency, Transformer requirements and peak inverse voltage (PIV) analysis. **Wave Shaping Circuits:** Clipping Circuits, Clamping Circuits.	9
UNIT-II	**BIPOLAR JUNCTION TRANSISTORS AND ITS BIASING:** BJT structure and working principle (NPN/PNP),CE, CB, and CC configurations: input/output characteristics and applications, BJT current and voltage relations, Switching operation of BJT: cutoff, active, and saturation regions, DC load line: operating point (Q-point) determination, Biasing	9

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

TEXT BOOKS

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

REFERENCE BOOKS

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

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

SEM	SUBCODE	Course Name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
I/II	**25EC101/25EC202**	BASIC ELECTRONICS ENGINEERING	CO1	✓				
			CO2		✓			
			CO3			✓		
			CO4				✓	
			CO5					✓

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

COURSE OBJECTIVES (COs)

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

COURSE LEARNING OUTCOMES (CLOs)

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

LIST OF EXPERIMENTS

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

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

REFERENCE: LABORATORY MANUAL

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

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

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

COURSE OBJECTIVES (COs)

The objectives of this course are to:

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

COURSE LEARNING OUTCOMES (CLOs)

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

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

COURSE CONTENTS

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

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

TEXT BOOKS

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

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

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

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

COURSE OBJECTIVES (COs)

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

COURSE LEARNING OUTCOMES (CLOs)

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

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

LIST OF EXPERIMENTS

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

TEXT BOOKS

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

thinking.

6. **Tapan P. Bagchi***"Engineering Design"*, Wiley India Pvt. Ltd.
☞ Explores the fundamentals of creative problem-solving and product design.

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

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

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

COURSE OBJECTIVES (COs)

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

COURSE LEARNING OUTCOMES (CLOs)

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

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

COURSE CONTENTS

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

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

TEXT BOOKS

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

OPEN EDUCATIONAL RESOURCES

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

REFERENCE BOOKS

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

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

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

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

COURSE OBJECTIVES (COs)

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

COURSE LEARNING OUTCOMES (CLOs)

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

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

LIST OF EXPERIMENTS

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

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

TEXT BOOKS

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

REFERENCE BOOKS

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

OPEN EDUCATIONAL RESOURCES

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

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

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

MAPPED SDGs: SDG-4, SDG-9

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

COURSE OBJECTIVES (COs)

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

COURSE LEARNING OUTCOMES (CLOs)

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

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

COURSE CONTENTS

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

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

TEXTBOOKS

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

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

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

COMMUNICATIVE ENGLISH LAB	
Course Code: 25HS151/25HS252	**Continuous Evaluation:**40 Marks
Credits: 1	**End Semester Examination:** 60 Marks
L T P : 0 0 2	
Prerequisite: Basic Knowledge of English	

COURSE OBJECTIVES (COs)

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

COURSE LEARNING OUTCOMES (CLOs)

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

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

LIST OF ACTIVITIES

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

TEXT BOOKS

1. English Grammar in Use. Raymond Murphy. Cambridge UP.4th Edition.
2. Business Communication by Carol M Lehman, Debbie D Dufrene and Mala Sinha. Cengage Learning. 2nd Edition.
3. A Textbook of English Phonetics for Indian Students by T. Balasubramanian

[MACMILLAN]
4. Soft Skills: Key to Success in Workplace and Life by Meenakshi Raman and Shalini Upadhyay. Cengage Learning. 2018 Edition.

REFERENCE BOOKS

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

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

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

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

COURSE OBJECTIVES (COs)

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

COURSE LEARNING OUTCOMES (CLOs)

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

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

LIST OF EXPERIMENTS

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

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

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

SEM	SUB CODE	Course Name	Course Objectives	CLO1	CLO2	CLO3
I/II	25ME153/25ME254	ENGINEERING GRAPHICS & DESIGN LAB	CO1	√		
			CO2		√	
			CO3			√
			CO4			√

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

COURSE OBJECTIVES (COs)

हिन्दी विषय के प्रश्नपत्र की सामग्री में ज्ञान तथा शिक्षा के बदलते परिदृश्य को ध्यान में रखा गया है।हिन्दी के भक्तिकाल, रीतिकाल और आधुनिककाल के कवियों की कविताओं को पाठ्यक्रम में शामिल किया 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, भाषायीक्षमता एवम् अभिवृद्धि भी इस पाठ्यक्रम का लक्ष्य है।

COURSE LEARNING OUTCOMES (CLOs)
पाठ्यक्रमपरिणाम
1.Knowledge Outcome
ज्ञानकापरिणाम
At the end of the course, the student should be able to
पाठ्यक्रम केअंत में छात्र सक्षम होना चाहिए

1. -हिन्दी क़े प्रमुख कवि जो पाठ्यक्रम में शामिल है ,उनकी कविताओं की व्याख्या और काव्यगत विशेषताओं को छात्र समझेंगे।
2. छात्रों को काव्य में रस ,अलंकार और छन्द का ज्ञान प्राप्त होगा|
3. -व्याकरण के अध्ययन से छात्रों को भाषा बोलने, लिखने और पढने में सहायता प्राप्त होगी।

2.Skill Outcome
कौशल का परिणाम
At the end of the course, the student should be able to
पाठ्यक्रम केअंत में छात्रसक्षम होना चाहिए

1. -हिंदी कवियों व उनकी कविताओं से परिचित हो जाएंगे।
2. छात्र दोहे और कविता समझने में सक्षम होंगे।
3. -व्याकरण के ज्ञान के साथ– साथ शब्दों के उच्चारण के बोध से अवगत होंगे।

COURSE CONTENTS

UNIT	COURSE CONTENTS	HOURS
UNIT-I	इस इकाई में हिंदी भक्तिकाल के प्रमुख कविकबीरदास हैं। कबीरदास -कबीरदास के दोहे 5 दोहे	8
UNIT-II	इस इकाई में हिंदी रीतिकाल के प्रमुख कवि बिहारीलाल हैं। बिहारीलाल- बिहारीलाल के दोहे 5दोहे	7
UNIT-III	इस इकाई में हिंदी आधुनिककाल के प्रमुख कवि माखनलाल चतुर्वेदीहैं। माखनलाल चतुर्वेदी (पुष्पकीअभिलाषा) कविता	7
UNIT-IV	यह इकाई संचार कौशल से सम्बन्धित है. इसमें **(i)**हिंदी के प्रमुख मुहावरे और लोकोक्तियाँ **(ii)** आत्मपरिचय (self-introduction), साक्षात्कारकौशल (interview skills), कार्यक्रमसंचालन/मंचप्रबंधन (event management)	8

METHODOLOGY पद्धति

- कक्षाव्याख्यान

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

-समय-समय पर छात्रों को प्रदत्तकार्य दिया जाएगा|

- साप्ताहिकप्रश्नावली|

REFERENCE BOOKS/ TEXT BOOKS

आवश्यक पुस्तकें और सामग्री

1. -कबीरग्रन्थावली ,संपादक-श्यामसुन्दरदास ,काशीनागरी प्रचारिणी सभा|
2. बिहारीसतसई ,साहित्यसंस्थान प्रयाग|
3. -भाषाविज्ञान ,डॉ .भोलानाथ तिवारी, किताब महल इलाहाबाद|
4. -हिंदीव्याकरण ,कामताप्रसादगुरु ,प्रभातप्रकाशनदिल्ली

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

COURSE OBJECTIVES (COs)

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

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

COURSE LEARNING OUTCOMES (CLOs)

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

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

COURSE CONTENTS

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

	- Kleidung, Lebensmittel Leseverstehen.	

TEXT BOOKS

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

OPEN EDUCATIONAL RESOURCES

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

REFERENCE BOOKS

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

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

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

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

COURSE OBJECTIVES (COs)

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

COURSE LEARNING OUTCOMES (CLOs)

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

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

COURSE CONTENTS

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

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

TEXT BOOKS

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

REFERENCE BOOKS

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

Le Robert & Nathan Conjugation, Paperback, Le Robert Nathan

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

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

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

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

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

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

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

COURSE CONTENTS

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

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

RECOMMENDED TEXT BOOKS:

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

REFERENCE BOOKS:

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

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

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

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

COURSE OBJECTIVES (COs)

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

COURSE LEARNING OUTCOMES (CLOs)

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

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

COURSE CONTENTS

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

	• Fundamental Rights (Part III of the Constitution) • Protection of Fundamental Rights – Writ petitions in High Court and Supreme Court of India • Fundamental Duties • The concept of Fraternity and secularism • Public utilities and privatization	**7**

RECOMMENDED TEXT BOOKS:

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

REFERENCE BOOKS:

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

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

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

SEMESTER II

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

COURSE OBJECTIVES (COs):

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

COURSE LEARNING OUTCOMES (CLOs):

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

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

COURSE CONTENTS

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

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

TEXT BOOKS/REFERENCE BOOKS

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

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

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

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

COURSE OBJECTIVES (COs)

हिंदी विषय के प्रश्नपत्र 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 होताहै , इससे विद्यार्थियों की कल्पनाशक्ति के विकास के साथ-साथ मनोरंजन भी होताहै |संचार कौशल में मुहावरे ,लोकोक्तियां ,पत्रलेखनऔरअपठितगद्यांश की समझ के द्वारा हिंदीकाप्रचार-प्रसार होगा |इस प्रकार साहित्य के ज्ञान की अभिवृद्धि वैश्वीकरण के संदर्भ में प्रासंगिकता और उपयोगिकता सिध्द करती है

COURSE LEARNING OUTCOMES (CLOs)

पाठ्यक्रमपरिणाम

1. Knowledge Outcome

ज्ञान का परिणाम

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

1. पाठ्यक्रम के अंत में छात्र सक्षम होना चाहिए
2. हिंदी लघुकथाओं के मूल उद्देश्य को समझने में विद्यार्थी निपुण हो जाएंगे |लघुकथाओं से क्या शिक्षा मिलती है ? इसका ज्ञान छात्रों को होगा |व्याकरण के अध्ययन से विद्यार्थियों को भाषा बोलने, लिखने और पढ़ने में सहायता प्राप्त होगी

2. Skill Outcome

कौशल का परिणाम

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

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

1. -पाठ्यक्रम केअंत में छात्र सक्षम होना चाहिए
2. -हिंदी लघुकथाओं से मनोरंजन भी होगा|
3. -विद्यार्थी लघुकथाओं के मूलकथ्य को समझेंगे|
4. -विचार तत्व के बोध से अवगत होंगे|
5. -हिंदी में पत्र लेखन और अपठित गद्यांश को समझने में सक्षम होंगे|

COURSE CONTENTS

UNIT	COURSE CONTENTS	HOURS
UNIT-I	इस इकाई में हिंदी लघुकथाओं का संक्षिप्त परिचय दिया गया है– 1.हिंदी लघुकथा का सामान्य परिचय| 2.हिंदीलघुकथाकेप्रमुखप्रकार|	8
UNIT-II	इस इकाई में हिंदी की दो लघुकथाएं सम्मिलित की गई हैं- 1. अंगूरकीबेल 2. किसानऔरठग	8
UNIT-III	इस इकाई में हिंदी की दो लघुकथाएं सम्मिलित की गई हैं- 1 बुराईकाफल 2. चारविद्वानब्राह्मण	7

UNIT-IV	यह इकाई संचार कौशल से सम्बंधित है,इसमें (i) प्रेसरिपोर्ट, विज्ञापन, अनुवाद (ii)हिंदी पत्र लेखनऔरअपठित गद्यांश को समझना व तर्क संगत उत्तर देना अपेक्षित है|	7

METHODOLOG पद्धति
- कक्षाव्याख्यान
-व्याकरण के माध्यम से हिंदी शब्दों का उच्चारण व लेखन काअभ्यास किया जाएगा|
-समय-समय पर छात्रों को प्रदत्तकार्य दिया जाएगा|
- साप्ताहिकप्रश्नावली|
-दैनिकप्रश्नावली

REFERENCE BOOKS/ TEXT BOOKS
आवश्यक पुस्तकें और सामग्री

1. पाठ्यक्रममेंनिर्धारितलघुकथाओंकासंकलन|
2. -भाषाविज्ञान ,डॉ.भोलानाथतिवारी, किताबमहलइलाहाबाद|
3. -हिंदीव्याकरण ,कामताप्रसादगुरु ,प्रभातप्रकाशन

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

COURSE OBJECTIVES (COs)

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

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

COURSE LEARNING OUTCOMES (CLOs)

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

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

COURSE CONTENTS

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

TEXT BOOKS

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

OPEN EDUCATIONAL RESOURCES

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

REFERENCE BOOKS

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

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

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

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

COURSE OBJECTIVES (COs)

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

COURSE LEARNING OUTCOMES (CLOs)

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

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

COURSE CONTENTS

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

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

TEXT BOOKS

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

REFERENCE BOOKS

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

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

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

SEMESTER-III

	Engineering Mathematics-III	L	T	P	C
Course Code:	24AS301	3	1	0	4
Course Type:	ES				
Pre-Requisite	Engineering Mathematics - II				

COURSE OBJECTIVES (COs)

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 transforms.
5. To demonstrate understanding Z-transform.

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:

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

UNIT	COURSE 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.	8
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	8
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.	8
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.	8
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.	8

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.

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

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

	Electrical Machines-I	L	T	P	C
Course Code:	23EE0203	3	0	0	3
Course Type:	PC				
Pre-Requisite	NONE				

COURSE OBJECTIVES

1. To acquire fair knowledge on the working of various DC machines & Transformers.
2. To have knowledge about operation, testing, efficiency and various configurations of single phase & three phase transformers.
3. To understand the concepts of rotating electrical machines and principle of energy conversion.
4. To impart knowledge about the operation, various characteristics, starting and control of DC machines.

COURSE LEARNING OUTCOMES (CLO)

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

1. Model and analyze the performance of different types of DC machines.
2. Learn the performance, operation, various characteristics, starting and control of DC machines
3. Analyze the performance of different types of Transformers
4. Familiarize with the applications of DC machines and transformer

UNIT	COURSE CONTENTS	HOURS
UNIT-I	PRINCIPLE OF ELECTROMECHANICAL ENERGY CONVERSION Principle of electromechanical energy conversion, energy stored in a magnetic field system, singly and doubly excited systems. DC GENERATOR Electromechanical energy conversion concept, Single and multiple excited systems, Torque and force equations, Introduction – electric generator- Constructional features- Principle of operation of DC generator, EMF equation-circuit model - methods of excitation, Losses in DC generator –power stages –condition for maximum efficiency, armature reaction – compensating winding , commutation, Operating Characteristics of DC generators, Parallel operation of DC generators, Applications of DC generators	8
UNIT-II	DC MOTORS Principle of operation of DC motors, Back EMF, Torque equation-quantitative analysis, Types of DC motors- characteristics of DC motors, Starting of DC motors: review of mechanical starter, electronic soft starters for DC motor with energy saving, Speed control: Field control, Armature control, voltage control, Thyristor control – efficiency	8
UNIT-III	TRANSFORMERS Construction - principle of operation – transformer on no load, Ideal transformer – equivalent circuit – phasor diagram, Efficiency and voltage regulation-all day efficiency- per unit representation, Three phase transformers-connections - Scott Connection - Phasing of transformer- parallel operation of three phase transformers, Auto transformer - tap changing transformers- tertiary winding, Variable frequency transformer – audio frequency transformer, Grounding transformer – welding transformer	8
UNIT-IV	TESTING OF DC MACHINES & TRANSFORMERS Losses and efficiency –Condition for maximum efficiency, Testing of DC machines: Brake test, Swinburne's test, Retardation test, Hopkinson's test, Testing of transformer: polarity test, load test,Open circuit and short circuit test, Sumpner's test – All day efficiency.	8
UNIT-V	MODELING OF DC MACHINES Basic two pole DC machine-analysis of DC machine using Primitive two axis machine equation, Voltage and current relationship –torque equations, Mathematical model of separately excited DC motor and Dc series motor in state variable form - transfer function, Mathematical model of DC shunt motor and DC compound motor in state variable form - transfer function	8

TEXT BOOKS

1. Nagrath I. J and Kothari D. P. "Electric Machines", Tata McGraw Hill Publishing Company Ltd, 4^{th} Edition, 2010.
2. Dr. Murugesh Kumar K. "DC Machines and Transformers", Vikas Publishing House Pvt Ltd., 2010.

REFERENCE BOOKS

1. Fitzgerald. A.E., Charles Kingsely Jr, Stephen D.Umans, "Electric Machinery", 6^{th} edition, Tata McGraw Hill Books Company, 2006.
2. P.S. Bimbhra, "Electrical Machinery", Khanna Publishers, 7^{th} edition paper back, 2011.
3. S.Sarma & K.Pathak "Electric Machines", Cengage Learning India (P) Ltd., Delhi,
4. Syed A. Nasar, "Electric Machines and Power Systems: Volume I", Mcgraw-Hill College; International Edition, 2014.

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
III	23EE0203	Electrical Machine-I	CO1	x		x	x
			CO2		x		
			CO3		x		
			CO4	x	x		

	Electromagnetic Theory	L	T	P	C
Course Code:	23EE0205	3	0	0	3
Course Type:	PC				
Pre-Requisite	NONE				

COURSE OBJECTIVES

1. Understand the basic concepts of different coordinate systems.
2. Understand the basic concepts of electric field and magnetic field
3. Need for Maxwell equations, Comparison of field and circuit theory
4. Different types of waveguides

COURSE LEARNING OUTCOMES (CLO)

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

1. Apply different coordinate systems and their application in electromagnetic field theory, establish a relation between any two systems and also understand the vector calculus.
2. Understand the concept of static electric field. Understand the concept of current and properties of conductors. Establish boundary conditions and to calculate capacitances of different types of capacitors
3. Understand the concept of static magnetic field, magnetic scalar and vector potential, forces due to magnetic field, magnetic boundary conditions and inductors.
4. Understand displacement current, time varying fields, propagation and reflection of EM waves and waveguides.

UNIT	COURSE 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.	8
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.	8
UNIT-III	**MAGNETOSTATIC** Lorentz force, magnetic field intensity (H). Biot–Savart's Law. Ampere's Circuit Law – H due to straight conductors, circular loop, infinite sheet of current, Magnetic flux density (B) – B in free space, – Boundary conditions, scalar and vector potential.	8
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.	8
UNIT-V	**PARELLEL 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	8

TEXT BOOKS

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

REFERENCE BOOKS

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

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
III	23EE0205	Electromagnetic Theory	CO1	x			
			CO2		x		
			CO3			x	
			CO4	x	x	x	x

	Digital System Design	L	T	P	C
Course Code:	23EE0207	3	0	0	3
Course Type:	PC				
Pre-Requisite	NONE				

COURSE OBJECTIVES

1. To acquire an in-depth knowledge on Digital logic families, Combinational circuits and should be able to design and analyze sequential circuits.
2. To impart knowledge about the concept of digital design, number system and codes
3. To introduce the fundamental concepts related to design of combinational logic circuits
4. To enable the students to understand the design of Sequential Circuits

COURSE LEARNING OUTCOMES (CLO)

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

1. Understand the concepts of digital logic circuits.
2. Design combinational and sequential logic circuits.
3. Learn the concepts of Memory devices.
4. Design combinational logic circuits using digital ICs.

UNIT	COURSE 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.	8
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 -McClucskey Method.	8
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 .	8
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.	8
UNIT-V	**ASYNCHRONUS SEQUENTIAL LOGIC AND MEMORY** **Asynchronus Sequential Logic:** Analysis of clocked sequential circuits with state machine designing, State reduction and assignments, 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.	8

TEXT BOOKS

1. Morris. M. Mano and Michael.D.Ciletti, "Digital Design", Pearson Education,Fifth edition, 2013
2. Floyd and Jain, "Digital Fundamentals", Pearson Education, Eleventh edition,2015.

REFERENCE BOOKS

3. John M.Yarbrough, “Digital Logic Application & Design”, West Publishing Company, Thomson,First edition, 2002.
4. Raj Kamal, “Digital systems-Principles and Design”, Pearson education,Second edition, 2007
5. Charles H.Roth, ‘Fundamentals Logic Design’, Jaico Publishing, Seventh edition,2014.
6. John F.Wakerly, "Digital Design Principles and Practice”, Pearson Education, Third edition,2006.
7. Roger L.Tokheim,”Digital Electronics: Principles and Applications”, Mc Graw Hill Education,8th edition,2014
8. Bhasker.J, “A VHDL Primer” PHI Learning, Third edition, 2009.
9. G K Kharate, " Digital Electronics", Oxford University Press India ,1st Edition, 2010,
10. David J Comer, "Digital Logic and State Machine Design”, Oxford University Press India,3rd Edition, 2012,

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
III	23EE0207	Digital System Design	CO1	x			
			CO2	x	x		
			CO3		x		x
			CO4			x	x

	Network Analysis and Synthesis	L	T	P	C
Course Code:	23EE0209	3	0	0	3
Course Type:	PC				
Pre-Requisite	None				

COURSE OBJECTIVES

1. To impart knowledge about the network theorems for AC circuits and transient response of R-L-C for DC and sinusoidal excitation
2. To apply Laplace, Transform analysis to electrical circuits
3. To enable the students to learn two-port networks and graph theory
4. To introduce the fundamental concepts of Network realizability and its synthesis

COURSE LEARNING OUTCOMES (CLO)

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

1. Analyse AC electrical circuits using basic laws and theorems of electrical circuits
2. Apply the Laplace, Transform analysis to electrical circuits
3. Solve two-port networks and Apply graph theory
4. Design analog filter and Synthesize networks

UNIT	COURSE 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.	8
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,	8
UNIT-V	Network Synthesis Active Network Synthesis and Realizability: Elements of Realizability 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.	8

TEXT BOOKS

1. Alexander, Charles K., and Matthew Sadiku, "Fundamentals of electric circuits", McGraw, Hill Education.
2. Van-Valkenburg M E, "Network Analysis", Prentice Hall, New Delhi
3. Sudhakar, A, "Circuits and Networks", Tata McGraw-Hill
4. Hayt, W., "Engineering Circuit Analysis", Tata McGraw-Hill

5. Bell D A, “Electric Circuit,” Oxford University press

6. Van-Valkenburg M E, “Introduction to Modern Network Synthesis”, Wiley and Sons

7. Suresh Kumar,“ Introduction to Modern Network Synthesis”, Dorling Kindsley

REFERENCE BOOKS

1.Network and Systems by D. Roy Chowdhury, Wiley Eastern.

2.Network Theory and Filter Design by Vasudev K. Aatre, New Age International Publisher.

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
III	23EE0209	Network Analysis and Synthesis	CO1	x			
			CO2		x		
			CO3			x	
			CO4				x

	Electrical Machines Laboratory – I	L	T	P	C
Course Code:	23EE0253	0	0	2	1
Course Type:	P				
Pre-Requisite	23EE0203				

COURSE OBJECTIVES

1. To acquire fair knowledge on the working of various DC machines and Transformers.
2. To provide basic information about electrical machine parts and their tests.
3. To impart knowledge and understanding about of D.C. machine and transformer.
4. To acquire basic understanding about the working of dc machines as generators and motors.

COURSE LEARNING OUTCOMES (CLO)

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

1. Obtain the performance characteristics of Electrical machines.
2. Simulate the circuits of DC machines.
3. Discriminate the concept of efficiency and the short circuit impedance of a transformer from no-load test, winding resistance, short circuit test, and load test.
4. Infer the operation of DC Shunt Generator under different loading conditions.

Experiments	List of Experiments	HOURS
	1.To perform Load test on DC series motor 2. To conduct Load test on DC shunt motor 3. To perform Load test on DC compound motor 4. To study the speed control of a D.C shunt motor by field control method. 5. To study the speed control of a D.C shunt motor by armature control method. 6. To conduct open circuit and short circuit test on a single-phase transformer 7. To obtain open circuit and load characteristics of Self Excited DC generator 8.To obtain magnetization characteristics of separately excited DC Generator 9. To obtain the efficiency of DC machine using Swinburne's test 10. To find the efficiency of single-phase transformers by conducting Hopkinson's test 11. To perform back-to-back test (Sumpner's Test) on a single-phase transformer. 12. To study Three-phase transformer connections and to convert three phase system in to two phase by Scott connection. 13. To study the constructional details and working of transformer. The list of experiments given above is only suggestive. The instructor may add new experiments as per the requirement of the course.	20

TEXT BOOKS

1. Laboratory Manual

REFERENCE BOOKS

1. Nagarath.I.J. and Kothari.D.P., "Electric Machines", T.M.H. Publishing CoLtd., New Delhi, 4th edition 2010.

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
III	23EE0253	Electrical Machines Laboratory-I	CO1	x	x		
			CO2	x		x	
			CO3	x		x	
			CO4	x			x

	Digital Electronics Lab	L	T	P	C
Course Code:	23EE0257	0	0	2	1
Course Type:	P				
Pre-Requisite	23EE0207				

COURSE OBJECTIVES
1. Learn and understand the basics of digital electronics, Boolean algebra, and able to design the simple logic circuits and test/verify the functionality of the logic circuits.
2. Familiarization with digital integrated circuits.
3. Implementation and design of combinational logic circuits using different gates
4. To understand concepts of sequential circuits and to analyze and design sequential circuits

COURSE LEARNING OUTCOMES (CLO)
At the end of the course, the student will be able to
1. Distinguish between analog and digital systems.
2. Identify the various digital ICs and understand their operation.
3. Develop skills for designing combinational logic circuits and their practical implementation on breadboard
4. Understand the function of elementary digital circuits under real and simulated environment.

Experiments	List of Experiments	HOURS
	1. To study about the logic gates and verify their truth table. 2. Realization of AND and OR gates using (i) Diodes and resistors. (ii) Universal gates 3. Design and implement half adder and full adder circuits and verifies the truth table using logic gates. 4. Design and implement half subtractor and full subtractor circuits and verifies the truth table using logic gates. 5. Design and implement 4-bit binary to gray code converter and gray to binary code converter circuits. 6. Design and implement BCD to excess-3 code converter and excess-3 to BCD code converter. 7. Design and implement (i) 2-Bit magnitude comparator using basic gates (ii) 8-Bit magnitude comparator using IC 7485 8. Design and implement multiplexer and demultiplexer using logic gates and study of IC 74150 and IC 74154. 9. Design and verify the 4-bit asynchronous Counter 10. Design and implement encoder and decoder using logic gates and study of IC 7445 and IC 74147. 11. Realization of SR, JK, D and T flip flop using gates. 12. Design and implement 3-bit asynchronous up/down counter. 13. To Implement ladder programming of AND,OR ,NOT,NAND,NOR,XOR and XNOR gates with Programmable Logic Controller using Virtual lab The list of experiments given above is only suggestive. The instructor may add new experiments as per the requirement of the course.	20

TEXT BOOKS
1. Digital Principles and Applications, Donald P Leach, Albert Paul Malvino, Goutam Saha, McGraw-Hill publications.

REFERENCE BOOKS
1. Digital Systems Principles and Applications, Ronald J.Tocci,Neal S Widmer,Gregory L.Moss. Pearson Publication.
2. http://www.vlab.co.in/
3. http://www.asic-world.com/

4. http://www.vlab.co.in/
5. http://electrical4u.com/
6. http://www.electronics-tutorials

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
III	23EE0257	Digital Electronics Lab	CO1	x			
			CO2		x		
			CO3			x	
			CO4				x

	Essentials of Block Chain & Internet of Things	L	T	P	C
Course Code:	23CS0201	0	0	2	1
Course Type:	SEC				
Pre-Requisite	None				

TRAINING OBJECTIVES

1. Familiarise the functional/operational aspects of cryptocurrency ECOSYSTEM.
2. Understand emerging abstract models for Block chain Technology.
3. Identify major research challenges and technical gaps existing between theory and practice in cryptocurrency domain.
4. To design portable IoT using appropriate boards.

TRAINING LEARNING OUTCOMES (CLO)

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

1. Understand and learn how bitcoin and other coins work in real world.
2. Understand the vision of IoT and communication protocols from a global context.
3. Analyze various protocols of IoT.
4. Evaluate the applications of IoT in agriculture, healthcare, smart grid, factory.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	CRYPTOGRAPHY cryptographic basics for cryptocurrency - a short overview of Hashing, signature schemes, encryption schemes and elliptic curve cryptography	8
UNIT-II	BITCOIN Bitcoin Introduction, Wallet - Blocks - Merkley Tree - hardness of mining - transaction verifiability - anonymity - forks - double spending - mathematical analysis of properties of Bitcoin.	8
UNIT-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: IEEE 802.15.4, ZigBee, 6LoWPAN, RFID, HART, NFC, Bluetooth, Zwave, ISA100.11a.	8
UNIT-IV	Introduction to Arduino: Basic Concepts of Arduino Platform, Examples of Arduino Programming, Integration of Sensors and Actuators with Arduino, Introduction to Raspberry Pi, Implementation of IoT with Raspberry, Software Defined Networking, Software Defined IoT Networking	8
UNIT-V	Research Activity Based on Blockchain and IoT	8

TEXT BOOKS

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press, 2016.
2. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014, ISBN: 9789350239759

REFERENCE BOOKS/RESOURCES

1.https://eprint.iacr.org/2014/349.pdf
2.https://eprint.iacr.org/2012/718.pdf
3.https://github.com/ElementsProject/lightning/blob/master/doc/deployable-lightning.pdf
4.https://www.hyperledger.org/use/tutorials
5.https://docs.soliditylang.org/en/latest
6.https://github.com/ethereum/wiki/wiki/White-Paper
7.http://gavwood.com/paper.pdf
8.Honbo Zhou," The Internet of Things in the Cloud:A Middleware Perspective" — CRC Press-2012
9.Arshdeep Bahga, Vijay Madisetti, "Internet of Things (A Hands-On-Approach)", VPT, 2014.
10.Raspberry Pi Cookbook, Software and Hardware Problems and solutions, Simon Monk, O'Reilly (SPD), 2016, ISBN 7989352133895

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
III	23CS0201	Essentials of Blockchain and Internet of Things	TO1	x			
			TO2		x		
			TO3			x	
			TO4				x

	FFECTIVE COMMUNICATION SKILLS	L	T	P	C
Course Code: 2	3SS351	0	0	2	1
Course Type: S	EC				
Pre-Requisite	None				

Training Objectives (TO): -

1. To define and understand communication & its process.
2. To make students practice on communication skills via LSRW approach via instructing, engaging, assessing and re engaging.
3. To enhance the confidence and motivation of students by honing their communication skills.

Training Learning Outcomes (TLO): -
After the completion of the training, the student will have ability:

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

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	Non Verbal Communication Skills - Importance of non verbal skills in effective communication - Types of non verbal (body language) skills - Barriers to non verbal 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 Skills - Role of reading skills in effective communication - Types of reading strategies to enhance improve reading skills - Comprehension skills	The What IF Activity
Unit-V	Writing Skills - Role of writing skills in effective communication - Types of written communication - Advantages & Disadvantages of written communication	The What IF Activity
Unit- VI	Visual Communication - Types of visual communication - Importance of visual communication - Picture narration/description technique	Interpret The Picture Activity

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 focussing 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)
1	Verbal Communication Skills	Speech Activity	15	Written Test	10
2	Non Verbal Communication Skills	Role Play	15		
3	Listening Skills	Oral Assessment	10		
4	Reading Skills		10	Viva	20
5	Written Skills	Written Assignment	10		
6	Visual Communication		10		

Test Books

1. Communication Skills by Sanjay Kumar & Pushp Lata: Oxford University Press, 2018. (ISBN No – 978-0199492985)

Reference Book

1. Personality Development & Communication Skills-1 by C B Gupta: Scholar Tech Press,2019. (ISBN No. – 9382209131)

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

SEM	SUB CODE	Course name	Training Objectives	TLO 1	TLO 2	TLO 3
III	23SS351	Effective Communication Skills	TO1	x		
			TO2	x	x	
			TO3		x	x

Semester-IV

	NUMERICAL METHODS (ME & EEE)	L	T	P	C
Course Code:	24MDC401C	**3**	**0**	**0**	**3**
Course Type:	**ES**				
Pre-Requisite	Engineering. Mathematics – II				

COURSE OBJECTIVES (CO)

6. To have a clear perception of the power of numerical techniques, ideas.
7. To demonstrate the applications of these techniques to problems drawn from industry, management and other engineering fields.
8. To make familiar with error analysis and some numerical methods to solve equations which are not easily solved by algebraic methods.
9. To familiar with different operators which are useful in Numerical Analysis and introduce the concept of interpolation.

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:

10. Find solutions by various numerical methods to get approximation solutions of algebraic a transcendental, simultaneous linear equations.
11. Get interpolating values by different numerical methods.
12. Do differentiation and integrations of tabular data.
13. To find numerical solutions of ordinary and partial differential equations.

UNIT	COURSE CONTENTS	HOURS
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.	8
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.	8
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.	8
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	8

TEXT BOOKS/ REFERENCE BOOKS

1. B.S. Grewal, “Numerical Methods in engineering and science”, Khanna Publishers, 42ndEdition, 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.

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

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

	Electrical Machines II	L	T	P	C
Course Code:	23EE0201	3	0	0	3
Course Type:	PC				
Pre-Requisite	23EE0203				

COURSE OBJECTIVES
1. To acquire knowledge about different types of AC machines
2. To learn about operation, characteristics, testing and control of induction machines.
3. To have knowledge about operation, starting, characteristics and testing of synchronous machines.
4. To impart knowledge about synchronization methods and parallel operation of alternators.

COURSE LEARNING OUTCOMES (CLO)
At the end of the course, the student will be able to
1.Compute the magnetic field pattern and the MMF of an AC machine when excited.
2.Analyze the effect of parameter variation on torque of Induction Motor to identify suitable starting, speed control and braking methods for Induction Motor.
3.Discuss the operation of various types of Single-phase induction motor.
4. Determine the voltage regulation of an Alternator or predetermine the efficiency of an AC rotating machine to inspect the synchronized operation of an Alternator with an Infinite bus bar.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	THREE PHASE INDUCTION MOTOR Construction details of three-phase induction motor, Rotating magnetic field, principle of operation, Slip, Effect of slip on rotor parameters, Torque equation, Torque-slip characteristics, Power Stages, Induction motor as generalized transformer-Equivalent circuit, No load and blocked rotor tests, Equivalent circuit	8
UNIT-II	STARTING, SPEED CONTROL AND PERFORMANCE CALCULATION FROM CIRCLE DIAGRAM Performance calculation from circle diagram, Need for starters–Starting methods of three-phase induction motor, Speed control of three-phase induction motor: Stator side, Rotor side, Slip power recovery schemes, Double cage rotor, Induction generator, Cogging, Crawling, Electric Braking.	8
UNIT-III	SINGLE-PHASE INDUCTION MOTOR AND SPECIAL MOTORS Single-phase induction motor: Construction detail, Double revolving field theory, Torque equation, Torque-speed characteristics, Equivalent circuit, No load and Blocked rotor tests, Performance analysis, Methods of Self-starting-shaded pole induction motor, Construction, Principle of operation and applications of Linear Induction motor, Universal motor, stepper motor, Construction, Principle of operation and applications of reluctance motor, repulsion motor, AC series Motor	8
UNIT-IV	SYNCHRONOUS GENERATORS Alternators: Construction features and types, EMF equation of alternators, armature reaction in alternators, Alternator on load, Synchronous reactance, Synchronous Impedance, Voltage regulation, Pre-determination of voltage regulation using EMF and MMF methods, Pre-determination of voltage regulation using ZPF and ASA methods, Synchronizing and parallel operation of alternators, Salient pole synchronous machine, two-reaction theory, slip test	8
UNIT-V	SYNCHRONOUS MOTOR Principle of operation, Methods of starting, Torque and power equations, Synchronous motor on load, Synchronous motor on constant excitation variable load, Synchronous motor on constant load variable excitation, 'V' and inverted 'V' curves, Synchronous condenser, Hunting and its suppression, Behavior of synchronous machine on short circuit, capability curves, Brushless DC motor, PMSM	8

TEXT BOOKS

1. Nagarath.I.J. and Kothari.D.P., "Electric Machines", T.M.H. Publishing CoLtd., New Delhi, 4th edition 2010.
2. Gupta., "Theory and Performance of Electrical Machines",. Kataria andSons, 14 th edition 2009.
3. MulukutlaS.Sarma and Mukesh.K.Pathak, "Electric Machines", Cengage Learning.,New Delhi, 2012

REFERENCE BOOKS

4. Fitzgerald Kingsley and Umans, "Electric Machinery" McGraw HillBooks co., New Delhi, 7th Edition, 2013.
5. R.K.Srivastava, "Electric Machines", Cengage Learning.,New Delhi,2nd edition, 2013
6. Bhag S.Guru and Huseyin R.Hiziroglu "Electric Machinery and Transformers" Oxford University Press,3rd edition, 2012.

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	23EE0201	Electrical Machines II	CO1	x			
			CO2		x	x	
			CO3		x	x	
			CO4				x

	Control Engineering	L	T	P	C
Course Code:	23EE0206	3	0	0	3
Course Type:	PC				
Pre-Requisite	NONE				

COURSE OBJECTIVES

1. To provide students an introduction to the basic principles and tools for the design and analysis of feedback control systems.
2. To impart knowledge about developing mathematical models of physical systems and deriving their transfer function.
3. To introduce the concept of analyzing the LTI systems for stability in time domain and frequency domain.
4. To enable the students to understand the basic control design methods to meet out desired performance/specifications.

COURSE LEARNING OUTCOMES (CLO)

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

1. Identify different physical systems and classify them as open loop and close loop control systems.
2. Describe the mathematical relation between input and output for LTI systems.
3. Apply different time domain and frequency domain tools to analyze the absolute and relative stability of LTI systems.
4. Assess the performance of LTI systems to different inputs and to design basic controllers to meet out desired performance.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	**INTRODUCTION TO CONTROL SYSTEM** Introduction and classification of control systems-linear, nonlinear, time varying, time in-variant, continuous, discrete, SISO and MIMO systems – definitions. Transfer function – Mathematical modeling of mechanical (translation and rotational), Electrical systems- mechanical-electrical analogies– Block Diagram reduction technique and Signal flow graphs. **COMPENSATION OF CONTROL SYSTEMS:** Transfer function of potentiometers, armature controlled and field controlled dc motor –tacho generators -gear trains- controllers (On – Off, P, PI,PD, PID), Need for compensation -Introduction to lead, lag, lead-lag compensating networks.	8
UNIT-II	**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.	8
UNIT-III	**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.	8
UNIT-IV	**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	8
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	8

	equations and transfer functions. Similarity Transformation, Decomposition of transfer functions, Controllability and observability.	

TEXT BOOKS

1. Nise, N.S, "Control System Engineering", Wiley, 6th Edition, 2010.
2. Golnaraghi, F and Kuo, B.C, "Automatic control systems" Prentice Hall, 9th Edition, 2008.

REFERENCE BOOKS

1. Dorf, R.C and Bishop, R.H, "Modern Control systems", Addison-Wesley, 12th Edition, 2011.
2. Ogata, K, "Modern control engineering", Prentice Hall, 5th Edition, 2010.
3. Nagrath I.J and Gopal M, "Control Systems Engineering", New Age Publishers, 5th Edition, 2009.

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	23EE0206	Control Engineering	CO1	x			
			CO2		x		
			CO3			x	
			CO4				x

	Linear Integrated Circuits	L	T	P	C
Course Code:	23EE0208	3	0	0	3
Course Type:	PC				
Pre-Requisite	None				

COURSE OBJECTIVES

1. To design simple circuits like amplifiers using op-amps
2. To design waveform generating circuits
3. To gain knowledge in designing a stable voltage regulators

COURSE LEARNING OUTCOMES (CLO)

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

1. Understand the concept of multistage amplifiers, analysis of multistage amplifier and its frequency response, Darlington pair and bootstrap circuits.
2. Describe the basics of tuned amplifiers such as single tuned, double tuned, stagger tuned & power amplifiers.
3. Analyze the performance of negative as well as positive feedback circuits.
4. Categorize the wave shaping circuits and operational amplifies.

UNIT	COURSE 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	8
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	8
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	8
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	8
UNIT-V	**DATA CONVERSION DEVICES** Advantages and disadvantages of working in the digital domain, Digital to Analog Conversion: DAC Specifications-DAC circuits-Weighted Resistor DAC-R-2R Ladder DAC-Inverted R-2R Ladder DAC-Monolithic DAC, Analog to Digital conversion: ADC specifications-ADC circuits-Ramp Type ADC-Successive Approximation ADC-Dual Slope ADC-Flash Type ADC-Tracking ADC-Monolithic ADC	8

TEXT BOOKS

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

REFERENCE BOOKS

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

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
III	23EE0208	Linear Integrated Circuits	CO1	x			
			CO2		x		
			CO3			x	
			CO4				x

	Electrical Machines Laboratory- II	L	T	P	C
Course Code:	23EE0254	0	0	2	1
Course Type:	P				
Pre-Requisite	23EE0204				

COURSE OBJECTIVES

1. To acquire fair knowledge on the working of different types of AC machines
2. To learn about operation, characteristics, testing and control of induction machines.
3. To have knowledge about operation, starting, characteristics and testing of synchronous machines.
4. To impart knowledge about synchronization methods and parallel operation of alternators.

COURSE LEARNING OUTCOMES (CLO)

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

1. Conduct a suitable test to determine the system parameters of Synchronous Machine.
2. Evaluate the performance factors of Induction and Synchronous Machines.
3. Understand operation, starting, characteristics and testing of synchronous machines
4. Perform synchronization of alternator with infinite bus-bar.

Experiment	List of Experiments	HOURS
	1. To perform Speed control of squirrel cage induction motor by variable frequency method 2. To perform no load and block rotor test on single phase induction motor and determine the equivalent circuit parameter from these tests 3. To perform load test on three-phase Induction motor 4. To study the Synchronization of alternator with infinite bus by bright lamp method 5. To perform no load and block rotor test on three phase induction motor and determine the equivalent circuit parameter from these tests 6. Speed control of three phase slip ring induction motor by rotor resistance Control 7. To determine voltage regulation of three phase alternator by EMF and MMF & ZPF methods 8. To draw circle diagram of three phase induction motor 9. To conduct slip test on the salient pole synchronous machine and calculate Xd and Xq parameters. 10. To plot V curves of a synchronous motor. 11. Determination of positive, Negative and Zero sequence reactance of synchronous machines 12. To control the speed of a slip ring induction motor by varying in rotor resistance 13. To control the speed of 3 phase induction motor using pole changing method 14. To study the dissectible machine system The list of experiments given above is only suggestive. The instructor may add new experiments as per the requirement of the course.	20

TEXT BOOKS

1. Laboratory Manual

REFERENCE BOOKS

2. Nagarath.I.J. and Kothari.D.P., "Electric Machines", T.M.H. Publishing CoLtd., New Delhi, 4thedition 2010.
3. Gupta., "Theory and Performance of Electrical Machines",. Kataria andSons, 14 th edition 2009.

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	23EE0254	Electrical Machines Laboratory II	CO1	x			
			CO2		x		
			CO3			x	
			CO4				x

		L	T	P	C
	lectrical Measurement & Control Laboratory	L	T	P	C
Course Code: 2	3EE0256	0	0	2	1
Course Type:	PC				
Pre-Requisite	23EE0206				

COURSE OBJECTIVES

1. To develop skills in designing and conducting experiments related to applications of measuring instruments, transducers and control systems
2. Solve and measure the basic parameters like resistance, capacitance and inductance using suitable methods.
3. To study different control components and their utility as error detectors.
4. To learn and implement basic control mechanisms using compensators and PID controllers.

COURSE LEARNING OUTCOMES (CLO)

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

1. Learn the measurement of non-electrical variables and electrical quantities
2. Apply the fundamentals of measuring methods in computing basic R,L and C parameters.
3. Understand the characteristic behaviour of transducers and Programmable Logic Controller in industrial applications.
4. Design and develop simple control mechanisms for given LTI systems.

Experiment	List of Experiments	HOURS
	17. To measure amplitude and frequency of the signal using CRO (Y-T mode) 18. To measure frequency of an unknown signal and phase angle between two Signals obtaining Lissajous pattern using a CRO 19. To Verify and Study Low Resistance Kelvin Double Bridge Kit 20. To Verify and Study Self Inductance by Maxwell Bridge 21. To Verify and Study Self Inductance by Hay's Bridge 22. To Verify and Study Self Inductance by Anderson's Bridge 23. To Verify and Study Self Inductance of Owen's Bridge 24. To Verify and Study Capacitance by De Sauty's Bridge 25. To Verify and Study Capacitance by Schering Bridge 26. To Verify and Study Capacitance by Wien's Bridge 27. To plot calibration curve for a single-phase energy meter 28. Stability analysis of a second order system using MATLAB software. 29. Digital simulation of the P, PI, PD, PID controllers using MATLAB software, 30. To study synchro transmitter – receiver pair and its operation as an error detector. 31. Study of two-phase AC servo motor and draw its speed torque characteristics. 32. To study speed control of DC Motor using Labview/Matlab. 33. To study Programmable Logic Controller (PLC) by using Ladder diagram for various real time applications. 34. To study various types of Temperature Transducer (RTD, NTC Thermistor, LM 35 and K Type Thermocouple). 35. Calculation of Phase margin and gain margin of Bode Plot using MATLAB. The list of experiments given above is only suggestive. The Instructor may add new experiments as per the requirement of the course.	20

TEXT BOOKS

1. Laboratory Manual

REFERENCE BOOKS

2. Jerome J "Virtual Instrumentation Using Labview" PHI publication, paperback 2010.
3. P. Gruggett," LABVIEW Technical Resource Lynda" LTR Publishers, Dallas, TX.

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	23EE0256	Electrical Measurement & Control Laboratory	CO1	x			
			CO2		x		
			CO3			x	
			CO4				x

	Linear Integrated Circuits Laboratory	L	T	P	C
Course Code:	23EE0258	0	0	2	1
Course Type:	P				
Pre-Requisite	23EE0208				

COURSE OBJECTIVES

4. To introduce the theoretical & circuit aspects of Op-amp, which is the backbone for the basics of Linear integrated circuits.
5. To acquire the skills of designing and testing analog integrated circuits
6. To impart knowledge on assessing performance of electronic circuit through monitoring of sensitive parameters

COURSE LEARNING OUTCOMES (CLO)

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

1. Elucidate and design the linear and non-linear applications of an opamp and special application ICs.
2. Design and construct waveform generation circuits
3. Illustrate the function of application specific ICs such as Voltage regulators, PLL and its applications
4. Elucidate and design the active filters and oscillators.

Experiment	List of Experiments	HOURS
	15. Operational Amplifiers (IC741)-Characteristics and Application. 16. Waveform Generation using Op-Amp (IC741). 17. Applications of Timer IC555. 18. Design of Active filters. 19. Study and application of PLL IC's 20. Op-Amp voltage Regulator- IC 723 21. To study the working of Hartley Oscillator and measure the frequency of oscillations 22. To study the working of Colpit's Oscillator and measure the frequency of oscillations 23. To study the functioning of Crystal Oscillator and measure the frequency of oscillations 24. To study the frequency response of two-stage RC coupled amplifier and find the voltage gain 25. To identify the type of feedback used in an amplifier and determine the voltage gain 26. To study the push-pull amplifier and plot the frequency response 27. To study the transformer coupled amplifier and determine the frequency response. The list of experiments given above is only suggestive. The instructor may add new experiments as per the requirement of the course.	20

TEXT BOOKS

2. Laboratory Manual

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	23EE0258	Linear Integrated Circuits Laboratory	CO1	x			x
			CO2		x		x
			CO3			x	x

	Live Project-I & Industrial Visits	L	T	P	C
Course Code:	23EE0260	0	0	1	1
Course Type:	LP				
Prerequisite	None				

INDUSTRIAL INTERNSHIP OBJECTIVES (IIOs):
To obtain hands-on experience in converting a small novel idea/technique into a working model/prototype involving multi-disciplinary skills and/or knowledge and working in as team.
INDUSTRIAL INTERNSHIP LEARNING OUTCOMES (IILOs):
At the end of the course, the student will be able to
1. To conceptualize a novel idea/technique into a product
2. To think in terms of a multi-disciplinary environment
3. To estimate the ability of the student in transforming the theoretical knowledge studied so far into a working model of an electrical/electronic system.
4. To prepare a presentation in a professional manner, and document all aspects of design work.

SESSION	Description of Topic	HOURS
	The purpose of the live project in the second year of Electrical and Electronics Engineering is to familiarize them with the process of designing electronic devices, circuits and systems as practiced in industry. This course requires students to develop a project based on the knowledge and skills acquired in earlier coursework and integrate their technical knowledge through practical design effort.	15

Mapping Matrix of Industrial Internship Objectives (ILOs) and Industrial Internship Learning Outcomes (IILOs)

SEM	SUB CODE	Course name	Industrial Internship Objectives	IILO 1	IILO 2	IILO 3	IILO 4
IV	20EE0260	Live Project-I & Industrial Visits	IIO1	x	x	x	x

	TEAMWORK & INTERPERSONAL SKILLS	L	T	P	C
Course Code:	23SS452	0	0	2	1
Course Type:	SEC				
Pre-Requisite	None				

Training Objectives (TO): -

1. To make the students learn & demonstrate effective team work, leadership & interpersonal skills.
2. To equip the students with capability of handling stress and utilisation of work time effectively.
3. To make the student 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:

1. To be confident working in a team and leading it as well.
2. To categorise 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-energise himself to bounce back from such situations.
3. To get benefitted from Emotional Quotient in building stronger professional relationships and achieving career and personal goals.
4. To face complex problems and effectively deal with it in the job due to Critical Thinking & Problem-Solving Skills.

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 & behavioural 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
Unit-VII	Problem Solving - Types of problems & its solutions - Problem solving process & tools	Think Pair Share Activity

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 focussing 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)
1	Team Management	Role Play / Group Activity	10	Written Test	10
2	Time Management		10		
3	Leadership		10		
4	Stress Management	Assignment	10	Viva	20
5	Emotional Intelligence	Written Test	10		
6	Critical Thinking		10		
7	Problem Solving	Case Story Telling	10		

TEXT BOOKS
1. Communication Skills by Sanjay Kumar & Pushp Lata: Oxford University Press, 2018.
REFERNCE BOOKS
1. Personality Development & Communication Skills-1 by C B Gupta: Scholar Tech Press,2019.(ISBN No. – 9382209131)

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

SEM	SUB CODE	Course name	Training Objectives	TLO 1	TLO 2	TLO 3	TLO 4
IV	23SS452	TEAMWORK & INTERPERSONAL SKILLS	TO1	x			
			TO2		x		
			TO3			x	x

	rtificial Intelligence and Machine Learning	L	T	P	C
Course Code: 2	3CS0202	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

6	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: Depth-first, breadth-first search, Problem Reduction, Constraint Satisfaction, Means-End Analysis.	Solving manually constraint satisfaction problem
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.

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	23CS0202	Artificial Intelligence and Machine Learning	CO1	x			
			CO2		x		
			CO3		x	x	
			CO4			x	x

Semester – V

	DISCRETE MATHEMATICS (EEE)	L	T	P	C
Course Code:	24MDC506B	3	0	0	3
Course Type:	ES				
Pre-Requisite	None				

COURSE OBJECTIVES (COs)

1. To introduce most of the basic terminologies for Logical and Mathematical maturity that impart analytical ability to describe, analyse 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 and systematic fashion.

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. 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, rings and fields.
4. Get idea of Boolean algebra and its applications.

UNIT	COURSE CONTENTS	HOURS
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.	8
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	8
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.	8
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.	8

TEXT BOOKS / REFERENCE BOOKS

1. B. Kolman, R. Busby, and S. C. Ross., Discrete Mathematical Structure, 6thedition.,Pearson's Publication,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, 4th edition,2017.
6. Yadav S. K., Discrete Mathematics with Graph Theory, Anne Books Pvt. Ltd., 2013.
7.

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

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

	Power Electronics	L	T	P	C
Course Code:	23EE0305	3	0	0	3
Course Type:	PC				
Pre-Requisite	NONE				

COURSE OBJECTIVES

1. To learn the characteristics and applications of power electronic devices and circuits.
2. To impart knowledge about construction, working principles of key power electronic switches & their switching characteristics.
3. To introduce the fundamental concepts relevant to operation of power electronic converters and output waveforms.
4. To enable the students, understand about various factors which must be considered while designing power electronic systems.

COURSE LEARNING OUTCOMES (CLO)

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

1. Describe the details of power semiconductor switches (Construction, Characteristics, and operation).
2. Understand the operation of controlled rectifiers, choppers, and inverters.
3. Apply the operation of AC-to-AC converters
4. Design various power electronic converters

UNIT	COURSE CONTENTS	HOURS
UNIT-I	POWER ELECTRONIC DEVICES Introduction to power semiconductor devices, Construction - Principle of operation - Dynamic characteristics of Power diodes, SCR, Power MOSFET, IGBT, Protection circuits: Snubber, over voltage and over current, Crowbar, Power loss calculation (Switching, conduction and leakage losses)	8
UNIT-II	AC TO DC CONVERTERS Single-phase and three-phase controlled rectifiers (half and full converters) with R, RL and RLE load, Estimation of average and RMS load voltages, RMS load current and input power factor, Effect of source inductance, Single-phase and three-phase dual converters, Generation of control signals for single-phase AC to DC converters – Cosine wave crossing control, ramp comparator approach	8
UNIT-III	DC TO DC CONVERTERS Principle of step up and step down operation – single quadrant DC chopper with RLE load –Time ratio control, Forced commutated chopper :Voltage commutated choppers, Forced commutated chopper :Current and load commutated choppers, Sepic, Cuk converter - Buck-Boost converter.	8
UNIT-IV	DC TO AC CONVERTERS Single-phase voltage source inverter, Three-phase voltage source inverter (120° and 180°), Single phase diode clamped multilevel inverter, PWM techniques: multiple PWM, SPWM, modified SPWM - Harmonic reduction	8
UNIT-V	AC TO AC CONVERTERS AND POWER ELECTRONIC APPLICATIONS AC Voltage regulator, Cycloconverter: Three-phase to single-phase and three-phase to three- phase, Introduction to matrix converter, UPS - SMPS – HVDC systems – Tap changing of transformers	8

TEXT BOOKS

1. Rashid, M.H., "Power Electronics - Circuits Devices and Applications", Prentice Hall of India,2014, 4th edition.
2. Sen.P C, "Power Electronics", Tata Mc Graw Hill Education, 2012, 39 th reprint .
3. Bhimbra .P. S. "Power Electronics", Khanna publishers, 2012, Fifth edition.

REFERENCE BOOKS

4. Singh. M.D and Kanchandani-"Power Electronics"-Tata McGraw-Hill & Hill Publication Company Ltd, 2015, 23rd reprint.
5. Joseph Vithayathil, "Power Electronics Principle and applications", Mc Graw Hill Education, edition 2010.
6. Ned Mohan,T.M Undeland and W.P Robbin, "Power Electronics: converters, Application and

design", John Wiley and sons, 3rd edition, 2006.

7. Andrzej M. Trzynadlowski "Introduction to modern power electronics", John Wiley and sons,
3rd edition, 2015.
8. V R Moorthi, "Power Electronics: Devices, Circuits and Industrial Applications", Oxford University Press India, 2005.

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	23EE0305	Power Electronics	CO1	x			
			CO2		x		
			CO3			x	
			CO4				x

	Generation, Transmission and Distribution	L	T	P	C
Course Code:	24EEXXX	3	0	0	3
Course Type:	ES				
Pre-Requisite	Basic Knowledge of circuit theory				

COURSE OBJECTIVES (COs)

10. To identify major components of power transmission and distribution systems.
11. 2. To describe the principle of operation of transmission and distribution equipment.
12. 3. To understand the key factors in transmission and distribution system equipment specification and network design.

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:

14. Understand the major components of Transmission and Distribution Systems (TDS) and its practical significance.
15. Apply knowledge of various equipment specifications to design transmission and distribution systems.
16. Understand the latest technologies in the field of electrical transmission and distribution.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	**Transmission line parameters:** Resistance, Inductance, and Capacitance calculations – Single-phase and three-phase lines – double circuit lines – effect of the earth on transmission line capacitance.	8
UNIT-II	**Performance of transmission lines:** Regulation and efficiency – Tuned power lines, Power flow through a transmission line – Power circle diagrams, Introduction to Transmission loss and Formation of the corona – critical voltages – effect on line performance – traveling waveform phenomena	8
UNIT-III	**Mechanical design of overhead lines:** Line supports – Insulators, Voltage distribution in suspension insulators – Testing of insulators – string efficiency – Stress and sag calculation – effects of wind and ice loading.	8
UNIT-IV	**Underground cables:** Comparison with overhead line – Types of cables – insulation resistance –potential gradient – capacitance of single-core and three-core cables.	8
UNIT-V	**Distribution Systems:** General aspects – Kelvin's Law – A.C. distribution – Single-phase and three-phase – Techniques of voltage control and power factor improvement – Introduction to Distribution loss – Recent trends in transmission and distribution systems.	8

TEXTBOOKS

1. D.P.Kothari and I.J. Nagrath, ‘Power System Engineering’, Tata McGraw–Hill, 2ndEdition, 2008.
2. Gupta B.R, 'Power System Analysis & Design', S.Chand and Company Ltd., 5th Edition, 2001.
3. John .J. Grainger & Stevenson. W. D., 'Power System Analysis', McGraw-Hill, 1st Edition, 2003.

REFERENCE BOOKS

1. Turan Gonen, ‘Electric Power Distribution System Engineering’, CRC Press INC, 2ndEdition 2007.

2. ‘Electrical Transmission and Distribution Reference Book’, Westinghouse Electric Corporation, 4thEdition 2007.

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

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

	POWER ELECTRONICS LAB	L	T	P	C
Course Code:	23EE0355	0	0	2	1
Course Type:	P				
Pre-Requisite	NONE				

COURSE OBJECTIVES

1. To make the students gain comprehensive knowledge on power electronics devices and their applications.
2. To learn the operation and characteristics of different power semiconductor switches.
3. To understand and analyze the operation of controlled rectifier, chopper and cyclo-converter.
4. To simulate power electronics converter using MATLAB/LABVIEW

COURSE LEARNING OUTCOMES (CLO)

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

1. Design converter and inverter circuits using power electronic devices.
2. Construct commutation circuits.
3. Set up the speed control of machines using various power electronic circuits.
4. Analyze various power electronic converters using MATLAB/LABVIEW

Experiment	List of Experiments	HOURS
	1. To study characteristics of R, RC & UJT triggering circuit with Pulse Transformer. 2. To Verify and Study Single Phase Half Wave Convertor 3. To Verify and Study Single Phase Fully Bridge Control Convertor 4. To Verify and Study Single Phase AC Voltage Convertor using TRIACS 5. To Verify and Study Single Phase Series Inverter Circuit using SCR 6. To Verify and Study Parallel Inverter circuit 7. To Verify and Study Series Inverter circuit 8. To Verify and Study Commutation circuit 9. To Verify and Study Mc - Murray Bedford half & full bridge Inverter circuit 10. To Verify and Study speed control of DC Motor using rectifier circuit 11. To Verify and Study Commutation Circuitry of thyristor 12. To Verify and Study Speed Control of Universal Motor using SCR 13. To Verify and Study speed control of three phase induction Motor using Voltage Source Inverter 14. To determine switching characteristics of MOSFET BASED Chopper Motor Controller 15. To determine Transfer Function Characteristics of AC Servo Motor The list of experiments given above is only suggestive. The Instructor may add new experiments as per the requirement of the course.	20

TEXT BOOKS

1. M.D Singh & K.B. Kanchandhani “Power Electronics” Tata Mc Graw – Hill Publishing Company, 2007
2. M.H. Rashid “Power Electronics: Circuits, Devices and Applications” Prentice Hall of India

REFERENCE BOOKS

1. Vedam Subramanyam “Power Electronics” New Age International (P) Limited, Publishers.
2. V.R. Murthy “Power Electronics” 1st Edition 2005, Oxford University Press
3. P.C. Sen “Power Electronics” Tata Mc Graw-Hill Publishing.

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	23EE0355	Power Electronics Lab	CO1	x			
			CO2		x		

			CO3			x	
			CO4				x

	Electrical Simulation and Programming Lab	L	T	P	C
Course Code:2	3EE0357	0	0	2	1
Course Type:	P				
Pre-Requisite	NONE				

COURSE OBJECTIVES

1. To impart practical working knowledge of Electrical and Electronics Simulation and
2. Analysis using Mathematical computing languages such as MATLAB and/or SCILAB.
3. To Solve, Simulate and Analyse basic Electrical and Electronics Circuits and Applications by writing Ohm's law, KCL and KVL Mathematical Equations and Programs.
4. To develop hands on working experience with reference to Solve, Simulate and Analyse Electrical & Electronics Circuits using MATLAB or SCI LAB environments.

COURSE LEARNING OUTCOMES (CLO)

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

1. Understand the main features and importance of the MATLAB/ SCI LAB mathematical programming environment.
2. Apply working knowledge of MATLAB/ SCI LAB package to simulate and solve Electrical, Electronics circuits and Applications.
3. Solve, Simulate and Analyse various AC and DC circuits.
4. Solve, Simulate and Analyse various Transformer, DC Generator circuits, Analog and Digital Electronics circuits.

Experiment	List of Experiments	HOURS
	1. Introduction to MATLAB/ SCI LAB; features, applications and software versions, STARTING and QUITTING, MATLAB DESKTOP. 2. DESKTOP TOOLS; Command Window, Command History, Launch Pad, Help Browser, Current Directory Browser, Workspace Browser, Editor/ Debugger 3. GETTING STARTED MATLAB; Using it as a calculator, Creating variables, Overwriting variable, Error messages, Making corrections, Controlling the hierarchy of operations or precedence, Controlling the appearance of floating point number, Managing the workspace Keeping track of your work session, Entering multiple statements per line, Getting help 4. Generation of various signals and sequences (Periodic and Aperiodic), such as unit Impulse, Step, Square, Saw tooth, Triangular, Sinusoidal, Ramp Signals. 5. Operations on signals and sequences such as Addition, Multiplication, Scaling, Shifting, Folding, Computation of Energy, and Average Power 6. Application of Network Theorems to Electrical Networks. 7. Locating the Zeros and Poles and Plotting the Pole-Zero maps in S plane and Z-Plane for the given transfer function 8. Simulation of DC Circuits 9. Simulation of single phase diode bridge rectifiers with filter for R & RL load 10. Design of Low Pass and High Pass filters 11. Simulation of Diode,MOSFET and IGBT characteristics 12. Analysis of three phase circuit, representing generator, transmission line and load 13. TRANSIENT STABILITY STUDIES The list of experiments given above is only suggestive. The Instructor may add new experiments as per the requirement of the course.	20

Laboratory Manual References

1. http://in.mathworks.com/
2. https://www.scilab.org/resources/documentation/tutorials
3. Introduction to Programming with Matlab by J. Michael Fitzpatrick and John D. Crocetti, Department of Electrical Engineering and Computer Science, School of Engineering, Vanderbilt University, Nashville, TN, 2000-2011.
4. Introduction to Matlab: Application to Electrical Engineering by Houssem Rafik ElHana Bouchekara, Umm El Qura University, Februray 2011.
5. A Matlab Tutorial by Dr. L. Doyle and Dr. A. Kokaram, Department of Electronic and Electrical Engineering, University of Dublin Trinity College, 2000.
6. Electronics and circuit analysis using MATLAB by John. O. Attia, Department of Electrical Engineering, Prairie View A&M University, Boca Raton London, New York, Washington D.C., CRC Press, 1999.
7. MATLAB for Electrical and Computer Engineering, Students and Professionals with Simulink by Roland Priemer, University of Illinois at Chicago, Scitechpub.com, Edison, NJ, 2013.

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	23EE0357	Electrical Simulation and Programming Lab	CO1	x			
			CO2		x		
			CO3			x	
			CO4				x

23EE0363	Computer Aided Manufacturing (CNC) Laboratory	L	T	P	C
Course Code:	23EE0363	0	0	2	1
Course Type:	P				
Pre-Requisite	None				

COURSE OBJECTIVES

- To provide hands-on training to the students on various design software in mechanical engineering.
- Create 2D and 3D models of components.
- Create assembly drawing of components.
- Preparing standard drawing layout for modeled parts or assemblies with BoM

COURSE LEARNING OUTCOMES (CLO)

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

- Drafting practice using computer.
- Modeling of 2D and 3D parts.
- Creating assembly drawing of components.
- Prepare standard drawing layout for modeled parts or assemblies with BoM

Experiments	List of Experiments	HOURS
	Exp. No. 1: Drawing of simple objects using the options offset, mirroring, arrays. **Exp. No. 2:** Drawing of a title block with necessary text and projection symbols. **Exp. No. 3**: Drawing of front view, top view and side view of simple solids. **Exp. No. 4**: Assembly of Plummer Block. **Exp. No. 5**: Assembly of Screw Jack. **Exp. No. 6**: Assembly of Sleeve &Cotter joints. **Exp. No. 7**: Assembly drawing of Connecting Rod. **Exp. No. 8**: Assembly of Couplings – Flange. **Exp. No. 9**: Assembly drawing of Knuckle Joint **Exp. No. 10**:Assembly of Bush Bearing.	20

TEXT BOOKS

2. Laboratory Manual

REFERENCE BOOKS

2. Nagarath.I.J. and Kothari.D.P., "Electric Machines", T.M.H. Publishing CoLtd., New Delhi, 4 th edition 2010.

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	23EE0363	Computer Aided Design Laboratory	CO1	x			
			CO2		x		
			CO3			x	
			CO4				x

	Live Project-II & Industrial Visits	L	T	P	C
Course Code:	23EE0359	0	0	1	1
Course Type:	LP/SI				
Prerequisite	23EE0260				

INDUSTRIAL INTERNSHIP OBJECTIVES (IIOs):

To obtain hands-on experience in converting a small novel idea/technique into a working model/prototype involving multi-disciplinary skills and/or knowledge and working in as team.

INDUSTRIAL INTERNSHIP LEARNING OUTCOMES (IILOs):

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

1. To conceptualize a novel idea/technique into a product
2. To think in terms of a multi-disciplinary environment
3. To estimate the ability of the student in transforming the theoretical knowledge studied so far into a working model of an electrical/electronic system.
4. To prepare a presentation in a professional manner, and document all aspects of design work.

SESSION	Description of Topic	HOURS
	The purpose of the live project in the third year of Electrical and Electronics Engineering is to familiarize them with the process of designing electronic devices, circuits and systems as practiced in industry. This course requires students to develop a project based on the knowledge and skills acquired in earlier coursework and integrate their technical knowledge through practical design effort.	15

Mapping Matrix of Industrial Internship Objectives (ILOs) and Industrial Internship Learning Outcomes (IILOs)

SEM	SUB CODE	Course name	Industrial Internship Objectives	IILO 1	IILO 2	IILO 3	IILO 4
V	20EE0359	Live Project-II & Industrial Visits	IIO1	x	x	x	x

	Industrial Training-I	L	T	P	C
Course Code:	**23EE0361**	0	0	2	1
Course Type:	LP/SI				
Prerequisite	NONE				

COURSE OBJECTIVES

To provide short-term work experience in an Industry/ Company/ Organization

COURSE LEARNING OUTCOMES (CLO)

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

1. To Get an inside view of an industry and organization/company
2. To Gain valuable skills and knowledge
3. To Make professional connections and enhance networking
4. To Get experience in a field to allow the student to make a career transition

SESSION	Description of Topic	HOURS
	1. It is mandatory for every student to undergo this course. 2. Every student is expected to spend a minimum of 15-days in an Industry/ Company/ Organization, during the summer vacation. 3. The type of industry must be NOT below the Medium Scale category in his / her domain of the degree programme. 4. The student must submit the "Training Completion Certificate" issued by the industry / company / Organisation as well as a technical report not exceeding 15 pages, within the stipulated time to be eligible for making a presentation before the committee constituted by the department. 5. The committee will then assess the student based on the report submitted and the presentation made. 6. Marks will be awarded out of maximum 100. 7. Appropriate grades will be assigned as per the regulations. 8. Only if a student gets a minimum of pass grade, appropriate credit will be transferred towards the degree requirements, as per the regulations. 9. It is solely the responsibility of the individual student to fulfill the above conditions to earn the credits. 10. The attendance for this course, for the purpose of awarding attendance grade, will be considered 100%, if the credits are transferred, after satisfying the above (1) to (8) norms; else if the credits are not transferred or transferable, the attendance will be considered as ZERO. 11. The committee must recommend redoing the course, if it collectively concludes, based on the assessment made from the report and presentations submitted by the student, that either the level of training received or the skill and / or knowledge gained is NOT satisfactory.	30

Evaluation:

COURSE NATURE		Training--100% INTERNAL CONTINUOUS ASSESSMENT		
ASSESSMENT METHOD- (WEIGHTAGE 100%)				
In-Semester	Assessment tool	Presentation	Report	Total
	Weightage	80%	20%	100%
End semester examination Weightage:				0%

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	**23EE0361**	Industrial Training-I	CO1	x	x	x	x	x

	PRESENTATION SKILLS	L	T	P	C
Course Code:	23SS553	0	0	2	1
Course Type:	SEC				
Pre-Requisite	None				

Training Objectives (TO):-
1. To develop the public speaking skills in the student.
2. To make the students learn and adapt to the necessary etiquettes required to work and grow in corporate culture.
3. To make the student 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:
1. To be confident in presenting himself in front of audience.
2. To become professional in his approach towards work culture.
3. To enhance the level of communication skills while interacting with others.

Unit	Course Contents	Student Engagement Activity
Unit-I	Presentation Skills • Importance of presentation skills • 4 P's of presentation skills – plan, prepare, practice & present • Guidelines for effective presentation	PPT Presentation Activity
Unit-II	Story Telling Skills • 4 P's of story telling skills – people, place, plot & purpose • Types of story telling techniques • Importance of story telling skills	Start From Where I Stopped Activity
Unit-III	Corporate Culture Etiquettes • Importance of professional behaviour 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 • Role of verbal & non verbal communication in debate / extempore • Importance of current affairs / general knowledge	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

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 focussing 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)

1	Presentation Skills	Presentation Activity	20	Written Test	10
2	Story Telling Skills	Speech Activity	15		
3	Corporate Culture Etiquettes	Assignment	10		
4	Debate/Extempore	Speech Activity	15	Viva	20
5	Art of Creating Impression		10		

TEXT BOOKS

1. Communication Skills by Sanjay Kumar & Pushp Lata: Oxford University Press, 2018.

REFERNCE BOOKS

1. Personality Development & Communication Skills-1 by C B Gupta: Scholar Tech Press,2019.(ISBN No. – 9382209131)

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

SEM	SUB CODE	Course name	Training Objectives	TLO 1	TLO 2	TLO 3
V	23SS553	Presentation Skills	TO1	x	x	
			TO2		x	
			TO3		x	x

	Design Thinking and Augmented Virtual Reality	L	T	P	C
Course Code:	23CS0301	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.

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

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

Semester – VI

	Power System Protection	L	T	P	C
Course Code:	24EEXXX	3	0	0	3
Course Type:	ES				
Pre-Requisite	Basic Knowledge of Power System				

COURSE OBJECTIVES (COs)

13. To understand all types of protective relays, and circuit breakers and provide a strong background for working in practical power system protection.
14. To gain knowledge of the protection of transmission lines, transformers, and bus bar protection.
15. To explain the working principle and application of circuit breakers.

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:

17. Classify and describe the working of various relaying schemes.
18. Identify and implement an appropriate relaying scheme for different power apparatus.
19. Illustrate the function of various CBs and related switching issues.
20. Describe the causes of overvoltage and protection against overvoltage.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	**Introduction to Relays and its Operation** General classification, Principle of operation, types, characteristics, Torque equation, Relaying Schemes, Relay coordination.	8
UNIT-II	**Apparatus and line protection:** Line Protection – Distance protection, Differential protection, and Carrier current protection. Generator protection – protection against abnormal conditions, stator and rotor protection. Transformer Protection–Incipient fault–Differential protection, Feeder, and Bus bar protection.	8
UNIT-III	**Surge Protection and Insulation Coordination:** Introduction to substation architecture, automation, and protection - Protection against overvoltages – Causes of overvoltage, Ground wires, Surge absorbers, and diverters. Earthing - types. Insulation coordination.	8
UNIT-IV	**Circuit Breakers:** Theory of arcing and arc quenching circuit breakers-types – rating and comparison, RRRV, Resistor switching, and capacitor switching.	8
UNIT-V	**Modern Protection System:** Introduction to Static relays – Digital relays - Microprocessor-based relays – Apparatus and line protection – Basics of Numerical relays.	8

TEXTBOOKS

1. Badri Ram and Vishwakarma, D.N., 'Power System Protection and Switchgear', Tata McGraw Hill Publishing Company Ltd., 2nd Edition, 2011.
2. Ravindranath B., and Chander, N., 'Power Systems Protection and Switch Gear', Wiley Eastern Ltd., 1st Edition, 1977.

REFERENCE BOOKS

1. Sunil S. Rao, 'Protective Switch Gear', Khanna Publishers, New Delhi, 13th Edition, 2008.

2. Y. G. Paithangar, ‘Fundamentals of Power System Protection’, PHI Learning Private Limited, 2nd Edition, 2010.
3. C.L. Wadhwa, ‘Electrical Power Systems’, Wiley-Blackwell, 6th Edition, 2007.
4. Ramesh Bansal, "Power System Protection in Smart Grid Environment", CRC Press, 1st Edition, 2019.

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

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

	icroprocessor & Microcontroller	L	T	P	C
Course Code: 2	3EE0308	3	0	0	3
Course Type:	PC				
Pre-Requisite	NONE				

COURSE OBJECTIVES

1. To impart knowledge about microcomputers, microprocessor, associated hardware and its architecture.
2. To enable students to write programme in assembly language.
3. To enable the students to understand about the interfacing and peripherals used and application of 8085 microprocessor and its applications.
4. To introduce the basic concepts relevant to 8086 microprocessor architecture and its operating modes.

COURSE LEARNING OUTCOMES (CLO)

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

1. Identify various hardware components of microcomputers and peripherals.
2. Understand the architecture and working of Intel 8086 microprocessor
3. Design small practical systems using microcontrollers.
4. Comprehend the architecture Intel 8051 microcontroller, assembly language programming using 8051 instructions set.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	Introduction to Microprocessor Systems: Architecture and PIN diagram of 8085, Timing Diagram, memory organization, Addressing modes, Interrupts. Assembly Language Programming.	8
UNIT-II	8086 Microprocessor: 8086 Architecture, difference between 8085 and 8086 architecture, generation of physical address, PIN diagram of 8086, Minimum Mode and Maximum mode, Bus cycle, Memory Organization, Memory Interfacing, Addressing Modes, Assembler Directives, Instruction set of 8086, Assembly Language Programming, Hardware and Software Interrupts.	8
UNIT-III	Interfacing of 8086 with 8255, 8254/ 8253, 8251, 8259: Introduction, Generation of I/O Ports, Programmable Peripheral Interface (PPI)-Intel 8255, Sample-and-Hold Circuit and Multiplexer, Keyboard and Display Interface, Keyboard and Display Controller (8279), Programmable Interval timers (Intel 8253/8254), USART (8251), PIC (8259), DAC, ADC, LCD, Stepper Motor.	8
UNIT-IV	Overview of Microcontroller 8051: Introduction to 8051 Micro-controller, Architecture, Memory organization, Special function registers, Port Operation, Memory Interfacing, I/O Interfacing, Programming 8051 resources, interrupts, Programmer's model of 8051, Operand types, Operand addressing, Data transfer instructions, Arithmetic instructions, Logic instructions, Control transfer instructions, Timer & Counter Programming, Interrupt Programming.	8
UNIT-V	Case studies of different Applications: Measurement and control of electrical and physical systems, data acquisition etc.	8

TEXT BOOKS

1. Microprocessor Architecture, Programming and Applications with the 8085 by R. S. Gaonkar, Penram International Publishing (India) Pvt Ltd.
2. Introduction to Microprocessors by A. P. Mathur, TMH.
3. John E. Uffenbeck, “The 8086/8088 Family: Design, Programming, and Interfacing”, PHI
4. Barry B. Bray, “Intel Microprocessors 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium, Prentium Proprocessor, Pentium II, III,”
5. Rajkamal, “8051 Microcontroller”.

REFERENCE BOOKS

1. Fundamentals of Microprocessors and Microcomputers B. Ram, Dhanpat Rai & Sons.
2. Microprocessor Microcomputer and their Applications by A. K. Mukhopadhyay, Narosa Publishing House.
3. Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. MCKinlay “The 8051 Microcontroller

and Embedded Systems",2nd Edition, Pearson Education 2008.
4. Kenneth J. Ayala, "The 8086 Microprocessor: Programming & Interfacing The PC", Delmar
Publishers, 2007.
5. A K Ray, K M Bhurchandi, "Advanced Microprocessors and Peripherals", Tata McGraw Hill, 2007.
6. Vaneet Singh, Gurmeet Singh, "Microprocessor and Interfacing", Satya Prakashan, 2007.

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
VI	23EE0308	Microprocessors and Microcontrollers	CO1	x			
			CO2		x		
			CO3			x	
			CO4				x

	Power Systems Simulation Laboratory	L	T	P	C
Course Code:	23EE0356	0	0	2	1
Course Type:	Prerequisite				
Pre-Requisite	None				

COURSE OBJECTIVES

To develop skills in simulation software's and conducting experiments related to power system studies.
Provide hands-on experience to the students so that they are able to put theoretical concepts to practice.
To impart knowledge about the experimental determination of transmission line parameters.
To familiarize the students with the methods/ techniques for analyzing breakdown voltage.

COURSE LEARNING OUTCOMES (CLO)

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

1. Acquire skills of using computer packages for power system studies.
2. Acquire knowledge in conducting experiments related to power system studies.
3. Explain the use of MATLAB package to assess the performance of medium and long transmission lines.
4. Simulate single-area and two-area frequency control

Experiments	List of Experiments	HOURS
	At least 8 experiments are to be performed out of the following list: 1. To develop a computer program to solve the set of non-linear load flow equations using G-S load flow algorithm. 2. To develop a software program to obtain real and reactive power flows, bus voltage magnitude and angles by using N – R method. 3. To become proficient in the usage of software in solving load flow problems using Fast decoupled load flow method. 4. Program to read and print out the power system load flow data of 5 BUS – IEE 14 Bus and IEEE 30 Bus systems. 5. To develop a computer program to carry out simulation study of a symmetrical three phase short circuit on a given power system. 6. To develop a program to transient stability of a given power system. 7. To develop a program for solving economic dispatch problem without transmission losses for a given load condition using direct method and Lambda-iteration method. 8. To develop a Simulink model of single-area and two-area load frequency control of power system. 9. To develop a computer program to obtain the building algorithm for bus impedance matrix of the given power system. 10. To measure ABCD parameters of a transmission line and calculate its efficiency at various loads. 11. To plot the trip time characteristics of over voltage relay (microprocessor based) on testing kit. 12. To plot the trip time characteristics of under voltage relay (microprocessor based) on testing kit. 13. To plot the characteristics of an over current relay (Inverse Type CDG) for plug setting of 2.5A and 5A and TMS of 0.6 and 1.0. 14. To study the Negative phase sequence protection scheme on testing kit. 15. To find the string efficiency without the guard ring, with guard ring. 16. To measure zero sequence components of line current in a 3-phase, 4 wire system. 17. To measure (PPS and NPS) sequence components of supply voltage by segregating networks and verify graphically. 18. To measure earth resistance with the help of digital earth resistance tester. The list of experiments given above is only suggestive. The instructor may add new experiments as per the requirement of the course.	10

TEXT BOOKS

1. Laboratory Manual

REFERENCE BOOKS

2. Olle.I.Elgerd, “Electric Energy systems theory- An Introduction”, Tata Mc Graw Hill publishing Ltd, New Delhi, 2008
3. D.P.Kothari, I.J.Nagrath, “Modern Power System analysis”, 4 th Edition, Mc Graw Hill, 2011

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
VI	23EE0356	Power System Simulation Laboratory	CO1	x			
			CO2		x		
			CO3			x	
			CO4				x

	Microprocessors and Microcontrollers Lab	L	T	P	C
Course Code:	23EE0358	0	0	2	1
Course Type:	PC				
Pre-Requisite	None				

COURSE OBJECTIVES

1.To enable the students to do basic programs in the microprocessors INTEL 8085 and microcontroller INTEL 8051.

2.To provide ability for drawing flowcharts and writing Assembly Language Programs for a given problem.

3.To provide skills to decide machine codes corresponding to Mnemonics and writing/entering machine codes on 8085 microprocessor kit.

4.To enable the students to debug the Assembly Language Programs.

COURSE LEARNING OUTCOMES (CLO)

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

1. Execute 8085/8051 Microprocessor & microcontroller using assembly language
2. Apply various arithmetic operations using microprocessors.
3. Test various code conversions.
4. Perform various types of interfacing.

Experiments	List of Experiments	HOURS

	1. To study the operation of 8085 microprocessor and its applications 2. To write an assembly language program for adding , subtracting two 8 bit numbers by using 8085 microprocessor kit 3. To write an assembly language program for adding, subtracting two 16 bit numbers using 8085 microprocessor kit 4. To write an assembly language for multiplying two 8 bit numbers by using 8085 microprocessor kit 5. To write an assembly language program to sort given 'n' numbers in ascending order for microprocessor 8085 6. To write an assembly language program for microprocessor 8085 to sort given 'n' numbers in descending order 7. To write an assembly language program to calculate the sum of data using 8085 microprocessor kit 8. To write an assembly language program to calculate the factorial of a number using 8085 microprocessor (between 0 to 8). 9. To write an assembly language program to convert BCD data to Binary data using 8085 microprocessor kit 10. To write an assembly language program to obtain a rolling display of a particular data by using 8085 microprocessor 11. To write an assembly language program to obtain the flashing display of a particular data using microprocessor 8085 12. To write an assembly program to make the stepper motor run in forward and reverse direction for microprocessor 8085 13. To write an assembly language program for adding , subtracting two 16 bit numbers by using 8086 microprocessor kit 14. To write an assembly language program to sort given 'n' numbers in ascending order and descending for microprocessor 8086 15. Write a Program to read 16 bit Data from a port and display the same in another port. 16. Write a Program to generate a square wave using 8254. 17. Write a Program to generate a square wave of 10 kHz using Timer 1 in mode 1(using 8051). 18. Write a Program to transfer data from external ROM to internal (using 8051). 19. Design a Minor project using 8086 Micro processor (Ex: Traffic light controller/temperature controller etc) 20. Design a Minor project using 8051 Micro controller The list of experiments given above is only suggestive. The Instructor may add new experiments as per the requirement of the course. NOTE: - At least 8 Experiments out of the list must be done in the semester.	30

REFERENCE

1. Laboratory Manual.
2. Processor User Manual.
3. Microcontroller user Manual.

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
VI	23EE0358	Microprocessors and Microcontrollers Lab	CO1	x			
			CO2		x		
			CO3			x	
			CO4				x

	Live Project-III & Industrial Visits	L	T	P	C
Course Code:	23EE0360	0	0	1	1
Course Type:	LP				
Prerequisite	23EE0260,23EE0359				

INDUSTRIAL INTERNSHIP OBJECTIVES (IIOs):
To obtain hands-on experience in converting a small novel idea/technique into a working model/prototype involving multi-disciplinary skills and/or knowledge and working in as team.
INDUSTRIAL INTERNSHIP LEARNING OUTCOMES (IILOs):
At the end of the course, the student will be able to
1. To conceptualize a novel idea/technique into a product
2. To think in terms of a multi-disciplinary environment
3. To estimate the ability of the student in transforming the theoretical knowledge studied so far into a working model of an electrical/electronic system.
4. To prepare a presentation in a professional manner, and document all aspects of design work.

SESSION	Description of Topic	HOURS
	The purpose of the live project in the third year of Electrical and Electronics Engineering is to familiarize them with the process of designing electronic devices, circuits and systems as practiced in industry. This course requires students to develop a project based on the knowledge and skills acquired in earlier coursework and integrate their technical knowledge through practical design effort.	15

Mapping Matrix of Industrial Internship Objectives (ILOs) and Industrial Internship Learning Outcomes (IILOs)

SEM	SUB CODE	Course name	Industrial Internship Objectives	IILO 1	IILO 2	IILO 3	IILO 4
VI	20EE0360	Live Project-III & Industrial Visits	IIO1	x	x	x	x

	PROFESSIONAL SKILLS	L	T	P	C
Course Code:	23SS654	0	0	2	1
Course Type:	SEC				
Pre-Requisite	None				

Training Objectives (TO): -
1. To encourage students to learn and apply the effective writing skills.
2. To make the students learn various types of business correspondence letters, cover letters & resume.
3. To encourage students to learn as to how to talk and convince people in GD & interview.
4. 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:
1. To understand the importance of professional writing required in workplace.
2. To explore different formats in resume, cover letters & other business-related letters.
3. To develop knowledge, skills and understanding people in-group and individually.
4. To apply communication strategies either in-group or one on one basis and will be confident to lead the discussion among them.

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	Cover Letter Writing • Objective of cover letter writing • Types of cover letters • Format & content of the cover letter	Cover Letter Practice Activity
Unit--IV	Other Business Letters Writing • Application Letters • Acknowledgement Letters • Complaint Letters • Memos	Letter Writing Practice Activity

TEXT BOOKS

1. Communication Skills by Sanjay Kumar & Pushp Lata: Oxford University Press, 2018.

REFERNCE BOOKS

1. Personality Development & Communication Skills-1 by C B Gupta: Scholar Tech Press, 2019.(ISBN No. – 9382209131)

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

SEM	SUB CODE	Course name	Training Objectives	TLO 1	TLO 2	TLO 3	TLO 4
VI	23SS654	PROFESSIONAL SKILLS	TO1	x			
			TO2	x	x		
			TO3		x	x	x
			TO4			x	x

	BIG DATA ANALYTICS, TOOLS AND TECHNIQUES	L	T	P	C
Course Code:	23CS0302	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 Big Data performance using MapReduce and Real-World Design Constraints.
4. Applying and analyzing architecture and APIs with use of Devices, Gateways and Data Management in Big data.

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
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.

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	23CS0302	BIG DATA ANALYTICS, TOOLS AND TECHNIQUES	TO1	x			
			TO2		x	x	
			TO3				x

Semester – VII

	Solid State Electrical Drives and Control	L	T	P	C
Course Code:	23EE0405	3	0	0	3
Course Type:	PC				
Pre-Requisite	23EE0203, 23EE0201, 23EE0305				

COURSE OBJECTIVES

1. To acquire a comprehensive knowledge on solid state drives, digital control and applications of electric drives.
2. To impart basic knowledge on electrical drive.
3. To introduce the fundamental concepts relevant to ac and dc motor drives.
4. To enable the students to understand the factors that causes the selection of a drive for particular application.

COURSE LEARNING OUTCOMES (CLO)

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

1. Understand the steady state operation and transient dynamics of motor-load system
2. Learn the characteristics and control of solid-state DC and AC drives
3. Learn digital control and applications of electric drives
4. Select suitable converters and their controls for drive applications.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	Introduction: Electric drives, Requirement of electric drives, fundamental torque equation, speed torque converter and multi quadrant operation, equivalent values of drive parameters, concept of load torque, calculation of time and energy loss in transient operation, steady state stability and load equalization	8
UNIT-II	Control of Electric Drive: Closed loop control of drives, current limit control, closed loop torque control, closed loop speed control, closed loop speed control of multi motor drives, phase locked loop controller (PLL), closed loop position control.	8
UNIT-III	DC Drives: Single-phase half controlled and fully controlled converter fed dc motor drives, operation of dc drives with continuous armature current, voltage and current waveforms; Concept of energy utilization and effect of free-wheeling diode; Operation of drive under discontinuous current, expression for speed-torque characteristic, Chopper controlled dc drives, motoring operation of chopper fed separately excited dc motor, Chopper controlled of Series motor, steady state analysis of drive with time-ratio control.	8
UNIT-IV	AC Drives: Variable voltage, rotor resistance and slip power recovery control of induction motors, torque-speed characteristic sunder different control schemes; Variable frequency control of induction motor, analysis of induction machine under constant V/f operation, Inverter fed AC Drives, Voltage source inverter fed induction motor drive in open loop, frequency and voltage control in PWMVSI; Current source inverter Control, advantage of CSI fed drives, scalar control, vector control, sensor-less control.	8
UNIT-V	Brushless DC Drive: Self- control, CSI with load commutation, low speed commutation, inverter control strategies and performance. Switched Reluctance Motor Drive System: Construction, principle of operation, advantages, disadvantages, characteristics, closed loop control, applications.	8

TEXT BOOKS

1. G.K. Dubey, "Fundamentals of Electrical Drives", Narosa Publishing House Pvt. Ltd., 2nd Edition, 2010
2. Pillai.S.K., "A First Course on Electrical Drives", New Age International (P) Ltd., 2nd Edition, 2015

REFERENCE BOOKS

3. Vedam Subramanyam, “Thyristor control of Electrical Drives”, Mc Graw Hill Education (India) Pvt. Ltd., 3rd Edition, 2015
4. Bimal K.Bose “Modern Power Electronics and AC Drives”, Prentice Hall of India, 2nd Edition, 2010

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
VII	23EE0405	Solid State Electrical Drives and Control	CO1	x			
			CO2		x		
			CO3			x	
			CO4				x

	ower System Analysis	L	T	P	C
Course Code:	2 3EE0411	3	0	0	3
Course Type:	PC				
Pre-Requisite	NONE				

COURSE OBJECTIVES

1.To gain comprehensive knowledge on power system analysis problems.
2.To impart knowledge about the various analysis of power system.
3.To introduce the fundamental concepts relevant to power networks, bus impedance algorithms, short circuit, power flow and stability studies.
4.To enable the students to understand the factors related with short circuit, power flow and stability studies.

COURSE LEARNING OUTCOMES (CLO)

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

1. Identify different power system analysis problems.
2. Describe problems related with power networks, bus impedance algorithms, short circuit, power flow and stability studies.
3. Apply principles to solve problems described in CLO2.
4. Assess the results obtain by solving above problems.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	Introduction of Power Sector at National & International Level: Need of system planning and operational studies, basic components of power system, Introduction to power system restructuring, power system computation and control, Smart grid concept, Single line diagram, per phase and per unit analysis, Generator, transformer, transmission line and load representation for different power system studies, Primitive network – construction of Y-bus using inspection and singular transformation methods, Z-bus.	8
UNIT-II	Power flow analysis: Importance of power flow analysis in planning and operation of power systems, statement of power flow problem, classification of buses, development of power flow model in complex variables form, iterative solution using Gauss-Seidel method, Q-limit check for voltage-controlled buses, power flow model in polar form, iterative solution using Newton-Raphson method.	8
UNIT-III	Fault analysis of balanced faults: Importance of short circuit analysis, assumptions in fault analysis, analysis using Thevenin's theorem, Z-bus building algorithm, fault analysis using Z bus, computations of short circuit capacity, post fault voltage and currents.	8
UNIT-IV	Fault analysis of unbalanced faults: Introduction to symmetrical components, sequence impedances, sequence circuits of synchronous machine, transformer and transmission lines, sequence networks analysis of single line to ground, line to line and double line to ground faults using Thevenin's theorem and Z-bus matrix.	8
UNIT-V	Stability analysis: Importance of stability analysis in power system planning and operation classification of power system stability, angle and voltage stability, Single Machine Infinite Bus (SMIB) system: Development of swing equation, equal area criterion, determination of critical clearing angle and time, solution of swing equation by modified Euler method and Runge-Kutta fourth order method.	8

TEXT BOOKS

1. John.J.Grainger, William D. Stevenson, Jr ,"Power System Analysis", Mc Graw Hill Education (India) Private Limited, New Delhi, 2015.
2. William D. Stevenson, Jr. ,"Elements of Power System Analysis", McGraw-Hill Hill Education (India) Private Limited, New Delhi, 2014.

REFERENCE BOOKS

3. Nagarath I.J. and Kothari D.P. ,"Modern Power System Analysis", Fourth Edition, Mc Graw Hill Education (India) Private Limited, New Delhi, 2015.
4. Hadi Sadat, "Power System Analysis", Tata Mc Graw Hill Publishing company, New Delhi, 2002.
5. Pai M.A. and Dheeman Chatterjee "Computer Techniques in Power System Analysis", Mc Graw

Hill Education (India) Private Limited, New Delhi, 2016.
6. Elgerd OI, "Electric Energy Systems Theory: An Introduction", Tata McGraw Hill
7. Computer Techniques in Power System Analysis by M.A. Pai, Tata McGraw Hill, New Delhi.

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
VI	23EE0411	Power System Analysis	CO1	x			
			CO2	x	x		
			CO3			x	
			CO4	x	x	x	x

	Electric Drives and Renewable Energy Laboratory	L	T	P	C
Course Code:	23EE0455	0	0	2	1
Course Type:	PC				
Pre-Requisite	NONE				

COURSE OBJECTIVES

1.To prepare the students to understand, demonstrate and analyze the role of Electric Drives for Renewable Energy Systems.
2.To impart practical working knowledge of Electrical and Electronics Simulation and Analysis using Mathematical computing languages such as Energy Plus, TRNSYS, HOMER.
3.To understand operational aspects of power electronic devices
4. To understand different aspects of controlling AC machines

COURSE LEARNING OUTCOMES (CLO)

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

1.Apply the usage of modern power converters for PV systems.
2.Understand the main features and importance of the Energy Plus, TRNSYS, HOMER mathematical programming environment.
3.To learn underlying concepts, modelling inputs and modelling methods of renewable energy systems.
4.To interpret and validate simulation results.

Experiments	List of Experiments	HOURS
	1. Introduction to energy simulation tools 2. Modeling techniques, 3. Validation of simulation model 4. Simulation of renewable energy systems 5. Simulation for energy efficiency of buildings, Software to be used: Energy Plus, TRNSYS, HOMER 6. Multilevel Inverter with RLE Load 7. Matrix Converter with RLE Load 8. Control of 8/6 SRM Drive 9. Multilevel Inverter in transformer less PV Systems 10. Matrix Converter for Photovoltaic systems 11. Generator side converter control of Wind Energy System 12. Load side converter control of Wind Energy System 13. Matrix converter for Wind Energy Systems 14. Multilevel Inverter for Wind Energy Systems 15. Simulation of Variable Speed Wind turbine with Permanent Magnet Synchronous Generator. The list of experiments given above is only suggestive. The instructor may add new experiments as per the requirement of the course.	20

REFERENCES

1. Bose.B.K, "Modern Power Electronics and AC drives", McGraw Hill , Second Edition, 2010.
2. Ned Mohan, "Advanced Electric Drives: Analysis, Control, and Modeling Using MATLAB / Simulink", August 2014, ISBN: 978-1-118-48548-4.
3. Laboratory Manual References
4. https://energyplus.net/documentation
5. http://www.trnsys.com/
6. http://web.mit.edu/parmstr/Public/Documentation/01-GettingStarted.pdf
7. https://www.homerenergy.com/products/pro/docs/index.html

8. https://www.homerenergy.com/pdf/HOMER2_2.8_HelpManual.pdf

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
	23EE0455	Electric Drives and Renewable Energy Laboratory	CO1	x			
			CO2		x		
			CO3			x	
			CO4				x

	MINOR PROJECT	L	T	P	C
Course Code:	23EE0457	0	0	24 (6)	12
Course Type:	LP/SI				
Prerequisite	None				

MINOR PROJECT OBJECTIVES (MPOs):

1. To obtain hands-on experience in converting a small novel idea/technique into a working model/prototype involving multi-disciplinary skills and/or knowledge and working in as team.
2. Demonstrate skills in undertaking critical review of relevant literature and designing clear and well-justified research questions, aims and experimental design
   - Intellectual ability,
   - Professional judgment and decision-making ability,
   - Inter-disciplinary approach,
   - Skills for data handling,
   - Ability in written and oral presentation,
   - Sense of responsibility
   - Developing professional Skills
   - Application of theory, concepts in given industry /practical /field scenario.

MINOR PROJECT LEARNING OUTCOMES (MPLOs):

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

1. To conceptualize a novel idea / technique into a product
2. To think in terms of multi-disciplinary environment
3. To estimate the ability of the student in transforming the theoretical knowledge studied so far into a working model of an electrical/electronic system.
4. To take on the challenges of teamwork, prepare a presentation in a professional manner, and document all aspects of design work.

MAPPING MATRIX OF THE MPOs AND MPLOs:

SEM	SUB CODE	Course name	Course Objectives	**MPLO**	**MPLO**	**MPLO**	**MPLO**
VII	23EE0457	MINOR PROJECT	MPO	x	x	x	x
			MPO	x	x	x	x

	Live Project-IV & Industrial Visits	L	T	P	C
Course Code:	23EE0459	0	0	1	1
Course Type:	LP				
Prerequisite	23CS0201,23EE0207,23EE0209,23EE0205,23EE0257				

INDUSTRIAL INTERNSHIP OBJECTIVES (IIOs):

To obtain hands-on experience in converting a small novel idea/technique into a working model/prototype involving multi-disciplinary skills and/or knowledge and working in as team.

INDUSTRIAL INTERNSHIP LEARNING OUTCOMES (IILOs):

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

1. To conceptualize a novel idea/technique into a product
2. To think in terms of a multi-disciplinary environment
3. To estimate the ability of the student in transforming the theoretical knowledge studied so far into a working model of an electrical/electronic system.
4. To prepare a presentation in a professional manner, and document all aspects of design work.

SESSION	Description of Topic	HOURS
	The purpose of the live project in the fourth year of Electrical and Electronics Engineering is to familiarize them with the process of designing electronic devices, circuits and systems as practiced in industry. This course requires students to develop a project based on the knowledge and skills acquired in earlier coursework and integrate their technical knowledge through practical design effort.	15

Mapping Matrix of Industrial Internship Objectives (ILOs) and Industrial Internship Learning Outcomes (IILOs)

SEM	SUB CODE	Course name	Industrial Internship Objectives	IILO 1	IILO 2	IILO 3	IILO 4
VII	20EE0459	Live Project-IV & Industrial Visits	IIO1	x	x	x	x

	Industrial Training-II	L	T	P	C
Course Code:	23EE0461	0	0	2	1
Course Type:	LP/SI				
Prerequisite	NONE				

COURSE OBJECTIVES

To provide short-term work experience in an Industry/ Company/ Organization

COURSE LEARNING OUTCOMES (CLO)

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

1. To Get an inside view of an industry and organization/company
2. To Gain valuable skills and knowledge
3. To Make professional connections and enhance networking
4. To Get experience in a field to allow the student to make a career transition

SESSION	Description of Topic	HOURS
Evaluation:	1. It is mandatory for every student to undergo this course. 2. Every student is expected to spend a minimum of 15-days in an Industry/ Company/ Organization, during the summer vacation. 3. The type of industry must be NOT below the Medium Scale category in his / her domain of the degree programme. 4. The student must submit the "Training Completion Certificate" issued by the industry / company / Organisation as well as a technical report not exceeding 15 pages, within the stipulated time to be eligible for making a presentation before the committee constituted by the department. 5. The committee will then assess the student based on the report submitted and the presentation made. 6. Marks will be awarded out of maximum 100. 7. Appropriate grades will be assigned as per the regulations. 8. Only if a student gets a minimum of pass grade, appropriate credit will be transferred towards the degree requirements, as per the regulations. 9. It is solely the responsibility of the individual student to fulfill the above conditions to earn the credits. 10. The attendance for this course, for the purpose of awarding attendance grade, will be considered 100%, if the credits are transferred, after satisfying the above (1) to (8) norms; else if the credits are not transferred or transferable, the attendance will be considered as ZERO. 11. The committee must recommend redoing the course, if it collectively concludes, based on the assessment made from the report and presentations submitted by the student, that either the level of training received or the skill and / or knowledge gained is NOT satisfactory.	30

COURSE NATURE	Training--100% INTERNAL CONTINUOUS ASSESSMENT			
ASSESSMENT METHOD- (WEIGHTAGE 100%)				
In-Semester	Assessment tool	Presentation	Report	Total
	Weightage	80%	20%	100%
End semester examination Weightage:				0%

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
VII	**23EE0461**	Industrial Training-II	CO1	x	x	x	x	x

	Aptitude & Reasoning	L	T	P	C
Course Code:	23AR755	0	0	2	1
Course Type:	SEC				
Pre-Requisite	None				

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.

Unit	Course Contents
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
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

Pedagogy

- The training will be based on the concept of learning by practice.
- The training will involve 50% of the training time on briefing and demonstration & the remaining 50% 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 Interpersonal Skills: Strategies					
Unit No.	Unit Name	Internal Assessment Parameter	Internal Marks (70)	End Term Assessment Parameters	End Term Marks (30)

<table>
<tr><td>1</td><td rowspan="3">Quantitative Ability</td><td rowspan="6">Written Assignment</td><td>10</td><td rowspan="6">Written Test</td><td rowspan="6">30</td></tr>
<tr><td>2</td><td>10</td></tr>
<tr><td>3</td><td>10</td></tr>
<tr><td>4</td><td rowspan="3">Logical Reasoning</td><td>15</td></tr>
<tr><td>5</td><td>15</td></tr>
<tr><td>6</td><td>10</td></tr>
</table>

TEXT BOOKS

Quantitative Aptitude for Competitive Examinations by R S Aggarwal: S Chand Publishing, 2022

REFERNCE BOOKS

A Modern Approach to Logical Reasoning by R S Aggarwal: S Chand Publishing, 2022.

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

<table>
<tr><th>SEM</th><th>SUB CODE</th><th>Course name</th><th>Training Objectives</th><th>TLO 1</th><th>TLO 2</th><th>TLO 3</th></tr>
<tr><td rowspan="3">VII</td><td rowspan="3">23AR755</td><td rowspan="3">Aptitude & Reasoning</td><td>TO1</td><td>x</td><td></td><td></td></tr>
<tr><td>TO2</td><td>x</td><td>x</td><td>x</td></tr>
<tr><td>TO3</td><td></td><td>x</td><td>x</td></tr>
</table>

	Data Structures and Algorithm using C++	L	T	P	C
Course Code:	23CS0401	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.

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

MODULE	TRAINING CONTENTS	HOURS
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.

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

	MAJOR PROJECT (INDUSTRIAL INTERNSHIP)	L	T	P	C	

Course Code:	23EE0430	0	0	24 (6)	12
Course Type:	LP/SI				
Prerequisite	23EE0260,23EE0359,23EE0361,23EE0360,23EE0457,23EE0459,23EE0461				

PROJECT WORK OBJECTIVES (PWOs):

1. The Major Project/Industry Internship provides engineering graduates with the opportunity to practice and/or apply knowledge and skills in various electrical and computer engineering professional environments. The Major Project/Industry Internship is intended to provide a capstone experience to the engineering graduate students by integrating prior course work into a working engineering environment.
2. To provide the opportunity for the industry to identify potential employees and actively contribute to the teaching-learning process by ensuring that program curriculum satisfies the expectations of the industry and continual improvement.
3. To provide an opportunity for students to correlate theoretical lessons and principles with practical applications. Students will acquire practical skills and experience working on projects alongside industry experts.
4. To provide an opportunity for students to discover grass root problems and fundamental issues in industry with a view to take up major project and development of innovative solutions.
5. To provide an opportunity for students to familiarize with the industry of their discipline, experience work culture and discover the organizations within the industry. Students will acquire interpersonal skills through meeting with professionals in their field of study.

PROJECT WORK LEARNING OUTCOMES (PWLOs):

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

1. Extend their academic experience into areas of personal interest, working with new ideas, issues, organizations, and individuals. Identification of relevant problems in the industry and innovative solutions.
2. Think critically and creatively about academic, professional, or social issues and to further develop their analytical and ethical leadership skills necessary to address and help solve these issues.
3. Refine research skills and demonstrate their proficiency in written and/or oral communication skills.
4. Take on the challenges of teamwork, prepare a presentation in a professional manner, and document all aspects of design work.

<u>Stages in Industrial Internship</u>

<u>Stages in Field project/ Internship</u>
<u>Stage 01: Orientation in the company 01 months.</u>
i. During the first one months of internship, the intern shall undergo an extensive orientation programme in industry.
ii. The intern should carry out a detailed study of products /services, processes offered by the industry.
iii. Intern should identify the suppliers, customers and competitors of the industry.
iv. Intern should understand the organization structure, vision, mission policies and top management of the industry.
<u>Stage 02: Identification of Problem/Case study & Survey 02 months.</u>
i. Intern should identify relevant problem based on issues involving product design and development, automation, process optimization, cost reduction, quality control, material handling, logistics, lay out design, energy audit, waste reduction, pollution control etc.
ii. Intern should carry out comprehensive field/literature survey relevant to the selected topic.
iii. Intern should finalize the methodology along with relevant software tools and prepare preliminary design , evaluate alternative solutions.
<u>Stage 03: Completion of Project/ Case study 02 months</u>
i. Intern is expected to arrive at final solution/conclusion for the stated problem.
ii. Intern should prepare a comprehensive report on the work done in the industry in the prescribed format.
iii. Intern is expected to publish/present his contribution at national/international project/paper presentation competitions after obtaining necessary prior permissions.

D os a n d D on ’ts

Dos

1. Always report in time and be regular.
2. Always maintain formal dress code as per company rules.
3. Strictly adhere to all rules and regulations and safety norms.
4. Be polite and cordial in all your interactions with industry personnel.
5. Make a habit of noting down important points during meeting/discussions.
6. Maintain strict confidentiality of company information.
7. Take initiative and complete all assigned tasks with enthusiasm.
8. Have a focused approach and positive attitude.
9. Be open to constructive criticism.
10. Always stay in touch with your college guide.
11. Report your progress on fortnightly basis to college and industry.

D on ’ts

1. Compromise with your safety.
2. Do lose talk or criticize company policies/executives.
3. Take leaves without prior permission of industry/college.
4. Be late.
5. Misuse the facilities offered by the company.
6. Take photographs/videos without permission.
7. Encourage friends, relatives visiting workplace.
8. Handle equipments in the absence of company supervisor.

General guidelines for the B.Tech Major Project

1. The Major project is a major component of our engineering curriculum: it is the culmination of the program of study enabling the students to showcase the knowledge and the skills they have acquired during the previous four years, design a product/service of significance, and solve an open-ended problem in engineering.
2. Each team in the major project course will consist of maximum of 5 students.
3.Student shall select an internal supervisor and decide on the scope of work he/she would be working as part of his/her project work in consultation with the supervisor.
4. Student should identify relevant problem based on issues pertaining to product design and development, automation, process optimization, cost reduction, quality control, material handling, logistics, lay out design, energy audit, waste reduction, pollution control etc.
5. Each group must document and implement a management structure. Group leadership roles must be clearly identified including who has responsibility for monitoring project deliverables and group coordination.
6. Each student team is expected to maintain a log book that would normally be used to serve as a record of the way in which the project progressed during the course of the session.
7. Salient points discussed at meetings with the supervisor (i.e., suggestions for further meetings, changes to experimental procedures) should be recorded by the student in order to provide a basis for subsequent work.
8. The logbook may be formally assessed
9. The contribution of each individual team member will be clearly identified and the weightage of this component will be explicitly considered while assessing the work done.
10. A project report is to be submitted on the topic which will be evaluated during the final review.
11.The student should try to publish his/her project work in reputed conferences/journals.
12. The department will announce a marking scheme for awarding marks for the different sections of the report.
13.The project report must possess substantial technical depth and require the students to exercise analytical, evaluation and design skills at the appropriate level.Z

MAPPING MATRIX OF THE PWOs AND PWLOs:

SEM	SUB CODE	Course name	PROJECT WORK OBJECTIVES	PWLO	PWLO	PWLO	PWLO
VIII	20EE0430	MAJOR PROJECT (INDUSTRIAL INTERNSHIP)	PWO	x	x	x	x
			PWO	x	x	x	x
			PWO	x	x	x	x
			PWO	x	x	x	x
			PWO				

PROFESSIONAL ELECTIVES

	Data acquisition and Telemetry	L	T	P	C
Course Code:	21EEPE01	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES

1. To introduce the student with theoretical concepts pertaining to Data acquisition and Telemetry.
2. To understand the functionality of different components and configuration of data acquisition system
3. To understand the working and functionality of the Data Logger
4. To gain knowledge on different telemetry systems working principle, design techniques, signal transmission method, media and salient features
5. To gain knowledge on digital communication techniques and applications of single and multiple channel digital telemetry systems.

COURSE LEARNING OUTCOMES (CLO)

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

1. Understand the functionality of different components and configuration of data acquisition system
2. Understand the working and functionality of the Data Logger
3. Gain knowledge on different telemetry systems working principle, design techniques, signal transmission method, media and salient features
4. Gain knowledge on digital communication techniques and applications of single and multiple channel digital telemetry systems.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	Data Acquisition System: Definition and generalized block diagram of data acquisition system (DAQ), Classification of DAQ, working principle block diagram, construction and salient features of the following data acquisition systems: Analog data acquisition system using time division multiplexing, Analog data acquisition system using frequency division multiplexing, Digital data acquisition system with different configurations and Data logger.	8
UNIT-II	Analog Communication Techniques: Analog communication techniques: analog modulation of AC carrier; amplitude modulation of AM wave and frequency spectrum, frequency modulation and frequency spectrum of FM wave, Phase modulation and frequency spectrum of PM wave. Analog modulation of pulse carrier; basis of PAM, PFM.	8
UNIT-III	Digital Communication Techniques: Digital modulation of pulse carrier, basis of PCM, DCPM; Digital modulation of AC carrier, ASK, FSK, PSK, error detection and correction methods, error control techniques.	8
UNIT-IV	Telemetry: Introduction, signal formation, conversion and transmission, general block diagram of telemetry system , classification of telemetry system, signal transmission media: Wires and cables, Power line carrier communication, terrestrial and satellite radio links, optical fiber communication, Multiplexing – TDM, FDM and WDM.	8
UNIT-V	Telemetry Systems: Direct voltage and current telemetry system, AM and FM telemetry system, Multi-channel PAM and PWM telemetry system, single and multi-channel digital telemetry system, modem based telemetry system, short range radio telemetry and satellite telemetry system, fibre optics telemetry system.	8

TEXT BOOKS

1. Karp HR (Ed.), "Basics of Data Communication," McGraw-Hill
2. Tomasi W, "Fundamentals of Electronic Communication Systems," Prentice Hall
3. Gruenberg EL, "Handbook of Telemetry and Remote Control," McGraw-Hill
4. Ginzberg, Lekhtman and Malov, "Fundamentals of Automation and Remote Control," Mir Publishers

REFERENCE BOOKS

5. Rangan CS, Sharma GR and Mani VSV, “Instrumentation Devices and Systems,” Tata McGraw-Hill

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
21EEPE01	Data acquisition and Telemetry	CO1	x	x	x	x
		CO2	x			
		CO3		x		
		CO4			x	
		CO5				x

	Instrumentation System	L	T	P	C
Course Code:	21EEPE02	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES

To acquire knowledge on working of sensors, transducers and various display devices.

1. To learn about various transducers and their working principles.
2. To learn different Op-amp based filters used for signal conditioning before data acquisition.
3. To learn the working principle of telemetry system used for transmission of acquired data.
4. To learn about various display devices.

COURSE LEARNING OUTCOMES (CLO)

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

1. Learn about various transducers and their working principles.
2. Learn different Op-amp based filters used for signal conditioning before data acquisition.
3. Learn the working principle of telemetry system used for transmission of acquired data.
4. Learn about various display devices.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	Introduction: Generalized Measurement systems, Transduction principles, Classification of transducers, General transducers characteristics, Criteria for transducer selection. Transducers: Resistive, Inductive, Capacitive, Elastic andOther types-Principles of operation, construction, theory, advantages, disadvantages and applications	8
UNIT-II	Signal Conditioning: Concept of signal conditioning, Applications of AC/DC bridges in instrumentation, Op-amp circuits used in instrumentation, Instrumentation amplifiers, Signal filtering, averaging, correlation, interference, grounding, and shielding.	8
UNIT-III	Data Transmission Systems: Definition, generalized block diagram of Telemetry system, classification of Telemetry system the working principle, block diagram, construction, salient features and applications of the following Telemetry systems: DC voltage, current and position telemetry system (Landline Telemetry system), Radio frequency amplitude modulated and frequency modulated telemetry system – theory related to amplitude and frequency modulation techniques, Pulse telemetry systems, Modem based telemetry system.	8
UNIT-IV	Display Systems: Construction, principle of operation and salient features of various kinds of display devices such as LED, LCD, single and multi-digit LED 7-segmental display system (study of BCD to 7 segment code converter / decoder),to design LED Dot Matrix (3 x 5) numeric display system and LCD 7-segmental numeric display system.	8
UNIT-V	Recorders: The working principle, construction, operation and salient features of X- t strip chart recorder, X-Y strip chart recorder.	8

TEXT BOOKS

1. Sawhney A.K.,"A course in Electrical& Electronic Measurement and Instrumentation", Dhanpat Rai and Co(P)Ltd.,reprint 2013
2. William Bolton, "Instrumentation and control systems", Newnes, 2 nd Edition, 2015

REFERENCE BOOKS

3. Neubert H K P, "Instrument Transducers - An introduction to their performance and design" Clare don press, Oxford (1975).
4. Patranabis D., "Sensors and Transducers",PHI,2003.
5. Murty D V S, "Transducers & Instrumentation", PHI, New Delhi
6. Bell David A, "Electronic Instrumentation and Measurement", PHI, Inc, New Delhi

7. Kalsi H S, “Electronic Instrumentation”, Tata McGraw Hill
8. Patranabis D, “Sensors and Transducers”, PHI, New Delhi.

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
21EEPE02	Instrumentation System	CO1	x	x	x	x
		CO2	x			
		CO3		x		
		CO4			x	
		CO5				x

	Sensors and Transducers	L	T	P	C
Course Code:	21EEPE03	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES
1T.o impart knowledge on various types of sensors and transducers used in industrial automation.
2.To obtain knowledge on the basic concepts of various sensors and transducers.
3.To acquire knowledge in mechanical and electromechanical sensors.
4.To understand the working principle of capacitive inductive sensor and transducers.
5.To know the principle and operation of piezoelectric and electro chemical sensors.
COURSE LEARNING OUTCOMES (CLO)
At the end of the course, the student will be able to
1. Obtain knowledge on the basic concepts of various sensors and transducers.
2. Acquire knowledge in mechanical and electromechanical sensors.
3. Understand the working principle of capacitive inductive sensor and transducers.
4. Know the principle and operation of piezoelectric and electro chemical sensors.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	Sensors and Transducers Characteristics Definition, classification, Characterization, Electrical, mechanical, thermal, optical, biological and chemical, Classification of errors, Error analysis, Static and dynamic characteristics of transducers, Performance measures of sensors	8
UNIT-II	Mechanical and Electromechanical Sensors Resistive sensors: Potentiometer, strain gauge and electrode elements, Magnetic sensors: Types, Principle, Requirement and Advantages, Magneto resistive sensors: Hall Effect sensor, Eddy current sensors	8
UNIT-III	Capacitive, Inductive Sensors and Transducers Capacitive sensors: Capacitance circuitry, Feedback type condenser microphone, Frequency modulating oscillator circuit, Dynamic capacitance variation, Applications: Proximity, Microphone, Pressure, Displacement, Inductive transducers: LVDT, RVDT, Synchro, Microsync, Applications: Pressure, Position, Angle and Acceleration,	8
UNIT-IV	Piezoelectric, Radiation, Electrochemical Sensors and transducers Piezoelectric Materials and properties, Modes of deformation, Multimorphs, Environmental effects. Application: Accelerometer, Radiation sensors: Photo conductive cell, Photo voltaic, Photo resistive, Fiber optic sensors, X-ray and Nuclear radiation sensors, Electro Chemical sensors: Electrochemical cell, Polarization, sensor Electrodes,	8
UNIT-V	Application of Sensors and Transducers Film sensors, Micro scale sensors, Particle measuring systems, Applications and case studies of sensors and transducers in Automobile: Fuel Injection System, Aeronautics: Tire Pressure Monitoring Systems, Machine tools and Manufacturing process: Diagnostics of machine tool linear axes, Home automation,	8

TEXT BOOKS

1. Ernest O. Doeblin, “Measurement System, Application and Design”, Tata McGraw Hill Publishing Company Ltd., 5th Edition, 2008.
2. Patranabis D, “Sensor and Actuators”, Prentice Hall of India (Pvt) Ltd., 2006

REFERENCE BOOKS

1. Ian Sinclair, "Sensor and Transducers", Elsevier India Pvt Ltd, 3rdEdtion, 2011.
2. H. S. Kalsi, "Electronic Instrumentation", Tata McGraw Hill Publishing Company Ltd., 2010, 3rd edition.
3. Sawhney.A.K, Puneethsawhney, "A Course in Electrical and Electronic Measurements and Instrumentation", DhanpatRai Publications, 2012.

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
21EEPE03	Sensors and Transducers	CO1	x	x	x	x
		CO2	x			
		CO3		x		
		CO4			x	
		CO5				x

	Wind and Solar Energy Systems	L	T	P	C
Course Code:	21EEPE04	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES

1. To study various aspects of technologies pertaining to renewable energy sources in the current energy scenario
2. To learn the basic physics of wind and solar power generation.
3. Learn to interface power electronic for wind and solar generation.
4. To interpret the issues related to the grid-integration of solar and wind energy systems

COURSE LEARNING OUTCOMES (CLO)

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

1. Identify the need for technologies pertaining to renewable energy sources in the current energy scenario
2. Describe the basic physics of wind and solar power generation.
3. Outline the power electronic interfaces for wind and solar generation.
4. Interpret the issues related to the grid-integration of solar and wind energy systems

UNIT	COURSE CONTENTS	HOURS
UNIT-I	Physics of Wind Power: History of wind power, Indian and Global statistics, Wind physics, Betz limit, Wind speed statistics-probability distributions, Wind speed and power-cumulative distribution functions.	8
UNIT-II	Wind generator topologies: Review of modern wind turbine technologies, Tip speed ratio, Stall and pitch control, Fixed and Variable speed wind turbines, Induction Generators, Doubly-Fed Induction Generators and their characteristics, Permanent Magnet Synchronous Generators, Power electronic interfaces for wind generators, Wind farm development.	8
UNIT-III	Solar photovoltaic: Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability. Technologies-Amorphous, monocrystalline, polycrystalline; V-I characteristics of a PV cell, PV module, array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms. Converter Control.	8
UNIT-IV	Network Integration Issues: Overview of grid code technical requirements. Fault ride-through for wind farms - real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behavior during grid disturbances. Power quality issues. Power system interconnection experiences in the world. Hybrid and isolated operations of solar PV and wind systems.	8
UNIT-V	Solar thermal power generation: An overview of solar-thermal applications, Solar air heaters, Flat plate collectors, concentrating collectors, Thermal energy storage, Solar water heating, Building heating, Solar cooling, Solar thermal power systems, Solar ponds.	8

TEXT BOOKS

1. Ackermann T., “Wind Power in Power Systems”, John Wiley and Sons Ltd., 2nd Edition, 2012.
2. SukhatmeS. P., NayakJ. K., “Solar Energy: Principles of Thermal Collection and Storage”, 3rd Edition, McGraw Hill, 2009.

REFERENCE BOOKS

3. Masters G. M., “Renewable and Efficient Electric Power Systems”, 2nd Edition, John Wiley and Sons, 2013.
4. Siegfried. H., Waddington R., “Grid Integration of Wind Energy Conversion Systems”, 2nd Edition, John Wiley and Sons Ltd., 2006.

5. Tiwari G.N., Ghosal M.K., “Renewable Energy Applications”, Narosa Publications, 2004.
6. Duffie J.A., Beckman W.A., “Solar Engineering of Thermal Processes”, 4thEdition, John Wiley & Sons, 2013.

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
21EEPE04	Wind and Solar Energy Systems	CO1	x	x	x	x
		CO2		x	x	
		CO3		x	x	
		CO4				x

	Python Programming	L	T	P	C
Course Code:	21EEPE05	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES

1. To identify and use various in-built functions, operators and statements supported by python.
2. To learn how to use lists, tuples, and dictionaries in Python programs and to learn how to identify Python object types.
3. To learn how to write or implement control and decision statements in python.
4. To implement the real-use cases of the functions in python.
5. To learn how to build and package python module for reusability and understand the concepts of file handling.
6. To identify the patterns in the given data and learn how to import in-built library and use the matplotlib for the graphical representation.
7. To learn the implementation of Machine Learning and learn how to create a model in python.

COURSE LEARNING OUTCOMES (CLO)

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

1. Understand the vision of Python from a global context.
2. Understand the content that how to write loops, decision statements, write functions and pass arguments in Python.
3. Learn how to use lists, tuples, and dictionaries in Python programs and to learn how to identify Python object types.
4. Learn how to read and write files in Python. Will learn how to create Pandas Data Frames, calculate aggregates, and merge multiple tables.
5. Understand how to import in-built library and use matplotlib for graph representation and how regular pattern matching will be done.
6. Understand the concepts of algorithm of Machine learning and learn how to train the models.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	INTROUCTION TO PYTHON Definition with Real Use Cases, History of Python, How Python is installed, Execution of the basic program of the python, Character set, Token, core Data types, Variables, input(), eval() & print() function, Formatting String, Operators and Expressions.	8
UNIT-II	Conditional & Control Statements Decision Making statements, Conditional Expressions, Boolean type, Boolean operators, String Operators, While Loop, For Loop, Nested loop, Break & continue Statement, range() Function.	8
UNIT-III	DATA STRUCTURES, FUNCTIONS & OOPS Syntax and Basics of Functions, Use of functions, Parameters and Arguments, local & global Scope of variable, return statement, recursive function, Str class, inbuilt functions of string, traversal of string, string operator & operations, Creating a list, Tuple, Dictionaries & sets, In-built functions of list, tuple, set & dictionaries, list operators, replacing values in dictionaries, retrieving value from dictionaries, OOPs introduction, classes and objects, methods, operators, inheritance, super() and method() overriding.	8
UNIT-IV	FILE HANDLING & DATA ANALYSIS Need of File Handling, Different modes of file handling, Read/Write text and numbers to/from a file, Directories on a disk, Introduction of Pandas, Data frames, Series, Data analysis using Pandas.	8
UNIT-V	DATA HANDLING Regular Expression Pattern Matching, Parsing Data, Introduction to Regression, Use Cases of Regression, Types of Regression, Exploratory Data Analysis, Correlation Matrix, Visualisation using Matplotlib, Implementation of Linear Regression.	8

UNIT-VI	MACHINE LEARNING Introduction of Machine Learning, Algorithms Random Forest, Support Vector Machine, Random Forest, Build your own model in python and difference between the Random Forest and decision tree.	

TEXT BOOKS

1. Ashok Namdev Kamthane, Programming and Problem Solving with Python, Mc Graw Hill Education Publication, ISBN(13):978-93-87067-57-8.
2. Allen B. Downey, Think Python, O'Reilly Media.
3. Kenneth A. Lambert, The Fundamentals of Python: First Programs, 2011, Cengage Learning

REFERENCE BOOKS

1. Effective Computation in Physics: Field Guide to Research with Python Anthony Scopatz, Kathryn D. Huff (O'Reilly, 2015)
2. Python Cookbook , David Beazley & Brian K. Jones (O'Reilly, 3rd edition, 2013)

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5	CLO 6
21EEPE05	Python Programming	CO1	x	x	x	x		
		CO2		x				
		CO3			x			
		CO4				x		
		CO5					x	
		CO6					x	
		CO7						x

	Solar Photovoltaic Systems	L	T	P	C
Course Code:	21EEPE06	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES

1. To acquire knowledge on Photovoltaic and its applications and to understand the power conditioning of PV system's power output.
2. To comprehend the performance and operating characteristics of PV system and its components.
3. To understanding the design of photovoltaic systems for variety of applications.
4. To explain basics of solar photovoltaic systems. Also, to identify the feasibility of PV systems as an alternative to the fossil fuels.

COURSE LEARNING OUTCOMES (CLO)

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

1. Understand the principle of direct solar energy conversion to power using PV technology.
2. Comprehend the performance and operating characteristics of PV system and its Components.
3. Understanding the design of photovoltaic systems for variety of applications.
4. Explain basics of solar photovoltaic systems. Also, to identify the feasibility of PV systems as an alternative to the fossil fuels.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	PHOTOVOLTAIC (PV) CELL Historical development of PV –PV in world –Indian energy scenario Photovoltaic effect - Principle of direct solar energy conversion into electricity in a solar cell system, Solar cell - p-n Junction-Semiconductor properties-energy levels, basic equations and equivalent circuit, Solar cell- basic structure -crystalline, multi-crystalline, thin film silicon solar cells, Emerging new technologies and Characteristics-Single, Solar Cell Parameters.	8
UNIT-II	PV MODULE PERFORMANCE ANALYSIS Solar PV Module, Specifications of Solar PV Module, PV Module Parameters, Parallel and series connections, I-V characteristics of a PV module, maximum power point-MPPT basic Algorithms, Cell efficiency, fill factor, effect of irradiation and temperature	8
UNIT-III	DESIGN OF PV SYSTEM Classification -Central Power Station System, Distributed PV System-Stand alone PV System-Grid Interactive PV System, Charge controllers -Batteries –Inverters, Design of a standalone PV system-water pumping system	8
UNIT-IV	GRID TIED PHOTOVOLTAIC SYSTEMS Principle components in Grid –PV system, Cost and Investment, Classification of Grid Tie Inverters and Working Central inverter, String Inverter, Micro Inverter, Sizing the inverter and efficiency, Metering Concepts in Grid Tie systems, Introduction to hybrid PV system.	8
UNIT-V	PV APPLICATIONS Building-integrated photovoltaic units, grid-interacting central power stations, stand-alone devices for distributed power supply in remote and rural areas, PV applications in aircraft, power satellites. Home lighting - solar water pumping systems, Socio-economic and environmental merits of photovoltaic systems.	8

TEXT BOOKS

1. Chetan Singh Solanki., "Solar Photovoltaic: Fundamentals, Technologies and Application", PHI Learning Pvt., Ltd., 2nd edition 2011
2. R. Messenger, J. Ventre, "Photovoltaic Systems Engineering", CRC Press 3rd edition.,2010.

REFERENCE BOOKS

3. Jha A.R., "Solar Cell Technology and Applications", CRC Press, 2010.
4. S.P. Sukhatme, J.K.Nayak., "Solar Energy", Tata McGraw Hill Education Private Limited, New Delhi, 2010.

5. Antonio Luque Steven Hegedus , ,"Handbook of Photovoltaic Science and Engineering", Wiley
2nd Edition 2010.
6. John R. Balfour, Michael L. Shaw, Sharlave Jarosek., "Introduction to Photovoltaics", Jones & Bartlett Publishers, Burlington, 2011.
7. Michael Boxwell,"Solar Electricity Handbook : A simple, practical guide to solar energy - designing and installing solar PV systems" 2015.

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
21EEPE06	Solar Photovoltaic Systems	CO1	x	x	x	x
		CO2		x		
		CO3			x	
		CO4				x

	Design of Hydro Power Station	L	T	P	C
Course Code:	21EEPE07	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES

1. To impart knowledge about the planning involved in setting up of a hydro power plant and to understand the impact of hydro units in a global and societal context.
2. To introduce the fundamental concepts relevant to hydro power plants.
3. Highlight the importance of stability of hydro power plants.
4. To explain the parameters to be taken into consideration while designing a hydro power plant.

COURSE LEARNING OUTCOMES (CLO)

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

1. Apply the fundamentals of hydrology, to various hydraulic and civil structures as required for hydro-power projects.
2. Contribute as well as bring about innovations and developments in some areas like wave power and new technologies in hydraulic structures.
3. Realize the requirement of pre-requisite measures required to maintain the stability in a hydro power plant.
4. Design hydro power plant particularly, electrical design part.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	Layout and Planning of Hydro Power Plant: Introduction, layout of power house, types of hydro power schemes, stages of investigation, PFR, DPR, hydrology, water availability and water conductor system. Penstocks, types, penstock supports, trash racks	8
UNIT-II	Power Potential Estimation of Hydro Power Plants: Head, dependability analysis, layout of electrical equipment in hydro power station, selection of number of units, capacity of power plant and energy generation, and economics of the hydro power plant.	8
UNIT-III	Turbines: Introduction, types of hydraulic turbines and their suitability for power plant, governing of turbines, electro hydraulic governors, time constants of governors and their importance, hydraulic turbine losses and efficiency, cavitation, silt erosion.	8
UNIT-IV	Hydro Generators: Introduction, construction and types of hydro generators, specifications of hydro generators, characteristics of hydro generators, general arrangement of water wheel generators: large horizontal shaft generators, vertical and reversible generators, low speed generators, umbrella type, brakes and jacks, losses and efficiency of hydro generators, parallel operation of alternator in a hydro power plant. Insulation and temperature limits, testing of generators, generator cooling and ventilation, fire protection, design of auxiliary and grounding systems, switchyard equipment's, transformers and circuit breakers.	8
UNIT-V	Stability of Hydro Power Plants: Special features of hydro power plant stability.	8

TEXT BOOKS

1. Hydro Electric Engineering: Vol.I,II,III, by J. Guthrie Brown, Blackie & Son Ltd., London.

2. A Hand Book of Hydro Electric Engineering by N.C. Nigam, Nem Chand Publishers, Roorkee.

REFERENCE BOOKS

3. Generation of Electrical Energy by B.R. Gupta, S. Chand & Co.

4. Elements of Electrical Power Station, Design by M.V.Deshpande, AH Wheeler & Co. Ltd.

5. Electrical Machines, by D.P. Kothari and I.J. Nagrath, TMH.

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
21EEPE07	Design of Hydro Power Station	CO1	x	x	x	x
		CO2	x	x		
		CO3			x	
		CO4				x

	LC, DCS and SCADA	L	T	P	C
Course Code:	1EEPE08	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES
1. To gain knowledge in PLC, DCS and SCADA
2. To Apply PLC and SCADA programming for selected industrial processes
3. To study various aspects of DCS architecture and industrial automation
4. To learn various aspects of industrial data communication protocols

COURSE LEARNING OUTCOMES (CLO)
At the end of the course, the student will be able to
1. Learn hardware, architecture and software for PLC and SCADA
2. Learn PLC and SCADA programming for selected industrial processes
3. Study DCS architecture and industrial automation
4. Learn various industrial data communication protocols

UNIT	COURSE CONTENTS	HOURS
UNIT-I	Distributed Control System: Meaning and necessity of distributed control; hardware components of DCS; DCS software.	8
UNIT-II	Introduction Programmable Logic Controller (PLC): PLC versus microprocessor/microcontroller/ computer, advantages and disadvantages of PLC, architecture and physical forms of PLC. Basic PLC functions: Registers: holding, input and output registers; Timers and timer functions; counters and counter functions Intermediate PLC functions: Arithmetic functions: addition, subtraction, multiplication, division and other arithmetic functions; Number comparison and conversion.	8
UNIT-III	Data Handling Functions of PLC: Skip function and applications; master control relay function and applications; jump with non-return and return; data table, register and other move functions. Bit Functions of PLC: Digital bit functions and applications; sequencer functions and applications. Advanced Functions of PLC: Analog input and output functions, analog input and output modules, analog signal processing in PLC; PID control function, network communication function.	8
UNIT-IV	PLC programming: PLC programming languages, ladder programming, mnemonic programming and high-level language programming. Case study of Tank level control system and Sequential switching of motors.	8
UNIT-V	SCADA: Supervisory control versus distributed control; Layout and parts of SCADA system, detailed block schematic of SCADA system; Functions of SCADA system: data acquisition, monitoring, control, data collection and storage, data processing and calculation, report generation; MTU: functions, single and dual computer configurations of MTU; RTU: functions, architecture / layout; MTU-RTU communication and RTU-field device communication.	8

TEXT BOOKS

1. Johnson CD, "Process Control Instrumentation Technology," Prentice Hall
2. Chemsmond CJ, "Basic Control System Technology," Viva Books
3. Webb JW and Reis RA, " Programmable Logic Controllers" Prentice-Hall India
4. Hackworth JR and Hackworth FD, " Programmable Logic Controllers," Pearson Edition
5. Boyer SA, "Supervisory Control and Data Acquisition (SCADA), International Society of Automation

REFERENCE BOOKS

1. Stuart A. Boyer: "SCADA- Supervisory Control and Data Acquisition", Instrument Society of America Publications, USA, The Instrumentation system and Automation Society, 4 th Edition, 2010
2. Gordon Clarke, Deon Reynders" Practical Modern SCADA Protocols: DNP3, 60870.5 and

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
21EEPE08	PLC, DCS and SCADA	CO1	x	x	x	x
		CO2		x		
		CO3			x	
		CO4				x

	Programming with Java	L	T	P	C
Course Code:	21EEPE09	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES

1. To provide an overview of an desktop application development and web application development using Java
2. To introduce the tools and frameworks required to build Java Enterprise Applications.
3. To teach the fundamental techniques and principles in achieving the concepts of Object Oriented Programming.
4. To enable students to have skills that will help them to solve complex real-world problems regarding Web, Desktop and Enterprise Application Development.

COURSE LEARNING OUTCOMES (CLO)

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

1. Understand the vision of Object Oriented Programming from industry context.
2. Understand and apply Object Oriented Programming using Java using java I.D.E.
3. Apply and analyze multithreading programming of Java Language to create more robust and fast applications.
4. Evaluate the application of Web Server and Application Server and how to deploy Web Applications.
5. Build and create Web Applications using front end as html, css and java script and backend using Java Servlets and J.S.P(Java Server Pages). Creating projects by establishing database connection with IBM DB2 or MySql.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	INTRODUCTION Introduction to object-oriented programming, Object concepts, Key principles of object-oriented programming.	8
UNIT-II	INTRODUCTION TO UML AND JAVA PROGRAMMING LANGAUGE Development project life cycle. Introduction to UML -Static UML Diagrams :Class, Object, Component, Deployment - Dynamic UML Diagrams – Use Case, Sequence, Activity, State Chart. Introduction to the Java programming language. Introduction to the Java development and Productivity tools. Object-oriented programming : Java syntax basics - Part 1 ,Java syntax basics - Part 2 .	8
UNIT-III	CONCEPTS OF CORE JAVA Writing simple Java code using the IDE, Building classes, Debug applications, Inheritance, Design patterns and refactoring, Interfaces, Collections, Generics, Threads and synchronization, Utility classes, Exceptions and exception handling, I/O and serialization.	8
UNIT-IV	INTRODUCTION TO ENTERPRISE APPLICATION DEVELOPMENT JavaBeans, Introduction to Java EE Web Component, Overview of Servlets, Java EE Container Services Overview, Servlet API, Overview of JavaServer Pages, JavaServer Pages Specification and Syntax.	8
UNIT-V	ENTERPRISE APPLICATION DEVELOPMENT Create and Edit HTML and JSPs, Debugging Web Applications, Web Archive Deployment Descriptor, Session State Storage Issues, Cookie API, HttpSession: Management of Application Data, URL Rewriting, Best Practices for Session Management, JSP Expression Language, JSP Custom Tags, JSP Tag Files. Create and Edit Servlets, Filters, and Listeners, XDoclet and Annotations, Connecting to a database, Web Application Security, Java EE 12 Packaging and Deployment, Best Practices for Server, Side Application Development.	8
UNIT-VI	PROJECT	5

TEXT BOOKS

1. Effective Java, Author – Joshua Bloch, Latest Edition – 3rd Edition, Publisher – Addison Wesley.
2. Java - The Complete Reference, Author – Herbert Schildt, Latest Edition – 11th Edition, Publisher – McGraw Hill Education.

REFERENCE BOOKS

1. Core Java An Integrated Approach (Black Book), Author: Dr. R. Nageswara Rao
2. Thinking in Java, Author: Bruce Eckel

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4	CLO 5
21EEPE09	Programming with Java	CO1	x	x	x	x	
		CO2		x			
		CO3			x		
		CO4				x	x

	MECHATRONICS	L	T	P	C
Course Code:	21EEPE10	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES

1. To understand the fundamentals of fluid power Principles, characteristics of the fluid power system components.
2. To acquire knowledge of fluid power system components for various application
3. To develop fluid power circuits to various mechatronic systems.
4. To acquire knowledge of fluid power in to various mechatronic applications.

COURSE LEARNING OUTCOMES (CLO)

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

1. Understand the fundamentals of fluid power Principles, characteristics of the fluid power system components.
2. Analyze the fluid power system components for various application
3. Design and develop fluid power circuits to various mechatronic systems.
4. Understand fluid power in to various mechatronic applications.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	Mechanical Actuating Systems: Types of motion, Degrees of freedom, constraints, Kinematic Chains, Cam, Gear and gear trains, Ratchet and pawl Belt drive, chain drive, Bearing, pre loading. Hydraulic & Pneumatic Actuation Systems: Fluid power systems, hydraulic systems, Pneumatic systems, system structure and signal flow, hydraulic pumps and Pressure Control Valves and regulation, air compressors and treatment, Cylinders, Direction Control Valves, Process control valves, Rotary Actuators, Accumulators, Amplifiers, and Pneumatic Sequencing Problems	8
UNIT-II	Electrical Actuation Systems: Switching Devices, Mechanical Switches – SPST, SPDT, DPDT, keypads; Relays, Electronic sensors, Diodes, Thyristors, Transistors, solenoid operating Valve, Solenoid Operated Hydraulic and Pneumatic Valves, Electro-Pneumatic Sequencing Problems. Control of DC Motors, Permanent Magnet DC Motors, Bush less Permanent Magnet DC Motors, AC Motors and speed controls, Stepper Motors and Controls, Servo Motors. Digital Electronics and systems: Number Systems, Binary Mathematics, Boolean Algebra, Gates and Integrated Circuits Like 7408, 7402, Karnaugh Maps, Application of Logic Gates as: Parity Generators, Digital Comparators, BCD to Decimal Decoders, Flip Flops and applications, sequential logic, Microprocessor and microcontrollers, programming, instruction set, assembly language, C programming for Intel 8051 / 8082 micro-controller.	8
UNIT-III	Sensors, transducers and application: Performance Terminology, Static and Dynamic Characteristics, Displacement, Position and Proximity Sensors, Potentiometer Sensors, Strain Gauge Element, LVDT, Optical Encoders, Pneumatic Sensors, Hall Effect Sensors, Tacho generators, Strain Gauge Load Cell, Thermostats, Photo Darlington. Interfacing Sensors in Mechatronic System.	8
UNIT-IV	System Interfacing and data acquisition: Data acquisition systems, Data loggers, SCADA, Interfacing requirements, Buffers, Darlington Pair, Handshaking, Serial and Parallel Port Interfacing, Peripheral Interface Adapters, Analog to Digital Conversion, Digital To Analog Conversion, Sample and Hold Amplifiers, Multiplexers, Time Division Multiplexing, Digital Signal Processing, Pulse Modulation, Component Interconnection and Impedance Matching, Interfacing Motor drives. Electrical power supply and protection. Introduction to signal conditioning: Signal Conditioning Processes, Inverting Amplifiers, Non Inverting Amplifiers, Summing, Integrating, Differential, Logarithmic Amplifiers, Comparators, Amplifiers Error, Filtering, wheatstone Bridge, Temperature Compensation, Thermocouple Compensation,	8

UNIT-V	Programmable Logic Controller (PLC): Evolution of PLC's - Sequential and programmable controllers - Architecture- Programming of PLC - Relay logic - Ladder logic - Gates, Flip flops and Timers. COMMUNICATION IN PLC's: Requirement of communication networks of PLC - connecting PLC to computer - Interlocks and alarms - Case study of Tank level control system and Sequential switching of motors.	8

TEXT BOOKS

1.W. Bolton, "Mechatronics – Electronic control systems in Mechanical & Electrical Engineering", Pearson Education Ltd., 2003.

2.K. P. Ramachandran, G.K. Vijayaraghavan, M.S. Balasundaram, Mechatronics - Integrated Mechanical Electronic Systems, Wiley.

REFERENCE BOOKS

1.Joji P, Pneumatic Controls, Wiley.
2.Dan Necsulescu, Mechatronics, Pearson
3.David g Alciatore, Michael B Histand, "Introduction to Mechatronics and measurement systems", Mc Graw Hill Education.
4.A Smaili, F Mrad, "Mechatronics – Integrated Technologies for Intelligent Machines, Oxford Higher Education.
5.Nitaigour Premchand Mahalik, "Mechatronics Principles, Concepts & Application", Tata McGraw Hill Publishing Co.Ltd., 2003.
6.John Pippenger, Tyler "Hicks, Industrial Hydraulics", McGraw Hill International Edition
7. AndrewParr, "Hydraulics and pneumatics", Jaico Publishing House
8. FESTO, "Fundamentals of Pneumatics", Vol I, II, III.
9. Petrezeulla, "Programmable Controllers", McGraw Hill
10. Hughes .T, "Programmable Logic Controllers", ISA Press
11. Curtis D. Johnson "Process Control Instrumentation" Tech 8TH Edition Prentice Hall
12. Anthony "Esposito, " Fluid Power with applications", Prentice Hall international
13. Majumdar .S.R, "Oil Hydraulics", Tata McGraw Hill

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
21EEPE10	MECHATRONICS	CO1	x			
		CO2		x		
		CO3			x	
		CO4				x

	Advanced Topics in Electrical Insulation	L	T	P	C
Course Code:	21EEPE11	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES

1.To acquire fair knowledge on the characteristics of insulation materials and to familiarize the testing and measurement of insulation for various equipment's.
2.To select the appropriate insulation material and to understand about failures.
3.To familiarize about dielectrics and vacuum insulation.
4. Acquire knowledge on advanced measuring and testing techniques.

COURSE LEARNING OUTCOMES (CLO)

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

1. Select the appropriate insulation material and to understand about failures.
2. Familiarize about dielectrics and vacuum insulation.
3. Acquire knowledge on advanced measuring and testing techniques.
4. To familiarize testing and measurement of insulation for various equipment's.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	INSULATION MATERIALS AND FAILURES Electrical discharge – partial break down, Classification of electric fields, Types of Dielectrics, Electric strength of dielectrics, Organic and inorganic insulation materials, Insulation materials properties – application, Causes of insulation degradation, Failure modes, Recent insulation testing and diagnostic techniques	8
UNIT-II	DIELECTRICS Sources of dielectrics – characteristics, Behavior of dielectrics in electric fields, Machine insulation system, Insulation defects – insulation stress, Composite insulation system, Nano dielectrics, Properties and handling of Sulphur hexafluoride – application	8
UNIT-III	VACUUM INSULATION Breakdown electron emission, Pre-breakdown conduction, Effective condition of electrodes, Breakdown mechanism in vacuum, Factors affecting breakdown voltage, Vacuum circuit breaker, Space application, Tutorial	8
UNIT-IV	INSULATION TESTING Classification of testing – Procedures and standards, Testing automation, Partial discharge test, Dielectric loss test, Insulation Testing of equipments, Testing of Transformer and cable accessories, Testing of Electrical switchgear and circuit breakers, Testing of Motor and Generators	8
UNIT-V	ADVANCED MEASUREMENT AND DIAGNOSTIC TECHNOLOGIES Digital impulse recorders – digital techniques in testing, Testing automation, Electric field measurements, Electro optic sensors – Magneto Optic Sensors, Space charge measurement techniques, Electro – optical imaging techniques, Insulation resistance measuring instruments	8

TEXT BOOKS

1. Ravindra Arora, Wolfgang Mosch, "High voltage and electrical insulation engineering", IEEE press series on power engineering, 2011
2. Paul Gill, "Electrical power equipment maintenance and testing", Second edition, CRC Press, Taylor & Francis group, 2009

REFERENCE BOOKS

1. N.H.Malik, A.A.Al-Arainy, M.I.Qureshi, " Electrical insulation in power systems", CRC Press, Taylor & Francis group, 1998

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
21EEPE11	Advanced Topics in Electrical Insulation	CO1	x			x
		CO2	x			x
		CO3		x		
		CO4			x	x

	Reactive Power Control and FACT Devices	L	T	P	C
Course Code:	21EEPE12	3	0	0	3
Course Type:	PE				
Pre-Requisite					

COURSE OBJECTIVES

1. To introduce the various topologies of the power electronics circuits.
2. To provide basic understanding of the emerging power electronics technologies for power utility applications.

3.To enable students to understand the harmonics issues in power utility and means of controlling it using power electronics.

4. To enable students to design power electronics circuit that can control active and reactive power flow.

COURSE LEARNING OUTCOMES (CLO)

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

1. Describe the technical characteristics and performance of the electric power system with and without power electronics support.
2. Identify, formulate and analyse complex problems in electric power engineering.
3. Identify different power electronic based solutions for improving both the steady state and the transient.
4. Communicate and work effectively on why and how power electronics can be used for power u utility applications.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	Introduction: Fundamentals of ac power transmission, transmission problems and need emergence of FACTS-FACTS control considerations, FACTS controllers.	8
UNIT-II	Principles of Shunt Compensation: Variable Impedance type and switching converter type- Static Synchronous Compensator (STATCOM) configuration, characteristics and control.	8
UNIT-III	Design Principles of Static Series Compensation: Series compensation using GCSC, TCSC and TSSC, applications, Static Synchronous Series Compensator (SSSC).	8
UNIT-IV	Principles of Operation: Steady state model and characteristics of a static voltage regulators and phase shifters- power circuit configurations.	8
UNIT-V	UPFC: Principles of operation and characteristics, independent active and reactive power flow control, comparison of UPFC with the controlled series compensators and phase shifters. Stability Analysis: Modeling of FACTS devices, optimization of FACTS, transient and dynamic stability enhancement	8

TEXT BOOKS

1. Mohan Mathur, R. & Rajiv K. Varma, “Thyristor Based FACTS Controller for Electrical Transmission Systems”, Wiley Interscience Publications, 2002.
2. Narain G. Hingorani& Laszlo Gyugyi, “Understanding FACTS – Concepts & Technology of Flexible AC Transmission Systems”, Standard Publishers, New Delhi, 2001.
3. Enrique Acha, Claudio R. Fuerte-Esquivel, Hugo Ambriz-Pe´rez and Ce´sar Angeles-Camacho, “FACTS - Modelling and Simulation in Power Networks” John Wiley and sons Ltd., 2004
4. Dash.S.S , “Flexible AC Transmission Systems for Power system”, Vijay Nicole publication, Second edition, 2015

REFERENCE BOOKS

5. K.A. Padiyar, “FACTS Controllers in Power Transmission and Distribution”, New Age International Publishers., India, 2007.
6. Hingorani, L.Gyugyi, ‘Concepts and Technology of Flexible AC Transmission System’, IEEE Press, New York, 2000 ISBN –078033 4588.
7. Padiyar K.R., ‘FACTS controllers for Transmission and Distribution systems’ New Age International Publishers.
8. Song, Y.H. and Allan T. Johns, ‘Flexible AC Transmission Systems (FACTS)’, Institution of

Electrical Engineers Press, London

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
21EEPE12	Reactive Power Control and FACT Devices	CO1				x
		CO2	x			x
		CO3			x	
		CO4		x	x	

	Micro Electro Mechanical Systems	L	T	P	C
Course Code:	21EEPE13	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES

1. To impart basic knowledge of various fabrication techniques, design and analysis of micro electro mechanical system (MEMS) based components.
2. To understand standard micro fabrication techniques.
3. Conversant with mechanical and electrical behaviors of MEMS.
4. To demonstrate sensing and actuation techniques of MEMS system. Also, to understand the application of MEMS in real-world systems.

COURSE LEARNING OUTCOMES (CLO)

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

1. Understand the fundamentals of Micro Electro Mechanical Systems (MEMS).
2. Identify and understand standard micro fabrication techniques.
3. Conversant with mechanical and electrical behaviors of MEMS.
4. Demonstrate sensing and actuation techniques of MEMS system. Also, to understand the application of MEMS in real-world systems.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	Introduction to MEMS Overview of MEMS, new trends in engineering and science, Micro and Nano scale systems, Intrinsic characteristics of MEMS, Elements of MEMS: Micro sensors and micro actuators, Microelectronics fabrication process, Energy domains, materials for MEMS: Silicon, polymers, metals, Packaging and integration: Glass encapsulation, MEMS process integration strategies, Applications of micro and nano lectromechanical systems.	8
UNIT-II	Fabrication Technologies Surface micromachining: Sacrificial layer processes (Micro motors), Bulk micromachining: Micro needles, micro nozzles, Etching: Dry etching, plasma etching, Wet etching: Principle and process architect, High Aspect-Ratio Processes: Lithographie Galvanoformung Abformung (LIGA), Deep Reactive Ion Etching (DRIE), Thin film deposition: Chemical Vapor Deposition (CVD), Physical Vapor Deposition (PVD): Evaporation and sputtering.	8
UNIT-III	Mechanical and Electrical Concepts Mechanical concepts: Crystal planes and orientation, Internal force analysis: Newton's law of motion, Definitions of stress and strain, general scalar relationship between stress and strain, Mechanical properties of silicon and related thin films, Flexural beam bending analysis under simple loading conditions, Torsional deflections, spring constant and resonant frequency, Electrical concepts, semiconductor materials, Calculation of charge carrier concentration, Conductivity and resistivity of semiconductor.	8
UNIT-IV	Sensing and Actuation Techniques Micro sensors: Electrostatic sensor, principle of parallel plate capacitors and its applications, Thermal sensor: Fundamentals of thermal transfer, thermal bimorph principle, Piezoresistive sensor: Materials, piezoresistivity, Piezoelectric sensor: Materials and Piezoelectric effect, Micro actuators: Actuation using thermal forces, Actuation using shape memory alloys, Actuation using piezoelectric crystals, Actuation using electrostatic forces (Parallel plate, torsion bar), Actuation using electrostatic forces (Comb drive actuators), Micromechanical motors and pumps.	8
UNIT-V	Case Studies of MEMS MEMS inertial sensors in automobiles: Airbag deployment, automobile navigation, MEMS vibratory gyroscope, MEMS accelerometer, MEMS devices in commercial applications: Inkjet printers, Digital Micro mirror Devices (DMD), Radio frequency MEMS switches, MEMS devices in space exploration, micropower sources, microturbines and microfluidics, MEMS devices in Biotechnology: Scanning Tunneling Microscopes (STM), Polymerase Chain Reaction (PCR) microsystems for DNA	8

	amplification.	

TEXT BOOKS

1. Chang Liu, “Foundation of MEMS”, 2nd edition, Dorling Kindersley India Pvt. Ltd, 2012.
2. Tai Ran Hsu, “MEMS and Microsystems Design and Manufacture”, Tata McGraw Hill, 2002.

REFERENCE BOOKS

3. Reza Ghodssi, Pinyen, “MEMS Materials and Processes Handbook”, Springer Science Business Media, 2011.
4. Rai-Choudhury P., “MEMS and MOEMS Technology and Applications”, Prentice Hall of India Learning Private Limited, 2009.
5. Nadim Maluf, “An Introduction to Microelectromechanical Systems Engineering”, 2nd edition, Artech House, 2004.
6. Sergey Edward Lyshevski, “MEMS and NEMS: Systems, Devices, and Structures”, CRC Press, 2002.

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
21EEPE13	Micro Electro Mechanical Systems	CO1	x	x	x	
		CO2		x		
		CO3			x	
		CO4				x

	Electrical Power Utilization and Illumination	L	T	P	C
Course Code:	21EEPE14	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES

1. To gain the knowledge about power utilization by heating, welding, traction, refrigeration and air conditioning and illumination systems
2. To gain the knowledge about industrial drives and traction system
3. To gain knowledge regarding problems in refrigeration and air conditioning systems.
4. To understand current guidelines in the design, construction, and management of safe and energy-efficient lighting schemes.

COURSE LEARNING OUTCOMES (CLO)

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

1. Select the heating and welding requirements and the lighting system
2. Familiarize the industrial drives and traction system
3. Bring solutions for the problems in refrigeration and air conditioning systems.
4. List the current guidelines in the design, construction, and management of safe and energy-efficient lighting schemes.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	ELECTRIC HEATING AND WELDING Principle of heating – modes of heat transfer, Types of heating – Resistance heating, Arc heating – Induction heating, Eddy current heating – dielectric heating, Advantages – Applications – related simple problems, Principles of welding – types of welding, Welding electrodes – Resistance welding, Arc welding – ultrasonic welding – testing of welding, Power supply – comparison of types – problems	8
UNIT-II	ILLUMINATION Laws of illumination – lighting calculation, Sources of light – photometers, Illumination systems – lighting schemes, Lighting systems – indoor / outdoor lighting, Electrical lamps – discharge / arc lamps, Sodium Vapour – High Pressure Mercury Vapour lamps, Neon lamps – Fluorescent tubes, Design of lighting - illumination calculation	8
UNIT-III	INDUSTRIAL UTILISATION Selection of motors – types of drives, Nature of load – characteristics, Speed control – enclosures, Transmission of drives, Size and Rating, Temperature – time curves, Insulation materials, Energy conservation in electrical drives - Types of services, problems	8
UNIT-IV	TRACTION AND BRAKING Systems of electric traction – comparison of supply systems – requirement, Speed – time curves – mechanics of train movement, Power energy output – factors affecting energy consumption, Related simple problems, Types of braking – regenerative braking, Mechanical braking – auxiliary equipment, Over-head equipment – current collectors, Sag and tension of trolley wires, Feeding and distribution systems - Energy saving	8
UNIT-V	REFRIGERATION AND AIR-CONDITIONING SYSTEMS Elements of refrigeration system – rating, Vapour compression system, Domestic refrigerator – water cooler, Electrical circuits of refrigerator and controls, Concept of Psychometrics, Human comfort, Air conditioning system, Classification of air conditioning systems, Applications of air conditioning systems	8

TEXT BOOKS

1. S.L.Uppal, “ Electric power ”, Khanna publication, 1997
2. R.K.Rajput, “ Utilisation of electrical power”, First edition, Lakshmi publications, 2006

REFERENCE BOOKS

3. Soni, Gupta, Bhatnagar, “ A course in electric power” , Dhanpatrai and sons, 1999

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
21EEPE14	Electrical Power Utilization and Illumination	CO1	x	x	x	x
		CO2		x		
		CO3			x	
		CO4				x

	Design of Electrical Machines	L	T	P	C
Course Code:	21EEPE15	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES

1. To impart knowledge design principles, design limitations and latest design trends of DC machines.
2. To introduce the fundamental concepts relevant to the Design of Distribution and Power transformers.
3. To enable the students to understand Complete Design Procedure of Single and Three phase Induction Motors.
4. To enable the students to understand Design Procedure of Three phase Synchronous Cylindrical and Salient type of Alternator.
5. To make the students aware about the use of computers in the electrical machines design.

COURSE LEARNING OUTCOMES (CLO)

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

1. Understand the basic design principles, design limitations and latest design trends of DC machines.
2. Apply design concepts to design the winding, core, frame and cooling circuit of single phase and three phase transformers.
3. Analyze the performance and accomplish complete design of single phase and three phase induction motors.
4 Design the main dimensions, selection of stator and rotor slots, insulation, type of windings of three phase alternators.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	DC Machine design- Main dimensions, output equation, specific electrical loading, specific magnetic loading, torque developed, choice of number of poles, Armature reaction-mmf distribution, shape of mmf wave, saturation and brush shifting, methods to reduce armature reaction. Commutation-commutator design. Magnetic circuit- mmf, reluctance, slot and ventilating ducts, apparent and real flux, flux density in teeth, calculations Field coil Armature winding- types, lap and wave, numbering, number of slots, equalizer connections, symmetry of commutator winding, layout Starters.	8
UNIT-II	Transformer Design: Output equation, design of core, yoke and windings, overall dimensions, computation of no-load current, voltage regulation and design of cooling systems.	8
UNIT-III	Induction Motor Design- Main dimensions, output equation, specific electrical loading, specific magnetic loading, air gap, winding-layout, Calculation of magnetizing current, no load current. Leakage reactance calculations- specific slot permeance, significance, semi closed rectangular slot, inductance calculations, rotor bar current calculation, semi-closed round slot, reactance/slot and slot reactance per phase. Eddy current loss ratio, Rotor bar currents- slip ring induction motor, squirrel cage induction motor, current distribution, cage rotor resistance, transformation ratio, rms value of rotor bar current, ring current, copper losses, equivalent cage resistance.	8
UNIT-IV	Synchronous Motor Design- Main dimensions. Harmonic calculations- pitch factor, distribution factor, winding factor, mmf wave, armature reaction, design considerations to reduce harmonics, Cooling design- cooling system, cooling media, calculations, AC Windings- three phase windings, single layer windings, doube layer windings, fractional slot winding.	8
UNIT-V	Computer aided design: Philosophy of computer aided design, advantages and limitations. Computer aided design approaches analysis, synthesis and hybrid methods. Concept of optimization and its general procedure. Flow charts for design of transformer, dc machines, three phase induction and synchronous machines.	8

TEXT BOOKS

1. Sawhney, A.K., "A Course in Electrical Machine Design", Dhanpat Rai & Sons, New Delhi, 2013
2. Deshpande,M.V."Design and Testing of Electrical Machines", PHI learning Pvt Ltd',2015

REFERENCE BOOKS

3. A.Shanmugasundaram, G.Gangadharan, R.Palani "Electrical Machine Design Data Book",
   New Age Intenational Pvt. Ltd., Reprint 2007
4. Rai.H.M, "Electrical Machine Design", Sathya Prakashan Publications, Third edition, 2004

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
21EEPE15	Design of Electrical Machines	CO1	x			
		CO2		x		
		CO3			x	
		CO4				x
		CO5	x	x	x	x

	Special Electrical Machines	L	T	P	C
Course Code:	21EEPE16	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES

1. To acquire a fair knowledge in the working principle, construction and applications of stepper motors and reluctance motors
2. To acquire a fair knowledge in principle of operation, characteristics and control of permanent magnet brushless dc motors and synchronous motors
3. To acquire a fair knowledge to select an energy efficient linear or rotary motor based on the characteristics of the load & application.
4. To acquire a fair knowledge to incorporate the correct control technique to the machine for efficient operation.

COURSE LEARNING OUTCOMES (CLO)
At the end of the course, the student will be able to

1. Understand the working principle, construction and applications of stepper motors and reluctance motors
2. Gain knowledge in principle of operation, characteristics and control of permanent magnet brushless dc motors and synchronous motors
3. Select an energy efficient linear or rotary motor based on the characteristics of the load & application.
4. Incorporate the correct control technique to the machine for efficient operation.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	STEPPER MOTOR Constructional features-Principle of operation-Modes of excitations-Theory of torque predictions, Types of stepper motor- Variable reluctance motor , Single and multi stack configurations, Hybrid motor, Disc Magnet motor, Claw tooth motor, Linear and non-linear analysis-Static and Dynamic Characteristics, Drive Circuits, Microprocessor based control of stepper motors, Closed loop control, Applications of stepper motors in robotics, CNC, computer peripherals, 3D printers	8
UNIT-II	SWITCHED RELUCTANCE MOTOR Constructional features, Principle of operation, Types of SRM, Torque production, design of stator and rotor PLOle arc, Steady state performance, Non-linear analysis, Power converter circuits- Control of SRM, Rotor position sensors-Hall effect sensing scheme, Optical position sensing scheme, Current Regulators-Voltage PWM type, Hysteresis type, Sensor-less operation-Closed loop control of SRM-Characteristics	8
UNIT-III	SYNCHRONOUS RELUCTANCE MOTORS Constructional features-Types-Axial and Radial flux motors - Operating principles, Variable Reluctance and Hybrid Motors, SYNREL Motors- Voltage and Torque Equations, Control of SRM, Phasor diagram- Characteristics-Vernier motor, Steady state and Dynamic analysis of Synchronous reluctance motors controlled by voltage -fed converters	8
UNIT-IV	PERMANENT MAGNET BRUSHLESS D.C.MOTORS Permanent Magnet materials-Magnetic Characteristics – Permeance coefficient-Magnetic circuit analysis, Electronic commutation- Principle of operation –Types of motors, Theory of brushless DC Motor as variable speed synchronous motor, EMF and torque equations, Commutation, Power controllers, Motor characteristics and control, Closed loop control of BLDC motor-using DSP, Microprocessor	8
UNIT-V	PERMANENT MAGNET SYNCHRONOUS MOTORS Principle of operation, Ideal PMSM, EMF and Torque equations, Armature reaction MMF, Synchronous Reactance, Sine wave motor with practical windings , Phasor diagram, Circle diagram-Control of PMSM, Power Converter-Volt-ampere requirements-Torque speed characteristics, Linear Synchronous Motors, Microprocessor based control of synchronous motors	8

TEXT BOOKS

1. Kenjo T., “Stepping Motors and Their Microprocessor Controls”, Clarendon Press, Oxford, 1984
2. Miller T.J.E., “Brushless Permanent Magnet and Reluctance Motor Drives”, Oxford University Press, 1989

REFERENCE BOOKS

3. Krishnan R., “Switched Reluctance Motor Drives – Modeling, Simulation, Analysis, Design and Application”, CRC Press, New York, 2009.
4. Krishnan R., “Permanent Magnet Synchronous and Brushless DC Motor Drives”, CRC Press, New York, 2010.
5. Jacek F. Gieras, Jacek F. Gieras, Mitchell Wing, “Permanent Magnet Motor Technology: Design and Applications”, CRC Press , Second Edition, 2002.
6. Hendershot J. R. and Miller T. J. E., “Design of Brushless Permanent Magnet Machines”, Motor Design Books LLC, 2nd Edition, 2010.
7. Janardanan E.G., “Special Electrical Machines”, PHI Learning Private Limited, 2015.

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
21EEPE16	Special Electrical Machines	CO1	x			
		CO2		x		
		CO3			x	
		CO4				x

	Electrical Safety and Safety Management	L	T	P	C
Course Code:	21EEPE17	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES
1. To Understand the Indian electricity rules and their significance
2. To understand the safety standard in residential, commercial and agricultural Loads
3. To Learn about electrical safety installation, testing and commission
4. To study the electrical safety rules, regulations and quality management by the power factor improvement.

COURSE LEARNING OUTCOMES (CLO)
At the end of the course, the student will be able to
1. Understand the Indian electricity rules and their significance
2. Elucidate the safety standard in residential, commercial and agricultural
3. Learn about electrical safety installation, testing and commission
4. Understand about electrical safety in distribution system

UNIT	COURSE CONTENTS	HOURS
UNIT-I	INDIAN ELECTRICITY RULES AND ACTS AND THEIR SIGNIFICANCE Objective and scope – ground clearances and section clearances – standards on electrical safety - safe limits of current, voltage – earthing of system neutral – Rules regarding first aid and firefighting facility	8
UNIT-II	ELECTRICAL SAFETY IN RESIDENTIAL, COMMERCIAL AND AGRICULTURAL INSTALLATIONS Wiring and fitting – Domestic appliances – water tap giving shock – shock from wet wall –fan firing shock – multi-storied building – Temporary installations – Agricultural pump installation – Do's and Don'ts for safety in the use of domestic electrical appliances	8
UNIT-III	SAFETY DURING INSTALLATION, TESTING AND COMMISSIONING, OPERATION AND MAINTENANCE Preliminary preparations – safe sequence – risk of plant and equipment – safety documentation – field quality and safety - personal protective equipment – safety clearance notice – safety precautions – safeguards for operators – safety	8
UNIT-IV	ELECTRICAL SAFETY IN HAZARDOUS AREAS Hazardous zones – class 0,1 and 2 – spark, flashovers and corona discharge and functional requirements – Specifications of electrical plants, equipments for hazardous locations –Classification of equipment enclosure for various hazardous gases and vapours –classification of equipment/enclosure for hazardous locations.	8
UNIT-V	ELECTRICAL SAFETY IN DISTRIBUTION SYSTEM Total quality control and management – Importance of high load factor – Disadvantages of low power factor – Causes of low P.F. – power factor improvement – equipments –Importance of P.F. improvement.	8

TEXT BOOKS

1. Rao, S. and Saluja, H.L., "Electrical Safety, Fire Safety Engineering and Safety Management", Khanna Publishers, 1988.
2. Pradeep Chaturvedi, "Energy Management Policy, Planning and Utilization", Concept Publishing Company, 1997.

REFERENCE BOOKS

1. Nagrath, I.J. and Kothari, D.P., "Power System Engineering", Tata McGraw Hill,1998.
2. Gupta, B.R., "Power System Analysis and Design", S. Chand and Sons, 2003.

3. Wadhwa, C.L., “Electric Power Systems”, New Age International, 2004

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
21EEPE17	ELECTRICAL SAFETY AND SAFETY MANAGEMENT	CO1	x			
		CO2		x		
		CO3			x	
		CO4				x

	Electrical Systems Design for Building	L	T	P	C
Course Code:	21EEPE18	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES

1.The course aim is to provide knowledge on the underlying working principles of the electrical service installations in high rise buildings and to introduce the governing regulations and maintenance principles of electrical services in buildings.
2.To understand illumination schemes in buildings.
3.To understand Solar Electric System Design for Buildings.
4.To Know regulation and safety installation practices of buildings against lightning, earthing, electric shock, electric fire.

COURSE LEARNING OUTCOMES (CLO)

At the end of the course, the student will be able to
1.Understand design of electrical installations in high rise buildings
2.Understand Illumination schemes in buildings
3.Understand Solar Electric System Design for Buildings
4.Learn regulation and safety installation practices of buildings against lightning, earthing, electric shock, electric fire.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	National electrical code/standards in the design of electrical installation .electrical symbols and diagrams-design consideration of electrical installations-electric supply system-electric services in building-service connections-service mains-sub-circuits, Reception and distribution of main supply .guideline for installation of fittings-wiring installations-testing of electrical installation-neutral and earth wire.	8
UNIT-II	Electrical installations in high rise buildings - design-testing of rising main - main supply board and distribution board for high rise buildings - electrical room layout-building services - ventilation and air conditioning load - heat exchange of building -calculation of air conditioning load-summer and winter air conditioning . parts of operation of a/c plant-systems of air conditioning - vertical transportation-lifts and escalators - design consideration-features, operation and arrangement-fire load-design consideration.	8
UNIT-III	Illumination schemes in buildings-laws of illumination - photometric quantities- day lighting - day light factor and components-design of artificial lighting-interior and exterior lighting installations-lamps and luminaries - design consideration of good lighting schemes-lighting calculation-polar distribution curve-lumen method-point by point method-requirements of good lighting.	8
UNIT-IV	Regulation: principles of safety- safety installation practice and regulations -low voltage system - single & poly phase services-protection of buildings against lightning, earthing, electric shock, electric fire.	8
UNIT-V	Introduction to Solar Electric System Design, Operation and Installation	8

TEXT BOOKS

1. Raina & Battacharya, .Electrical System Design Estimating &costing., Wiley Eastern, 1978
2. Mohamed E.EI-Hawary, Electrical Power Systems: Design and Analysis, Wiley-IEEE Press.
3. ISI, National Electric Code, Bureau of Indian Standard Publications
4. Relevant IS Specifications
5. Adler R.,Vertical Transportation for Buildings., American Elsevier Publishing Company, 1970, New York
6. Indian Standard Institution, National Building Code of India, ISI, 1984, New Delhi.
7. http://www.energy.wsu.edu/Documents/SolarPVforBuildersOct2009.pdf
8. Joseph Burdick, Philip Schmidt, Install Your Own Solar Panels: Designing and Installing a Photovoltaic System to Power Your Home, Storey Publishing, LLC

REFERENCE BOOKS

1. IEC for electrical distribution in building
2. NEC for electrical distribution in building
3. Philips & dialux for indoor and outdoor lighting design catalogue
4. M. K. Giridharan, Electrical Systems Design, I. K. International Pvt Ltd

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
21EEPE18	Electrical Systems Design for Building	CO1	x			x
		CO2		x		
		CO3			x	
		CO4				x

	Communication Systems	L	T	P	C
Course Code:	21EEPE19	3	0	0	3
Course Type:	Prerequisite				
Pre-Requisite	None				

COURSE OBJECTIVES

1. Various Amplitude modulation and demodulation systems
2. Various Angle modulation and demodulation systems
3. Basics of Noise theory and Noise performance of various analog communication systems
4. Basics of Information Theory.

COURSE LEARNING OUTCOMES (CLO)

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

1. Design Amplitude Modulation communication systems.
2. Design Angle Modulation communication systems.
3. Analyse the Noise performance of Analog communication systems.
4. Analyse the Capacity of the Channel and limits of the Communicatin systems.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	AMPLITUDE 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. Design & Physical Implementation of AM Radio Transmitter & Receiver	8
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 Design & Physical Implementation of FM & PM Radio Transmitter & Receiver	8
UNIT-III	NOISE THEORY Noise Sources and types - Calculation of Noise in Linear systems – Noise figure, Noise temperature and Noise bandwidth - Noise in Cascade Systems - Narrow Band noise representation – Inphase and Quadrature – Envelope and Phase. Physical Implementation of Channel Noise Models in Radio Transmitter & Receiver and Study its characteristics.	8
UNIT-IV	NOISE PERFORMANCE OF AM & FM RECEIVERS Noise performance analysis in AM and FM systems - Pre emphasis & De-emphasis - Capture effect, Threshold effect. Physical Implementation of Channel Noise Models in Radio Transmitter & Receiver and Study its Noise performance	8
UNIT-V	INFORMATION THEORY Information & Entropy- Rate of information-Discrete Memoryless Channel-Joint Entropy & Conditional Entropy-Mutual information-Channel Capacity-Shannon's Theorem-Continuous Channel-Shannon-Hartley Theorem-BW S/N Trade-off. Physical Implementation of Data transfer in Radio Transmitter & Receiver and Study its Information theory characteristics.	8

TEXT BOOKS

1.Simon Haykin, “Communication Systems”, John Wiley & Sons, 5th Edition, 2009

2.R.P. Singh & S.D.Spare, “Communication Systems, Analog & Digital”, 3rd Edition, Tata McGraw Hill, 2017

REFERENCE BOOKS

1.Upamanyu Madhow, “Introduction to Communication Systems”, 1st Edition, 2014

2.J.G.Proakis, M.Salehi, “Fundamentals of Communication Systems”, 2nd Edition, Pearson Education 2014.

3.B.P. Lathi, Zhi Ding & Hari Mohan Gupta,” Modern Digital and Analog Communication”,4th Edition, 2017

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
21EEPE19	Communication Systems	CO1	x	x	x	x
		CO2		x		
		CO3			x	
		CO4				x

	Wireless Communication Systems	L	T	P	C
Course Code:	21EEPE20	3	0	0	3
Course Type:	Prerequisite				
Pre-Requisite	None				

COURSE OBJECTIVES
1. To understand basic wireless and cellular concepts
2. To understand various aspects of Mobile Channels
3. To understand various aspects of Wireless Modulation Schemes and Signal Processing techniques
4. To understand various aspects of 1G,2G, 3G, 4G, 5G systems

COURSE LEARNING OUTCOMES (CLO)
At the end of the course, the student will be able to
1. Understand technologies used in wireless comm.
2. Understand Cellular concept.
3. Understand multiple access technologies.
4. Gain knowledge about the effect of Different fading models and diversity techniques

UNIT	COURSE CONTENTS	HOURS
UNIT-I	AMPLITUDE 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. Design & Physical Implementation of AM Radio Transmitter & Receiver	8
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 Design & Physical Implementation of FM & PM Radio Transmitter & Receiver	8
UNIT-III	NOISE THEORY Noise Sources and types - Calculation of Noise in Linear systems – Noise figure, Noise temperature and Noise bandwidth - Noise in Cascade Systems - Narrow Band noise representation – Inphase and Quadrature – Envelope and Phase. Physical Implementation of Channel Noise Models in Radio Transmitter & Receiver and Study its characteristics.	8
UNIT-IV	NOISE PERFORMANCE OF AM & FM RECEIVERS Noise performance analysis in AM and FM systems - Pre emphasis & De-emphasis - Capture effect, Threshold effect. Physical Implementation of Channel Noise Models in Radio Transmitter & Receiver and Study its Noise performance	8
UNIT-V	INFORMATION THEORY Information & Entropy- Rate of information-Discrete Memoryless Channel-Joint Entropy & Conditional Entropy-Mutual information-Channel Capacity-Shannon's Theorem-Continuous Channel-Shannon-Hartley Theorem-BW S/N Trade-off. Physical Implementation of Data transfer in Radio Transmitter & Receiver and Study its Information theory characteristics.	8

TEXT BOOKS

1.Rappaport T.S, "Wireless Communications: Principles and Practice", 2nd Edition, Pearson, 2010.

2.William Stallings, " Wireless Communications & Networks", Pearson, 2nd Edition, Pearson, 2009

REFERENCE BOOKS

1.Feher K. "Wireless Digital Communications", Pearson, 2015.

2.Lee W.C.Y, "Mobile Communications Engineering: Theory & Applications", McGraw Hill, 2nd Edition, 2017.

3.Schiller, “Mobile Communication”, Pearson, 2nd Edition, 2003

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
21EEPE20	Wireless Communication Systems	CO1	x	x	x	x
		CO2		x		
		CO3			x	
		CO4				x

	Switched Mode Power Conversion	L	T	P	C
Course Code:	21EEPE21	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES

1.To acquire knowledge on the modelling and performance of various configurations of power converters

2.To understand the operation and steady state analysis of Switching power converters

3.To develop the knowledge on analysis, modelling and performance functions of switching power converters.

4.To understand the closed-loop control of switching power converters. Also, Familiarize with the applications of Switched mode power converters.

COURSE LEARNING OUTCOMES (CLO)

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

1. Apply the concept of ideal and real characteristics of switching devices and design the reactive circuit elements for switched mode converters
2. Learn various concepts on the operation and steady state analysis of Switching power converters
3. Learn various concepts on analysis, modelling and performance functions of switching power converters.
4. Learn various concepts on closed-loop control of switching power converters. Also, Familiarize with the applications of Switched mode power converters.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	DC-DC CONVERTERS Power semiconductor switches- Diode, Controlled Switches, Issues related to switches, Reactive components- Design of Inductor, Transformer, Capacitor, Energy storage – Capacitor, Inductor, Primitive Converter-Non-Isolated converter, Isolated converters	8
UNIT-II	CCM AND DCM OPERATION OF CONVERTERS Principles of Steady State Converter Analysis-Inductor Volt-Second Balance, Capacitor Charge Balance, Design of various converter and determining the component using Small-Ripple Approximation, Boundary conduction, DC transformer model, Steady state analysis of DC-DC converter in Continuous Conduction Mode(CCM) and Discontinuous Conduction Mode(DCM), Problems-Non-Isolated DC-DC converters	8
UNIT-III	MODELING OF DC-DC CONVERTERS Modeling of converters- State space representation, State Space Model of Boost Converter, Circuit Averaging Modeling Technique, PWM switch modeling, Current Injected Equivalent Circuit Averaging(CIECA), Dynamic Model of Converters Operating in DCM, Review of control theory, analysis of converter transfer functions	8
UNIT-IV	CONTROLLER DESIGN DC-DC converter controller, Controller Structure, Implementation of PID controller for Buck and Boost Converter, Pulse Width Modulator, Controller design principles, Problem- Closed loop control of switched mode power converters	8
UNIT-V	APPLICATION OF DC-DC CONVERTERS Application of DC-DC Converters in Power conditioning system, Hybrid Electric Vehicle (HEV) Application, Space application, Renewable Energy System (RES), Bidirectional power converters, Multi-input converter Using High/Low Voltage Sources, Flux Additive DC-DC Converter	8

TEXT BOOKS

1. Erickson, Robert W., Fundamentals of Power Electronics, Springer International edition, 6^{th} edition, 2012.
2. Slobodan Cuk, Power Electronics: Advanced Topics and Design, TESLAco, 2015.

REFERENCE BOOKS

3. V. Ramanarayanan, Course Material on Switched Mode Power Conversion, Department of
Electrical Engineering, Indian Institute of Science, Bangalore
560012. http://minchu.ee.iisc.ernet.in/new/people/faculty/vr/book.pdf
4. Slobodan Cuk, “Advances in Switched-Mode Power Conversion Part I & II” IEEE Transactions on Industrial Electronics, Vol: IE-30, 2007.

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
21EEPE21	Switched Mode Power Conversion	CO1	x			
		CO2		x		
		CO3			x	
		CO4				x

	Power Converter Analysis and Design	L	T	P	C
Course Code:	21EEPE22	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES

To acquire knowledge on configurations, analysis, design and control of power converters.

1. To understand the basics of snubber and drive circuits design
2. To understand the knowledge on analysis and design of power converters
3. To understand design aspects of various types of controllers
4. To understand the operation and design of resonant converter

COURSE LEARNING OUTCOMES (CLO)

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

1. Know the basics of snubber and drive circuits design
2. Develop the knowledge on analysis and design of power converters
3. Design various types of controllers
4. Understand the operation and design of resonant converter

UNIT	COURSE CONTENTS	HOURS
UNIT-I	SNUBBER AND DRIVE CIRCUITS Design considerations: Snubber circuit for power switching devices, Thermal design: temperature control, Heat sink, Gate Trigger Circuits for Thyristors, Base drive circuits for BJT and Gate drive circuit for MOSFET, Practical converter design considerations	8
UNIT-II	ANALYSIS AND DESIGN OF DC-DC CONVERTERS Classification of DC-DC converters. Analysis of buck, boost in continuous and discontinuous operations, Analysis of buck- boost, Cuk and Sepic converters in continuous and discontinuous operations, Analysis of Forward, Fly back ,half bridge and full bridge isolated converters, Design of isolated and non-isolated DC-DC converters, Estimating the Output Voltage Ripple in Converters Containing Two-Pole Low-Pass Filters, Input and output filter design	8
UNIT-III	ANALYSIS AND DESIGN OF MULTILEVEL INVERTERS Multilevel concept, Classification of multilevel inverters, Diode clamped, improved diode Clamped, Flying capacitors multilevel inverter analysis, Design of multilevel inverters, Influence of PWM techniques on switching loss, design of PWM for low inverter loss	8
UNIT-IV	DESIGN OF CONVERTER CONTROL Control and analysis of voltage mode and current modes, Review of different controllers used in power electronic converters Introduction to controller design, Sliding Mode Control of Power Converters , Fuzzy Logic Control of Power Converters	8
UNIT-V	RESONANT CONVERTERS Principles of resonant converters, Classical series resonant and parallel resonant converters, Quasi-Resonant Converters, Multi resonant Converters, Zero-Voltage-Transition (ZVT) Converters, Zero-voltage and Zero-current switching, Resonant converter design techniques based on frequency response.	8

TEXT BOOKS

1. Ned Mohan, Tore M. Undeland, William P. Robbins, “Power Electronics Converters, Applications, and Design”, Wiley India Pvt Ltd,Third Edition, 2011.
2. Rashid M.H., "Power Electronics Circuits, Devices and Applications", Prentice Hall India, Third Edition, 2011.

REFERENCE BOOKS

3. Umanand.L ,"Power Electronics Essentials and Applications", John Wiley & Sons, First Edition 2009.
4. Erickson R. W. and Maksimovic .D, “Fundamentals of Power Electronics”, Kluwer Academic Publishers, Second Edition, Reprint 2012.
5. http://www.peg.ee.iisc.ernet.in/people/faculty/vram/smpc/smpcbook.pdf-Course Material on Switched Mode Power Conversion, V. Ramanarayanan 2008.
6. M.H. Rashid “Power Electronics Handbook”, ISBN 978-0-12-382036-5, Elsevier Third Edition, 2011

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
21EEPE22	Power Converter Analysis and Design	CO1	x			
		CO2		x		
		CO3			x	
		CO4				x

	Advanced Control Theory	L	T	P	C
Course Code:	21EEPE23	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES

1. To Apply various stability concepts to non-linear control systems.
2. To Understand the basics of optimal and adaptive control.
3. To Understand the practical utility of controllability, observability and state observer Concepts.
4. To analyze various advanced control strategies with the applications of mathematical problems.

COURSE LEARNING OUTCOMES (CLO)

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

1. Apply various stability concepts to non-linear systems.
2. Gain knowledge on the basics of optimal and adaptive control.
3. Familiarize with the practical utility of controllability, observability and state observer
   a. Concepts.
4. To enable students to study and analyse various advanced control strategies with the applications of mathematical problems.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	NON-LINEAR SYSTEMS Introduction- Types of non-linear phenomena- singular point, Phase plane method- Construction of phase trajectories using delta method, Construction of phase trajectories using isoclines method, Derivation of describing functions – Relay, Hysteresis, Dead-zone, Saturation and Jump resonance	8
UNIT-II	STABILITY CONCEPTS Stability concepts – stability in the sense of Lyapunov, BIBO stability, Stability of non- linear systems by describing function method, Lyapunov Theory - Generation of Lyapunov functions - Variable gradient method, Krasooviski's method, Stability analysis of linear continuous time invariant systems using Lyapunov criterion, Stability analysis – Popov and Circle criterion	8
UNIT-III	OPTIMAL CONTROL Performance Indices - Linear Optimal Control with quadratic performance index - Solution of Riccati equation, Method of calculus of variations - minimum principle, Formulation of the optimal control problem- State regulator problem for continuous time systems, Output regulator problem for continuous time systems, Optimal control problem using Hamiltonian – Jacobi method	8
UNIT-IV	ADAPTIVE CONTROL Need for adaptive control systems - Mathematical models used in adaptive control - MIT rule, Methods of adaptation- Gain scheduling - Classifications of Model Reference Adaptive Control (MRAC), Direct and indirect MRAC, Design of MRAC using Lyapunov theory, Different approaches to self-tuning - Recursive parameter estimation , Implicit and explicit STR, Pole assignment approaches to multivariable self-tuning regulators	8
UNIT-V	MODAL CONTROL Controllable and Observable companion forms, State feedback - Effect on Controllability and Observability, Pole placement technique, Observer - Full order, Reduced order	8

TEXT BOOKS

1. M.Gopal, "Modern Control System Theory", New Age International (P) Limited, Publishers, Third edition, 2015
2. Ogata.K, "Modern Control Engineering", Prentice Hall of India, Fifth edition, 2010
3. Nagrath.I.J, and Gopal.M, "Control Systems Engineering", New Age International (P) Limited, Publishers, Fifth edition, 2014

REFERENCE BOOKS

4. Donald E.Kirk, " Optimal Control Theory an Introduction" , Dover Publications, 2004
5. Graham.C, Goodwill, Graebe.S, and Salgado.M, "Control System Design" Prentice Hall India, New Delhi, 2000.

6. Astrom.K.J, and Wittenmark.B, “Adaptive control”, Pearson Education India, Fifth impression, 2009
7. Brian D. O. Anderson, John Barratt Moore, “Optimal Control: Linear Quadratic Methods”, Dover Publications, 2007
8. R.T.Stefani, B. Shahian, C.J.Savant and G.H Hostetter, “Design of feedback control systems,” Oxford University Press, 2002

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
21EEPE23	Advanced Control Theory	CO1	x			
		CO2		x		
		CO3			x	
		CO4				x

	AIRCRAFT ELECTRONIC SYSTEMS	L	T	P	C
Course Code:	21EEPE24	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES

1. To Realize the insights of the flight instruments.
2. To classify the monitoring and management systems of Aircraft.
3. To differentiate electrostatic and electromagnetic effects.
4. To understand the control and indicating systems in aircraft. Also, enrich about recording and reporting systems in aircraft.

COURSE LEARNING OUTCOMES (CLO)

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

1. Understand the insights of the flight instruments.
2. Appreciate and classify the monitoring and management systems.
3. Differentiate electrostatic and electromagnetic effects.
4. List the control and indicating systems in aircraft. Also, enrich about recording and reporting systems in aircraft.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	Basic flight instruments – Electronic flight instrument systems – primary flight display – navigation display – Display processor unit - Electronic attitude and direction indicator (EADI) – Electronic Horizontal situation indicator (EHSI) – Multi-function processor unit.	8
UNIT-II	Electronic centralized aircraft Monitor - Engine indicating and crew alerting system - Flight management system – cockpit layouts.	8
UNIT-III	Electrostatic sensitive devices (ESD) – Different devices and its features - tribo-electric series – handling and transporting ESDs - Electromagnetic compatibility – EMI generation – EMC and avionics equipment– spectrum analysis.	8
UNIT-IV	Airframe control and indicating systems - Landing gear - Trailing edge flaps - Control surfaces -Electronic indicating systems – Terrain awareness warning systems.	8
UNIT-V	Flight data and cockpit voice recorders - Health and usage monitoring system (HUMS) - Aircraft Communication Addressing and Reporting System - Fly-by-wire (FBW).	8

TEXT BOOKS

1. Mike Tooley, 'Aircraft Digital Electronic and Computer Systems: Principles, Operation and Maintenance', 1st Edition, Elsevier, 2007.

2. Mike Tooley and David Wyatt, 'Aircraft Electrical and Electronic Systems: Principles, Operation and Maintenance', Elsevier, 2009.

REFERENCE BOOKS

1. IEEE Guide for Aircraft Electric Systems, 1976.

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
21EEPE24	AIRCRAFT ELECTRONIC SYSTEMS	CO1	x			
		CO2		x		
		CO3			x	
		CO4				x

	Power System Harmonics	L	T	P	C
Course Code:	21EEPE25	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES

1. To familiarize with the terminology and concepts to evaluate the quality of power in an electric power system, and allow them to identify the source of the problem.
2. To learn the concept of filters to keep the power quality indices within the standards.
3. To enable the students to understand the factors that cause the power quality and harmonics problems in the power electronics converters.
4. To enable the students to understand the overall concept and the changing power definitions under non sinusoidal power system environment.

COURSE LEARNING OUTCOMES (CLO)

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

1. Familiarize with the terms and standards associated with harmonics
2. Understand the causes for harmonic producing loads in power electronics converter.
3. Apply principles of harmonic mitigation to bring down the level of harmonics within the standard limits
4. To design filters for harmonic elimination with computer simulation.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	DEFINITIONS AND STANDARDS Definition – RMS value, average power, True power factor, Definition – K factor, Phase shift, Phase sequence, Standards – factors influencing the development of standards, existing harmonic standards (IEC, IEEE), General harmonic indices.	8
UNIT-II	SOURCES AND GENERATION OF HARMONICS Transformer magnetization, machines, fluorescent lamps with magnetic ballasts, Power electronics loads such as line-commutated converters – typical current waveforms and THD, Switched mode power supplies – typical current waveforms and THD, Uncharacteristic and inter-harmonics	8
UNIT-III	EFFECTS OF HARMONICS Resonance, nuisance tripping, blown capacitor fuses and capacitor cells, Degradation of internal capacitance, digital clocks, motor overheating, Overloading neutrals, telephone interference.	8
UNIT-IV	INVESTIGATION OF HARMONICS Field measurements, requirements, harmonic phase angle displacement, Harmonic symmetrical components, transducers, Harmonic instrumentation, Computer simulation with an example	8
UNIT-V	HARMONICS ELIMINATION Passive filter definitions, Conventional design criteria, Tuned filters (basics only singly-tuned), automatically tuned filters with an example, Damped filters – design, conventional six-pulse design with an example	8

TEXT BOOKS

1. Arrillaga J. and Watson N. R., “Power system harmonics”, Wiley, Second Edition, U. S. A.
2. Understanding Power Quality Problems by Math H. Bollen, John Wiley IEEE Press.
3. Power System Quality Assessment by J. Arrillaga, John Wiley

REFERENCE BOOKS

1. Electrical Power System Quality bySurya Santoso, H. Wayne Beaty, Roger C. Dugan, and Mark F. McGranaghan, McGraw Hills.
2. Electric Power Quality by G. T. Heydt, Stars in a Circle Publishers.
3. Research papers of reputed authors taken from IEEE, IET, Elsevier Science and other std. Journals and magazines.

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
21EEPE25	Power System Harmonics	CO1	x			
		CO2				x
		CO3			x	
		CO4	x	x	x	x

	ehicular Power Systems	L	T	P	C
Course Code: 2	1EEPE26	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES
1. To acquire knowledge of power system for aircraft system
2. To acquire knowledge of power system and power electronics for space system.
3. To acquire knowledge of power system for sea and undersea vehicles.
4. To acquire knowledge of power system for automotive and fuel cell-based vehicles.

COURSE LEARNING OUTCOMES (CLO)
At the end of the course, the student will be able to
1.Understand concept of power system for aircraft system
2.Learn the concept of power system and power electronics for space system.
3.Learn the concept of power system for sea and undersea vehicles.
4.Understand concept of power system for automotive and fuel cell-based vehicles.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	AIRCRAFT POWER SYSTEMS Introduction –conventional electrical systems, power generation systems- overview of vehicular power systems, Introduction – aircraft electrical distribution systems, Stability analysis	8
UNIT-II	SPACE POWER SYSTEMS Introduction – international space station, primary power system, secondary power system, Support systems, space craft power systems, alternate power sources, Earth observing system, electrical power systems for space based radar satellites, Modeling, analysis and simulation considerations – typical DC/DC converter in a multi-converter dc power electronic system with the zero-order approximations of its inputs and outputs	8
UNIT-III	POWER SYSTEMS FOR SEA AND UNDERSEA VEHICLES Introduction – power system configurations, power electronics building blocks – pebb applications in the system, Controller architecture for power electronic – centralized digital controller, Direct stiffness method - portal frames – single bay single storey – with and without sway, Tutorials on digital controller design and direct stiffness method, Concepts -Element and Global stiffness matrices -Co-ordinate transformations - Rotation matrix – Derivation of global stiffness matrix from element stiffness	8
UNIT-IV	AUTOMOTIVE POWER SYSTEMS Introduction – conventional 14V electric system architecture, Advanced electrical loads, increasing the system voltage to 42V, Advanced distribution systems, starter, alternator and integrated starter/alternator (ISA), Machine in brief: induction, permanent magnet and axial flow, ISA coupling configurations	8
UNIT-V	FUEL CELL BASED VEHICLES Introduction – important properties of fuel cells for vehicles, light-duty vehicles and heavy-duty vehicles, Various alternate fuels cell vehicles, fuel cell transit bus technology current status and future technologies, Aerospace applications, other applications of fuel cells	8

TEXT BOOKS

1. A. Emadi, M. Ehsani and John M. Miller, “Vehicular Power Systems”, Marcel Dekker, New York, 2004.

REFERENCE BOOKS

2. A. Emadi, M. Ehsani and John M. Miller, “Vehicular Power Systems”, Marcel Dekker, New York, 2004.

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
21EEPE26	Vehicular Power Systems	CO1	x			
		CO2		x		
		CO3			x	
		CO4				x

	Industrial Power System	L	T	P	C
Course Code:	21EEPE27	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES

1.To gain knowledge on various aspects of power system in industries.
2.To acquire knowledge on Induction Motor Starting Studies.
3. To understand about Power Factor Correction in Induction Motor.
4. To analyse Harmonic, Flicker, Ground Grid problem in power system.
5. To understand the terminologies used in the context of an electrical distribution system.

COURSE LEARNING OUTCOMES (CLO)

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

1. Acquire knowledge on Induction Motor Starting Studies.
2. Understand about Power Factor Correction in Induction Motor.
3. Analyse Harmonic, Flicker, Ground Grid problem in power system.
4. To understand the terminologies used in the context of an electrical distribution system.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	INDUCTION MOTOR STARTING STUDIES Introduction, Evaluation Criteria and Starting Methods, System Data, Voltage Drop Calculations and Calculation of Acceleration time, Motor Starting with Limited Capacity Generators, Computer-Aided Analysis: For multiple generators with feedback network Connections	8
UNIT-II	POWER FACTOR CORRECTION STUDIES Introduction, System Description, Modeling & Acceptance Criteria, Frequency Scan Analysis and Voltage Magnification Analysis, Sustained Overvoltage, Switching Surge Analysis, Back-to-Back Switching	8
UNIT-III	HARMONIC ANALYSIS Harmonic Sources, System Response to Harmonics, System Model for Computer Aided Analysis, Acceptance Criteria, Harmonic Filters and Harmonic Evaluation, Case Study: Chemical plant	8
UNIT-IV	FLICKER ANALYSIS Sources of Flicker, Flicker Analysis, Flicker Criteria, Data for Flicker analysis, Case Study: Arc Furnace Load, Minimizing the Flicker Effects	8
UNIT-V	GROUND GRID ANALYSIS Introduction, Acceptance Criteria, Ground Grid Calculations, Computer-Aided Analysis for ground grids, Improving the Performance of the Grounding Grids	8

TEXT BOOKS

1. Ramasamy Natarajan, “Computer-Aided Power System Analysis”, Marcel Dekker Inc., 2002.
2. J. Duncan Glover, Mulukutla S.Sarma, Thomas Overbye, “Power System Analysis and Design”, 2011

REFERENCE BOOKS

3. Turan Gonen“ Electrical Power Transmission System Engineering: Analysis and Design”,Mcgraw Hill publishers,1986.

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
21EEPE27	Industrial Power System	CO1	x	x	x	x
		CO2	x			
		CO3		x		

		CO4			x	
		CO5				x

	Smart Grid	L	T	P	C
Course Code:	21EEPE28	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES
1.To equip the students with the fundamental knowledge on the smart grid.
2. Understand the meaning and the architecture of smart grid.
3. Learn the techniques for the analysis of smart grid
4. Learn control and communication aspect of smart grid.
COURSE LEARNING OUTCOMES (CLO)
At the end of the course, the student will be able to

1. Understand the challenging issues and architecture of smart grid
2. Understand the communication and wide area monitoring in smart grid
3. Rudimentary energy management issues in smart grid
4. Acquire the knowledge in computational intelligence and security issues in smart grid. Also, to know the role of Power electronics and energy storage in smart grid

UNIT	COURSE CONTENTS	HOURS
UNIT-I	Introduction: Smart Grid, Working definitions of Smart Grid and Associated Concepts –Smart Grid Functions-Traditional Power Grid and Smart Grid –New Technologies for Smart Grid –Advantages –Indian Smart Grid –Key Challenges for Smart Grid. Smart Grid Architecture: Components and Architecture of Smart Grid Design –Review of the proposed architectures for Smart Grid. The fundamental components of Smart Grid designs –Transmission Automation –Distribution Automation –Renewable Integration	8
UNIT-II	Tools and Techniques for Smart Grid: Computational Techniques –Static and Dynamic Optimization Techniques –Computational Intelligence Techniques –Evolutionary Algorithms –Artificial Intelligence techniques.	8
UNIT-III	Distribution Generation Technologies: Introduction to Renewable Energy Technologies –Micro grids –Storage Technologies –Electric Vehicles and plug –in hybrids –Environmental impact and Climate Change –Economic Issues.	8
UNIT-IV	Communication Technologies and Smart Grid: Introduction to Communication Technology –Synchro Phasor Measurement Units (PMUs) – Wide Area Measurement Systems (WAMS).	8
UNIT-V	Control of Smart Power Grid System: Load Frequency Control (LFC) in Micro Grid System –Voltage Control in Micro Grid System –Reactive Power Control in Smart Grid. Case Studies and Test beds for the Smart Grids.	8

TEXT BOOKS
1. James Momoh, “Smart Grid – fundamentals of design and analysis”, John Wiley and Sons, 2012
2. Janaka Ekanayake, “Smart Grid-Technology and Applications”, John Wiley and Sons, 2012
3. Clark W. Gellings, “The Smart Grid- Enabling energy efficiency and demand response”, CRC press, 2009

REFERENCE BOOKS
4. Fereidoon P.Sioshansi, “Smart grid- integrating renewable, distributed and efficient energy”, Elsevier, 2012
5. Stuart Borlase,”Smart Grids, Infratructure, technology and solutions”, CRC press, 2013

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
21EEPE28	Smart Grid	CO1	x	x	x	x

		CO2		x	x	
		CO3			x	x
		CO4		x		x

	MICROGRIDS	L	T	P	C
Course Code:	21EEPE29	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES

1. To study the concept of microgrids and its configuration
2. To gain the knowledge on microgrids controllers.
3. To understand the benefits of microgrids.
4. To distinguish on the technical difference between smart grids and microgrids

COURSE LEARNING OUTCOMES (CLO)

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

1. Explain the operational methods of microgrids.
2. Design a prototype model of Micro Grid and implement its feature.
3. Summarize the various control techniques and communication protocols used in microgrids.
4. Perform assessment on the different benefits of microgrids. Also, to distinguish on the technical difference between smart grids and microgrids

UNIT	COURSE CONTENTS	HOURS
UNIT-I	BASICS OF A MICROGRID: Concept and definition of microgrid, microgrid drivers and benefits, review of sources of microgrids, typical structure and configuration of a microgrid, AC and DC microgrids, Power Electronics interfaces in DC and AC microgrids.	8
UNIT-II	CONTROL AND OPERATION OF MICROGRID: Modes of operation and control of microgrid: grid connected and islanded mode, Active and reactive power control-Power Electronic Interfaces (AC to DC and DC to AC)-Power Architecture.	8
UNIT-III	IMPACT OF GRID INTEGRATION: Requirements for grid interconnection, limits on operational parameters: voltage, frequency, THD, response to grid abnormal operating conditions, islanding issues. Impact of grid integration with NCE sources on existing power system: reliability, stability and power quality issues.	8
UNIT-IV	POWER QUALITY ISSUES IN MICROGRIDS: Power quality issues in microgrids-Modelling and Stability analysis of Microgrid, regulatory standards, Microgrid economics, Introduction to smart microgrids, Microgrids case study.	8
UNIT-V	MICROGRID PROTECTION AND COMMUNICATION: Microgrid Communication used for frequency and voltage in Home area network and Neighborhood area network. -Protection- Power Saving. Used in System reliability, Power theft detection. Micro Energy Management System -Used in Residential and Distribution system.	8

TEXT BOOKS

1. Nikos Hatziargyriou, "Microgrids: Architectures and Control", Wiley-IEEE Press, USA, Press, 2013.
2. Shin'ya Obara, "Optimum Design of Renewable Energy Systems: Microgrid and Nature Grid Methods", Engineering Science Reference Series, USA, 2014

REFERENCE BOOKS

3. Carlos Moreira., "Microgrids", LAP Lambert Academic Publishing, 2012.

Ritwik Majumder, "Microgrid: Stability Analysis and Control", VDM Publishing, Germany, 2010.

4. Robert Galvin, Kurt Yeager, "Perfect Power", McGraw Hill Incorporation, USA, 2009

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
21EEPE29	MICROGRIDS	CO1	x	x	x	x
		CO2		x		
		CO3	x			x
		CO4				x

	Power System Deregulation	L	T	P	C
Course Code:	21EEPE30	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES

1. To study the various role of entities in restructured and deregulated power system
2. To impart knowledge about the restructuring and deregulation of power sector.
3. To introduce the fundamental concepts relevant to transmission pricing, models of deregulation, ancillary services and international experience of deregulation.
4. To enable the students to understand the basic concepts of deregulation.

COURSE LEARNING OUTCOMES (CLO)

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

1. Understand the basics of deregulation, power system economic operation and its Benefits.
2. Learn the role of independent system operator
3. Understand the transmission services
4. Acquire knowledge on security and congestion management

UNIT	COURSE CONTENTS	HOURS
UNIT-I	Introduction: Basic concept and definitions, privatization, restructuring, transmission open access, wheeling, deregulation, congestion management components of deregulated system, advantages of competitive system. Benefits from a competitive Electricity Market, After effects of Deregulation.	8
UNIT-II	Power System Operation in Competitive Environment: Role of Independent System operator, Operational Planning activities of ISO, operational planning activities of Genco.	8
UNIT-III	Transmission Pricing: Marginal pricing of Electricity, nodal pricing, zonal pricing, embedded cost, postage stamp method, contract path method, boundary flow method, MW mile method, MVA-mile method, Comparison of different methods.	8
UNIT-IV	Deregulation of Power Sector: Separation of ownership and operation deregulated methods, pool model, pool and bilateral trades model, multilateral trade model, ancillary services.	8
UNIT-V	Deregulation Scenario: England and Wales, Norway, China, California, New Zealand and Indian Power System.	8

TEXT BOOKS

1. Kankar Bhattacharya,"Operation of Restructured Power Systems", Kluwer academic publishers, 2001.
2. Mohammad Shahidehpoura and Muwaffaq A lomoush "Restructured Electric Power System operation trading and volatility", Macsel Dekker Inc,2001
3. Zaccour.G. "Deregulation of Electric Utilities", Kluwer academic publishers, 1998

REFERENCE BOOKS

4. Sally Hunt, "Making competition work in electricity", John Willey and Sons Inc. 2002.

5. Steven Stoft, “Power system economics: designing markets for electricity”, John Wiley & Sons, 2002.
6. Lei Lee Lal, “Power System Restructuring and Deregulation”. UK: John Wiley and Sons,

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
21EEPE30	Power System Deregulation	CO1	x	x		
		CO2	x	x		
		CO3			x	
		CO4	x	x	x	x

	Modern Power System Analysis	L	T	P	C
Course Code:	21EEPE31	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES

1.To acquire ability to analysis power system problems and state estimation with various numerical tools.
2. To acquire ability to use numerical methods for power flow analysis and optimal power flow Analysis.
3.To understand the contingency, Stability and transient state estimation problems in Power systems.
4. To impart the knowledge on various optimization methods related to power flow analysis, FACTS devices and Optimal power flow solution.

COURSE LEARNING OUTCOMES (CLO)

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

1. Learn the algorithms for computing network matrices.
2. Understand the use of numerical methods for power flow analysis and optimal power flow analysis.
3. Analyse the contingency, Stability and transient state estimation problems in Power systems.
4. To apply various optimization methods related to power flow analysis, FACTS devices and Optimal power flow solution.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	PRELIMINARIES FOR POWER SYSTEM PROBLEMS Modeling of generators, transformers, off nominal tap setting and phase shifting transformers, transmission lines and load, Per unit quantities, Primitive parameters - Bus admittance matrix, Bus impedance matrix, Solution through factored matrices, Solution of non-linear algebraic equation and non-linear differential equations	8
UNIT-II	POWER FLOW ANALYSIS Formulation of power flow problem, Solution through Newton Raphson method, Decoupled and fast decoupled power flow solutions, DC power flow solution, Power flow solution using FACTS devices, Optimal power flow solution	8
UNIT-III	CONTINGENCIES ANALYSIS Importance of contingency analysis, Addition/removal of one line, Construction of a column of bus impedance matrix from the bus admittance matrix, Calculation of new bus voltages due to addition/removal of one line, Calculation of new bus voltages due to addition/removal of two lines.	8
UNIT-IV	TRANSIENT STABILITY ANALYSIS Swing equation - equal area criterion, Critical clearing angle - critical clearing time, Multi-machine transient stability studies by classical representation, Solution of swing curve and algorithms for multi-machine transient stability studies using Modified Euler's method, Algorithm for multi-machine transient stability studies using Fourth order Runge Kutta method	8
UNIT-V	POWER SYSTEM STATE ESTIMATION Introduction to Power system state Estimation, Method of weighted least square for DC circuits, Maximum Likelihood Estimation-Measurement Model, Measurement Jacobian matrix-Gain matrix, Development of WLS algorithm-solution procedure	8

TEXT BOOKS

1. John.J.Grainger, William D. Stevenson, Jr ,"Power System Analysis", Mc Graw Hill Education (India) Private Limited, New Delhi, 2015.
2. William D. Stevenson, Jr., "Elements of Power System Analysis", McGraw-Hill Hill Education (India) Private Limited, New Delhi, 2014.

3. Ali Abur and A.G.Exposito,"Power System State Estimation-Theory and Implementation",
Maecel Dekker,Inc.,2004.

REFERENCE BOOKS

1. Kothari D.P. and Nagarath I.J., “Power System Engineering”, Second Edition, Mc Graw Hill Education (India) Private Limited, New Delhi, 2015.
2. Hadi Sadat, “Power System Analysis”, Tata Mc Graw Hill Publishing company, New Delhi, 2002.
3. Pai M.A. and Dheeman Chatterjee “Computer Techniques in Power System Analysis”, Mc Graw Hill Education (India) Private Limited, New Delhi, 2016.

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
21EEPE31	Modern Power System Analysis	CO1	x	x	x	x
		CO2		x		
		CO3			x	
		CO4				x

	High Voltage Engineering	L	T	P	C
Course Code:	21EEPE32	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES

1. To get a fair knowledge on the generation, measurements, testing of high voltages and currents.
2. To impart knowledge about the physical high voltage phenomena and their impact in HV systems.
3. To introduce the fundamental concepts relevant to high voltage insulations and their characterization.
4. To enable the students, understand about various factors that must be considered while design and safer use of high voltage systems.

COURSE LEARNING OUTCOMES (CLO)

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

1. Understand the causes of over voltages and their effects on power system
2. Familiarize the concept of solid, liquid and gaseous dielectrics
3. Gain knowledge on the generation and measurement of high voltages and currents as well as the testing of high voltage equipment.
4. Investigate the technique used for the generation and measurement of high voltages and currents.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	Breakdown in Gases: insulating media, Ionization processes, Electron avalanche, Townsend's criterion for breakdown, streamer theory of breakdown, Gaseous discharge in uniform field, Paschen's law, Breakdown in non-uniform field, corona discharges, effect of polarity on corona & breakdown voltage. Corona in transmission lines, Empirical formulae for corona loss, Methods of reducing corona loss.	8
UNIT-II	Liquid Dielectrics: conduction & breakdown in pure liquids and commercial liquids, Methods for determination of breakdown strength. Factors affecting dielectric strength of liquids Solid Dielectrics: -Breakdown mechanism, Intrinsic breakdown, Electromechanical breakdown, thermal breakdown, breakdown of solid dielectric in practice, Breakdown due to treeing & tracking, breakdown due to the internal discharges.	8
UNIT-III	Generation of high voltages: Generation of high D.C. voltages, half wave & full wave rectifier circuits, Voltage doublers and multiplier circuits Van De Graff generators, Electrostatic Generators, Generation of high alternating voltages, cascade transformers, Resonant transformer, Generation of impulse voltages, Standard impulse wave shapes, Analysis of model, Multistage Impulse generator, Marx circuit, Tripping & control of Impulse generators.	8
UNIT-IV	Measurement of high Voltages: Measurement of high AC and DC voltages by micro ammeter, Resistance and potential divider, series Impedance voltmeter, series capacitance voltmeter capacitance potential dividers & capacitance voltage transformers, Resistance potential dividers, Generating voltmeters, Electrostatic voltmeter, Spark gap for measurement of high D.C., A.C. & impulse voltages, Potential divider for impulse voltage measurements, CRO for impulse voltage measurements.	8
UNIT-V	High Voltage Testing of Electrical Apparatus: Test on insulators, Dry & wet flash Over tests & withstand tests, Impulse flash over & withstand voltage test, High voltage tests on cables Impulse testing of transformers. Non-Destructive Testing: Measurement of dielectric constant & loss factor, High voltage Schering Bridge, Partial Discharge Measurements.	8

TEXT BOOKS

1. Naidu.M.S, and Kamaraju, "High Voltage Engineering", Tata McGraw Hill,2014.
2. Wadhwa.C.L, "High Voltage Engineering" New age international publishers Ltd.-New Delhi 2010.
3. Kuffel "High Voltage: Engineering fundamentals"; Butterworth-Heineman,

REFERENCE BOOKS

4. Ravindra Arora, Wolfgang Mosh, “High Voltage and Electrical Insulation Engineering”, Wiley-IEEE
Press 2011.
5. G.V. Barbosa –Canovas , “Pulsed electric fields in food processing: Fundamental Aspects and applications” CRC Publisher Edition March 1 2001.
6. H L M Lelieveld and Notermans.S,et.al., “Food preservation by pulsed electric Fields: From research
7. to application”, Woodhead Publishing Ltd. October 2007.
8. R.D. Begamudre“Extra High Voltage A.C. Transmission Engineering” Wiley Eastern Limited.

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
21EEPE32	High Voltage Engineering	CO1	x		x	x
		CO2	x	x	x	x
		CO3		x		
		CO4			x	x

	Power Quality	L	T	P	C
Course Code:	21EEPE33	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES

1. To study the various issues affecting Power Quality, their production, monitoring and mitigation methods
2. To impart knowledge about the power system and power quality.
3. To introduce the fundamental concepts relevant to harmonics and grounding.
4. To enable the students to understand the factors that cause the power quality and harmonics problems in the distribution system.
5. To enable the students to understand the overall concept and the changing power definitions under non sinusoidal power system environment.

COURSE LEARNING OUTCOMES (CLO)

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

1. Perceive the power quality major events like voltage sag, interruptions and harmonics.
2. Study the various methods of power quality mitigation and monitoring.
3. Understand the power quality issues due to distributed generation.
4. To acquire knowledge regarding monitoring of power quality events and analyse the data.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	INTRODUCTION TO POWER QUALITY EVENTS Introduction to power distribution system- deregulated environment- Power quality: concepts and definition, Characterization of Electric Power Quality: Transients, short duration and long duration voltage variations, Voltage imbalance, waveform distortion, Voltage fluctuations, Power frequency variation, Causes and effects of power quality problems- CBEMA, ITIC curves, Domestic Appliances and industrial-linear and nonlinear loads, Computer simulation of Power Quality events	8
UNIT-II	VOLTAGE SAG, SHORT AND LONG DURATION VARIATIONS Sources and characteristics (magnitude, duration) of Voltage sag, short and long duration power quality events, Voltage sag influence on computer and consumer equipment-Voltage sag and interruption indices- Basic Reliability evaluation techniques-interruption criterion- general component model, Voltage regulation using Dynamic Voltage Restorer (DVR), Distribution static synchronous compensator (DSTATCOM) and unified power quality conditioner (UPQC)	8
UNIT-III	HARMONICS Definitions- Average –RMS value- True power factor –phase sequence - Fourier series –Numerical example for harmonic analysis, Voltage and current distortions. Harmonics indices-(THD and TDD). Harmonics standards (IEEE, IEC), Harmonics sources from commercial and industrial loads. Effect of harmonics on various equipment, Devices for controlling Harmonics- Inline choke -Zig Zag transformer, Harmonic filters: Passive, Active and Hybrid filters, Computer aided simulation of Harmonics filters, Harmonic analysis of Industry-case study	8
UNIT-IV	POWER QUALITY MONITORING Power Quality Monitoring –Industry requirements – standards, Power Quality Measurement Equipment: Power line disturbance analyser, Harmonic analyser-Spectrum analyser, Flicker meters and Disturbance analyser- Assessment of Power Quality Measurement Data, Application of Intelligent Systems to power quality monitoring.	8
UNIT-V	POWER QUALITY IN DISTRIBUTED GENERATION Introduction to DG Technologies-Interface to the Utility System-Power Quality issues, Operating conflicts-DG on Distribution Networks, Site study for Distributed Generation-Interconnection standards, Issue on Power Quality in Smart Grids and Micro Grids.	8

TEXT BOOKS

1. Roger C. Dugan, Mark Mc Granaghan, Surya Santoso, H.Wayne, H. Wayne Beaty," Electrical

Power Systems Quality ” Tata McGraw Hill, Third edition.2012

2. Dash.S.S, Rayaguru.N.K, “ Power Quality Management”, 2nd Edition, Vijay Nicole Publishers, 2016
3. Jos Arrillaga, Neville R. Watson, “Power System Harmonics”, 2nd Edition, Wiley Publishers, 2015

REFERENCE BOOKS

1. Arindam Ghosh ,“Power Quality Enhancement Using Custom Power Devices”, Kluwer Academic Publishers, 2002
2. G.T.Heydt, “Electric Power Quality”, Stars in a Circle Publications, 1994(2nd edition)

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
21EEPE33	Power Quality	CO1	x	x		
		CO2			x	x
		CO3	x		x	
		CO4	x			x
		CO5	x	x	x	x

	Power System Optimization	L	T	P	C
Course Code:	21EEPE34	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES

1.To know the importance of power system optimization

2.To acquire a comprehensive idea on various aspects of power system optimization problems and their formulations.

3.To understand various optimization techniques.

4.To understand advance optimization methods and multi objective optimization for power system optimization problems.

COURSE LEARNING OUTCOMES (CLO)

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

1. Categorize various power system optimization problem.
2. Apply evolutionary optimization techniques in power system applications.
3. Compare the different optimization techniques.
4. Analyze the optimal operation of the power system network using advance optimization methods and multi objective optimization methods.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	FUNDAMENTALS OF OPTIMIZATION: Definition-Classification of optimization problems- Unconstrained and Constrained Optimization-Optimality Conditions-Classical Optimization techniques (Linear and non-linear programming, Quadratic programming, Mixed integer programming)-Intelligent Search methods (Optimization neural network, Evolutionary algorithms, Tabu search, Particle swarm)	8
UNIT-II	EVOLUTIONARY COMPUTATION TECHNIQUES: Evolution in nature-Fundamentals of Evolutionary Algorithms-Working Principles of Genetic Algorithm- Evolutionary Strategy and Evolutionary Programming-Genetic Operators-Selection, Crossover and Mutation-Issues in GA implementation- GA based Economic Dispatch solution- GA for unit commitment-GA based Optimal power flow.	8
UNIT-III	PARTICLE SWARM OPTIMIZATION: Fundamental Principle-Velocity Updating-Advanced Operators-Parameter selection- Hybrid approaches (Hybrid of GA and PSO, Hybrid of EP and PSO) -Binary, discrete and combinatorial PSO-Implementation Issues-Convergence issues- PSO based OPF problem and unit commitment-PSO for reactive power and voltage control-PSO for power system reliability and security.	8
UNIT-IV	ADVANCED OPTIMIZATION METHODS: Simulated annealing algorithm-Tabu search algorithm- SA and TS for unit commitment-Ant colony optimization- Bacteria Foraging Optimization-Differential evolution.	8
UNIT-V	MULTI OBJECTIVE OPTIMIZATION: Concept of Pareto Optimality-Conventional approaches for MOOP-Multi-objective GA-Fitness Assignment-Sharing Function-Economic Emission dispatch using MOGA-Multi- objective PSO (Dynamic neighborhood PSO, Vector evaluated PSO) –Multi-objective OPF problem	8

TEXT BOOKS

1. Kothari D.P., Dhillon J.S., "Power System Optimization", Prentice Hall India learning private limited, 2nd Edition,2010.
2. Kalyanmoy Deb, "Multi objective optimization using Evolutionary Algorithms", John Wiley and Sons, 2008

REFERENCE BOOKS

1. Soliman Abdel Hady,Abdel Aal Hassan Mantawy, "Modern optimization techniques with applications in Electric Power Systems" Springer,2012.

2. Carlos A.Coello Coello, Gary B.Lamont, David A.Van Veldhuizen, "Evolutionary Algorithms for solving Multi Objective Problems", 2nd Edition, Springer, 2007.
3. Jizhong Zhu, "Optimization of Power System Operation", IEEE Press Series in Power Engineering, Wiley- IEEE Press, 2nd Edition, 201

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
21EEPE34	Power System Optimization	CO1	x	x		
		CO2		x		x
		CO3		x	x	x
		CO4		x		x

	Energy Storage Technology	L	T	P	C
Course Code:	21EEPE35	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES

1.To understand the importance and operation of energy storage
2.To know different energy storage options
3.To gain the knowledge on the selection of energy storage systems
4.To discuss different aspects, utilization and parameters of electrical energy storage systems.

COURSE LEARNING OUTCOMES (CLO)

At the end of the course, the student will be able to
1. Apply the suitable energy storage technique for different energy sources.
2. Differentiate the energy storage options based on operating conditions
3. Understand need and types of energy storage system.
4. Economically analyze the storage options

UNIT	COURSE CONTENTS	HOURS
UNIT-I	Introduction of energy storage technology, requirement for energy storage, Current status, electricity storage services and benefits, cost performance and maturity of storage technology, methods and tools for evaluation of storage, future prospect of storage	8
UNIT-II	Introduction to Electrochemical energy storage: lead acid battery, Li ion battery, Ni metal hydride battery, Flow Battery, Capacitor etc. Comparison, Ragone plot and state-of-art application, their function and deployments. Technical characteristics, introduction to battery states and their estimation methods, battery-based hybrid storage system, battery aging. Performance characteristics, testing, safety, standards and system sizing. Case study/project.	8
UNIT-III	Thermal energy storage (TES) methods - Sensible TES, Latent TES, Thermochemical TES, Selection depending on the application. Types of storage systems Design and operation of thermal storage systems - Performance characteristics, testing, safety, standards and system sizing, Case study/project.	8
UNIT-IV	Hydrogen energy: hydrogen economy, Hydrogen based energy storage, safety.	8
UNIT-V	Mechanical energy storage systems, flywheel energy storage (FES), pumped hydropower storage (PHS), and compressed-air energy storage (CAES). Comparison and application state-of-art including principle, function and deployments. Performance characteristics, testing, safety, standards and system sizing. Case study/project based on mechanical energy storage. Introduction to Hybrid energy storage systems	8

TEXT BOOKS

1. Patrick T. Moseley, Jurgen Garche, "Electrochemical Energy Storage for Renewable Sources and Grid Balancing", Elsevier, USA, 2014
2. Ter-Gazarian, A., "Energy Storage for Power Systems", Peter Peregrinus Limited, London, 2011.
3. Energy Storage - Technologies and Applications by Ahmed Faheem Zobaa, InTech.
4. Fundamentals of Energy Storage by J. Jensen and B. Sorenson, Wiley-Interscience, New York,
5. Handbook of battery materials by C. Daniel, J. O. Besenhard,Wiley VCH Verlag GmbH & Co. KgaA

REFERENCE BOOKS

1.Marc A. Rosen , "Energy Storage ", Nova Science Publishers, 2012 .
2.Jonathan M. Bowen, "Energy Storage: Issues and Applications", Nova Science Publishers, 2011.
3.Robert A. Huggins, "Energy Storage", Springer, Germany, 2015.
4.Energy Storage Edited by Md. Rafiqul Islam Sheikh. Publisher Sciyo. ISBN 978-953-307-119-0
5.Energy Storage –Technologies and Applications Edited by Ahmed Faheem Zobaa. Publisher Intech Publishers. ISBN 978-953-51-0951-8

6.Energy Storage Edited by Marc A. Rosen. Publisher Nova Science Publishers Inc. ISBN 16132470
87, 9781613247082
7.Emerging Advanced Energy Storage Systems: Dynamic Modeling, Control and Simulation Edited by Marcelo Gustavo Molina. Publisher Nova Science Publishers Inc. ISBN 1613243928, 9781613243923
8.Energy Storage: High-Impact Strategies - What You Need to Know: Definitions, Adoptions, Impact, Benefits, Maturity, Vendors Edited by Kevin Roebuck. Publisher Tebbo. ISBN 1743333404, 9781743333402
9.Large Energy Storage Systems Handbook Edited by Edited by Frank S. Barnes Jonah G. Levine. Publisher CRC Press Taylor & Francis Group ISBN 978-1-4200-8601-0

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
21EEPE35	Energy Storage Technology	CO1	x	x	x	x
		CO2		x		
		CO3			x	x
		CO4			x	x

	POWER ELECTRONICS FOR RENEWABL ENERGY SYSTEMS	L	T	P	C
Course Code:	21EEPE36	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES

1.To understand the application of power electronics in renewable energy systems
2.To know the different kinds of power converter topologies
3.To control the power converters in a grid-connected distributed power generation system.
4.To understand universal operation of small/medium sized renewable energy systems.

COURSE LEARNING OUTCOMES (CLO)
At the end of the course, the student will be able to
1. Identify the impact of power electronics in renewable energy systems
2. Demonstrate the application of power electronics in solar PV
3. Analyze the performance of power converters in wind technology
4. Devise the complete operation of small/medium sized renewable energy system. Also, to estimate the parameters of power converters for renewable energy systems.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	IMPACT OF POWER ELECTRONICS: Energy conservation – Renewable Energy Systems – Energy Transmission and Distribution - Bulk Energy Storage – Smart Grid – Electric/Hybrid Electric Vehicles.	8
UNIT-II	POWER CONVERTERS FOR RENEWABLE ENERGY: AC-link Universal Power Converters - AC- DC-AC Converters for distributed power generation system – Multilevel converter/ inverter topologies - Multiphase matrix converter topologies	8
UNIT-III	POWER ELECTRONICS FOR SOLAR PV: Grid-connected PV system configurations: Centralized, String, Multi-string, AC-module – Control of grid-connected PV systems: MPPT, DC-DC stage converter control, Grid tied converter control – Multilevel Inverter-based PV systems	8
UNIT-IV	POWER ELECTRONICS FOR WIND TECHNOLOGY: Power converters for wind turbines – Power semiconductors for wind power converters – Controls and grid requirements for modern wind turbines: Active power control, Reactive power control, Total Harmonic Distortion, Fault ride-through capability – Reliability issues in wind power system	8
UNIT-V	UNIVERSAL OPERATION OF SMALL/MEDIUM SIZED RENEWABLE ENERGY SYSTEMS: Distributed power generation systems: Single-stage photovoltaic systems, Small/ medium sized wind turbine system, control structure – Control of power converters for grid interactive distributed power generation system: Droop control, Power control in microgrids, Control design parameters, Harmonic compensation.	8

TEXT BOOKS

1. Abu-Rub H., M. Malinowski, K. Al-Haddad, "Power Electronics for Renewable Energy Systems, Transportation and Industrial Applications, John Wiley & Sons Limited, UK, 2014.
2. Chakraborty S., M. G. Simões, W. E. Kramer, "Power Electronics for Renewable and Distributed Energy Systems: A Sourcebook of Topologies, Control and Integration", Springer – Verlag, London, 2013

REFERENCE BOOKS

3. Luo F. L., Y. Hong, “Renewable Energy Systems: Advanced Conversion Technologies and Applications”, CRC Press, New York, 2013.
4. Zhong Q., T. Hornik, “Control of Power Inverters in Renewable Energy and Smart Grid Integration”, John Wiley & Sons, Ltd, United Kingdom, 2013
5. Fuchs E. F., M. A.S. Masoum, “Power Conversion of Renewable Energy Systems”, Springer Science & Business Media, LLC, London, 2011

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
21EEPE36	POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS	CO1	x	x	x	x
		CO2		x	x	x
		CO3				x
		CO4			x	x

	UBSTATION DESIGN	L	T	P	C
Course Code: 2	1EEPE37	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES
1. To acquire knowledge of basic substation components.
2. To understand on the constructional features and design of substations.
3. To understand substation communication design requirements.
4. To gain basic concepts of substation automation and control.

COURSE LEARNING OUTCOMES (CLO)
At the end of the course, the student will be able to
1. Develop Substation Layouts.
2. Design Air Insulated and Gas Insulated Substation and Interface Communication Techniques.
3. Monitor and Control the Substation Operation.
4. Adopt Substation Technology Advances in future along with GIS.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	AIR INSULATED SUBSTATION DESIGN: Substation Types - Traditional and Innovative Substation Design, Construction and Commissioning Process – Air-Insulated Substations: Bus/Switching Configurations – High Voltage Switching Equipments.	8
UNIT-II	GAS INSULATED SUBSTATION DESIGN: Construction and Service Life – Circuit Breaker, Current Transformers, Voltage Transformers, Disconnect Switches, Ground Switches - Interconnecting Bus, Air Connection, Power Cable Connections, Direct Transformer Connections - Surge Arrester, Control System, Gas Monitor System, Gas Compartments and Zones - Electrical and Physical Arrangement, Grounding, Testing - Installation Operation and Interlocks, Maintenance.	8
UNIT-III	SUBSTATION GROUNDING AND SHIELDING DESIGN: Reasons for Substation Grounding System - Accidental Ground Circuit - Design Criteria - Lightning Stroke Protection - Lightning Parameters - Empirical Design Methods - The Electro Geometric Model (EGM).	8
UNIT-IV	SUBSTATION COMMUNICATIONS DESIGN: Supervisory Control and Data Acquisition: SCADA Functional Requirements, SCADA Communication Requirements, Relay Communication Requirements - Components of a SCADA System, Structure of a SCADA Communication Protocol, SCADA Communication Protocols: Past, Present and Future - Security for Substation Communications - Electromagnetic Environment.	8
UNIT-V	SUBSTATION AUTOMATION SYSTEMS: Physical Challenges – Measurements - State Monitoring and Control Functions - Communication Networks inside the Substation - Testing Automation Systems - Role of Substations in Smart Grids: Transformation of the Grid - Substation Technology Advances - Platform for Smart Feeder Applications - IEC 61850 in Smart Substations, Smart Grid	8
UNIT-VI	GIS Geographical Information System (GIS): Definition - Objectives - Components of GIS - Spatial data models: Raster and Vector - Data inputting in GIS - Linkage between spatial and non-spatial data -Spatial data analysis: Vector and raster based spatial data analysis - Integration of RS and GIS data -Digital Elevation Model –GIS Software Packages	

TEXT BOOKS
1. John D. McDonald, “Electric Power Substations Engineering”, CRC Press, USA, 3rd Edition, 2012.
2. Gupta P.V., Satnam P.S., “Substation Design and Equipment”, Dhanpat Rai Publications Private Limited, New Delhi, 2013.

REFERENCE BOOKS
3. Dominik Pieniazek P.E., “HV Substation Design: Applications and Considerations”, IEEE

CED, USA, 2012.
4. Leon Kempner, “Substation Structure Design Guide”, ASCE Publications, USA, 2008.
5. Praneesh Prasad, “Substation Design”, California State University, Sacramento, 2006.

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
21EEPE37	SUBSTATION DESIGN	CO1	x			
		CO2		x		
		CO3		x	x	
		CO4				x

	Hybrid Electric Vehicles	L	T	P	C
Course Code:	21EEPE38	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES

1. To acquire knowledge on the fundamental concepts, principles, and analysis of hybrid electric vehicles.
2. To understand the concept of electrical vehicles and its operations.
3. To understand the need for energy storage in hybrid vehicles.
4. To provide knowledge about various possible emerging technologies that can be used in electric vehicles.

COURSE LEARNING OUTCOMES (CLO)

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

1. Realize the importance of electric transportation systems.
2. Understand the basics of electric vehicle components and configuration.
3. Understand the various charging types, comfort and safety methods.
4. Understand the application of electric vehicle in Smart grid.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	ELECTRIC VEHICLES History of Modern Transportation, Importance of Different Transportation Development Strategies to Future Oil Supply, Introduction to Electric Vehicles, History of hybrid and electric vehicles, Social, environmental importance and key challenges of hybrid and electric vehicles, Specifications of PHEVs, BEVs, EVs, Plug-in Hybrid Vehicle characteristics, The future of electric vehicles.	8
UNIT-II	ENERGY STORAGE AND BATTERY TECHNOLOGY Introduction to Energy Storage system, Battery Requirements for HEVs, PHEVs, and EVs, Types of batteries, Properties of batteries, Working principle and construction of lead-acid, nickel cadmium, nickel metal hydride, lithium ion batteries, Maintenance and charging of batteries, Diagnosing lead-acid battery faults, Advanced battery technology, Developments in electrical storage, Case studies.	8
UNIT-III	CHARGING AND STARTING SYSTEMS Requirements of the charging system, Charging system principles, Alternators and charging circuits, Diagnosing charging system faults, Advanced charging system technology, New developments in charging systems, Requirements of the starting system, Starter motors and circuits, Types of starter motor, Diagnosing starting system faults, Advanced starting system technology, New developments in starting systems, Case studies.	8
UNIT-IV	HYBRID ELECTRIC VEHICLE DRIVE TRAIN AND SAFETY Requirement of drive train, Architecture of hybrid drive train, Sizing of components, Series configuration, Parallel configuration, parallel and series configuration, Security, Airbags and belt tensioners, Diagnosing comfort and safety system faults, Advanced comfort and safety systems technology, New developments in comfort and safety systems.	8
UNIT-V	EMERGING TECHNOLOGIES Introduction, Electric Vehicle Supply Equipments, Smart vehicles in smart grid, Vehicle-to-grid technologies: Unidirectional and Bidirectional, Need of Charging Station Selection (CSS) server, Smart grid technologies: Applications / Benefits, Smart meter, Smart charger: Purpose and benefits.	8

TEXT BOOKS

1. M. Ehsani, Y. Gao, and A. Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design” Second Edition,CRC Press, ISBN: 978-1-4200-5398-2, Aug. 2009.
2. Tom Denton,” Automobile Electrical and Electronic Systems” Elsevier Butterworth-Heinemann, Third edition, 2004.
3. A. Emadi ,”Advanced Electric Drive Vehicles, CRC Press, ISBN: 978-1-4665-9769-3, Oct. 2014.

REFERENCE BOOKS

1. Iqbal Hussain, “Electric & Hybrid Vehicles – Design Fundamentals”, Second Edition, CRC Press, 2011.
2. James Larminie, “Electric Vehicle Technology Explained”, John Wiley & Sons, 2003.
3. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, “Smart Grid: Technology and Applications”, John Wiley & sons inc, 2012.

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
21EEPE38	Hybrid Electric Vehicles	CO1	x	x	x	x
		CO2	x	x	x	
		CO3	x			
		CO4				x

	ENERGY MANAGEMENT AND AUDIT	L	T	P	C
Course Code:	21EEPE39	3	0	0	3
Course Type:	Prerequisite				
Pre-Requisite	None				

COURSE OBJECTIVES

1.To impart basic knowledge to the students about current energy scenario, energy conservation, audit and management.
2.To inculcate among the student's systematic knowledge and skill about assessing the energy efficiency, energy auditing and energy management.
3. Ability to Select appropriate energy conservation method for the critical area identified.
4. Ability to prepare an energy audit report.

COURSE LEARNING OUTCOMES (CLO)

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

1.Students can evaluate the techno economic feasibility of the energy conservation technique adopted through audit
2.Students will gain the ability to identify the efficiency improvement process in any industry 3.Students will gain the ability to identify the demand supply gap of energy in Indian scenario.
4.To gain the ability to carry out energy audit of an industry/organization and prepare an audit report.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	Energy in Indian scenario: Energy Conservation, Indian Energy Conservation Act 2001 and its Features, Energy efficiency, Energy management, Necessity of Energy Management, Strategic Approach for Energy Management (Key Step Approach), designing an energy management program. Role of Energy auditor/manager, management and organization of energy conservation programs in industries, Bureau of Energy Efficiency Guidelines and Programmes, Energy Star Rating.	8
UNIT-II	Energy Accounting and Analysis: spreadsheet set-up, the energy use index , energy-using systems., identifying potential measures, Energy Management Control Systems, industrial audit opportunities Understanding the Utility Bill : Electric charges and Thermal Charges, Energy consumption in industries: Energy and material flow assessment, specific energy consumption, industry benchmarks for energy consumption. concept of ESCO, energy performance contracting.	8
UNIT-III	Energy Management & Audit: Definition, energy audit, need, types of energy audit. Energy management (audit) approach-understanding energy costs, 3.1 Bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel and energy substitution, energy audit instruments and metering	8
UNIT-IV	Thermal Utilities and systems: Energy efficiency in thermal utilities like boilers, furnaces, pumps and fans , compressors, cogeneration (steam and gas turbines), heat exchangers ,lighting system, Motors belts and drives, refrigeration system. Heat Recovery and Co-generation: Heat recovery from ventilation, air co-generation of heat and electricity, heat recovery and bottoming cycles.	8
UNIT-V	Financial Management: Investment-need, appraisal and criteria, financial analysis techniques simple payback period, return on investment, net present value, internal rate of return, cash flows, risk and sensitivity analysis; financing options, energy performance contracts and role of Energy Service Companies (ESCOs)	8

TEXT BOOKS

1. W. F. Kenny, "Energy Conservation In Process Industry".

2. AmlanChakrabarti, "Energy Engineering and Management", Prentice hall

3. CB Smith, "Energy Management Principles" , Pergamon Press, New York

4. Hand outs New Delhi, Bureau of energy efficiency

5. W. C. Turner, “Energy Management Hand Book”.John Wiley and sons

REFERENCE BOOKS

1. Guide to Energy management, by Barney L.Capehart, Wayne C.Turner, and William J.Kennedy, The fairmont press, INC. Fourth edition
2. Handbook of Energy Audits by Albert Thumann. CRC press 9th ed.

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
21EEPE39	ENERGY MANAGEMENT AND AUDIT	CO1	x		x	x
		CO2	x	x		
		CO3	x			x
		CO4	x	x	x	x

	Power System Operation and Control	L	T	P	C
Course Code:	21EEPE40	3	0	0	3
Course Type:	PC				
Pre-Requisite	NONE				

COURSE OBJECTIVES

1. To gain knowledge in the operation and control of power systems and to learn the modern computer control in power systems.
2. To impart knowledge about the power system operation and control.
3. To introduce the fundamental concepts relevant to economic dispatch, load frequency control, neutral grounding.
4. To enable the students to understand the factors that cause the generation of surge voltages on transmission lines.

COURSE LEARNING OUTCOMES (CLO)

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

1. Learn the basics of power system control
2. Control the frequency and voltage of power system
3. Understand the economic operation of power system
4. Realize the modern computer control in power system

UNIT	COURSE CONTENTS	HOURS
UNIT-I	REAL POWER FREQUENCY CONTROL Basic concepts of operation and control of power system, Plant and system level control, Modeling of speed governing mechanisms, Speed load characteristics- regulation of two alternators in parallel, Control area concept- single area frequency control-modeling, Steady state and dynamic response of single area system- state space model for single area, Two area frequency control modeling-proportional plus integral controllers- block diagram representation, Static and dynamic response of two area system- Economic dispatch added to LFC control.	8
UNIT-II	REACTIVE POWER CONTROL Overview of Reactive Power control – Reactive Power compensation in transmission systems – advantages and disadvantages of different types of compensating equipment for transmission systems; load compensation – Specifications of load compensator, Uncompensated and compensated transmission lines: shunt and Series Compensation.	8
UNIT-III	ECONOMIC OPERATION OF POWER SYSTEM Optimal operation of Generators in Thermal Power Stations – heat rate Curve – Cost Curve, Incremental fuel and Production costs, input-output characteristics, Optimum generation allocation with line losses neglected, Optimum generation allocation including the effect of transmission line losses – Loss Coefficients, General transmission line loss formula, Base point and participation factors, Classical economic dispatch by gradient method, Concept of Security constrained economic dispatch by linear programming	8
UNIT-IV	UNIT COMMITMENT AND OPTIMAL POWER FLOW Statement of unit commitment- constraints, Priority method (quantitative analysis), Dynamic programming (quantitative analysis), Lagrange relaxation method (qualitative analysis), OPF problem formulations, Newton's method of OPF neglecting security constraints.	8
UNIT-V	Hydro-thermal Scheduling: Optimal scheduling of Hydro-thermal System, Hydroelectric power plant models, scheduling problems, Short-term hydro-thermal scheduling problem..	8

TEXT BOOKS

1. Olle.I.Elgerd, "Electric Energy systems theory- An Introduction", Tata Mc Graw Hill publishing Ltd, New Delhi, 2008
2. I.J.Nagrath and D.P.Kothari, "Power system engineering", 2 nd edition, Tata Mc Graw Hill publishing

Ltd, 2008.
3. John J.Grainger, William D. Stevenson, “Power system analysis”, McGraw Hill series, 1994

REFERENCE BOOKS

4. Prabha Kundur, “Power system stability and control”, Tata Mc Graw Hill publishing Ltd, New Delhi, 5^{th} reprint, 2008.
5. Allen J.Wood and Bruce F. Woollenburg, “Power generation, operation and control”, 2^{nd} edition, John Wiley and sons, 1996
6. M.E. El-Hawary, G.S. Christensen, “Optimal Economic Operation of Electric Power Systems”, Academic Press (1979)
7. E. Mariani, S.S. Murthy, “Control of Modern Integrated Power Systems”, Springer, 1997

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
21EEPE40	Power System Operation and Control	CO1	x	x	x	x
		CO2	x	x	x	x
		CO3	x	x	x	x
		CO4	x	x	x	x

	OPERATION RESEARCH	L	T	P	C
Course Code:	21AS701	3	0	0	3
Course Type:	Prerequisite				
Pre-Requisite	None				

COURSE OBJECTIVES

1. To equip the students with scheduling and network analysis
2. To make the students aware of replacement policy and game theory
3. To introduce the topic of inventory control
4. To make students aware of the problems of linear programming
5. To understand the mathematical tools that are needed to solve Advanced Linear Programming and transportation problems.

COURSE LEARNING OUTCOMES (CLO)

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

1. Develops the managerial skill for budding engineers using network Analysis
2. Identify and develop operational research models from the verbal description of the real system.
3. Using mathematical software to solve the linear Programming.
4. Knowing solving technique, analyze the result for decision making processes in Management Engineering

UNIT	COURSE CONTENTS	HOURS
UNIT-I	Resource Scheduling and Network Analysis Problem of sequencing – Sequencing n jobs through 2 machines and 3 machines, 2 jobs through m machines. PERT and CPM –Critical path calculation – Probability and cost consideration.	8
UNIT-II	Replacement and Game Theory Replacement Models – Replacement of items that deteriorate with time, Equipment that fails suddenly. Two person zero sum games – Pure strategies and saddle point – Mixed strategies – 2 x n and m x 2games Method of dominance – Numerical and graphical solutions.	8
UNIT-III	Inventory Control Inventory models–Deterministic models–Economic ordering quantity, Reorder level, optimum cost – Instantaneous and Non-instantaneous receipt of goods with or without shortages.	8
UNIT-IV	Linear Programming Introduction to Linear Programming – Formulation of the problem – Graphical method – Simplex method – Artificial variable techniques - Primal-dual problems – Dual Simplex method.	8
UNIT-V	Advanced Linear Programming Problems Integer programming problem - Cutting plane algorithm – Transportation models-Vogel's Approximation method–MODI method – Unbalanced transportation problem – Degeneracy in transportation models – Assignment models – Traveling salesman problem-Dynamic Programming problem.	8

TEXT BOOKS

1. Kanti Swarup, Gupta P.K., and Man Mohan, "Operations Research" Sultan Chand & Sons, 1994.
2. Sharma S.D., "Operations Research", Kedar nath Ramnath & Co., Meerut,1994.

REFERENCE BOOKS

1. Gupta P.K., and Hira D.S., "Operations Research", S.Chand& Sons,2000.
2. Sundaresan. V, Ganapathy Subramanian. K.S. and Ganesan. K, "Resource Management Techniques", A.R.Publications,2002
3. Taha H.A., "Operations Research – An introduction", 7thedition, PHI,2002.
4. Billy B. Gillet, "Introduction to Operations Research "– TMH PublishingCo.

5. Gupta P.K., and Manmohan, “Operations Research and Quantitative Analysis” – S.Chand& Co.,
New Delhi.
6. Hamblin S., and Stevens Jr., “Operations Research”, McGraw HillCo.

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
21AS701	OPERATION RESEARCH	CO1	x			
		CO2	x			
		CO3		x		
		CO4			x	
		CO5				x

	Modern Optimization Techniques	L	T	P	C
Course Code:	21EEPE42	3	0	0	3
Course Type:	OE				
Pre-Requisite	NONE				

COURSE OBJECTIVES

To learn the concepts and techniques of evolutionary and optimization techniques in power system applications.

1.Obtain knowledge on optimization techniques applied to power system problems.
2.Understand the different evolutionary computation techniques and multi objective optimization and their applications in power system problems.
3.Understand the principles and fundamentals of GA, PSO and nature inspired algorithm.
4.Learn various topologies and learning algorithms of GA, PSO and nature inspired algorithm.

COURSE LEARNING OUTCOMES (CLO)

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

1. Obtain knowledge on optimization techniques applied to power system problems.
2. Understand the different evolutionary computation techniques and multi objective optimization and their applications in power system problems.
3. Understand the principles and fundamentals of GA, PSO and nature inspired algorithm.
4. Learn various topologies and learning algorithms of GA, PSO and nature inspired algorithm.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	FUNDAMENTALS OF OPTIMIZATION Definition-Classification of optimization problems-Unconstrained and Constrained optimization-Optimality conditions, Classical Optimization techniques (Linear and non-linear programming, Quadratic programming, Mixed integer programming), Intelligent Search methods – Genetic Algorithm, Ant Colony Optimization, Tabu search, Particle swarm optimization	8
UNIT-II	GENETIC ALGORITHM Evolution in nature-Fundamentals of Evolutionary and Genetic algorithms, Working Principles of Genetic Algorithm, Genetic Operators-Selection, Crossover and Mutation, Issues in GA implementation, Applications of GA in Engineering optimization problems.	8
UNIT-III	PARTICLE SWARM OPTIMIZATION Fundamental principle-Velocity Updating, Advanced operators-Parameter selection, Hybrid approaches (Hybrid of GA and PSO), Implementation issues-Convergence issues, Applications of PSO in Engineering optimization problems.	8
UNIT-IV	NATURE INSPIRED METHODS Simulated annealing algorithm, Differential Evolution, Ant colony optimization, Bacteria Foraging optimization –Firefly algorithm	8
UNIT-V	MULTI OBJECTIVE OPTIMIZATION Concept of pareto optimality-Conventional approaches for MOOP, Multi objective GA-Fitness assignment, Sharing function- MOGA, Multiobjective PSO (dynamic neighbourhood PSO, Vector evaluated PSO), Multi objective OPF problem.	8

TEXT BOOKS

1. S.P. Kothari and J.S.Dhillon,"Power System Optimization", 2nd Edition, PHI Learning Private Limited, 2010.
2. Kalyanmoy Deb,"Multi objective optimization using Evolutionary Algorithms", John Wiley and Sons, 2008.
3. Kalyanmoy Deb,"Optimization for Engineering Design", Prentice Hall of India First Edition,1988.

REFERENCE BOOKS

4. Carlos A.Coello Coello, Gary B.Lamont, David A.Van Veldhuizen,"Evolutionary Algorithms for solving Multi Objective Problems", 2nd Edition, Springer, 2007.

5. Soliman Abdel Hady, Abdel Aal Hassan Mantawy, “Modern optimization techniques with applications in Electric Power Systems”, Springer, 2012.
6. Jizhong Zhu, “Optimization of Power System Operation”, John Wiley and sons Inc publication, 2009.
7. Kwang Y.Lee,Mohammed A.El Sharkawi, “Modern heuristic optimization techniques”, John Wiley and Sons,2008.

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
21EEPE42	Modern Optimization Techniques	CO1	x	x	x	x
		CO2	x	x	x	x
		CO3	x	x	x	x
		CO4	x	x	x	x

	oft Computing	L	T	P	C
Course Code: 2	1EEPE43	3	0	0	3
Course Type:	OE				
Pre-Requisite	None				

COURSE OBJECTIVES

1. Introduce students to soft computing concepts and techniques and foster their abilities in designing and implementing soft computing-based solutions for real-world and engineering problems.
2. Introduce students to fuzzy systems, fuzzy logic and its applications.
3. Explain the students about Artificial Neural Networks and various categories of ANN.
4. Learn the basics of genetic algorithm.

COURSE LEARNING OUTCOMES (CLO)

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

1. Understand different topologies of Neural Networks.
2. Learn about fuzzy logic and support vector technique.
3. Learn the basics of genetic algorithm.
4. Develop application on different soft computing techniques like Fuzzy, GA and Neural network

UNIT	COURSE CONTENTS	HOURS
UNIT-I	Introduction: History of development in neural networks, neural network characteristics, Artificial neural network technology, Model of a neuron, topology, learning, types of learning, supervised, unsupervised and reinforcement learning.	8
UNIT-II	Supervised Learning: Basic hop field model, the perceptron, linear reparability, Basic learning laws, Hebb's rule, Delta rule, Widroff and Huff LMS learning rule, correlation learning rule, In star and out star learning rules. Unsupervised learning, competitive learning, K mean clustering algorithm, Kolwner's feature maps.	8
UNIT-III	Radial Basis Function: Basic learning laws in RBF network, recurrent networks, recurrent back propagation, Real time recurrent learning algorithm. Counter Propagation Networks: Introduction to counter propagation networks, CMAC networks, ART networks, Application of neural networks, pattern recognition, optimization, associative memories, vector quantization, control.	8
UNIT-IV	Fuzzy Logic: Basic concepts of fuzzy logic, Fuzzy logic crisp set, Linguistic variable, Membership functions, Operation of fuzzy set, Fuzzy IF-THEN rules, Variable inference techniques, Defuzzification techniques, Basic fuzzy inference algorithm, Application of fuzzy logic, Fuzzy system design, Implementation of fuzzy system, Useful tools supporting design.	8
UNIT-V	Basics of Genetic Algorithms: Evolution of Genetic and Evolutionary Algorithms, Applications. Nature Inspired Optimization Techniques, Ant Colony, particle swarm optimization. HYBRID SYSTEM Integrating Neural networks, fuzzy logic, and genetic algorithms, GA based back propagation networks, fuzzy back propagation networks.	8

TEXT BOOKS

1. Hoffmann, F., Koeppen, M., Klawonn, F., Roy, R: "Soft Computing: Methodologies and Applications", Springer, 2005
2. S. N. Sivanandam & S.N. Deepa, "Principles of Soft Computing", Wiley, 2007
3. Rafik Aziz oglyAliev, R. R. Aliev: "Soft Computing and Its Applications", World Scientific, 2001

REFERENCE BOOKS

4. S. Rajasekaran, G. A. Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic And Genetic Algorithm: Synthesis And Applications", Phi, 2003
5. David E. Goldberg, "Genetic Algorithms", Pearson Education India, 2006
6. B. Yagnanarayana, "Artificial Neural Networks", PHI, 2009

7. Simon O. Haykin, "Neural Networks and Learning Machines", 3/E, Prentice Hall, 2009.

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
21EEPE43	Soft Computing	CO1	x			
		CO2		x		
		CO3			x	
		CO4				x

	Introduction to Robotics and Industrial Automation	L	T	P	C
Course Code:	22EEPE44	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES (CO)

This course deals about

1.Review of Industrial Control Devices and Circuits; Basic Ladder Logic and Control
2.Programmable Logic Controllers and Applications;
3.Robot Fundamentals; Mechanisms and Actuators, Sensors and Detectors;
4.Modeling and Control of Manipulators; Robot Applications and Programming.

COURSE LEARNING OUTCOMES (CLO)

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

1. Explain basic concepts of Programmable Logic Controller (PLC) and Industrial automation.
2. Determine basic programming languages and instructions of a PLC and Use a particular Programmable Logic Controller (PLC) for various applications.
3. Design an automated system for industrial derive to meet defined operational specifications.
4. Explain basic concept, type and components of Robotic system and Define the principles and benefits of the various actuators, drives and sensors. Solve forward kinematics of any serial robot, compute position and orientation of end effectors as a function to joint variables.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	Introduction to Industrial Automation : Introduction to Industrial Automation Review of industrial control devices I/O devices (Electronics Circuit breakers, timers, relays)	8
UNIT-II	Programmable Logic controllers (PLC) 2.1 Introduction to Programmable Logic controllers ➢ Introduction to PLCs ➢ Overview of number systems and logic concepts ➢ PLC Programming Procedures and Devices ➢ Inputs (sensors) and Outputs (actuators) connected to PLC ➢ PLC and DCS programming software 2.2 Input/output and Memory Interaction ➢ PLC input/output systems and programming devices ➢ PLC Memory and Input/output Interaction ➢ Discrete input/output system ➢ Analog input/output system ➢ Special input/output modules: PID, Fuzzy-logic…. 2.3 Programming a PLC ➢ Programming languages and instructions ➢ Programming ON/OFF Inputs ➢ Creating Ladder diagrams ➢ Register Basics ➢ PLC Timers and Counters ➢ PLC Arithmetic functions ➢ Number comparison functions ➢ Data handling Functions ➢ PLC functions with BITS ➢ System programming and implementation: Control task definitions, strategies, program organization and implementations ➢ Programming practice: Siemens‟ PLC S7-300, S7-400 (practice on available PLC type)	8
UNIT-III	Introduction, Fundamentals of Robotics ➢ Introduction ➢ Types of Robots ➢ Robot Anatomy and Key Components ➢ Sensors and Actuators in robots ➢ Position, Velocity, Acceleration, Force and Torque	8

	➢ Touch and Tactile sensors ➢ Proximity and Range Sensors ➢ Hydraulic and Pneumatic Actuation systems ➢ Robot Applications	
UNIT-IV	Robot Motion Analysis (Kinematics) ➢ Representation of Rigid body motion ➢ Transformation of Coordinates ➢ Homogenous Transformation ➢ Forward Kinematics ➢ Inverse Kinematics	8
UNIT-V	Dynamics, Mechanism & Actuation 5.1. Dynamic Models of Rigid-Body Systems ➢ Euler Lagrange Equations ➢ Newton Euler formulation 5.2 Mechanical Structure (Links, Joints, Actuators, transmissions), Joint Mechanisms.	8

TEXT BOOKS

1.J. J. Craig, Introduction to robotics ,3rd edition, Pearson Education,2005

2.Herman Bruyninckx, Robot Kinematics and Dynamics, August 21, 2010

REFERENCE BOOKS

1.B. Siciliano, L. Sciavicco, et al, Robotics modeling planning and control, Springer, 2009

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

SUB CODE	Course Name	Course Objectives	CLO1	CLO2	CLO3	CLO4
22EEPE44	Introduction to Robotics and Industrial Automation	CO1	x			
		CO2		x		
		CO3			x	
		CO4				x

	CYBER SECURITY	L	T	P	C
Course Code:	22EEPE45	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES (CO)
This course aims to guide the student to
1. To aware the students about the cyber security and its implications.
2. To provide students with a practical and theoretical knowledge of cryptography and network security.
3. To provide the students' knowledge of different types of attacks on the Network.
4. To aware the student about data privacy.
COURSE LEARNING OUTCOMES (CLO)
At the end of the course the student will be able to:
1.Define the concept of ethical hacking and its associated applications in Information Communication Technology (ICT) world.
2.Underline the need of digital forensic and role of digital evidences.
3.Explain the methodology of incident response and various security issues in ICT world, and identify digital forensic tools for data collection.
4. Recognize the importance of digital forensic duplication and various tools for analysis to achieve adequate perspectives of digital forensic investigation in various applications /devices like Windows/ Unix system. Also, to apply the knowledge of IDS to secure network and performing router and network analysis.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	INTRODUCTION Cyber-attacks, types of attacks, Introduction to cyber security, objectives of security, elements of cyber security, Introduction to Information Security, Introduction to Data and Network Security, Finding vulnerabilities and exploits.	8
UNIT-II	INTRUSION DETECTION SYSTEMS Overview of intrusions, system intrusion process, dangers of system intrusions, anomaly detection, misuse detection, types of IDS, the limitations and open problems of intrusion detection systems, Statistical and machine approaches to detection of attacks on computers, Techniques for studying the Internet attacks, network based attacks, host based attacks.	8
UNIT-III	SECURITY IN CLOUD COMPUTING What is Cloud Computing, Essential Characteristics, Cloud security challenges, Software as a service security, secure software development life cycle, data usage, data privacy, identity access management, physical security.	8
UNIT-IV	DATA PRIVACY Fundamental Concepts, Definitions, Data Privacy Attacks, Data linking and profiling, access control models, role based access control, privacy in different domains- medical, financial, etc.	8
UNIT-V	CRYPTOGRAPHY Services, mechanisms and attacks, the OSI security architecture, Network security Model, classical Encryption techniques, Private and Public Key Cryptography.	8

TEXT BOOKS
1.Michael T. Goodrich and Roberto Tamassia, "Introduction to Computer Security", Addison Wesley, 2011.
2.B. Raghunathan, "The Complete Book of Data Anonymization: From Planning to Implementation", Auerbach Pub, 2013.
3.John W. Rittinghouse, "Cloud Computing: Implementation Management & Security", CRC Press.
4. Roberto Di Pietro, Luigi V. Mancini, "Intrusion Detection System", Springer ,2008
5. William Stallings-"Cryptography and Network Security", Pearson education, 6th edition, SBN 10: 0133354695, 2013
REFERENCE BOOKS
1. Russell Dean Vines and Ronald L. Krutz ,"Cloud Security: A Comprehensive Guide To Secure Cloud Computing", Wiley India Pvt Ltd, 2010.

2. Anderson, James P., "Computer Security Threat Monitoring and Surveillance," Washing, PA, James P. Anderson Co., 1980.
3. L. Sweeney, “Computational Disclosure Control: A Primer on Data Privacy Protection”, MIT Computer Science, 2002.

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

SUB CODE	Course Name	Course Objectives	CLO1	CLO2	CLO3	CLO4
22EEPE45	CYBER SECURITY	CO1	x			
		CO2		x		
		CO3			x	
		CO4				x

	SMART GRID TECHNOLOGIES & IOT	L	T	P	C
Course Code:	22EEPE46	3	0	0	3
Course Type:	PE				
Pre-Requisite	Fundamentals of Power Distribution System, Transmission and Distribution, Power system Operation and Control, Communication Networks				

COURSE OBJECTIVES (CO)

This course aims to guide the student to

1.To introduce fundamentals w.r.t smart grid
2.To acquire in-depth knowledge on different smart devices and smart meters
3.To introduce the fundamental concept related to modern power distribution system functions
4.To enable the students to learn various concepts pertaining to communication networks for Smart Grid applications

COURSE LEARNING OUTCOMES (CLO)

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

1.Understand the significance of smart grid concept
2.Get acquainted with different smart devices and smart meters
3.Describe how modern power distribution system functions
4.Identify suitable communication networks for Smart Grid applications

UNIT	COURSE CONTENTS	HOURS
UNIT-I	INTRODUCTION TO SMART GRID Introduction - Evolution of Electric Grid, Smart Grid Concept - Definitions and Need for Smart Grid – Functions – Opportunities – Benefits and challenges, Difference between conventional & Smart Grid, Technology Drivers	8
UNIT-II	ENERGY MANAGEMENT SYSTEM Energy Management System (EMS) - Smart substations - Substation Automation - Feeder Automation, SCADA – Remote Terminal Unit – Intelligent Electronic Devices – Protocols, Phasor Measurement Unit – Wide area monitoring protection and control, Smart integration of energy resources – Renewable, intermittent power sources – Energy Storage	8
UNIT-III	DISTRIBUTION MANAGEMENT SYSTEM Distribution Management System (DMS) – Volt / VAR control – Fault Detection, Isolation and Service Restoration, Network Reconfiguration, Outage management System, Customer Information System, Geographical Information System, Effect of Plug in Hybrid Electric Vehicles	8
UNIT-IV	SMART METERS Introduction to Smart Meters – Advanced Metering infrastructure (AMI), AMI protocols – Standards and initiatives, Demand side management and demand response programs, Demand pricing and Time of Use, Real Time Pricing, Peak Time Pricing.	8
UNIT-V	COMMUNICATION NETWORKS & IOT Elements of communication and networking – architectures, standards, PLC, Zigbee, GSM, BPL, Local Area Network (LAN) - House Area Network (HAN) - Wide Area Network (WAN) - Broadband over Power line (BPL) - IP based Protocols - Basics of Web Service and CLOUD Computing, Cyber Security for Smart Grid.	8

TEXT BOOKS

1 Stuart Borlase 'Smart Grid: Infrastructure, Technology and Solutions', CRC Press 2012.
2 Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, 'Smart Grid: Technology and Applications', Wiley, 2012

REFERENCE BOOKS

1. Mini S. Thomas, John D McDonald, 'Power System SCADA and Smart Grids', CRC Press, 2015
2. Kenneth C.Budka, Jayant G. Deshpande, Marina Thottan,Communication Networks for Smart Grids', Springer, 2014.

OTHER RESOURCES

E BOOKS

1 https://books.google.co.in/books?isbn=1119969093

2 https://books.google.co.in/books?isbn=135123093X
MOOC
1 https://www.mooc-list.com/course/smart-grids-electricity-future-edx
2 https://www.mooc-list.com/course/distributed-energy-smart-grid-resources-future-edx
Mapping Matrix of Course Objectives (CO) and Course Learning Outcomes (CLO)

SUB CODE	Course Name	Course Objectives	CLO1	CLO2	CLO3	CLO4
22EEPE46	Smart Grid Technologies & IOT	CO1	x			
		CO2		x		
		CO3			x	
		CO4				x

	DISTRIBUTED GENERATION AND MICROGRIDS	L	T	P	C
Course Code:	22EEPE47	3	0	0	3
Course Type:	PE				
Pre-Requisite	The students are preferred to have a basic knowledge in Power System Analysis and Distribution Systems				

COURSE OBJECTIVES (CO)

This course aims to guide the student to

1. To impart knowledge on current scenario of Distributed Generation and the need to implement DG sources.
2. To acquire an in-depth knowledge on different types of RES as DGs.
3. To enable the students to understand grid integration, interfaces and technical impacts of DGs upon transmission and distribution systems.
4. To introduce the fundamental concepts related to Power quality and reliability along with different types of storage systems

COURSE LEARNING OUTCOMES (CLO)

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

1. Understand the current scenario of Distributed Generation and the need to implement DG sources.
2. Investigate the different types of RES as DGs.
3. Appraise the grid integration, interfaces and technical impacts of DGs upon transmission and distribution systems.
4. Analyze the aspects of Power Quality and Reliability. Also, to understand comprehensively about different types of Storage systems.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	INTRODUCTION, PLACING, AND SIZING THE DISTRIBUTED ENERGY RESOURCES: Need for Distributed generation, renewable sources in distributed generation, current scenario in Distributed Generation, Planning of DGs – Siting and sizing of DGs – optimal placement of DG sources in distribution systems. Suggested Reading: Detailed study of Renewable Energy Sources Applications: Siting and Sizing of DGs using ETAP	8
UNIT-II	RENEWABLE ENERGY SOURCES: Wind Power-Photovoltaic and Thermo-solar power-Biomass Power, Fuel cells types, types of Tidal power generation schemes, mini and micro hydro power schemes.	8
UNIT-III	GRID INTEGRATION, INTERFACES, AND IMPACTS OF DGS : Grid integration of DGs – Different types of interfaces - Inverter based DGs - Aggregation of multiple DG units. – Transmission systems, Distribution systems, Deregulation – Impact of DGs upon protective relaying Suggested Reading:Rotating machine based interfaces	8
UNIT-IV	POWER QUALITY AND RELIABILITY IN DER: Voltage control techniques, Reactive power control, Harmonics, Power quality issues. Reliability of DG based systems – Steady-state and Dynamic analysis. Suggested Reading: Various aspects of Operations	8
UNIT-V	ENERGY STORAGE AND CONTROL TECHNIQUES: Energy Storage for use with Distributed Generation-Battery Storage, Capacitor Storage, ultra-capacitors and Mechanical Storage: Flywheels, Pumped and Compressed Fluids. Control Techniques for DER integration systems- Standards and codes for interconnection- future structure of grid. Suggested Reading: Various aspects such as Market Management Retailing , Trading and Ancillary Services. LAB / MINI PROJECT/FIELD WORK Simulation in ETAP/HOMER	8

TEXT BOOKS:

1 "Distributed Power Generation, Planning & Evaluation" by H. Lee Willis & Walter G. Scott, 2000 Edition, CRC Press Taylor & Francis Group.

2 "Renewable energy power for a sustainable future" by Godfrey Boyle ,2004 Oxford University Press in association with the Open university.

3 Godoy Simoes, Felix A.Farret, 'Renewable Energy Systems – Design and Analysis with Induction

Generators', CRC press.

4 Robert Lasseter, Paolo Piagi, ' Micro-grid: A Conceptual Solution', PESC 2004, June 2004.

REFERENCE BOOKS

1 Z. Ye, R. Walling, N. Miller, P. Du, K. Nelson 'Facility Microgrids', Subcontract report, May 2005,

2 Mohammad Shahidehpour, M. Alomoush, Restructured Electrical Power Systems: Operation: Trading, and Volatility, CRC Press, 2001

3 N. Jenkins, J.B. Ekanayake and G. Strbac, Distributed Generation, The Institution of Engineering and Technology,2010

4 S. Chowdhury, S.P. Chowdhury and P. Crossley,' Microgrids and Active Distribution Networks', The Institution of Engineering and Technology

OTHER RESOURCES

E BOOKS

1 N. Jenkins, J.B. Ekanayake and G. Strbac,Distributed Generation, The Institution of Engineering and Technology,2010

2 S. Chowdhury, S.P. Chowdhury and P. Crossley,'Microgrids and ActiveDistribution Networks', The Institution of Engineering and Technology

MOOC

1 Micro grid, Course era .

2 Introduction to Smart Grid, NPTEL online

3 Solar Energy: Integration of Photovoltaic Systems in Microgrids ,EDX

4 Distributed Energy - Smart Grid Resources for the Future , EDX

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

SUB CODE	Course Name	Course Objectives	CLO1	CLO2	CLO3	CLO4
22EEPE47	Distributed Generation and Microgrids	CO1	x			
		CO2		x		
		CO3			x	
		CO4				x

	Infrastructure for Smart Cities	L	T	P	C
Course Code:	22EEPE48	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES (CO)

1. To develop a basic understanding about various types of Infrastructure and Smart city.
2. To enable the students to apply the basic need and planning concept to solve various Infrastructure problems.
3. To understand smart transport system for smart cities and its application.
4. To study water resources systems for smart city and its application. Also, to understand National and Global policies to implement for smart city development.

COURSE LEARNING OUTCOMES (CLO)

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

1. Understand the necessity of infrastructural development for smart cities.
2. Identify components of infrastructure and Prepare infrastructure plan for smart city.
3. Understand smart transport system for smart cities and its application
4. Study of water resources systems for smart city and its application. Also, to understand National and Global policies to implement for smart city development.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	Fundamental of smart city & Infrastructure: Introduction of Smart City, Concept of smart city, Objective for smart cities, History of Smart city world and India. Need to develop smart city, Challenges of managing infrastructure in India and world, various types of Infrastructure systems, Infrastructures need assessment	8
UNIT-II	Planning and development of Smart city Infrastructure : Energy and ecology, solar energy for smart city, Housing, sustainable green building, safety, security, disaster management, economy, cyber security, Project management.	8
UNIT-III	Intelligent transport systems Smart vehicles and fuels, GIS, GPS, Navigation system, traffic safety management, mobility services, E-ticketing	8
UNIT-IV	Management of water resources and related infrastructure Storage and conveyance system of water, sustainable water and sanitation, sewerage system, flood management, conservation system	8
UNIT-V	Infrastructure Management system & Policy for Smart city Integrated infrastructure management systems for smart city, Infrastructure management system applications for existing smart city. Worldwide policies for smart city Government of India - policy for smart city, Mission statement & guidelines, Smart cities in India, Case studies of smart city.	8

TEXT BOOKS / REFERENCE BOOKS

1. Smart City on Future Life - Scientific Planning and Construction by Xianyi Li
2. The Age of Intelligent Cities: Smart Environments and Innovation-for-all Strategies (Regions and Cities) by Nicos Komninos
3. Smart Cities: Big Data, Civic Hackers, and the Quest for a New Utopia by Anthony Townsend
4. Grig N.S., Infrastructure engineering and management, Wiley-Interseience, 1988
5. Hudson W.R., Haas R., Uddin W., Infrastructure Management, McGraw-Hill, 1997
6. Giffinger, Rudolf; Christian Fertner; Hans Kramar; Robert Kalasek; Nataša Pichler-Milanovic; Evert Meijers (2007). "Smart cities – Ranking of European medium-sized cities". Smart Cities. Vienna: Centre of Regional Science 7. Mission statement &guidelines on Smart City Scheme". Government of India - Ministry of Urban Development http://smartcities.gov.in/upload/uploadfiles/files/Smart City Guidelines(1).pdf

Other Learning Resources

List of Open Source Software/learning website:

1. Smart city government of India. http://smartcities.gov.in

2. Reconceptualising Smart Cities: A Reference Framework for India

https://www.niti.gov.in/writereaddata/files/document_publication/CSTEP%20Report%20Smart%20Cities%20Framework.pdf

3. Draft Concept Note on Smart City Scheme". Government of India - Ministry of Urban Development - martcitiesoftomorrow.com/wp-content/uploads/2014/09/CONCEPT_NOTE_
3.12.2014__REVISED_AND_LATEST_.pdf

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

SUB CODE	Course Name	Course Objectives	CLO1	CLO2	CLO3	CLO4
22EEPE48	Infrastructure for Smart Cities	CO1	x			
		CO2		x		
		CO3			x	
		CO4				x

	Electric Vehicle Machines and Drives	L	T	P	C
Course Code:	22EEPE49	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES (CO)

This course aims to guide the student to

1. Motor Drive Technology
2. DC Motor Control
3. Induction Motor Drives for EVs
4. SR Motor Drives for EVs

COURSE LEARNING OUTCOMES (CLO)

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

1. Motor Drive Technology, Energy Source Technology
2. Design Criteria of DC Motor Drives for EVs
3. Design Criteria of PM Brushless Motor Drives for EVs,
4. Design Criteria of SR Motor Drives for EVs

UNIT	COURSE CONTENTS	HOURS
UNIT-I	Overview of EV Technologies Motor Drive Technology, Energy Source Technology, Battery Charging Technology, Vehicle-to-Grid Technology, Pure Electric Vehicle, Hybrid Electric Vehicle, Gridable Hybrid Electric,Vehicle, Fuel-Cell Electric Vehicle.	8
UNIT-II	DC Motor Drives System Configurations, DC Machines, DC–DC Converters, Soft-Switching DC–DC Converter Topologies, DC Motor Control, Regenerative Braking, Design Criteria of DC Motor Drives for EVs, Design Example for EVs.	8
UNIT-III	Induction Motor Drives System Configurations, induction Machines, Inverters for Induction Motors, Induction Motor Control, Design Criteria of Induction Motor Drives for EVs, Application Examples of Induction Motor Drives in EVs	8
UNIT-IV	Permanent Magnet Brushless Motor Drives System Configurations, PM Brushless Machines, PM Brushless Motor Control, Design Criteria of PM Brushless Motor Drives for EVs, Design Examples of PM Brushless Motor Drives for EVs, Planetary-Geared PM Synchronous Motor Drive, Outer-Rotor PM Brushless DC Motor Drive, Application Examples of PM Brushless Motor Drives in EVs	8
UNIT-V	Switched Reluctance Motor Drives SRM Machines, SR Converters, Comparison of SR Converters for EVs, SR Motor Control, Design Criteria of SR Motor Drives for EVs, Machine Initialization, Planetary-Geared SR Motor Drive, Outer-Rotor In-Wheel SR Motor Drive, Application Examples of SR Motor Drives in EVs , Stator-Permanent Magnet Motor Drives Integrated-Starter-Generator Systems, Planetary-Geared Electric Variable Transmission Systems	8

Text Book:

1. K T Chau, Electric Vehicle Machines and Drives- Design, Analysis and Application, (1e) JohnWiley & Sons, 2015.

Reference Book:

1. Iqbal Hussein, Electric and Hybrid Vehicles-Design Fundamentals, (2e), CRC Press, 2010.
2. Gianfranco Pistoia, Electric and Hybrid Vehicles - Power Sources, Models, Sustainability, Infrastructure and the Market, (1e), Elsevier, 2010.

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

SUB CODE	Course Name	Course Objectives	CLO1	CLO2	CLO3	CLO4
22EEPE49	Electric Vehicle Machines and Drives	CO1	x			
		CO2		x		
		CO3			x	
		CO4			x	x

	Real-Time Control of Power Systems and Energy Management	L	T	P	C
Course Code:	22EEPE50	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES (CO)

This course aims to guide the student to

1.Develop mathematical models for analysis of linear and non–linear State Estimation, Observability and Contingency analysis of any practical Power System
2.Prepare the practical input data required for linear and non–linear State Estimation methods and Contingency studies.
3.Identify the strategic locations for measurements to analyses the state of the
4.To have complete overview of Real Time operation of Power system (RTPS) and communication & protocols employed in RTPS. Also, to understand the need and importance of energy audit, management and evaluate the benefits of different energy management techniques

COURSE LEARNING OUTCOMES (CLO)

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

1.Develop mathematical models for analysis of linear and non–linear State Estimation, Observability and Contingency analysis of any practical Power System
2.Prepare the practical input data required for linear and non–linear State Estimation methods and Contingency studies.
3.Identify the strategic locations for measurements to analyses the state of the
4.To have complete overview of Real Time operation of Power system (RTPS) and communication & protocols employed in RTPS. Also, to understand the need and importance of energy audit, management and evaluate the benefits of different energy management techniques.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	Real Time Control of Power Systems: Need for Real Time and Computer Control of Power Systems – Operating states of a Power System SCADA Functions: Introduction to SCADA: Grid Operation & Control, Difficulties in operating the large power systems manually, need for going to SCADA operation, advantages of SCADA operation. Lay out of substation / Generating Station, Main Equipment in Sub Station/ Generating Station, Instrument Transformers and their importance in measurements and protection, important parameters necessary for Grid operation: Analog Points (MW, MVar, Tap Position, Voltage, Frequency), Status Points (CB Status, Isolator Status, SOE Points), Alarms. Hardware required to get these parameters to RTU: Transducers & their connectivity. Data Acquisition, Monitoring and Event Processing, Control Functions, Time tagged data, Disturbance data collection and analysis, Reports and Calculations.	8
UNIT-II	Man – Machine Communication :Operator's Console, VDU Display and its use, Operator Dialogs, Mimic Diagram Functions, Printing Facilities. Remote Terminal Unit (RTU) –Phase angle Measurement unit(PMU) & Communication Practices: Major Components: RTU Panel, Interface Panel. D20M Main Processor, Analog Card, Status Card, Control Card, Modems. Types Of Communications: Power Line Carrier Communications, Microwave, Optical fibre, VSAT Communications. Types of Network Elements in LAN & WAN. Process of Data Communication.	8
UNIT-III	Introduction to SCADA PROTOCOLS and Communication Standards for Electrical Power Systems: Power System Control requirements and evolution of Protocol for Communication, Protocols - Modbus, Distributed Network Protocol (DNP), IEC 870-5 and 60870 series, Benefits from the IEC(International Electrotechnical Commission) communication Standards.	8

	Sub-load Dispatch Center(Sub-LDC) : Various Equipment in Sub LDC: (a) Work Stations: details (b) FEPS: Function of FEPS(Front End Processors). (c) Routers : function of routers, interconnectivity of the equipment by LAN, Functionality and responsibilities of Sub LDC-Real Time Software Classification of Programs, Structure of Real time Programs, Construction Techniques & Tools, Programming Language Requirements for Process Control.	
UNIT-IV	Overview of Computer control of Electrical Power Systems: Evolution of System Control, time scale of system control, online computer control, and Software Elements: State Estimation, Monitoring & Prediction, Generation & Load Control, Security Analysis; Software Coordination & Systems Simulation. National Load Dispatch Center (SLDC): Inter Connectivity Of Sub-LDCs & SLDCs, Hierarchy of Data Transfer, Functions & Responsibilities of SLDC, Real Time Operation carried at SLDC.	8
UNIT-V	Energy audit and management: Energy Scenario & Conservation -Demand Forecasting Techniques-Integrated Optimal Strategy for Reduction of T&D Losses - DSM Techniques and Methodologies- Loss Reduction in Primary and Secondary Distribution system and capacitors - Energy Management – Role of Energy Managers - Energy Audit - Metering Energy audit: Energy audit concepts, Basic elements and measurements, Mass and energy balances, Scope of energy auditing in industries, Evaluation of energy conserving opportunities and environmental management, Preparation and presentation of energy audit reports, case studies and potential energy savings. NB ! Latest/recent developments regarding the specified course applications can be incorporated.	8

TEXT BOOKS

1. Allen J. Wood and Bruce Woolenberg: Power System Generation, Operation and Control, John Wiley and Sons, 1996.
2. Real – Time Computer Control – by S. Bennett and D.A. Linkens (Editors), IEE Control Engineering series (24), peter Peregrinus Ltd., 1984.

REFERENCE BOOKS

1. Larry C. Witte, Schmidt & Brown, Industrial energy management and utilization. Hemisphere publishing, Co. New York, 1988.
2. Wayne. C Turner: Energy management handbook, Wiley Inter-science publications. New York, 1982.

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

SUB CODE	Course Name	Course Objectives	CLO1	CLO2	CLO3	CLO4
22EEPE50	Real-Time Control of Power Systems and Energy Management	CO1	x			
		CO2		x		
		CO3			x	
		CO4				x

	Distribution System Planning and Automation	L	T	P	C
Course Code:	22EEPE51	3	0	0	3
Course Type:	PE				
Pre-Requisite	Power Systems Analysis				

COURSE OBJECTIVES (CO)

This course aims to guide the student to
1.To understand and distinguish characteristics of distribution system from transmission systems. Also, analyzing and to evaluate distribution system design based on forecasted data.
2.To learn how to identify and select appropriate sub-station location.
3.To learn the implementation of design and evaluate a distribution system for a given geographical service area from alternate design alternatives.

COURSE LEARNING OUTCOMES (CLO)

After completion of the course, students would be able to:
1.Understand and distinguish characteristics of distribution system from transmission systems. Design, analyze and evaluate distribution system design based on forecasted data.
2.Identify and select appropriate sub-station location.
3.Design and evaluate a distribution system for a given geographical service area from alternate design alternatives.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	Distribution System Planning: Planning and forecasting techniques – Present and future – Role of computers- Load Characteristics-Load forecasting using ANN – Load management – tariffs and metering of energy.	8
UNIT-II	Distribution Transformers: Types – Three phase and single phase transformers – connections – causes and types of failures in distribution transformers Primary distribution systems and Distribution Sub–Stations: Distribution substations –Bus schemes –comparison of switching schemes-Substation location and rating- Types of feeders – voltage levels.	8
UNIT-III	Voltage Drop And Power Loss Calculations: Three phase primary lines – Copper loss – Distribution feeder costs – Loss reduction and Voltage improvement in rural networks. Capacitors In Distribution Systems: Effects of series and shunt capacitors – justification for capacitors – Procedure to determine optimum capacitor size and location.	8
UNIT-IV	Distribution System Automation: Reforms in power sector – Methods of improvement – Reconfiguration – Automation – Communication systems – Sensors –Basic architecture of Distribution automation system – software and open architecture – RTU and Data communication – SCADA requirement and application functions – Communication media for distribution system automation- Communication protocols for Distribution systems – IEC 61850 and IEEE 802.3 standards.	8
UNIT-V	Distribution system management: Integrated sub–station metering system – Revenue improvement – issues in multi–year tariff and availability based tariff. NB ! Latest/recent developments regarding the specified course applications can be incorporated.	8

TEXT BOOKS

1. Turan Gonen : Electric Power Distribution Engg., Mc-Graw Hill,1986.

2.James A Momoh: Electric Power Distribution, Automation, Protection and Control, CRC press.

REFERENCE BOOKS

1. A. S. PABLA : Electric Power Distribution, TMH,2000.

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

SUB CODE	Course Name	Course Objectives	CLO1	CLO2	CLO3
22EEPE51	Distribution System Planning and Automation	CO1	x		
		CO2		x	
		CO3			x

	DIGITAL COMMUNICATION	L	T	P	C
Course Code:	22EEPE52	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES

This course aims to guide the student to

1. Pulse modulation and discuss the process of sampling, quantization and coding that are fundamental to thedigital transmission of analog signals
2. Base band pulse transmission which deals with the transmission of pulse amplitude modulated signals in theirbase band form
3. Pass band data transmission methods
4. Various Spread Spectrum techniques

COURSE LEARNING OUTCOMES

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

1. Design Digital communication system.
2. Design and implement Base Band transmission schemes.
3. Design and implement Base pass signaling schemes.
4. Design and implement Spread Spectrum Techniques. Also, design & physical implementation of Digital Radio Transmitter & Receiver.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	**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	8
UNIT-II	**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 effect- ChannelCapacity- 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. Design & Physical Implementation of Various Pulse Modulations Radio Transmitter	8
UNIT-III	**BASE BAND PULSE 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. Design & Physical Implementation of Various Pulse Modulations Radio Receiver.	8
UNIT-IV	**PASS BAND DATA TRANSMISSION** Pass Band Transmission Model-Generation, Detection, Signal Space Diagram, Probability of Error of BFSK, BPSK, QPSK Schemes- Comparison of BFSK, BPSK & QPSK. Design & Physical Implementation of Various Digital Modulations Radio Transmitter & Receiver.	8
UNIT-V	**INTRODUCTION TO SPREAD SPECTRUM TECHNIQUES** Introduction-Discrete Sequence Spread Spectrum technique-Use of Spread Spectrum with CDMA-Ranging Using Discrete Sequence Spread Spectrum- Frequency HoppingSpread Spectrum-Generation & Characteristics of PN Sequence-Acquisition of FH a Signal- Tracking of FH a signal-Acquisition of a DS Signal-Tracking of a DS signal. Design & Physical Implementation of Bluetooth & CMDA Radio Transmitter & Receiver.	8

TEXT BOOK

1. Herbert Taub, Donald L. Schilling, Goutam Saha, “Principle ofCommunication Systems”,
4th Edition, McGraw Hill, 2013.
2. Simon Haykin, “Digital Communication Systems”, John Wiley, 2013.

REFERENCE BOOKS

1.John G. Proakis, “Digital Communications”, 5th Edition, McGraw Hill, 2018.
2.Bernard Sklar, “Digital Communication, Fundamentals and Application”, Pearson, 2nd Edition, 2012.

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
22EEPE52	DIGITAL COMMUNICATION	CO1	x	x		
		CO2		x	x	
		CO3		x	x	
		CO4			x	x

	OPTICAL FIBER COMMUNICATION	L	T	P	C
Course Code:	22EEPE53	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES (CO)

This course aims to guide the student to

1. To learn the basic elements of optical fiber transmission link, fiber modes configurations and structures.
2. To understand the different kind of losses, signal distortion in optical wave guides and other signal degradation factors
3. To learn the various optical source materials, LED structures, quantum efficiency, laser diodes.
4. To learn the fiber optical receivers such as PIN, APD diodes, noise performance in photo detector, receiver operation and configuration. Also, to learn the fiber optical network components, variety of networking aspects, FDDI, SONET/SDH and operational principles WDM.

COURSE LEARNING OUTCOMES (CLO)

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

1. Fundamentals, advantages and advances in optical communication system.
2. Types, basic properties and transmission characteristic of optical fibers.
3. Knowledge of working and analysis of optical amplifiers and important parts at the transmitter (Semiconductor lasers/LEDs, modulators etc) as well as at the receiver sides (optical detector etc.) of the optical communications system.
4. To understand the fiber optical network components, variety of networking aspects, FDDI, SONET/SDH and operational principles WDM.

UNIT	COURSE CONTENTS	HOUR S
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.	8
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	8
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	8
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	8
UNIT-V	**PERIPHERAL INTERFACES 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 – Passive Optical Networks, Optical CDMA, Ultra high capacity Networks, Non linear effects on System performance	8

TEXT 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

REFERENCE BOOKS

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

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
22EEPE53	OPTICAL FIBER COMMUNICATION	CO1	x			
		CO2		x	x	
		CO3			x	
		CO4				x

	MOBILE COMMMUNICATION	L	T	P	C
Course Code:	22EEPE54	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES

This course aims to guide the student to

1.To understand the fundamentals and various computational processing of mobile networks.

COURSE LEARNING OUTCOMES

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

1.To study the specifications and functionalities of various protocols/standards of mobile networks.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	**INTRODUCTION** Introduction to Mobile Computing-Wireless transmission: Propagation, Modulation, Multiplexing, switching, Spread Spectrum and Error control coding.	**8**
UNIT-II	**WIRELESS LAN** Medium access Control and Physical layer specifications-IEEE 802.11-HIPERLAN- Bluetooth	**8**
UNIT- III	**WIRELESS NETWORKING** Satellite systems-Cellular networks-Cordless systems-Wireless Local Loop-IEEE 802.16	**8**
UNIT- IV	**MOBILE TCP/IP AND WAP** TCP/IP protocol suite-Mobile IP-DHCP-Mobile transport layer-Wireless application protocol	**8**
UNIT-V	**MOBILE ADHOC NETWORKS** Characteristics-Performance issues-Routing algorithms; Proactive and Reactive, DSDV, AODV, DSR and Hierarchical algorithms.	**8**

Text Book

1. Jochen Schiller, "Mobile Communications", PearsonEducation, Second Edition 2002.

Reference Book

2. William Stallings, "Wireless Communications and Networks", Pearson Education 2002

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

SUB CODE	Course name	Course Objectives	CLO 1
22EEPE54	MOBILE COMMMUNICATION	CO1	x

	DATA COMMUNICATION NETWORK	L	T	P	C
Course Code:	22EEPE55	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES

This course aims to guide the student to

1. Understand about the functions and services of all 7 layers of OSI model
2. Get an idea of various network standards.

COURSE LEARNING OUTCOMES

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

1. To introduce basic concepts of Data communication with different models.
2. Enumerate the physical layer, DLL, NL, TL and AL, its explanation of the function(s) of eachlayer.
3. To introduce about the switching concept and its different types.

UNIT	1.1.1 COURSE 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.	8
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.	8
UNIT-III	**NETWORK LAYER** Need for Internetworking – Addressing – Routing Issues – Internet protocol (IPV4/V6) – Congestion & flow control mechanism – TCP/IP model.	8
UNIT-IV	**OSI HIGHER LAYERS** Transport layer – TCP & UDP – Session layer issues – Presentation layer – Application layer.	8
UNIT-V	**APPLICATION & INTRODUCTION TO ISDN** Application layer: Email – FTP – HTTP–Compression Techniques; Introduction to ISDN – Broadband ISDN Features – ATM Concept, applicationand security.	8

Text Book

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

Reference Book

2. W. Stallings, "Data & computer communication", 2nd Edition,NY Pearson, 1988.
3. Rarnier Handel , N.Huber , Schroder, "ATM Networks Concepts ,Protocols Applications'', Addison Welsey,1999

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3
22EEPE55	DATA COMMUNICATION NETWORK	CO1	x	x	
		CO2		x	x

	WIRELESS COMMUNICATION	L	T	P	C
Course Code:	22EEPE56	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES

This course aims to guide the student to

1. To study the characteristic of wireless channel
2. To understand the design of a cellular system
3. To study the various digital signalling techniques and multipath mitigation techniques
4. To understand the concepts of multiple antenna techniques

COURSE LEARNING OUTCOMES

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

1. Capable of characterizing a wireless channel and evolve the system design specifications.
2. Capable of designing a cellular system based on resource availability and traffic demands.
3. Able to identify suitable signalling and multipath mitigation techniques for the wireless channel and system under consideration.
4. Capable of exploiting multiple antenna techniques for capacity/ performance gains.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	**WIRELESS CHANNELS** Electromagnetic Wave Propagation Mechanisms - Reflection, Diffraction, Scatterin Models– Large scale path loss – Path loss models: Free Space and Two-Ray models - Lin Budget design – Small scale fading- Parameters of mobile multipath channels – Tim dispersion parameters-Coherence bandwidth – Doppler spread & Coherence time,Fadin due to Multipath time delay spread – flat fading – frequency selective fading – Fading du to Doppler spread – fast fading – slow fading.	**8**
UNIT-II	**CELLULAR ARCHITECTURE** Multiple Access techniques - FDMA, TDMA, CDMA – Capacity calculations–Cellula concept-Frequency reuse - channel assignment- hand off- interference & system capacit trunking & grade of service – Coverage and capacity improvement.	**8**
UNIT-III	**DIGITAL SIGNALING FOR FADING CHANNELS** Structure of a wireless communication link, Principles of Offset-QPSK, p/4-DQPSK, QAM Principle, Error performance in fading channels, OFDM principle – Cyclic prefix, Windowing, PAPR.	**8**
UNIT-IV	**MULTIPATH MITIGATION TECHNIQUES** Equalisation – Adaptive equalization, Linear and Non-Linear equalization, Zero forcing and LMS Algorithms, Diversity – Micro and Macro diversity, Diversity combining techniques, Error probability in fading channels with diversity reception, Rake receiver.	**8**
UNIT-V	**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.	**8**

Text Book

1. Rappaport,T.S., “Wireless communications”, Pearson Education, 3rdEdition, 2010.
2. Andreas.F. Molisch, “Wireless Communications”, John Wiley – India,2ndEdition 2012.

Reference Book

1. David Tse and PramodViswanath, “Fundamentals of WirelessCommunication”, Cambridge University Press, 2005.
2. Upena Dalal, “Wireless Communication”, Oxford University Press,2009.
3. Van Nee, R. and Ramji Prasad, “OFDM for wireless multimediacommunications”, Artech House, 2000.
4. Simon Haykins& Michael Moher, “Modern Wireless Communications”,Pearson Education, 2007.
5. Vijay. K. Garg, “Wireless Communication and Networking”, MorganKaufmann Publishers, 2007.

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
22EEPE56	WIRELESS COMMUNICATION	CO1	x	x		
		CO2		x	x	
		CO3				x
		CO4				x

	SATELLITE COMMUNICATION	L	T	P	C
Course Code:	22EEPE57	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES

This course aims to guide the student to

1. To introduce the concept of satellite orbits and launching of satellites
2. To enable the student to understand the different interferences and attenuation mechanisms affecting the satellite link design
3. To enable the student to understand the space segment and earth segment
4. To enable the student to understand the different multiple access methods along with advances in satellite-based navigation, GPS and the different application scenarios.

COURSE LEARNING OUTCOME

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

1. Design and implementation of various the satellite orbits
2. Analyse the Satellite link design.
3. Design and analyze the earth segment and space segment
4. Analyse the different multiple access methods along with various applications

UNIT	CONTENTS	HOURS
UNIT-I	**SATELLITE ORBIT** Satellite orbits: Kepler's laws- Earth satellite orbiting satellite terms- Orbital elements – Orbital perturbations –Inclined Orbits- Sun synchronous orbit.Constellation: Geo stationary satellites- Non geostationary constellation- Launching of Geostationary satellites. design and implementation	8
UNIT-II	**LINK DESIGN** EIRP- Transmission Losses –Power Budget equation- System Noise Carrier tonoise ratio –Uplink- Downlink – Effects of rain –Inter modulation Noiseanalysis	8
UNIT-III	**SPACE AND EARTH SEGMENT** Space Segment: Power Supply — Altitude control- Station keeping — Thermal Control- TT&C- Subsystems—Antenna subsystem — Transponders-Wide band Receiver. Earth Segment: receive only home TV system-Community antenna TV system.	8
UNIT -IV	**MULTIPLE ACCESS FOR SATELLITE COMMUNICATIONS** FDM-FM-FDMA - TDMA-structure and system design; Onboard Processing systems; DAMA and PAMA; CDMA-system design and capacity- design and Implementation	8
UNIT-V	Remote sensing, navigation, scientific and military application, VSAT—Network Architecture, Access Control protocols and techniques, VSAT Earth stations; Satellite Mobile Telephony— Global star, DBS/DTH Television, GPS, Weathersatellites-implementation	8

Text Book

1. Dennis Roddy, "Satellite Communications", McGraw Hill Publications,3rd Edition 2001.
2. M.Richaria, "Satellite Communication Systems Design Principles", Pearson Publications, 2nd Edition 1999

Reference Book

3. Wilbur L.Prichard, Henry G. Suyerhood, Ropert A. Nelson , "SatelliteCommunication SystemEngineering", Pearson education ,2ndEdition,.
4. Pratt, Timothy, Charles W. Bostian, "SatelliteCommunication", John Wiley and Sons, New York, 1986

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO4
22EEPE57	SATELLITE COMMUNICATION	CO1	x	x		
		CO2		x	x	
		CO3			x	
		CO4				x

	EMBEDDED SYSTEMS DESIGN	L	T	P	C
Course Code:	22EEPE58	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES

This course aims to guide the student to

1. Microcontrollers
2. Programming techniques
3. Interfacing
4. Development of Small projects base on microcontrollers

COURSE LEARNING OUTCOMES

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

1. The purpose of this course is to expose the concepts of embedded system principles –
2. Microcontrollers and its interfacing with peripherals.

UNIT	COURSE CONTENTS	HOURS
UNIT I	Introduction: Core of the embedded system, Memory, Sensors (resistive, optical, position, thermal) and Actuators (solenoid valves, relay/switch, opto-couplers), Communication Interface, Embedded firmware (RTOS, Drivers, Application programs), Power-supply (Battery technology, Solar), PCB and Passive components, Safety and reliability, environmental issues. Ethical practice.	8
UNIT II	Embedded Hardware and Design: Introduction to ARM-v7-M (Cortex-M3),ARM-v7-R (CortexR4) and comparison in between them.	8
UNIT III	Embedded Software, Firmware Concepts and Design: Embedded C- programming concepts (from embedded system point of view): Optimizing for Speed/Memory needs, Interrupt service routines, macros, functions, modifiers, data types, device drivers, Multithreading programming.	8
UNIT IV	RTOS: Real time operating system: POSIX Compliance , Need of RTOS in Embedded system software, Foreground/Background systems, multitasking, context switching, IPC, Scheduler policies, Architecture of kernel, task scheduler, ISR, Semaphores, mailbox, message queues, pipes, events, timers, memory management, RTOS services in contrast with traditional OS.	8
UNIT V	CASE STUDY: 1) Medical monitoring systems, 2) Process control system (temp, pressure) 3) Soft real time: Automated vending machines, 4) Communication: Wireless (sensor) networks.	8

Text Book

1. Introduction to Embedded Systems : Shibu K. V. (TMH)
2. Embedded System Design – A unified hardware and software introduction:
   F. Vahid (John Wiley) 3. Embedded Systems : Rajkamal (TMH)
3. Embedded Systems : L. B. Das (Pearson)
4. Embedded System design : S. Heath (Elsevier)

Reference Book andother materials

5. Embedded microcontroller and processor design: G. Osborn (Pearson)
6. Embedded Systems: Frank Vahid , Wiley India, 2002
7. Embedded Microcomputer Systems – Real Time Interfacing – Jonathan W.Valvano; Cengage Learning; Third or later edition

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2
22EEPE58	EMBEDDED SYSTEMS DESIGN	CO1	x	x
		CO2		x
		CO3	x	
		CO4		x

	RADAR & IMAGING SYSTEMS	L	T	P	C
Course Code:	22EEPE59	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVE (CO)

This course aims to guide the student to

1. To understand the fundamental concepts of radar detection.
2. To understand FM-CW radars and Fundamentals of Doppler measurements.
3. To understand images from range-Doppler mapping-Rigid rotating body.
4. Understanding of Imaging with SLR and SAR-Apparent rotation by with source motion.

COURSE LEARNING OUTCOMES (CLO)

After completion of course, students would be able to:

1. Understand basic of radar system.
2. To understand the fundamental concepts of radar detection.
3. To understand FM-CW radars and Fundamentals of Doppler measurements.
4. To understand images from range.

UNIT	COURSE CONTENTS	HOURS
UNIT I	Overview and class procedures, Introduction & early history, Basic concepts & measurements, Radar Equation, Examples of simple radar systems, Analysis of SNR	8
UNIT II	Radar detection in the presence of noise, Matched filter detection, Target effects on detection	8
UNIT III	FM-CW radars, Fundamentals of Doppler measurements, Doppler ambiguity	8
UNIT IV	Images from range-Doppler mapping-Rigid rotating body, Assignment and Discussion of Final Project	8
UNIT V	Imaging with SLR and SAR-Apparent rotation by with source motion, Range signal processing - pulse compression revisited, Azimuth signal processing - imaging	8

Text Books

1. P.Z.Peebles, Radar Principles, Wiley, 1998.
2. Merrill I. Skolink, Introduction to Radar Systems, (3/e), Tata MG Graw Hill,2001

Reference Books

1. N.Levanon, Radar Signals, Wiley, 2005.
2. D.Wehnar: High Resolution Radar, Artech Hous, 1987.
3. D.K.Barton: Radar systems Analysis, Prentice Hall, 1976. 4. Recent literature in Principles of Radar.

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
22EEPE59	RADAR & IMAGING SYSTEMS	CO1	x	x		
		CO2		x	x	
		CO3			x	
		CO4				x

	VIRTUAL INSTRUMENTATION	L	T	P	C
Course Code:	22EEPE60	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVE (CO)

This course aims to guide the student to
1. To Understand virtual instrumentation concepts.
2. To describe acquisition methodologies.
3. To compare traditional and virtual instrumentation.
4. Discuss operating systems required for virtual instrumentation.

COURSE LEARNING OUTCOMES (CLO)

At the end of the course, student will be able to:
1. Develop virtual instruments for specific application using LabVIEW software.
2. Ease the programming required to make computer interact with real world.
3. To acquire, analyze and display the throughput of any compactible system.
4. Knowledge to connect with third party software and hardware.

UNIT	COURSE CONTENTS	HOURS
UNIT I	INTRODUCTION Virtual Instrumentation - Definition and Flexibility - Block diagram and Architecture for Virtual Instruments versus Traditional Instruments Instrumentation -VI Programming techniques - VI, sub VI, Loop and Charts, Arrays, Clusters and Graphs, Case and Sequence Structures, Formula nodes, String and File Input / Output	**8**
UNIT II	DATA ACQUISTITION A/D and D/A converters, Plug-in Analog Input / Output cards – Digital Input and Output Cards, Organization of the DAQ VI system – Opto-isolation – Performing analog input and analog output – Scanning multiple analog channels – Issues involved in selection of Data acquisition cards – Data acquisition modules with serial communication – Design of digital voltmeter with transducer input –Timers and Counters.	**8**
UNIT III	COMMUNICATION NETWORKED MODULES, Introduction to PC Buses – Local busses- ISA, PCI, RS232, RS422 and RS485 – Interface Buses:- USB, PCMCIA, VXI, SCXI and PXI –Instrumentation Buses :- Modbus and GPIB – Networked busses – ISO/OSI Reference model, Ethernet and TCP/ IP Protocols.	8
UNIT IV	REAL TIME CONTROL IN Designs using VI Software - ON/OFF controller – Proportional controller – Modeling and basic control of level and reactor processes – Case studies on development of HMI, SCADA in VI	8
UNIT V	OPERATING SYSTEM AND HARDWARE OVERVIEW PC architecture, current trends, operating system requirements, PC based instrumentation, analog and digital interfaces, PXI and SCXI main frame - modular instruments – Transducers – power, speed and timing considerations.	8

Text Books:
1. LabVIEW Graphical Programming, Gary W. Johnson, Richard Jennings 3rd edition, McGraw-Hill Professional Publishing
2. Lisa K Wells, Lab view for Everyone‖, Prentice Hall of India.

Reference Books:
1.Kevin James, PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control, Newnes, 2000.
2.Rick Bitter, LabVIEW advanced programming technique, 2nd Edition, CRC Press, 2005
3.Jovitha Jerome, Virtual Instrumentation using LabVIEW, 1st Edition, PHI, 2001.
4.Barry Paton, ―Sensor, transducers and Lab view‖, Prentice Hall of India 2000.
5.Buchanan, W. ―Computer buses‖, CRC Press 2000.

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO4
22EEPE60	VIRTUAL INSTRUMENTATION	CO1	x	x		
		CO2		x	x	
		CO3			x	

	Microelectronics	L	T	P	C
Course Code:	22EEPE61	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

		CO4				x

COURSE OBJECTIVE (CO)

This course aims to guide the student to
1. To understand how computers are constructed out of a set of functional units and how the functional units operate, interact, and communicate.
2. To make the students to understand the concept of interfacing memory and various I/O devices to a computer system using a suitable bus system.
3. To introduce various aspects of VLSI circuits and their design including testing.
COURSE LEARNING OUTCOMES (CLO)
At the end of the course student will be able to:
1. Apply the basic knowledge of digital concept to the functional components of a Computer System and analyze the addressing mode concepts and design the instruction set Architecture. 2. Identify the functions of various processing units within the CPU of a Computer System and analyze the function of the memory management unit and create suitable memory interface to the CPU.
3. Describe the techniques used for VLSI fabrication, design of CMOS logic circuits, switches and memory.
4. Describe the techniques used the design of CMOS logic circuits, switches and memory in VLSI
And generalize the design techniques and analyze the characteristics of VLSI circuits such as area, speed and power dissipation.

UNIT	COURSE CONTENTS	HOURS
UNIT I	Introduction: Function and structure of a computer, Functional components of a Computer, Interconnection of components, Performance of a computer Representation of Instructions: Machine instructions, Memory locations & Addresses, Operands, Addressing modes, Instruction formats, Instruction sets Instruction set architectures - CISC and RISC architectures, Super scalar Architectures, Fixed point and floating point operations. Basic Processing Unit Fundamental concepts, ALU, Control unit, Multiple bus organization, Hardwired control, Micro programmed control, Pipelining, Data hazards, Instruction hazards, Influence on instruction sets, Data path and control considerations Performance considerations. Memory organization:	8
UNIT II	Basic concepts, Semiconductor RAM memories, ROM, Speed - Size and cost Memory Interfacing circuits, Cache memory, Improving cache performance Memory management unit, Shared/Distributed Memory, Cache coherency in multiprocessor, Segmentation, Paging, Concept of virtual memory, Address translation, Secondary storage devices. I/O Organization: Accessing I/O devices Input/output programming, Interrupts, Exception Handling, DMA, Buses, I/O interfaces- Serial port, Parallel port, PCI bus, SCSI bus, USB bus, Firewall and Infinity band, I/O peripherals.	8
UNIT III	VLSI design methodology, VLSI technology- NMOS, CMOS and BICMOS circuit fabrication. Layout design rules. Stick diagram. Latch up. Characteristics of MOS and CMOS switches. Implementation of logic circuits using MOS and CMOS technology, multiplexers and memory, MOS transistors, threshold voltage, MOS device design equations. MOS models, small-signal AC analysis. CMOS inverters propagation delay of inverters, Pseudo NMOS, Dynamic CMOS logic circuits power dissipation.	8
UNIT IV	Programmable logic devices- anti fuse, EPROM and SRAM techniques Programmable logic cells. Programmable inversion and expander logic Computation of interconnect delay, Techniques for driving large off-chip capacitors, long lines, Computation of interconnect delays in FPGAs Implementation of PLD, EPROM, EEPROM, static and dynamic RAM in CMOS.	8

UNIT V	An overview of the features of advanced FPGAs, IP cores, Soft core processors, Various factors determining the cost of a VLSI, Comparison of ASICs, FPGAs , PDSPs and CBICs . Fault tolerant VLSI architectures VLSI testing -need for testing, manufacturing test principles, design strategies for test, chip level and system level test techniques.	**8**

Text Books

1. C.Hamacher Z. Vranesic S. Zaky and Manjikian, "Computer Organization and Embedded Systems", 6 th Edition, McGraw-Hill, 2012.
2. W. Stallings, "Computer Organization and Architecture - Designing for Performance", 8Th Edition, Prentice Hall of India, 2010.
3. N. H. E. Weste, D.F. Harris, “CMOS VLSI design”, (3/e), Pearson , 2005.
4. J. Smith, “Application Specific Integrated Circuits, Pearson”, 1997.

Reference Books

1. B,Parhami, “Computer Architecture, From Microprocessors to Supercomputers,” Oxford University Press, Reprint 2014.
2. J. L. Hennessy and D. A. Patterson, "Computer Architecture, A Quantitative Approach”, 5 th Edition, Morgan Kaufmann,2012.
3. J .P. Hayes, "Computer Architecture and Organization", 3 rd Edition, McGraw-Hill, 1998.
4. M.M.Vai, “VLSI design”, CRC Press, 2001.
5. Pucknell & Eshraghian, “Basic VLSI Design”, PHI, (3/e), 2003.
6. Uyemura, “Introduction to VLSI Circuits and Systems”, Wiley, 2002.

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3
22EEPE61	MICROELECTRONICS	CO1	x	x	
		CO2		x	x
		CO3			x

	Computer Architecture and very large-scale Integration	L	T	P	C
Course Code:	**22EEPE62**	**3**	**0**	**0**	**3**
Course Type:	**PE**				
Pre-Requisite	**None**				

COURSE OBJECTIVE (CO)

This course aims to guide the student to
1. To introduce IC technology and MOS transistor theory.
2. To introduce circuit characterization and performance estimation.
3. To introduce various aspects of VLSI fabrication design including testing.

COURSE LEARNING OUTCOMES (CLO)

At the end of the course student will be able to:
1. Understand IC technology and MOS transistor theory.
2. Describe the techniques used the design of CMOS logic circuits.
3. Explain VLSI fabrication techniques.

UNIT	COURSE CONTENTS	HOURS
UNIT I	REVIEW OF MOS TECHNOLOGY: Introduction to IC technology, MOS Transistor enhancement mode and depletion mode operations, fabrication of NMOS, CMOS and BiCMOS devices. Equivalent circuit for MOSFET and CMOS.	**8**
UNIT II	MOS TRANSISTOR THEORY: MOS device design equations, MOS transistor, Evaluation aspects of MOS transistor, threshold voltage, MOS transistor transconductance & output conductance, figure of merit, determination of pull-up to pulldown ratio for an n-MOS inverter driven by another n-MOS inverter & by one or more pass transistor, alternative forms of pull-up, CMOS and BiCMOS-inverters. Latch up in CMOS circuitry and BiCMOS Latch up susceptibility.	**8**
UNIT III	MOS CIRCUITS AND LOGIC DESIGN: Basic physical design of simple logic gates using n-MOS, p-MOS and CMOS, CMOS logic gate design considerations, CMOS logic structures, clocking strategies.	**8**
UNIT IV	CIRCUIT CHARACTERIZATION AND PERFORMANCE ESTIMATION: Resistance estimation, capacitance estimation, inductance, switching characteristics, CMOS gate transistor sizing, and power dissipation.	**8**
UNIT V	VLSI FABRICATION : Crystal growth, wafer preparation, epitaxy, oxidation, lithography, etching, diffusion, dielectric and poly-silicon film deposition, ion implantation, yield and reliability, metalization. DESIGN EXAMPLE USING CMOS : Incrementer / decrementer, left/right shift serial/parallel register, comparator for two n-bit number, a two-phase non-overlapping clock generator with buffered output on both phases, design of an event driven element for EDL system	**8**

TEXT BOOKS:
1. Introduction to Digital Integrated Circuits: Rabaey,Chandrakasan & Nikolic.
2. Principles of CMOS VLSI Design: Neil H.E. Weste and Kamran Eshraghian; Pearson.

REFERENCE BOOKS:
1. Introduction to Digital Circuits: *Rabaey* Jan M, Prentice-Hall of India Pvt. Ltd, Edition: 2nd, 2009.
2. VLSI Technology: S.M. Sze; McGraw-Hill. 4. Integrated Circuits: K.R. Botkar; Khanna

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO4
2EEPE62	Computer Architecture and very large-scale Integration	CO1	x	x		
		CO2		x	x	
		CO3			x	x

	Biomedical Engineering	L	T	P	C
Course Code:	22EEPE63	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVE (CO)

This course aims to guide the student to

1. Understand the basic human physiology.
2. Basic knowledge of the applications of measuring, recording and monitoring instruments.
3. The concepts of various medical instruments and supporting systems.

COURSE LEARNING OUTCOMES (CLO)

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

1. Learn the basic human physiology.
2. Understand the applications of measuring, recording and monitoring instruments.
3. Understand the concepts of various medical instruments and supporting systems.

UNIT	COURSE CONTENTS	HOURS
UNIT I	Introduction, generalized medical instrumentation system, components of instrumentation system, physiological systems of the body, cardiovascular system. Respiratory system, Nervous system generation of bioelectric potentials, Action potential, resting potential, Neuronal communication.	**8**
UNIT II	The electrode – electrolyte interface, Polarization, Ag/Agcl Electrodes, Body surface electrodes, Internal Electrodes. Transducers in general, Pressure Transducers, Temperature transducers, pulse sensors, Basic recording system, Direct Writing recorder, UV recorders, Thermal array recorders, Electrostatic recorder, Instrumentation Tape recorder.	**8**
UNIT III	Information content of an image, Modulation transfer function, Noise – equivalent bandwidth, generation of X-rays, X-ray machine, computed Tomography, Magnetic Resonance Imaging – Principle, Image reconstruction techniques, Basic NMR components, Ultrasonic Imaging systems – Types of ultrasound imaging, Applications of different scan, Bio Telemetry.	**8**
UNIT IV	Electrocardiogram, Effects of artifacts on ECG recordings, ECG recorder Principles, EEG & EMG recorders, Phonocardiogram, stethoscope, BP measuring Instrument- Sphygmomanometer and cardiac catheterization, ultrasonic blood flow meter, Principle of Photoelectric calorimeter, computerized patient monitoring system.	**8**
UNIT V	Pacemaker systems – Different pacing modes of operation, Transcutaneous Electrical Nerve stimulation (TENS) – Stimulation modes & application techniques, surgical diathermy, laser applications in medicine, Hemo Dialysis, Lithotripsy and introduction to electrical safety.	**8**

TEXT BOOKS

1. John. G. Webster, Editor, Medical Instrumentation, Application and Design, John Wiley & Sons.1989.

2. Prof. Venkataram. S.K.,Bio-Medical Electronics & Instrumentation, Galgotia Publications.2000

REFERENCE BOOKS

1. Khandpur.R.S., Hand book of Bio-Medical Instrumentation Tate McGraw –Hill1987

2. Dr.Arumugam , Bio-Medical Instrumentation ,Anuradha Agencies,1994.

3. Cromwell, Bio-Medical Instruments and Measurements, Prentice Hall of India, 1990.

4. John. Can.Brown, Introduction to Bio Medical Equipment Technology, Pearson Education of

ASIA, 2001.

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3
22EEPE63	Biomedical Engineering	CO1	x	x	
		CO2		x	x
		CO3			x

	Computer Aided Design and Manufacturing	L	T	P	C
Course Code: 22EEPE64	2	0	0	2	
Course Type: PE Pre-					
Requisite None	COURSE				

OBJECTIVES (CO)

- To introduce the student to the basic tools of computer-aided design (CAD) and computer aided manufacturing (CAM).
- To impart the parametric fundamentals to create and manipulate geometric models using curves, surfaces and solids.
- To understand the importance of solid modelling.
- To introduce how computer can be applied in mechanical engineering design.
- To perform part programming for CNC operation

COURSE LEARNING OUTCOMES (CLO)

After completion ofcourse, students would be able to:

- Explain lifecycle of a product and the role of computer-aided design (CAD) in product development.
- Create the different wireframe primitives, surface primitives and solid primitives using parametric representations.
- Apply geometric transformations on the created wireframe, surface and solid models.
- Understand concepts of modeling in 2D and 3D.
- Understand different CAD Packages and its features. Also, to apply the CNC machine tools and programming manufacturing processes

UNIT	COURSE CONTENTS	HOURS
UNIT-I	Fundamentals of computer graphics: Design process - Computer Aided Design – Computer graphics – co-ordinate systems- 2D and 3Dtransformations- homogeneous coordinates - graphic primitives (point, line, circle drawing algorithms)-Clipping- viewing transformation.	8
UNIT-II	Geometric modeling: Representation of curves - Hermite cubic spline curve, Bezier curve, B-spline curves, Surface Modeling – Surface Entities, representation of Surface, Bezier Surface, B-Spline Surface and Coons Surface. Solid Modeling - Solid Entities, Solid Representation, Boundary Representation (B-Rep), Sweeps Representation, Constructive Solid Geometry (CSG).	8
UNIT-III	Visual realism: Need for hidden surface removal, The Depth - Buffer Algorithm, Properties that help in reducing efforts, Scan Line coherence algorithm, Span - Coherence algorithm, Area-Coherence Algorithms, Warnock's Algorithm, Priority Algorithms– shading – coloring – computer animation.	8
UNIT-IV	CAD standards: Standards for computer graphics- Graphical Kernel System (GKS) - Open Graphics Library (OpenGL) - Data exchange standards - IGES, STEP, ACIS and DXF - communication standards.	8
UNIT-V	Computer numerical control machine tools: Numerical control (NC) machine tools – CNC: types, constructional details, special features. -Part programming fundamentals – manual programming – computer assisted part programming – Turning, Drilling and Milling. Introduction to Distributed Numerical control (DNC) Machines. Introduction to computer aided process planning.	8

TEXT BOOKS

1. Ibrahim Zeid, CAD / CAM–Theory and Practice, Tata Mcgraw-Hill, New Delhi, 2010.
2. Radhakrishnan. P., CAD / CAM / CIM - New age international, 2012.
3. Chairs Mcmahon and Jimmie Browne, CAD/CAM, Addision Wesly, New York, 2000.

REFERENCE BOOKS

1. Chandupatla and Belagundu, Introduction to Finite Element Methods in Engineering, Prentice Hall of India Private Limited, New Delhi, 1997.
2. Newman and Sproull R. F., Principles of interactive computer graphics, Tata Mcgraw-Hill,

New Delhi,1997.

3. Mikell P. Groover, CAD/CAM, Prentice Hall of India Private Limited, New Delhi, 1997.

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4	CLO5
22EEPE64	Computer Aided Design and Manufacturing	CO1	x				
		CO2		x			
		CO3			x	x	
		CO4				x	
		CO5					x

	Electrical & Electronics, Measurements and Instrumentation	L	T	P	C
Course Code:	23EEPE65	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES

1. To acquire fair knowledge on construction, working of measuring instruments, bridges and display devices
2. To understand the working of analog meters for power and energy measurements.
3. To learn the operation of different measuring and display devices.
4. To Comprehend the measurement of non- electrical quantities.
5. To understand the working of Instrument transformers and Recorders.

COURSE LEARNING OUTCOMES (CLO)

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

1. Understand the working of analog meters for power and energy measurements.
2. Learn the operation of different measuring and display devices.
3. Comprehend the measurement of non- electrical quantities.
4. Understand the working of Instrument transformers and Recorders.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	General Principles of measurements, units, dimensions, standards and calibration of meters. Characteristics of Instruments - qualities and errors of Measurements and its analysis. Analog Measuring Instruments: Classification of analog instruments, operating forces in indicating instruments, T/W ratio, pointers and scales. Working principle, theory, construction and salient features of electromechanical indicating / registering instrument viz. PMMC, Electrodynamometer, Moving iron, Rectifier type, Induction type for the measurement of dc and ac voltage, current, power, energy (1-phase induction type wattmeter), power factor (single phase Electrodynamometer), Volt ohmmeter or multimeter.	8
UNIT-II	Measurement of Resistances: Classification of resistances, measurement of medium resistance, Measurement of low resistance (Kelvin double bridge, Ammeter - Voltmeter) and Measurement of high resistance including loss of charge method and Mega ohm bridge method. AC Bridges: General theory of ac bridge, Measurement of self-inductance, Measurement of capacitance, Measurement of mutual inductance, Measurement of frequency, Sources of error in ac bridges and their minimization.	8
UNIT-III	Cathode Ray Oscilloscope: Principle and working of CRO, Block diagram presentation of CRO and brief description of various elements of CRO – CRT, horizontal Deflecting system, Vertical deflecting system, CRO screen, Measurement of voltage, frequency and phase angle using CRO, CRO probes.	8
UNIT-IV	Wattmeter & Energy meters: Principle of measuring power by using Dynamometer and Induction type wattmeter's; Errors and compensation; Low power factor polyphase wattmeter's; Energy meter – difference between wattmeter & energy meter; Principle of construction of Induction type energymeter; Error compensation and adjustments in energymeter. Special Type Meters : Construction and working principle of Frequency meter, Synchroscope, Power factor meter, Flux meter, Maximum demand meter.	8
UNIT-V	Instrument Transformers: Uses of instrument transformers; Theory of CT & PT; Ratio & phase angle errors; Error's compensations; Testing of CT & PT. Recorders: Different types of recorders; Construction, working principle and circuit diagrams of Strip-chart & X-Y recorders.	8

TEXT BOOKS

1. Ernest O Doebelin and Dhanesh N Manik,"Measurements systems Application and design", McGraw Hill publication, 5th edition, 2015.
2. Sawhney A.K, "A course in Electrical and electronic Measurement and Instrumentation", Dhanpat Rai & Sons, New Delhi, 2008

REFERENCE BOOKS

1. Stout MB, “Basic Electrical Measurements”, Prentice Hall of India Pvt Ltd., 2007.
2. Rajendra Prasad, “Electrical Measurements & Measuring instruments”, Khanna Publishers,
4th Edition, 2010.
3. Albert D Halfride & William D Cooper, “Modern Electronic instrumentation and measurement techniques”, Prentice Hall of India Pvt Ltd., 2007

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
23EEPE65	Electrical & Electronics, Measurements and Instrumentation	CO1	x	x	x	x
		CO2	x			
		CO3		x		
		CO4			x	
		CO5				x

	Electron Devices and Circuits	L	T	P	C
Course Code:	23EEPE66	3	0	0	3
Course Type:	PC				
Pre-Requisite	None				

COURSE OBJECTIVES

1. To familiarize the students with operating point calculations and working of basic amplifiers.
2. To familiarize the students with working of different types of feedback amplifiers & oscillators.
3. To familiarize the students with frequency response and design of tuned amplifiers.
4. To familiarize the students with basic working & design of wave shaping circuits.

COURSE LEARNING OUTCOME

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

1. Understand the concept of multistage amplifiers, analysis of multistage amplifier and its frequency response, Darlington pair and bootstrap circuits.
2. Learn the basics of tuned amplifiers such as single tuned, double tuned, stagger tuned & power amplifiers.
3. Study and analyze the performance of negative as well as positive feedback circuits.
4. Study and analyze the wave shaping circuits and operational amplifies.

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- Cascode amplifier-Darlington Bootstrap amplifier- Differential amplifier. Large signal model(BJT). Simulation and implementation of Darlington Bootstrap amplifier- Differential amplifier.	8
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 re model. Small Signal analysis of BJT, Cascade amplifier- Cascode amplifier-Darlington Bootstrap amplifier- Differential amplifier. Large signal model (FET) Simulation and implementation of Darlington Bootstrap amplifier- Differential amplifier by using MOSFET.	8
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. Simulation and implementation of RC & LC oscillators.	8
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. Simulation and implementation Class-B push pull amplifier	8
UNIT-V	PERIPHERAL INTERFACES FREQUENCY RESPONSE AND WAVE SHAPING CIIRCUITS Low frequency and High frequency response of BJT and FET amplifier. Nonlinear wave shaping circuits: Astable - Bistable – Monostable Multivibrators. Schmitt Trigger - Time Base Generators.	8

TEXT BOOKS

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

REFERENCE BOOKS

1. David A Bell, “Electronic Devices and Circuits”, Prentice Hall of India, 1998.

2. JacobMillman, Christos C Halkias, “Electron Devices and Circuits”, Tata McGraw Hill, Edition 1991
3. Donald L Schilling, Charles Belove, “Electronic Circuits”, 3rd edition, 1989
4. Stanley G. Burns , Paul R,Bond, “ Principles of Electronic Circuits ” ,Galgottia publishers

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
23EEPE66	Electron Devices and Circuits	CO1	x	x		
		CO2		x		
		CO3			x	
		CO4				x

	Discrete Transforms and Signal Processing	L	T	P	C
Course Code:	23EEPE67	3	0	0	3
Course Type:	PC				
Pre-Requisite	NONE				

COURSE OBJECTIVES

1. To acquire in depth knowledge in analyzing discrete time signals and systems in the time and frequency domain and also in designing filters.
2. To develop students' understanding about discrete Fourier transform and its properties.
3. To design IIR filters using analog to digital transformation.
4. To design FIR filters using windows technique. Also, to understand digital signal processors and their programming.

COURSE LEARNING OUTCOMES (CLO)

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

1. Classify signals and systems and their mathematical representation.
2. Learn discrete Fourier transform and its properties.
3. Design IIR filters using analog to digital transformation.
4. Design FIR filters using windows technique. Also, to understand digital signal processors and their programming.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	Discrete Time Signals and Systems 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.	8
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	8
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.	8
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.	8
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.	8

TEXT BOOKS

1. John. G. Proakis , Dimitris .G. Manolakis, “Digital Signal Processing: Principles, Algorithms & Applications”, Prentice Hall of India, New Delhi, 2014
2. Oppenheim, A.V.and Schaffer, R.W., “Discrete Time Signal Processing”, Prentice Hall of India, New Delhi,2007

REFERENCE BOOKS

3. Emmanuel C. Ifeachor, Barrie W.Jervis, “Digital Signal Processing , A Practical approach”,
Pearson Education India Series, New Delhi, 2004
4. Sanjit K.Mitra, “Digital Signal Processing, A Computer based Approach”, Tata McGrawHill Publishing Company Limited, New Delhi, 2010
5. Lonnie C.Ludeman, “Fundamental of Digital Signal Processing”, John Wiley & Sons, New Jersey, 2003.
6. Venkataramani.B.,Bhaskar.M. “ Digital Signal Processors, Architecture, Programming and Application”, Tata McGrawHill, New Delhi,2003
7. Johny R. Jhonson, “Introduction to Digital Signal Processing” PHI, 2006
8. Robert X. Gao and Ruqiang Yan, Wavelets: Theory and Applications for Manufacturing, Springer, 2010.

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
23EEPE67	Discrete Transform and Signal Processing	CO1	x			
		CO2		x		
		CO3			x	
		CO4				x

	Renewable Energy Sources	L	T	P	C
Course Code:	23EEPE68	3	0	0	3
Course Type:	PC				
Pre-Requisite	NONE				

COURSE OBJECTIVES

1.To create awareness about sources of energy and able to estimate how long the available conventional fuel reserves will last.
2.To learn the fundamental concepts about solar energy systems and devices.
3.To design wind turbine blades and know about applications of wind energy for water pumping and electricity generation.
4.To understand the working of OTEC system and different possible ways of extracting energy from ocean, know about Biomass energy, mini-micro hydro systems and geothermal energy system.

COURSE LEARNING OUTCOMES (CLO)

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

1. Analyze the energy scenario of the world and nation.
2. Carry out a comparative analysis of different types of coal, including their treatment, liquefaction and gasification.
3. Compare the liquid and gaseous fuels sourced from petroleum including their characterization.
4. Analyze the potential of alternate energy sources and their scope and limitations.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	Introduction to Energy Sources: World energy futures, Conventional energy sources, Nonconventional energy sources, Prospects of Renewable energy sources. Environmental Aspects of Electric Energy Generation: Introduction Thermal pollution, Atmospheric pollution, Effects of Hydroelectric projects, Nuclear power generation and environment, Green House Gas Effects, Global Environmental awareness, Energy options for Indian Economy.	8
UNIT-II	Solar Energy: Introduction to solar radiation and its measurement, Introduction to Solar energy Collectors and Storage, Solar thermal electric conversion, Thermal electric conversion systems, Solar electric power generation, Solar photo-voltaic, Solar Cell principle, Semiconductor junctions, Conversion efficiency and power output, Basic photovoltaic system for power generation.	8
UNIT-III	Wind Energy and Wind Energy Conversion: Introduction to wind energy conversion, the nature of the wind, Power in the wind, Wind data and energy estimation, Site Selection considerations, basic Components of a Wind energy conversion system, Classification of WEC Systems, Schemes for electric generation using synchronous generator and induction generator, wind energy storage.	8
UNIT-IV	BIOMASS ENERGY Biomass conversion technologies bio mass generation, classification of Bio Gas Plants material used in Bio Gas Plants., Selection of site & applications. MHD & Hydrogen Energy: Basic Principle MHD SYSTEM, advantages, Power OUTPUT of MHD Generation, future Prospects. Principle and classification of fuel cell energy, hydrogen as alternative fuel for Generation of Electrical Energy & applications. Fuel Cell: Fuel Cell, Management of Fuel, Thermonic power generation.	8
UNIT-V	HYDRO POWER AND OTHER RENEWABLE ENERGY SOURCES Hydropower: Introduction, Capacity and Potential, Small hydro, Environmental and social impacts. Tidal Energy: Introduction, Capacity and Potential, Principle of Tidal Power, Components of Tidal Power Plant, Classification of Tidal Power Plants. Ocean Thermal Energy: Introduction, Ocean Thermal Energy Conversion (OTEC), Principle of OTEC system, Methods of OTEC power generation. Geothermal Energy: Introduction, Capacity and Potential, Resources of geothermal energy.	8

TEXT BOOKS

1. Sukhatme. S.P., Solar Energy, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997.
2. B. H. Khan, Non-Conventional Energy Resources, , The McGraw Hill
3. Twidell, J.W. & Weir, A. Renewable Energy Sources, EFN Spon Ltd., UK, 2006.
4. S. P. Sukhatme and J.K. Nayak, Solar Energy – Principles of Thermal Collection and Storage, Tata McGraw-Hill, New Delhi.
5. Garg, Prakash, Solar Energy, Fundamentals and Applications, Tata McGraw Hill.

REFERENCE BOOKS

1. G.D. Rai, Non-Conventional Energy Sources, Khanna Publications, New Delhi, 2011.
2. Godfrey Boyle, “Renewable Energy, Power for a Sustainable Future”, Oxford University Press, U.K., 1996.
3. Khandelwal, K.C., Mahdi, S.S., Biogas Technology – A Practical Handbook, Tata McGraw- Hill, 1986.
4. Tiwari. G.N., Solar Energy – “Fundamentals Design, Modeling & Applications”, Narosa Publishing House, New Delhi, 2002.
5. Freris. L.L., “Wind Energy Conversion Systems”, Prentice Hall, UK, 1990.
6. Frank Krieth& John F Kreider ,Principles of Solar Energy, John Wiley, New York

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
23EEPE68	Renewable Energy Sources	CO1	x			
		CO2		x		
		CO3			x	
		CO4				x

	Modern Control Systems	L	T	P	C
Course Code:	23EEPE69	3	0	0	3
Course Type:	PC				
Pre-Requisite	NONE				

COURSE OBJECTIVES

1.To impart knowledge about developing state space models from differential/transfer function based descriptions of linear systems.
2.To introduce difference equation description of discrete time LTI systems and analyzing their stability.
3.To introduce the typical nonlinear systems and to analyze the stability of such systems.
4.To introduce the preliminary understanding about the advanced control methodologies used to handle systems with uncertainty.

COURSE LEARNING OUTCOMES (CLO)

At the end of the course, the student will be able to
1.Develop different state space representations for linear time invariant systems.
2.Write descriptions for discrete time systems and analyse the stability of such systems.
3.Understand and justify the peculiar behaviours shown by nonlinear systems.
4.Analyse the stability of nonlinear systems using phase plane, describing function and Lyapunov method.

UNIT	COURSE CONTENTS	HOURS
UNIT -I	State Variable Analysis and Design: Introduction, concept of state, state variable and state model, state space representation of systems, block diagram for state equation, Transfer function decomposition, direct, parallel and cascade decomposition, solution of state equations, concept of controllability and observe ability, controller design using pole placement by state feedback, controller design using state observer.	8
UNIT -II	Sampled Data Control: Introduction, digital control systems, quantization concept, data acquisition, conversion and distribution system, z-transform, Important properties, inverse z transform, difference equation and solution using z-transform, Impulse sampling and data hold, reconstruction of original signals from the sampled version.	8
UNIT -III	Analysis of Discrete Time Systems : Pulse transfer function for open loop and closed loop systems, mapping between z-plane and s-plane, stability analysis using Jury's test, bilinear transformation and Schur-Cohn criteria, state space representation of discrete time systems and solution of discrete time state equations.	8
UNIT -IV	Analysis of Nonlinear Systems : Introduction : Behaviour of Non linear Systems, Investigation of nonlinear systems. Common Physical Non Linearities: Saturation, Friction, Backlash, Relay, Multivariable Nonlinearity. The Phase Plane Method: Basic Concepts, Singular Points: Nodal Point, Saddle Point, Focus Point, Centre or Vortex Point, Stability of Non Linear Systems: Limit Cycles, Construction of Phase. Trajectories: Construction by Analytical Method, Construction by Graphical Methods. The Describing Function Method: Basic Concepts: Derivation of Describing Functions: Dead-zone and Saturation, Relay with Dead-zone and Hysteresis, Backlash. Stability Analysis by Describing Function Method: Relay with Dead Zone, Relay with Hysteresis, Stability Analysis by Gain-phase Plots. Jump Resonance. Liapunov's Stability Analysis: Introduction, Liapunov's Stability Criterion: Basic Stability Theorems, Liapunov Functions, Instability. Direct Method of Liapunov & the Linear System: Methods of constructing Liapunov functions for Non linear Systems.	8
UNIT -V	Neuro-Fuzzy Modelling and Control of Systems Fuzzy Models- Mamdani and Takagi Sugeno Models- Construction of fuzzy models. Neural networks, Adaptive networks, supervised learning, Adaptive neuro-fuzzy inference systems, ANFIS architecture - ANFIS as a universal approximator - Simulation examples.	8

TEXT BOOKS

1. Discrete time Control Systems by K. Ogata, Prentice Hall International.
2. Control System Engineering by I.J. Nagrath and M. Gopal, Wiley Eastern.
3. Digital Control Systems by B.C. Kuo, Oxford University Press.

REFERENCE BOOKS

1.Digital control and state variable methods by M. Gopal, Tata McGraw Hill.
2.Applied Nonlinear Control by J.J.E. Slotine & W. Li, Prentice Hall, Englewood Cliffs, New

Jersey.

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

SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4
23EEPE69	Modern Control System	CO1	x			
		CO2		x		
		CO3			x	
		CO4				x

	Professional English	L	T	P	C
Course Code:	23AEC101/23AEC201	2	0	0	2
Course Type:	AEC				
Pre-Requisite	None				

COURSE OBJECTIVES

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 (CLO)

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

The syllabus has been prepared in alignment 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.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	**Introduction to Communication** • The importance of communication through English at the present time; the process of communication and factors that influence communication: sender, receiver, channel, code, topic, message, context, feedback, 'noise', filters and barriers; • Verbal and non-verbal communication • Listening Skills: Importance and types of Listening • Identifying and rectifying common errors: Subject-verb agreement, Concord, Types of Sentences (Statements, interrogative, exclamatory and imperative, wh- questions, question-tags) Use of modals • Vocabulary Building, word collocation	6
UNIT-II	**Workplace Communication** • Communication challenges in culturally diverse workforce; Ethics in Communication • Bias-free communication • Effective Business Presentations: Importance in workplace communication; Planning, Preparing, Organizing, Rehearsing, and Delivering Oral presentations, Handling Questions; Power Point Presentation	6
UNIT-III	**Writing at Work** • Business letters • Writing notices, circulars, emails. • Writing reports and precis writing • Writing CVs (for Technical Positions and Internships)	6
UNIT-IV	**Soft Skills/Life Skills** • Body Language • Connected Speech (Intonation in Everyday Speaking and Conversation) • Types of interviews, Planning and preparing for a Job Interview; Stages of an Interview; Mastering the art of giving interviews.	6

TEXT BOOKS

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

2. Business Communication by Carol M Lehman, Debbie D Dufrene and Mala Sinha. Cengage Learning. 2nd Edition.

3. A Textbook of English Phonetics for Indian Students by T. Balasubramanian [MACMILLAN]

4. Soft Skills: Key to Success in Workplace and Life by Meenakshi Raman and Shalini Upadhyay. Cengage Learning. 2018 Edition.

REFERENCE BOOKS

1. Technical Communication, Principle and Practice by Meenakshi Raman & Sangeeta Sharma, Oxford University Press.

2. Communication skill by Sanjay Kumar & Puspa Lata, Oxford University Press. 2nd Edition.

3. Business Communication Today by Courtland L Bovee and Thill, Pearson

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
I/II	**23AEC101/23AEC201**	**Professional English**	CO1	x				
			CO2		x	x		
			CO3			x		
			CO4				x	
			CO5					x

	Professional English Lab	L	T	P	C
Course Code:	23AEC151/23AEC251	0	0	2	1
Course Type:	AEC				
Pre-Requisite	None				

COURSE OBJECTIVES

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
5. both in their writing and speaking.
6. To study, understand and implement each unit according to National Education Policy 2020 and Bloom's Taxonomy.

COURSE LEARNING OUTCOMES (CLO)

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

The syllabus has been prepared in alignment 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.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	**Unit-I** • Listening and Speaking • Accent in speech • Longer Discourse (dialogues, songs, contextual speech etc.) • Role-play • Practicing sounds of English • Extempore • Presentations	2
UNIT-II	**Unit-II** • Reading comprehension practice: Technical text • General text	2
UNIT-III	**Unit-III** • Guided composition • Free-writing	2

TEXT BOOKS

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

2. Business Communication by Carol M Lehman, Debbie D Dufrene and Mala Sinha. Cengage Learning. 2nd Edition.

3. A Textbook of English Phonetics for Indian Students by T. Balasubramanian [MACMILLAN]

4. Soft Skills: Key to Success in Workplace and Life by Meenakshi Raman and Shalini Upadhyay. Cengage Learning. 2018 Edition.

REFERENCE BOOKS

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

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
I/II	**23AEC151/23AEC251**	**Professional English Lab**	CO1	x				
			CO2		x	x		
			CO3			x		
			CO4				x	
			CO5					x
			CO6					x

	GERMAN LANGUAGE PHASE - I	L	T	P	C
Course Code:	23AEC103	2	0	0	2
Course Type:	AEC				
Pre-Requisite	None				

COURSE OBJECTIVES

1. To develop oral and written skills of understanding, expressing and exchanging Information/ interacting.
2. To develops the ability to construct sentences and frame questions.
3. To provide German language as a competitive edge in career choices.
4. To know the culture of the countries where the German language is spoken.
5. This may be useful in the field of employment opportunities as well as helping them to develop projects on browsing German websites

COURSE LEARNING OUTCOMES (CLO)

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

1. Read and write short, simple texts.
2. Have Fluency in reading and writing.
3. Understand a 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.
5. Developing pronunciation so that they can read the text and e-mail during their employment, instructing them to write their own CV and developing a fundamental conversation with any German national.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	INTRODUCTION Grüße, Wortschatz	8
UNIT-II	THEMEN Das Alphabet, die Aussprache, die Zahlen, Land und Stadt beschreibung, Berufe, rede über Dinge, die Zeit, Mahlzeiten und Getränke	8
UNIT-III	GRAMMATIK Plural, Artikel, Possessive Artikel, Adjektive, Sich vorstellen, Verben (regulär, unregelmäßig, Pronomen), Nominativ Pronomen, Präpositionen	8
UNIT-IV	WORTSCHATZ emanden vorstellen, Nationalitäten, Länder, Zahlen, Über die Wochentage sprechen, Die Monate des Jahres, Die Berufe, Die Farben, Die Gegensätze, Die Sätze mit der Zeit	8
UNIT-V	MÜNDLICHER AUSDRUCK Mündliche und Höraktivitäten	8

TEXT BOOK

1. Tangram aktuell 1 (Lektion 1-4 Kursbuch + Arbeitsbuch, Lektion 5-8 Kursbuch + Arbeitsbuch, Übungsheft)

REFERENCE BOOKS

1. Wolfgang Hieber: Lernziel Deutsch, Teil 1. Max Hueber Verlag

2. Korbinian Braun, u.a.: Deutsch als Fremdsprache IA, Grundkurs. Ernst Klett Stuttgart

3. Rolf Brüseke: Starten Wir! A1. München: Hueber Verlag

Evaluation:

The evaluation of students' performance in this course will consist of internal tests, class participation and external end-semester examination in accordance with the rules and regulations of the University.

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
I	23AEC103	GERMAN LANGUAGE PHASE - I	CO1	x				
			CO2		x	x		
			CO3			x		
			CO4				x	
			CO5					x

	FRENCH LANGUAGE PHASE – I	L	T	P	C
Course Code:	23AEC104	2	0	0	2
Course Type:	AEC				
Pre-Requisite	None				

COURSE OBJECTIVES

1. To develop oral and written skills of understanding, expressing and exchanging Information/ interacting.
2. To develops the ability to construct sentences and frame questions.
3. To provide French language as a competitive edge in career choices.
4. To know the culture of the countries where the French language is spoken.

COURSE LEARNING OUTCOMES (CLO)

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

1. Read and write short, simple texts.
2. Have Fluency in reading and writing.
3. Understand a 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 French language is spoken.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	INTRODUCTION Les Salutations, Vocabulaire	8
UNIT-II	SUJETS L'Alphabet, Le Prounciation, Les Nombres, Décrire votre pays, ville, Les Professions, Parler de choses,L'Heure, Les Repas et les boissons	8
UNIT-III	GRAMMAIRE Le Nom et le pluriel des noms, Les Articles, Les Adjectifs Possessifs, Les Adjectifs Qualificatifs, Se présenter, Les Verbes (Regular, irregular, pronominaux), Les Pronoms Sujet, Les Prépositions, L'interrogation	8
UNIT-IV	LEXIQUE Présenter quelq'un, Les nationalités, Les Pays, Les Nombres, Parler des jours de la semaine, Les mois de l'année, Les Professions, Les Couleurs, Les Contraires, Les phrase avec l'heure	8
UNIT-V	**L'EXPRESSION D'ORALE** Les activites d'orale et ecouter	8

TEXT BOOK

1. Version Originale – 1 Livre de l'élève: Monique Denyer, Agustin Garmendia, Marie-Laure Lions Olivieri, Editions Maisons des Langues, Paris

REFERENCE BOOKS

1. Nathan verbs conjugasion , Le Robert Nathan, Paperback
2. Larrouse French to English Dictionary, Larrouse, Paperback
3. Le Nouveau Sans Frontiers, Vol. 1, P. Dominique, J. Girardet et al, Cle International, Paris.

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	23AEC104	FRENCH LANGUAGE PHASE – I	CO1	x			
			CO2		x	x	
			CO3			x	
			CO4				x

	GERMAN LANGUAGE PHASE - II	L	T	P	C
Course Code:	23AEC203	2	0	0	2
Course Type:	AEC				
Pre-Requisite	23AEC103				

COURSE OBJECTIVES

1. Students will demonstrate their ability to recognize, identify, extract and/or differentiate key information conveyed in spoken announcements, instructions, and in interactions between native speakers on familiar topics.
2. Students will demonstrate effective speaking and listening skills in German on informal and some formal topics related to personal, professional, academic, and leisure activities
3. To develop awareness of the nature of language and language learning

COURSE LEARNING OUTCOMES (CLO)

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

1. After completion of this student will be able to read and write short, simple texts.
2. After completion of this student will have Fluency in reading and writing.
3. After completion of this student will able to use language creatively and spontaneously.
4. Students will get awareness of cross-cultural and intercultural difference.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	THEMEN Einkaufen, Tagesablauf, Lebenslauf , Nach dem Weg fragen, Wegbeschreibungen, Der Körper, Ereignisse der Vergangenheit erzählen	8
UNIT-II	GRAMMATIK Trennbare und untrennbare Verben, Dativ , Modalverben, Präteritum von sein, haben, Perfekt	8
UNIT-III	WORTSCHATZ Kleidung, Haushaltswaren, Sachen zum Essen und Trinken, Verkehrsmittel, Namen von Orten und Sehenswürdigkeiten, Information über Deutschland, Ordinalzahlen	8
UNIT-IV	KOMPOSITION Themen zum schreiben wie Deutschland und Delhi, was haben Sie am wochenende gemacht, Traummann/Traumfrau	8
UNIT-V	Mündlicher Ausdruck Sprechen uber die Stadt, Das Haus, Meine Famile	8

TEXT BOOK

1. Tangram aktuell 1 (Lektion 1-4 Kursbuch + Arbeitsbuch, Lektion 5-8 Kursbuch + Arbeitsbuch, Übungsheft)

REFERENCE BOOKS

1. Wolfgang Hieber: Lernziel Deutsch, Teil 1. Max Hueber Verlag
2. Korbinian Braun, u.a.: Deutsch als Fremdsprache IA, Grundkurs. Ernst Klett Stuttgart
3. Rolf Brüseke: Starten Wir! A1. München: Hueber Verlag

Other Resources:

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

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
II	23AEC203	GERMAN LANGUAGE PHASE - II	CO1	x			
			CO2		x		
			CO3			x	x

	FRENCH LANGUAGE PHASE – II	L	T	P	C
Course Code:	23AEC204	2	0	0	2
Course Type:	AEC				
Pre-Requisite	23AEC104				

COURSE OBJECTIVES

1. To Demonstrate an elementary knowledge of French sentence structure through speaking and writing
2. To develop the language proficiency required to communicate effectively in French
3. To form a sound base of the skills, language and attitudes required for progression to work or further study, either in French or another subject area.
4. To develop awareness of the nature of language and language learning

COURSE LEARNING OUTCOMES (CLO)

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

1. After completion of this student will be able to read and write short, simple texts.
2. After completion of this student will have Fluency in reading and writing.
3. After completion of this student will able to use language creatively and spontaneously.
4. After completion of this student will able to know the culture of the countries where the French language is spoken.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	SUJETS La France, Le Fromage, le vin, Les saisons, Les recettes, Indiquer un chemin, Demander la direction, Donner des indications, Le corps, Les elements du passé, Raconteur une journée	8
UNIT-II	GRAMMAIRE La negation, L'imperatif ,Le passé recent,Le future, Le passé compose, L'imparfait, Les nombres ordinaux	8
UNIT-III	LEXIQUE Les vêtements, Les animaux, Parler de prix, Le corps, Vocabulaire de la gare et du train, Le voyage, Les achats Les Prepositions, L'interrogation	8
UNIT-IV	Composition les sujets pour l'ecriture comme la maison, l'ecole	8
UNIT-V	**L'expression d'orale** Les etudiants ecrivent le petit paragraphess sur les sujets en utillisant les expression et le temps comme ma maison , ma famille.	8

TEXT BOOK

1. Version Originale – 1 Livre de l'élève: Monique Denyer, Agustin Garmendia, Marie-Laure Lions Olivieri, Editions Maisons des Langues, Paris

REFERENCE BOOKS

1. Nathan verbs conjugasion , Le Robert Nathan, Paperback
2. Larrouse French to English Dictionary, Larrouse, Paperback
3. Le Nouveau Sans Frontiers, Vol. 1, P. Dominique, J. Girardet et al, Cle International, Paris.
5. Alter Ego Part 1
6. Echo Part 1

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
II	23AEC204	FRENCH LANGUAGE PHASE – II	CO1	x			
			CO2		x		
			CO3			x	
			CO4				x

Value Added Courses

	Environmental Protection, Sustainable development & Living	L	T	P	C
Course Code:	23VAC101/23VAC201	2	0	0	2
Course Type:	VAC				
Pre-Requisite	None				

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.

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-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).	2
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/

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

	INDIAN CONSTITUTION & POLITY	L	T	P	C
Course Code:	23VAC102/23VAC202	2	0	2	2
Course Type:	VAC				
Pre-Requisite	None				

COURSE OBJECTIVES

1. To acquaint the students with legacies of constitutional development in India and help them to understand the most diversified legal document of India and philosophy behind it.
2. To make students understand the detailed analysis and importance of Fundamental Rights, their relationship with Directive Principles and the significance of Fundamental Duties.
3. To acquaint the students with the way social, political and economic justice could be realized.
4. To acquaint the students with the basic postulates of constitutional framework regarding the organization, powers and functions of the various organs of the State.
5. To channelize students' thinking towards basic understanding of the legal concepts and its implications for engineers.
6. To acquaint students with latest intellectual property rights, relating to patent & copyright and innovation environment with related regulatory framework.

COURSE LEARNING OUTCOMES (CLO)

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

1. Identify and explore basic concepts in the Constitution and understand their applicability & scope and the importance of the role of judiciary in ensuring checks an balances.
2. Differentiate different aspects of Indian Legal System and its related bodies
3. To appreciate the critical Interface between fundamental Rights and directive principles of state policy and apply the rationale to emerging issues and challenges.
4. Know about the enforcement remedies available under the Constitution of India
5. To apply Intellectual Property Law principles to real problems and analyse the social impact of Intellectual Property Law and Policy
6. To apply the very dynamics of IP Law to the individuals, MNC's and other possible stakeholders.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	Meaning of the Constitution, Constitutional Law and Constitutionalism, Historical Background of the Constituent Assembly, Government of India Act of 1935 and Indian Independence Act of 1947, Enforcement of the Constitution, Indian Constitution and its Salient Features, The Preamble of the Constitution, Federal Nature of the Constitution, Parliamentary System	5
UNIT-II	Fundamental Rights: Right to Equality (Articles 14 to 18), Right to Freedom (Articles 19 to 22), Right against Exploitation (Articles 23 to 24), Right to Freedom of Religion (Articles 25 to 28), Cultural and Educational Rights (Articles 29 to 30), Directive Principles of State Policy (Article 36-51), Fundamental Duties (Article 51 A)	5
UNIT-III	Powers and Functions of the President and the Prime Minister (Articles 52-62, 74-78), Powers of Indian Parliament: Functions of Rajya Sabha, Functions of Lok Sabha , Centre-State Relations (Article 245-293) (Briefly refer Disaster Management Act 2005),Judiciary – Supreme Court: Appointment of Judges, Judicial Review, Writ jurisdiction (Article 32, 124,126) Functions of High Court and Subordinate Courts (Article 217, 224, 226, 233), Amendment of the Constitution: Powers and Procedure (Article 368)	5
UNIT-IV	Regulation to Information- Introduction, Right to Information Act, 2005, Information Technology Act, 2000, Intellectual Property Laws: Introduction, Legal Aspects of Patents, Filing of Patent Applications, Rights from Patents, Infringement of Patents Copyright and its Ownership, Infringement of Copyright, Civil Remedies for Infringement.	5

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
I/II	**23VAC102/23VAC202**	INDIAN CONSTITUTION & POLITY	CO1	x	x	x			
			CO2		x		x		
			CO3			x	x		
			CO4				x	x	
			CO5						x
			CO6						x

	Sports, Yoga & Fitness	L	T	P	C
Course Code:	23 VAC 103	1	0	2	2
Course Type:	VAC				
Pre-Requisite	None				

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.

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 groupRelationship, 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

Mapping Matrix between Course Objectives and Course Learning Outcomes:

SEM	SUB CODE	Course name	Course Objectives	CLO 1	CLO 2	CLO 3	CLO 4	CLO5
III	23 VAC 103	Sports , Yoga & Fitness	CO1	x				
			CO2		x	x		
			CO3			x		
			CO4				x	
			CO5					x

Multidisciplinary Courses

	Management Process & Organizational Behaviour	L	T	P	C
Course Code:	23MDC 4XX	3	0	0	3
Course Type:	Multidisciplinary				
Pre-Requisite	NONE				

COURSE OBJECTIVES

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 (CLO)

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.
   Identify group behaviour, leadership styles and the role of leaders in a decision making process.

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.

Evaluation:

The evaluation of students' performance in this course will consist of internal tests, class participation and external end-semester examination in accordance with the rules and regulations of the University.

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	23MDC 4XX	Principals of Management & Organizational Behaviour	CO1	x			
			CO2		x		
			CO3			x	
			CO4				x

	Personal Financial Planning	L	T	P	C
Course Code:	23MDC402	3	0	0	3
Course Type:	Multidisciplinary Course				
Pre-Requisite	NONE				

COURSE OBJECTIVES

1. To help the students gain understanding of the basic accounting skills
2. The students will be able to acquire technical knowledge of the financial accounting formats.
3. The students will be able to acquire skills of a finance manager
4. To acquire conceptual knowledge of the financial statement for analysis.

COURSE LEARNING OUTCOMES (CLO)

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

1. Understand the concepts related to financial accounting.
2. Understand and apply a theoretical basis upon which they will develop their knowledge in other areas of Accounting.
3. Understand the basic concept of Financial management and role of finance manager
4. Understand the specific format and formulae for analysis of financial statement.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	**INTRODUCTION** Accounting as an information system, the users of financial accounting information and their needs. Functions, advantages and limitations of accounting. The nature of financial accounting principles – Basic concepts and conventions: entity, money measurement, going concern, cost, realization, accruals, periodicity, consistency, prudence (conservatism), materiality and full disclosures. Basics of Journal entry and ledger posting	8
UNIT-II	Accounting Process: From recording of a business transaction to preparation of Trial balance, Knowledge of Final Account, Format and content of Profit & Loss Account, Basics of Balance sheet with format.	8
UNIT-III	Finance : meaning, need of finance, role of a finance manager, difference between accounting and finance, sources of finance, Financial Decisions- Investment Decision, Financing Decision, Dividend Decision	8
UNIT-IV	Basic knowledge of financial statement analysis, Common size statement, Comparative statement, Ratio Analysis: Current Ratio, leverage ratio, profitability ratio, solvency ratio. Basic knowledge of Fund flow and cash flow statement with format	8

REFERENCE BOOKS

1. Maheshwari, S.N.: -Financial Accounting, Sultan Chand, New Delhi
2. M.C. Shukla, T.S. Grewal, and S.C. Gupta, Advanced Accountancy; S Chand & Sons
3. Prasanna Chandra, Fundamentals of Financial Management. McGraw Hill Education

Evaluation:

The evaluation of students' performance in this course will consist of internal tests, class participation and external end-semester examination in accordance with the rules and regulations of the University.

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	23MDC4XX	Personal Financial Planning	CO1	x			
			CO2		x		
			CO3			x	
			CO4				x

	Library Information Science & Media Literacy	L	T	P	C
Course Code:	23MDC4XX	3	0	0	3
Course Type:	MDC				
Pre-Requisite	NONE				

COURSE OBJECTIVES

The Course is designed with the following objectives:

1: To know the library collection and their 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 (CLO)

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.

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

Evaluation:

The evaluation of students' performance in this course will consist of internal tests, class participation and external end-semester examination in accordance with the rules and regulations of the University.

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	23MDC4XX	Library Information Science & Media Literacy	CO1	x			
			CO2		x		
			CO3			x	
			CO4				x

	IPR for Business	L	T	P	C
Course Code:	23MDC4XX	3	0	0	3
Course Type:	Multidisciplinary Course (MDC)				
Pre-Requisite	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

At the end of this course, the students would 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

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-	8

	Designs, Plant varieties – commercialization - Monsanto cases, Geographical Indications, Biotechnology and IPR	

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

Evaluation:

The evaluation of students' performance in this course will consist of internal tests, class participation and external end-semester examination in accordance with the rules and regulations of the University.

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	23MDC4XX	IPR for Business	CO1	x				
			CO2		x			
			CO3			x		
			CO4				x	
			CO5					x

	Psychology and Emotional Intelligence	L	T	P	C
Course Code:	23MDC5XX	3	0	0	3
Course Type:	MDC				
Pre-Requisite	NONE				

COURSE OBJECTIVES

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 (CLO)

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 between Course Objectives and Course Learning Outcomes:

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 Interactionism, Exchange Theory, Labelling Theory	8
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)

Evaluation:

The evaluation of students' performance in this course will consist of internal tests, class participation and external end-semester examination in accordance with the rules and regulations of the University.

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
V	23MDC5X X	Psychology and Emotional Intelligence	CO1	x					
			CO2		x				
			CO3			x			
			CO4				x		
			CO5					x	x

	Indian Economy	L	T	P	C
Course Code:	23MDC5XX	3	0	0	3
Course Type:	Multidisciplinary Course				
Pre-Requisite	NONE				

COURSE OBJECTIVES

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 (CLO)

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

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.

Evaluation:

The evaluation of students' performance in this course will consist of internal tests, class participation and external end-semester examination in accordance with the rules and regulations of the University.

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	23MDC5XX	Indian Economy	CO1	x		
			CO2		x	
			CO3			x

	Electoral Literacy in India	L	T	P	C
Course Code:	23MDC604	3	0	0	3
Course Type:	MDC				
Pre-Requisite	NONE				

COURSE OBJECTIVES

1.To know the meaning and nature of the electoral democracy in India

2.To discuss electoral institutions in India

3.To understand the procedural aspect of elections in India

4.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)

At the end of the course, the student 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.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	**Elections in India** Suffrage, Types, and Methods of Elections, Parliamentary elections: Lok Sabha & Rajya Sabha, Presidential Elections, State Legislative Assembly Elections, Local Body Elections	8
UNIT-II	**Electoral Institutions** Election Commission (EC) State Election Commission Constitution: Part-15	8
UNIT-III	**Political Parties in India** One-party, Two Party, Multi-party system Model Code of Conduct, Party Funding, and Campaign	8
UNIT-IV	**Elections: Issues and Challenges**	8

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

Evaluation:

The evaluation of students' performance in this course will consist of internal tests, class participation and external end-semester examination in accordance with the rules and regulations of the University.

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
VI	23MDC604	Electoral Literacy in India	CO1	x			
			CO2		x		
			CO3			x	
			CO4				x

	Life science and Public Health	L	T	P	C
Course Code:	23MDC6XX	3	0	0	3
Course Type:	MDC				
Pre-Requisite	NONE				

COURSE OBJECTIVES

1. Basic concepts of life science and public health.
2. To recognize the factors causing environmental degradation and its outcome in the form of increasing number of diseases leading to deterioration of public health.
3. Analyse and debate therapeutic, diagnostic and preventive measures for communicable and non-communicable disease.

COURSE LEARNING OUTCOMES (CLO)

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

1. Familiarize with various aspects of environmental and biological risks and hazards.
2. Be aware about the various factors impacting human health through case studies and modes of prevention.
3. Learn about diagnosis, therapy and prevention of various diseases.
4. Be sensitized about social health problems for betterment of human race and all living beings.

UNIT	COURSE CONTENTS	HOURS
UNIT-I	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.	8
UNIT-II	Environment and Health hazards Environmental degradation, Environmental Pollution – Air, water, soil and noise; Associated health hazards.	8
UNIT-III	Communicable Diseases Different types of communicable diseases and their control measures – Tuberculosis, Measles, Dengue, Leprosy.	8
UNIT-IV	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.	8
UNIT-V	Social Health Problems Smoking, alcoholism, drug dependence and Acquired Immuno-Deficiency Syndrome (AIDS) - their causes, treatment and prevention.	8

Text Books

1. Park, K. (2017), Preventive and Social Medicine, B.B. Publishers
2. Brownson, R. C., Baker, E.A., Leet T.L., and Follespie K.N. (2003) Evidence based Public Health, Oxford University Press. 64 Suggested Readings:
3. Guyton A.C. and Hall J.E. Textbook of Medical Physiology, Saunders

Reference Books

1. Robbins and Cortan, Pathologic basis of Disease, VIII Edition, Saunders
2. Engelkirk P.G. and Duben-Engelkirk J. (2015) Burton's Microbiology for the Health Sciences, 10th Edn. Wolters Kluwer Health.

Evaluation:

The evaluation of students' performance in this course will consist of internal tests, class participation and external end-semester examination in accordance with the rules and regulations of the University.

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
VI	23MDC6XX	Life science and Public Health	CO1	x			
			CO2		x		x
			CO3			x	

	Statistical Methods	L	T	P	C
Course Code:	23MDC401	3	0	0	3
Course Type:	MDC				
Pre-Requisite	NONE				

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

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 Measures of Central Tendency- mathematical and positional. Measures of Dispersion: range, quartile deviation, mean deviation, standard deviation, coefficient of variation, Skewness and Kurtosis.	8
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.	8

	- 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	

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)

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	x			
			CO2		x		x
			CO3			x	
			CO4				x

	Chemistry & Society	L	T	P	C
Course Code:	23MDC502	3	0	0	3
Course Type:	MDC				
Pre-Requisite	NONE				

COURSE OBJECTIVES

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 (CLO)

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

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.	8

	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.	

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

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	23MDC502	Chemistry & Society	CO1	x			
			CO2		x		x
			CO3			x	
			CO4				x

	Creating an Entrepreneurial Mind	L	T	P	C
Course Code:	23MDC505	3	0	0	3
Course Type:	MDC				
Pre-Requisite	NONE				

COURSE OBJECTIVES

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 (CLO)

The syllabus has been prepared in Alignment 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.

UNIT	COURSE CONTENTS	HOURS
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.	8
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.	8
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.	8
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	8

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.

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	23MDC505	Creating an Entrepreneurial Mind	CO1	x			
			CO2		x		x
			CO3			x	
			CO4				x

	Photonics	L	T	P	C
Course Code:	23MDC501	2	0	0	2
Course Type:	MDC				
Pre-Requisite	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.

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	8

	Beam Propagation, Birefringent Media and Electrooptic Modulators, Nonlinear Effects and Loss Mechanisms in Waveguides.	
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)

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	23MDC501	Photonics	CO1	x			
			CO2		x		x
			CO3			x	
			CO4				x

	PHOTONICS LAB	L	T	P	C
Course Code:	23MDC5XX	0	0	2	1
Course Type:	MDC				
Pre-Requisite	NONE				

COURSE OBJECTIVES
1. Recall and remembering the experiments and methods.
2. Extend the principles underlying optical experiments.
3. Demonstrate proficiency in setting up and using experimental apparatus for wave and optics experiments.
4. Analyze experimental results to determine relationships between variables in wave and optics experiments.
5. Reproduce new experiments with new methods.

COURSE LEARNING OUTCOMES (CLO)

At the end of the course, the student will be able to
1. Interpret the various methods to perform waves and optics experiments.
2. Describe a comprehensive understanding of the Physics underpinning optical experiments.
3. Illustrate the practical understanding of diverse optical principles through hands-on experimentation
4. Explain with the analysis of results of optical experiments.
5. Design new experiments or variations of existing methods.

Experiments	List of Experiments	HOURS
	1. Diffraction grating: wavelength of a laser 2. Determination of angel of a prism 3. Determination of dispersive power of material of a prism 4. Determination of wavelength of light from mercury source by diffraction grating 5. Determination of wavelength of sodium yellow line by Newton's rings 6. Determination of Resolving Power of grating 7. Fiber optics: Numerical aperture & bending losses 8. Study of the characteristics of a laser beam. 9. Determination of specific rotation of sucrose by polarimeter. 10. To determine diameter/thickness of a thin wire by diffraction method 11. Diffraction at single slit: width of the slit 12. Diffraction at double Slit: diffraction pattern The list of experiments given above is only suggestive. The instructor may add new experiments as per the requirement of the course.	20

TEXT BOOKS

1." LABORATORY MANUAL IN APPLIED PHYSICS"-Second edition H. Sathyaseelam-New age International

2. LABORATORY EXPERIMENTS IN COLLEGE PHYSICS",C.H.Bernard and C.D.Epp.John Wiley and Sons Inc.,New York 1995

REFERENCE BOOKS

1.EXPERIMENTS IN MODERN PHYSICS",A.C.Melisson, AcademicPress,N.Y. 1966.

2. PRACTICAL PHYSICS",G.L.Squires, Cambridge University Press,1985

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	23MDC5XX	**PHOTONICS LAB**	CO1	x				
			CO2		x			
			CO3			x		
			CO4				x	
			CO5					x

	Interior Design	L	T	P	C
Course Code:	23MDC604	3	0	0	3
Course Type:	MDC				
Pre-Requisite	NONE				

COURSE OBJECTIVES

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.

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	8

	hotels, Light fittings, Selection of lighting systems and energy check list	
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

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	23MDC604	Interior Design	CO1	x				
			CO2		x			
			CO3			x		
			CO4				x	
			CO5					x

	COMPUTER-BASED NUMERICAL AND STATISTICAL TECHNIQUES	L	T	P	C
Course Code:	**24MDC101A**	**3**	**0**	**0**	**3**
Course Type:	**ES**				
Pre-Requisite	**Engineering Mathematics – III**				

COURSE OBJECTIVES (COs)

5. To familiar with different operators which are useful in Numerical Analysis and introduce the concept of interpolation.
6. To Familiar with numerical solutions of algebraic, transcendental and simultaneous equations. Also introduce numerical differentiation and integration with applications.
7. Familiarize with numerical solutions of ordinary differential equations.
8. 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 alignment with National Education Policy (NEP). After completion of course, students would be able to:

5. Get exposed to finite differences and interpolation
6. Get numerical solution of equations and find the numerical differentiation and integration.
7. Demonstrate the numerical solutions of ordinary differential equations by different methods.
8. Implement the probability concepts and the corresponding distributions and compute correlation coefficients and regression lines.

UNIT	COURSE CONTENTS	HOURS
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.	8
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.	8
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.	8
UNIT-IV	**Statistics:** Introduction, Measures of Central tendency and dispersion , Moments - Skewness and kurtosis based on moments.	8

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,

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

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

	✓			
CO-02		✓		
CO-03			✓	
CO-04				✓

	ntroduction to Python Programming	L	T	P	C
Course Code:	24xxxx	0	0	2	1
Course Type:	PC				
Pre-Requisite	Nil				

COURSE OBJECTIVES

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

COURSE LEARNING OUTCOMES (CLO)

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

4. Learn the measurement of non-electrical variables and electrical quantities
5. Outline the basic structure of a Python program and discuss its components.
6. Practice variable assignments, perform operations with integers and floats, and utilize control statements effectively.
7. Design and implement functions, using appropriate identifiers, keywords, and operators.
8. Write programs that take user input and display output, utilizing built-in data structures like strings, lists, sets, tuples, and dictionaries.
9. Develop a functional contact management system incorporating all learned concepts, demonstrating comprehensive Python programming skills.

MODULE	TRAINING CONTENT	STUDENTS ENGAGEMENT ACTIVITY
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

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

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

	Machine Learning with Python	L	T	P	C
Course Code: 2	4XXXX	0	0	2	1
Course Type:	PC				
Pre-Requisite					

COURSE OBJECTIVES

10. To understand the fundamental concepts of python programming.
11. To apply machine learning concepts and processes using Python libraries.
12. To analyze datasets to perform regression analysis and evaluate models.
13. To assess the performance of classification models using various metrics such as precision, recall, and F1 scored.
14. To design and Implement SVM for classification and regression tasks.

COURSE LEARNING OUTCOMES (CLO)

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

10. Articulate the basic syntax, data structures, and control flow in Python.
11. Implement basic machine learning algorithms and processes using libraries such as Scikit-Learn.
12. Conduct exploratory data analysis (EDA), perform regression analysis, and evaluate the performance of regression models using appropriate metric.
13. Evaluate classification models by calculating and interpreting performance metrics like precision, recall, and F1 score.
14. Create and deploy Support Vector Machines (SVM) for classification and regression tasks, including the use of different kernels and hyperparameter tuning.

MODULE	**TRAINING CONTENT**	**STUDENTS ENGAGEMENT ACTIVITY**
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.	Identify real-world problems for ML solutions. 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

1. "Python Machine Learning" by Sebastian Raschka and Vahid Mirjalili
2. "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" by Aurélien Géron
3. "Machine Learning with Python Cookbook" by Chris Albon
4. "Introduction to Machine Learning with Python: A Guide for Data Scientists" by Andreas C. Müller and Sarah Guido
5. "Machine Learning Yearning" by Andrew Ng

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

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

	ENERGY STORAGE SYSTEM AND MANAGEMENT SYSTEM	L	T	P
Course Code:	24PEEEXX	3	0	0
Course Type:	PE			
Pre-Requisite	None			

COURSE OBJECTIVES (CO)

- To understand the different types of energy storage system.
- To study about the battery characteristic & parameters.
- To model the types of batteries
- To know the concepts of battery management system and design the battery pack.
- To study about the battery testing, disposal and recycling.

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. Describe about working principle of electric vehicles.
2. Explain the construction and working principle of various motors used in electric vehicles.
3. Understand about working principle of electronics and sensor less control in electric vehicles.
4. Describe the different types and working principle of hybrid vehicles.
5. Illustrate the various types and working principle of fuel cells.

UNIT	COURSE CONTENTS	HOURS
1	**UNIT – I MOTOR AND DEVICE CHARACTERISTICS** Review of motor principles, motor load dynamics, starting, braking & speed control of dc and ac motors- power semiconductor SCRs, IGBTs and MOSFETs	8
2	**UNIT – II ELECTRIC DRIVE CONCEPTS** Basic drive, choice of electric drives, advantages, nature and classification of drives, control and stability of electric drives, feedback control of drives, thermal effects in electrical machines, selection of motor and rating.	8
3	**UNIT – III DC DRIVES** Transient analysis of separately excited dc motors, converter - single phase uncontrolled, half and fully controlled rectifiers, chopper control, closed loop control of solid-state DC drives.	8
4	**UNIT – IV AC DRIVES** Operation of induction and induction motor, direct torque and flux control of induction motor drives, starting methods and speed control of single-phase induction motors, self-controlled synchronous motor drive, selection of motor and rating vector control of synchronous motor.	8

5	**UNIT – V DRIVES FOR SPECIAL ELECTRICAL MACHINES** Drives for variable reluctance motors, microprocessor/ microcontroller –gate trigger signal generation applications to special 8 electrical machines, switched reluctance motor drives, brushless DC motor drives, permanent magnet drives.	

TEXT BOOK

1. Ibrahim Dinçer, Halil S. Hamut and Nader Javani, "Thermal Management of Electric Vehicle Battery Systems", John Wiley& Sons Ltd., 2016.
2. Chris Mi, Abul Masrur& David Wenzhong Gao, "Hybrid electric Vehicle- Principles & Applications with Practical Properties", Wiley, 2011.
3. Mehrdad Ehsani, Yimin Gao, Ali Emadi, "Modern Electric Hybrid Electric and Fuel Cell Vehicles",Taylor& Francis Group, 2010.
4. James Larminie, John Lowry, "Electric Vehicle Technology Explained", John Wiley & Sons Ltd,2003.

REFERENCES

1. G. Pistoia, J.P. Wiaux, S.P. Wolsky, "Used Battery Collection and Recycling", Elsevier, 2001. (ISBN:0-444-50562-8)
2. Guangjin Zhao, "Reuse and Recycling of Lithium-Ion Power Batteries", John Wiley & Sons. 2017.(ISBN: 978-1-1193-2185-9)
3. T R Crompton, "Battery Reference Book-3rd Edition", Newnes- Reed Educational and Professional Publishing Ltd., 2000.
4. 4Arno Kwade, Jan Diekmann, "Recycling of Lithium-Ion Batteries: The LithoRec Way", Springer

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
	24PEEEXX	**ENERGY STORAGE SYSTEM AND MANAGEMENT SYSTEM**	CO1	x				
			CO2			x		
			CO3		x	x	x	x
			CO4					
			CO5	x			x	x

	TESTING AND CERTIFICATION OF ELECTRIC HYBRID VEHICLES	L	T	P	C
Course Code:	**24PEEEXX**	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES (CO)

- To gain knowledge in the field of E-vehicle certification.
- To understand the concept of static testing of E-vehicle.
- To understand the concept of dynamic testing of E-vehicle.
- To study about various E-vehicle component testing.
- To understand the fundamentals of charging station & hybrid electric vehicle testing.

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. Gain knowledge in the field of E-vehicle certification.
2. Explain the concept of static testing of E-vehicle.
3. Explain the concept of dynamic testing of E-vehicle.
4. Know about various E-vehicle component testing.
5. Gain the insight of charging station & hybrid electric vehicle testing.

UNIT	COURSE CONTENTS	HOURS
1	**UNIT–I INTRODUCTION** Specification & Classification of Vehicles (including M, N and O layout), Homologation & its types, Regulations overview (EEC, ECE, FMVSS, AIS, CMVR), Type approval Scheme, Homologation for export, Conformity of Production, various Parameters, Instruments and Types of test tracks, Hardware in The Loop (HIL) concepts for EV/HEVs.	8
	UNIT – II STATIC TESTING OF VEHICLE	
2	Photographs, CMVR physical verification, Tyre Tread Depth Test, Vehicle Weightment, Horn installation, Rear view mirror installation, Tell Tales, External Projection, Wheel Guard, Arrangement of Foot Controls for M1 Vehicle, Angle & Dimensions Measurement of Vehicle, The requirement of temporary cabin for drive– away – Chassis, electric vehicle – Safety norms, Energy consumption and power test.	8
	UNIT – III DYNAMICS TESTING OF VEHICLE	
3	Hood Latch, Gradeability, Pass-by Noise, Interior Noise, Turning Circle Diameter & Turning Clearance Circle Diameter, Steering Effort, Constant Speed Fuel Consumption, Cooling Performance, Speedo-meter Calibration, Range Test, Maximum Speed, Acceleration Test, Coast-down test, Brakes Performance ABS Test, Broad band / Narrow band EMI Test, Electric vehicle – Range Test.	8
	UNIT – IV VEHICLE COMPONENT TESTING	

4	Horn Testing, Safety Glasses Test: Windscreen laminated and toughened safety glass, Rear View Mirror Test, Hydraulic Brakes Hoses Fuel Tank Test: Metallic & Plastic, Hinges and Latches Test, Tyre & Wheel Rim Test, Bumper Impact Test, Side Door Intrusion, Crash test with dummies, Demist test, Defrost Test, Interior Fittings, Steering Impact test (GVW<1500 kg), Body block test, Head form test, Driver Field of vision, Safety belt assemblies, Safety belt anchorages, Seat anchorages & head restraints test, Airbag Test, Accelerator Control System, Motor power, Safety Requirements of Traction Batteries, EMI-EMC (CI, BCI, RE,RI and CTE).	8
	UNIT – V TESTS FOR HYBRID ELECTRIC VEHICLES, RETRO-FITMENT AND CHARGING STATION	
5	Hybrid Electric Vehicles Tests (M and N category), Tests for Hybrid Electric System Intended for Retro-fitment on Vehicles of M and N Category (GVW < 3500 kg), Test for Electric Propulsion kit intended for Conversion, Test for Electric Vehicle Conductive AC Charging System, and Test for Electric vehicle conductive DC charging system.	8

TEXT BOOK

1. Michael Plint & Anthony Martyr, "Engine Testing & Practice", Butterworth Heinmenn, 3rd ed, 2007

REFERENCES

1. Proceedings- Automotive Testing & Certification held on 20th to 24th July 2010 at ARAI, PUNE

2. Bosch Automotive Handbook, Robert Bosch, 7th Edition, 2007.

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
	24PEEEXX	TESTING AND CERTIFICATION OF ELECTRIC HYBRID VEHICLES	CO1	x				
			CO2			x		
			CO3		x	x	x	
			CO4					x
			CO5	x			x	

	MODELLING AND SIMULATION OF EHV	L	T	P	C
Course Code:	**24PEEEXX**	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES (CO)

- To understand the modelling of vehicle performance parameters.
- To model battery electric vehicles.
- To describe the drivetrain characteristics.
- To know the concepts of energy management system.
- To know the vehicle dynamic control systems.

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. Understand the modelling of vehicle performance parameters.
2. Model battery electric vehicles.
3. Describe the drivetrain characteristics.
4. Apply the concepts of energy management system.
5. Explain the vehicle dynamic control systems.

UNIT	COURSE CONTENTS	HOURS
	UNIT – I MODELLING IN PERFORMANCE PARAMETER	
1	Modelling Vehicle Acceleration - Acceleration performance parameters, modelling the acceleration of an electric scooter, modelling the acceleration of a small car.	8
	UNIT – II MODELLING OF BATTERY ELECTRIC VEHICLES	
2	Electric Vehicle Modelling - Tractive Effort, Rolling resistance force, Aerodynamic drag, Hill climbing force, Acceleration force, Total tractive effort, Modelling Electric Vehicle Range - Driving cycles, Range modelling of battery electric vehicles, Constant velocity range modelling, Range modelling of fuel cell vehicles, Range modelling of hybrid electric vehicles.	8
	UNIT – III DRIVE TRAIN CHARACTERISTICS	
3	Modelling and Characteristics of EV/HEV Powertrains Components- ICE Performance Characteristics, Electric Motor Performance Characteristics - Battery Performance Characteristics-Transmission and Drivetrain Characteristics-Regenerative Braking Characteristics-Driving Cycles Modelling and Analysis of Electric and Hybrid Electric Vehicles Propulsion and Braking - Longitudinal Dynamics Equation of Motion - Vehicle Propulsion Modelling and Analysis - Vehicle Braking Modelling and Analysis.	8
	UNIT – IV ENERGY MANAGEMENT	

4	Handling Analysis of Electric and Hybrid Electric Vehicles - Simplified Handling Models Energy/Power Allocation and Management - Power/Energy Management Controllers - Rule-Based Control Strategies - Optimization-Based Control Strategies.	8
	UNIT – V VEHICLE DYNAMIC CONTROL	
5	Control of Electric and Hybrid Electric Vehicle Dynamics - Fundamentals of Vehicle Dynamic Control (VDC) Systems, VDC Implementation on Electric and Hybrid Vehicles – Case Studies, Rechargeable Battery vehicles, Hybrid Vehicles, Fuel Cell Powered Bus. **Simulation Tools:** Matlab/Simulink, ADVISOR and AVL Cruise.	8

TEXT BOOK

1 James Larminie, John Lowry, "Electric Vehicle Technology Explained", John Wiley & Sons

2 Amir Khajepour, Saber Fallah and AvestaGoodarzi, "Electric and Hybrid Vehicles-
Technologies, Modelling and Control: A Mechatronic Approach", John Wiley &

REFERENCES

1 Antoni Szumanowski, "Hybrid Electric Power Train Engineering and Technology:

2 Mehrdad Ehsani, Yimin Gao, Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell

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
	24PEEEXX	BASIC ELECTRICAL ENGINEERING	CO1	x				
			CO2			x		
			CO3		x	x	x	
			CO4					x
			CO5	x			x	

	ELECTRIC DRIVES AND CONTROLS FOR ELECTRIC VEHICLES	L	T	P	C
Course Code:	24PEEEXX	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES (CO)

- To study about the motor & device characteristics & parameters.
- To know the various electric drive concepts
- To have a knowledge of DC drive mechanism.
- To have a knowledge of AC drive mechanism.
- To understand about drives for special electrical machines.

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. Describe about the motor & device characteristics & parameters.
2. Explain about various electric drive concepts
3. Understand the DC drive mechanism.
4. Understand the AC drive mechanism.
5. Explain about drives for special electrical machines.

UNIT	COURSE CONTENTS	HOURS
	UNIT – I MOTOR AND DEVICE CHARACTERISTICS	
1	Review of motor principles, motor load dynamics, starting, braking & speed control of dc and ac motors- power semiconductor SCRs, IGBTs and MOSFETs	8
	UNIT – II ELECTRIC DRIVE CONCEPTS	
2	Basic drive, choice of electric drives, advantages, nature and classification of drives, control and stability of electric drives, feedback control of drives, thermal effects in electrical machines, selection of motor and rating.	8
	UNIT – III DC DRIVES	
3	Transient analysis of separately excited dc motors, converter - single phase uncontrolled, half and fully controlled rectifiers, chopper control, closed loop control of solid-state DC drives.	8
	UNIT – IV AC DRIVES	
4	Operation of induction and induction motor, direct torque and flux control of induction motor drives, starting methods and speed control of single-phase induction motors, self-controlled synchronous motor drive, selection of motor and rating vector control of synchronous motor.	8
	UNIT – V DRIVES FOR SPECIAL ELECTRICAL MACHINES	

5	Drives for variable reluctance motors, microprocessor/ microcontroller –gate trigger signal generation applications to special electrical machines, switched reluctance motor drives, brushless DC motor drives, permanent magnet drives.	8

TEXT BOOK	
1	Gopal K D, "Fundamentals of Electric Drives", Narosa Publishing House Pvt. Ltd.,
2	Pillai S K, "A first course on Electrical Drives", Wiley Eastern Ltd, Bombay 2011.
REFERENCES	
1	Ali Elamadi, "Handbook Automotive Power Electronics and Drives", CRC
2	Bimal K Bose, "Modern Power Electronics and Drives", Elsevier publishers, Butterworth
3	Krishnan R, "Permanent Magnet synchronous and Brushless DC Motor Drives", CRC Publishers,
4	Krishnan R, "Switched Reluctance Motor Drives: Modeling, Simulation, Analysis, Design and

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
	24PEEEXX	**ELECTRIC DRIVES AND CONTROLS FOR ELECTRIC VEHICLES**	CO1	x				
			CO2			x		
			CO3		x	x		
			CO4				x	x
			CO5	x			x	x

	ELECTRIC & HYBRID VEHICLES	L	T	P	C
Course Code:	24PEEEXX	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES (CO)

- To understand the concept of electric vehicles.
- To study about the motors & drives for electric vehicles.
- To understand the electronics and sensors in electric vehicles.
- To understand the concept of hybrid vehicles.
- To study about fuel cell for electric vehicles.

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. Describe about working principle of electric vehicles.
2. Explain the construction and working principle of various motors used in electric vehicles.
3. Understand about working principle of electronics and sensor less control in electric vehicles.
4. Describe the different types and working principle of hybrid vehicles.
5. Illustrate the various types and working principle of fuel cells.

UNIT	COURSE CONTENTS	HOURS
1	**Introduction to Electric Vehicles** Electric Vehicle – Need - Types – Cost and Emissions – End of life. Electric Vehicle Technology – layouts, cables, components, Controls. Batteries – overview and its types. Battery plug-in and life. Ultra-capacitor, Charging – Methods and Standards. Alternate charging sources – Wireless & Solar.	8
2	**Electric Vehicle Motors** Motors (DC, Induction, BLDC) – Types, Principle, Construction, Control. Electric Drive Trains (EDT) – Series HEDT (Electrical Coupling) – Power Rating Design, Peak Power Source (PPS); Parallel HEDT (Mechanical Coupling) – Torque Coupling and Speed Coupling. Switched Reluctance Motors (SRM) Drives – Basic structure, Drive Convertor, Design.	8
3	**Electronics and Sensor-less control in EV** Basic Electronics Devices – Diodes, Thyristors, BJTs, MOSFETs, IGBTs, Convertors, Inverters. Safety – Risks and Guidance, Precautions, High Voltage safety, Hazard management. Sensors - Autonomous EV cars, Self-drive Cars, Hacking; Sensor less – Control methods- Phase Flux Linkage-Based Method, Phase Inductance- Based, Modulated Signal Injection, Mutually Induced Voltage-Based, Observer-Based.	8
4	**Hybrid Vehicles** Hybrid Electric vehicles – Classification – Micro, Mild, Full, Plug-in, EV. Layout and Architecture – Series, Parallel and Series-Parallel Hybrid, Propulsion systems and components. Regenerative Braking, Economy, Vibration and Noise reduction. Hybrid Electric Vehicles System – Analysis and its Types, Controls.	8

5	Fuel Cells for Electric Vehicles Fuel cell – Introduction, Technologies & Types, Obstacles. Operation principles, Potential and I-V curve, Fuel and Oxidation Consumption, Fuel cell Characteristics – Efficiency, Durability, Specific power, Factors affecting, Power design of fuel Cell Vehicle and freeze capacity. Lifetime cost of Fuel cell Vehicle – System, Components, maintenance.	8

TEXT BOOK

1. Jack Erjavec and Jeff Arias, "Hybrid, Electric and Fuel Cell Vehicles", Cengage Learning, 2012.
2. Jack Erjavec and Jeff Arias, "Alternative Fuel Technology – Electric, Hybrid and Fuel Cell Vehicles", Cengage Learning Pvt. Ltd., New Delhi, 2007
3. Mehrdad Ehsani, Yimin Gao, sebastien E. Gay and Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", CRC Press, 2009.
4. Jack Erjavec and Jeff Arias, "Hybrid, Electric and Fuel Cell Vehicles", Cengage Learning, 2012.

REFERENCES

1. Hybrid Electric Vehicle System Modeling and Control - Wei Liu, General Motors, USA, John Wiley & Sons, Inc., 2017.
2. Hybrid Electric Vehicles – Teresa Donateo, Published by ExLi4EvA, 2017.
3. Electric and Hybrid Vehicles Power Sources, Models, Sustainability, Infrastructure and the Market Gianfranco Pistoia Consultant, Rome, Italy, Elsevier Publications, 2017.
4. Hybrid, Electric & Fuel-Cell Vehicles Jack Erjavec, Delmar, Cengage Learning.

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
	24PEEEXX	**ELECTRIC & HYBRID VEHICLES**	CO1	x				
			CO2			x		
			CO3		x	x	x	x
			CO4					
			CO5	x			x	x

	ELECTRO-CHEMISTRY OF FUEL CELLS	L	T	P	C
Course Code:	24PEEEXX	3	0	0	3
Course Type:	PE				
Pre-Requisite	None				

COURSE OBJECTIVES (CO)

- To study about the various types of fuel cells
- To understand the thermodynamics of fuel cells
- To understand the electro chemistry concept of fuel cells.
- To study the performance characteristics of fuel cell.
- To know about hydrogen fueling.

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. Explain the various types of fuel cells.
2. Leant the thermodynamics background of fuel cells.
3. Gain understanding the fundamental concepts of electro chemistry fuel cells.
4. Understand the performance behavior of fuel cell.
5. Know the various technology of hydrogen fueling.

UNIT	COURSE CONTENTS	HOURS
1	**Introduction of Fuel Cells** Introduction-working and types of fuel cell-Low, medium and high temperature fuel cell, Liquid and methanol types, Proton exchange fuel cell solid oxide, hydrogen fuel cells-Thermodynamics and electrochemical kinetics of fuel cells.	8
2	**Thermodynamics** Enthalpy change of a reacting system, systematic Gibbs free energy, Ideal efficiency of the energy conversion, energy balance in fuel cells	8
3	**Electro Chemistry** Nernst equation, relation of the fuel consumption versus current output, stoichiometric coefficients and utilization percentages of the fuel and oxygen, mass flow rate calculation for fuel and oxygen in single cell and fuel cell stack, total voltage and current for fuel cells in parallel and serious connection, over-potential and polarizations, DMFC operation scheme, generous issues -water flooding and water management, polarization in PEMFC.	8
4	**Fuel Cell Components and their impact on performance** Fuel cell performance characteristics- Current/voltage, voltage efficiency and power density, Ohmic resistance, Kinetic performance, mass transfer effects-membrane electrode assembly components, fuel cell stacks, bi-polar plate, humidifiers and cooling plates.	8
5	**Fueling** Hydrogen storage technology-pressure cylinders, liquid hydrogen, metal hydrides, methods of hydrogen production, carbon fibres-reformer technology- steam reforming, partial oxidation, auto thermal reforming- CO	8

	removal, fuel cell technology based on removal like bio-mass.	

TEXT BOOK

1. Frano Babir, "PEM FUEL CELLS: Theory and Practice", Elsevier Academic Press, USA, 2005.

2. Viswanathan B. and Scibioh Aulice M, "Fuel cells: Principles and Applications", University Press, 2006.

REFERENCES

1. Fuel cells for automotive applications - professional engineering publishing UK, 2004.
2. Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay and Ali Emadi, "Modem Electric, Hybrid Electric and Fuel cell Vehicles", Fundamental, Theory and design", CRS Press,
3. Fuel cell Technology Handbook SAE International Gregor Hoogers CRC Press, 2003.
4. Young G J, "Fuel cells", Rein hold publishing Copr., 1960.

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
	24PEEEXX	**ELECTRO-CHEMISTRY OF FUEL CELLS**	CO1	x				
			CO2			x		
			CO3		x	x	x	x
			CO4					
			CO5	x			x	x

COMPUTER ARCHITECTURE & ORGANIZATION	
Course Code: 24EEPEXX	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVE

1. To impart the basic concepts of component, architecture and register organization.
2. To understand concepts of data representation and binary value implementation usingarithmetic algorithms.
3. To teach the students how to describe machine capabilities and design an effective data pathof control unit
4. To provide knowledge of memory technologies, interfacing techniques and sub-system.
5. To make students understand the importance of IO interfacing techniques and theirperformance metrics for a typical computer.

COURSE LEARNING OUTCOMES (CLO)

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

1. Analyse the basic operational concepts of Functional unit, Instruction format and addressing mode.
2. Differentiate the RISC and CISC architecture. Analyze the performance of machines with different capabilities.
3. Illustrate the binary format of numerical and characters. Validate efficient algorithm for arithmetic operations.
4. Understand the need for an interface and instruction cycle phases. Implement the hardwiredand microprogrammed control unit for analyse the performance.
5. Explain the importance of hierarchical memory organization. Able to construct larger memories. Analyze and suggest efficient cache mapping technique and replacement algorithm for given design requirements.

MAPPING BETWEEN COURSE OBJECTIVES (COS) AND COURSE LEARNINGOUTCOMES (CLOS)

	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓	✓		
CO3				✓	
CO4					✓
CO5				✓	

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**INTRODUCTION** Evolution of Computer Systems-Computer Types-Functional units-Basic operational concepts-Bus structures- location and addresses-memory operations-Addressing modes-Design of a computer system- Memory Instruction and instruction sequencing, RISC versus CISC.
UNIT-II	**CENTRAL PROCESSING UNIT** Introduction-Arithmetic Logic Unit - Fixed point arithmetic, floating point arithmetic-Execution of complete instruction-Basic concepts of pipelining.
UNIT-III	**CONTROL UNIT DESIGN** Introduction-Control Transfer-Fetch cycle- Instruction Interpretation & Execution,Hardwired control- Micro-programmed control
UNIT-IV	**MEMORIES AND SUBSYSTEMS** Semiconductor memory - Static and Dynamic -Associative memory- Cache memory-Mapping methods, Organization of a cache memory unit, Fetch and write mechanisms Virtual memory-Secondary memories-Optical magnetic tape & magnetic disks &controllers.
UNIT-V	**I/O PROCESSING** Introduction-Data transfer techniques- Bus Interface- I/O Channel-I/O Processor, I/Odevices -Direct memory access.

TEXT BOOKS

- Computer Organization and Design - The Hardware/Software Interface-Author D. A. Patterson and J. L. Hennessy publisher Morgan Kaufmann Edition 2014
- Computer Organization, Carl Hamacher, Zvonko Vranesic and Safwat Zaky, V Edition,
- Computer System Architecture, Morris Mano, Third edition-2002, Prentice Hall of India Pvt Ltd publications.
- Computer Organization and Architecture – Designing for Performance", William Stallings,Ninth edition, Pearson publications.

REFERENCE BOOKS

- Structured Computer Organization, Andrew S. Tanenbaum
- David A. Patterson and John L. Hennessy, "Computer Organization and Design: TheHardware/Software interface".
- John P. Hayes, "Computer Architecture and Organization", Third Edition, Tata McGraw Hill

THEORY OF COMPUTATION	
Course Code: 24EEPEXX	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVES
1. To understand and design various finite Computing models.
2. To understand the basics of regular expression and its equivalence.
3. To gain knowledge about the concepts of grammar, normal forms.
4. To study the concepts of Push Down Automata and its applications.
5. To understand the recursive and recursively enumerable languages , decidability and undecidability of various problems.

COURSE LEARNING OUTCOMES (CLO)
The syllabus has been prepared in accordance with National Education Policy-2020 (NEP). After completion of course, students would be able to:
1. Comprehend regular languages and finite automata and develop ability to provide the equivalence between regular expressions, NFAs, and DFAs.
2. Design regular expressions to define simple and complex search criteria.
3. Disambiguate context-free grammars by mastering the concepts of context- free languages.
4. Design PDA to recognize context free grammars.
5. Apply the concepts of recursive and recursively enumerable languages and design efficient Turing Machines.

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

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

COURSE CONTENTS

UNIT NUMBER	CONTENTS
UNIT-I	BASIC COMPUTATIONAL CONSTRUCTS

UNIT NUMBER	CONTENTS
	Finite State Systems, Basic Definitions Non-Deterministic finite automata(NDFA), Deterministic finite automata (DFA), Equivalence of DFA and NDFA Finite automata with Ɛ-moves, minimization of finite Automata, Concept of basic Machine, Properties and limitations of FSM, Moore and Mealy Machines, Equivalence of Moore and Mealy machines, pumping lemma.
UNIT-II	**REGULAR EXPRESSIONS** Regular grammars, regular expressions, equivalence between regular languages, properties of regular languages, Regular Expressions, Equivalence of finite automata and Regular Expressions, Regular expression conversion and vice versa. Conversion of NFA to DFA by Arden's Method.
UNIT-III	**GRAMMAR** Context Free Languages – Leftmost and rightmost derivation, parsing and ambiguity, Chomsky Hierarchy, LR(k) Grammars, properties of LR(k) grammars, Simplification of CFG, Normal forms
UNIT-IV	**PUSHDOWN AUTOMATA** Pushdown Automata –Definition, Instantaneous Description, Applications of Pushdown Machines, NDPDA and DPDA, Equivalence: PDA to CFL and vice-versa, pumping lemma for CFL..
UNIT-V	**TURING MACHINES & COMPUTATIONAL COMPLEXITY** Turing Machines- Introduction, Definition, Instantaneous Description, Turing machine as Acceptors, Halting problem of T.M., Undecidability: Basics, Post's Correspondence Problem, Rice's Theorem, Properties of Recursive and Recursively Enumerable Languages, Introduction to NP-Hardness and NP-Completeness.

TEXT BOOKS
E. Hopcroft and J. D. Ullman, "Introduction to Automata Theory, Languages and Computation", Pearson, Education Publishers, 2nd Edition, 2004

REFERENCE BOOKS
Michael Sipser, "Introduction to the Theory of Computation", Thomson Asia, 2004
J.C.Martin, "Introduction to Languages and Theory of Computation", McGraw Hill,2003
K.L.P. Mishra, N.Chandrasekaran , " Theoretical Computer Science ", PHI, 3rd Edition, 2007

ANALYSIS AND DESIGN OF ALGORITHMS	
Course Code: 24EEPEXX	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVES (CO's)

1. To analyze the asymptotic performance of algorithms and to write rigorous correctness proofs for algorithms.
2. To demonstrate a familiarity with major Divide and conquer algorithms and data structures.
3. To apply important Dynamic programming design paradigms and methods of analysis.
4. To demonstrate through examples greedy design paradigm.
5. To synthesize efficient algorithms in common engineering design situations.

COURSE LEARNING OUTCOMES (CLO's)

The syllabus has been prepared in accordance with National Education Policy-2020 (NEP). After completion of course, students would be able to:

1. For a given algorithms analyze worst-case running times of algorithms based on asymptotic analysis and justify the correctness of algorithms.
2. Describe the divide-and-conquer paradigm and explain when an algorithmic design situation calls for it. Synthesize divide-and-conquer algorithms. Derive and solve recurrence relation.
3. Describe the dynamic-programming paradigm and explain when an algorithmic design situation calls for it. For a given problems of dynamic-programming and develop the dynamic programming algorithms, and analyze it to determine its computational complexity.
4. Describe the greedy paradigm and explain when an algorithmic design situation calls for it. For a given problem develop the greedy algorithms.
5. For a given model engineering problem model it using graph and write the corresponding algorithm to solve the problems.

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

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

CO5					✓

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**INTRODUCTION** **Algorithm analysis:** Time and space complexity - Asymptotic Notations and its properties Best case, Worst case and average case analysis – Recurrence relation: substitution method - Lower bounds – **searching:** linear search, binary search and Interpolation Search, Pattern search: The naïve string-matching algorithm - Rabin-Karp algorithm - Knuth-Morris-Pratt algorithm. **Sorting:** Insertion sort – heap sort.
UNIT-II	**GRAPH ALGORITHMS** **Graph algorithms:** Representations of graphs - Graph traversal: DFS – BFS - applications - Connectivity, strong connectivity, bi-connectivity - Minimum spanning tree: Kruskal's and Prim's algorithm- Shortest path: Bellman-Ford algorithm - Dijkstra's algorithm - Floyd-Warshall algorithm **Network flow:** Flow networks - Ford-Fulkerson method – Matching: Maximum bipartite matching.
UNIT-III	**ALGORITHM DESIGN TECHNIQUES** **Divide and Conquer methodology:** Finding maximum and minimum - Merge sort - Quick sort **Dynamic programming:** Elements of dynamic programming — Matrix-chain multiplication - Multi stage graph — Optimal Binary Search Trees. Greedy Technique: Elements of the greedy strategy - Activity-selection problem – Optimal Merge pattern — Huffman Trees.
UNIT-IV	**STATE SPACE SEARCH ALGORITHMS** **Backtracking:** n-Queens problem - Hamiltonian Circuit Problem - Subset Sum Problem – Graph colouring problem Branch and Bound: Solving 15-Puzzle problem - Assignment problem - Knapsack Problem - Travelling Salesman Problem
UNIT-V	**NP-COMPLETE AND APPROXIMATION ALGORITHM** **Tractable and intractable problems:** Polynomial time algorithms – Venn diagram representation -NP-algorithms - NP-hardness and NP-completeness– Bin Packing problem - Problem reduction: TSP – 3-CNF problem. **Approximation Algorithms:** TSP - **Randomized Algorithms:** concept and application - primality testing - randomized quick sort - Finding kth smallest number

TEXT BOOKS

- Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", 3rd Edition, Prentice Hall of India, 2009.
- Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran "Computer Algorithms/C++" Orient Blackswan, 2nd Edition, 2019.
- Richard Johnsonbaugh , Marcus Schaefer , " *Algorithms* " , Pearson Education, 2006 3rd edition

REFERENCE BOOKS

- Aho, Ullman & Hopcraft, "*The Design and Analysis of Algorithms*", Pearson Education, 2001
- S.E.Goodman , S.T.Hedetniemi , "*Introduction to the Design and Analysis of Algorithms*", McGraw Hill , 2002
- Anany Levitin, "Introduction to the Design and Analysis of Algorithms", 3rd Edition, Pearson Education, 2012.
- Sara Baase , "*Computer Algorithms - Introduction to design and analysis",* Pearson.
- S. Sridhar, "Design and Analysis of Algorithms", Oxford university press, 2014.

COMPILER DESIGN	
Course Code: 24EEPEXX	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVES (COs)
1. To introduce the major concept areas in compiler design and know the various phases of the compiler
2. To understand the various parsing algorithms and comparison of the same
3. To provide practical programming skills necessary for designing a compiler
4. To gain knowledge about the various code generation principles
5. To understand the necessity for code optimization.

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. Apply the knowledge of LEX & YACC tool to develop a scanner and parser
2. Design and develop software system for backend of the compiler
3. Suggest the necessity for appropriate code optimization techniques
4. Conclude the appropriate code generator algorithm for a given source language
5. Design a compiler for any programming language.

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

	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	Compilers - Analysis of the source program - Phases of a compiler - Cousins of the Compiler - Grouping of Phases - Compiler construction tools - Lexical Analysis - Role of Lexical Analyzer - Input Buffering - Specification of Tokens..
UNIT-II	Role of the parser - Writing Grammars - Context-Free Grammars - Top Down parsing - Recursive Descent Parsing - Predictive Parsing - Bottom-up parsing - Shift Reduce Parsing - Operator Precedent Parsing - LR Parsers - SLR Parser - Canonical LR Parser - LALR Parser
UNIT-III	Intermediate languages - Declarations - Assignment Statements - Boolean Expressions - Case Statements - Back patching - Procedure calls.

UNIT NUMBER	COURSE CONTENTS
UNIT-IV	Introduction - Principal Sources of Optimization - Optimization of basic Blocks - DAG representation of Basic Blocks - Introduction to Global Data Flow Analysis - Runtime Environments - Source Language issues - Storage Organization - Storage Allocation strategies - Access to non-local names - Parameter Passing - Error detection and recovery
UNIT-V	Issues in the design of code generator - The target machine - Runtime Storage management - Basic Blocks and Flow Graphs - Next-use Information - A simple Code generator - DAG based code generation - Peephole Optimization

TEXT BOOKS
Alfred V. Aho, Jeffrey D Ullman, "Compilers: Principles, Techniques and Tools", Pearson Education Asia, 2012. Jean Paul Tremblay, Paul G Serenson, "The Theory and Practice of Compiler Writing", BS Publications, 2005. Dhamdhere, D. M., "Compiler Construction Principles and Practice", Second Edition Macmillan India Ltd., New Delhi, 2008.
D.M.Dhamdhere, "*System Programming and Operating Systems*", 2nd Edition., Tata Mcgraw Hill,1995
REFERENCE BOOKS
Kenneth C. Louden, Compiler Construction, Principles and Practice, Thomson Books, 2007.
Aho. A.V & Ullman J.D, "Principles of Compiler Design", Narosa publications, 1985.
S.S. Muchnick Harcourt Asra," Advanced Compiler Design implementation", Morgan Kauf12man, 1997.
Anrew W. Appel, "Modern Compiler Implementation in JAVA", Cambridge University Press, 2003.

COMPUTER NETWORKS	
Course Code: 24EEPEXX	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVES (COs)
1. To study the basic taxonomy and terminology of the computer networking and enumerate the layers of OSI model and TCP/IP model
2. To study data link layer concepts, design issues, and protocols.
3. To gain core knowledge of Network layer routing protocols and IP addressing.
4. To study Session layer design issues, Transport layer services, and protocols.
5. To acquire knowledge of Application layer and Presentation layer paradigms and protocols.

COURSE LEARNING OUTCOMES (CLOs)
After completion of course, students would be able to:
1. Describe the functions of each layer in OSI and TCP/IP model.
2. Describe the functions of data link layer and explain the protocols.
3. Classify the routing protocols and analyze how to assign the IP addresses for the given network.
4. Describe the Session layer design issues and Transport layer services.
5. Explain the functions of Application layer and Presentation layer paradigms and Protocols.

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

	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENT
UNIT-I	**INTRODUCTION** **Internet**: A brief History; Internet Standards and Standards organization; OSI Reference Model; TCP/IP Model; Types of Networks : Local Area Networks, Metropolitan Area Networks, Wide Area Network; Topologies: Bus, Star, Ring, Hybrid, Tree, Complete, Irregular - Topology; Addressing. **Physical Layer** – Analog and digital signal properties: Sinewave, phase, wavelength, Bit rate, Transmission Impairment, Performance measures: Bandwidth, Throughput, Latency, Jitter; Guided and unguided transmission media; Circuit Switching, Packet Switching.
UNIT-II	**DATA LINK LAYERS**

UNIT NUMBER	COURSE CONTENT
	Data link Layer design issues: Framing, Error Detection & Correction: Byte and Bit stuffing, Checksum, CRC, Hamming codes; Elementary Data link Protocols- Sliding window Protocols; Media access control – Random Access: Aloha, CSMA, CSMA/CD; Controlled Access: Token Passing, Polling, Reservation; Channelization: TDMA, FDMA, CDMA; Ethernet Standard;
UNIT-III	**NETWORK LAYERS PROTOCOLS** IPV4 Addressing – classful and classless, Network Address Translation, IPV4 Packet format- IPV6 Addressing, IPV6 Packet format; ARP, RARP, DHCP, ICMP and IGMP.
UNIT-IV	**NETWORK ROUTING** LAN interconnecting devices: Hubs, Switches, Bridges, Routers, Gateways; Routing and Forwarding, Routing Table, Intra- and inter-domain routing, Distance vector routing, DVR Instability problem and solutions, RIP, Link State Routing, OSPF, Path Vector Routing, BGP; Virtual Private Networks; Routing- Link State and Distance Vector Routing Protocols- Implementation- Performance Analysis- Packet Tracer. TCP and UDP-Congestion Control-Effects of Congestion-Traffic Management-TCP Congestion Control-Congestion Avoidance Mechanisms-Queuing Mechanisms-QoS Parameters.
UNIT-V	**TRANSPORT & APPLICATION LAYER** Transmission Control Protocol; User Datagram Protocol; Congestion control mechanisms. Application Layer: Email – SMTP, POP, IMAP; FTP, NNTP, HTTP, DNS, WWW , Firewall.

TEXT BOOKS

- Andrew S. Tanenbaum, “Computer Networks”, Pearson Fourth Edition, 2005

REFERENCE BOOKS

- Behrouz A. Forouzan, “Data communication and Networking”, Tata McGraw-Hill, 2004.
- James F. Kurose and Keith W. Ross, “Computer Networking:A Top-Down Approach Featuring the Internet”, Pearson Education, Third Edition 2003.
- William Stallings, “Data and Computer Communication”, Seventh Edition, Pearson Education, 2003.

MACHINE LEARNING USING R	
Course Code: 24EEPEXX	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVES
1. To learn the basics of R programming and understands the role of mathematics in machine learning.
2. To identify potential application domains of machine learning in practice.
3. To describe the differences in approaches and applicability of regression, classification, clustering, clustering and transfer learning.
4. To be able to select machine learning task for a given application.
5. To and can build an application based on machine learning.

COURSE LEARNING OUTCOMES (CLO)
The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course, students will be able to:
1. Learn the fundamentals of R-programming and probability.
2. Understand the basics and need of Machine learning in global view.
3. Demonstrate in-depth knowledge of methods and theories in the field of machine learning.
4. Understand, apply and evaluate the supervised learning techniques.
5. Apply, analyze and evaluate the ensemble learning and unsupervised learning techniques
6. Understand the concepts of reinforcement learning and transfer learning.
7. To implement the machine learning techniques for building different applications.

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

	CLO1	CLO2	CLO3	CLO4	CLO5	CLO6	CLO7
CO1	✓						
CO2		✓	✓				
CO3				✓	✓	✓	
CO4							✓
CO5							✓

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**INTRODUCTION TO R AND PROBABILTY :** *R basics* – Math, Variables and strings, Vectors and Factors, Vector operations, Data Structure in R - Arrays & Matrices, Lists & Data frames, Conditions and Loops, functions in R, Objects & Classes, Debugging, R programming Fundamentals:- Conditions and loops, Functions in R, Objects and Classes, Debugging, Basics of probability and distribution function.
UNIT-II	**INTRODUCTION TO MACHINE LEARNING :** Machine Learning Basics, Need of Machine Learning, Application Domains, Basic Learning Techniques, Machine Learning Models, Data- pre-processing and feature Engineering
UNIT-III	**SUPERVISED LEARNING:** *Machine learning Algorithms for classification problem*: Decision Trees, K-NN, SVM, Naïve Bayes Classifier, Bayesian learning, Bayesian network. *Regression* : Linear , Logistic, Ridge, Regularization, Bias/ Variance Tradeoff,
UNIT-IV	**ENSEMBLE AND UNSUPERVISED LEARNING:** Bagging, Boosting, Random forest, *Clustering*: K-means, Heirarchical clustering, Partitional clustering, Apriori algorithm, FP growth, Validation Techniques in clustering.
UNIT-V	**REINFORCEMENT AND TRANSFER LEARNING:** Components of an RL – (Agent, Policy, Value function, Model), MDP, DP, TDL, Q-Learning. Introduction to Transfer learning, Transfer Learning Process and types and Application. **CASE STUDY:** Object Detection, Recommender System, Malware Classification, Crop Yield Prediction, machine Learning in Networks.

TEXT BOOKS
R for data science : Import, Tidy, Transform, Visualize, And Model Data, Hadley Wickham, O'Reilly
Introduction to Machine Learning, E. Alpaydin. MIT Press
Machine Learning, T.M. Mitchell, Mc-Graw Hill

REFERENCE BOOKS
Pattern Recognition and Machine learning , C.M. Bishop, Springer
Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning (ESL), Springer, 2009 (freely available online)

SOFTWARE ENGINEERING	
Course Code: 24EEPEXX	Continuous Evaluation: 40 Marks
Pre-Requisite : Concept of OOP and Methodology	End Semester Examination: 60 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVES

1. To analyse different software development process models.
2. To extract and analyse software requirements specifications for different projects.
3. To provide an understanding of the working knowledge of the techniques for estimation, design, testing and quality management of large software development projects
4. To gain knowledge of the system analysis and design concepts.
5. To apply different testing and debugging techniques and analysis their effectiveness.

COURSE LEARNING OUTCOMES (CLO)

After completion of course, students would be able to:

1. Analyze software development process models, including agile models and traditional models like waterfall. Acquire knowledge about the concepts of application of formal specification.
2. Demonstrate the use of software life cycle through requirements gathering, choice of process model and design model.
3. Apply testing principles on software project and understand the maintenance concepts.
4. Identify risks, manage the change to assure quality in software projects.
5. Think critically about ethical and social issues in software engineering for different applications

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

	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3		✓	✓		
CO4			✓	✓	
CO5					✓

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**INTRODUCTION** Introduction to Software Engineering, Software Components, Software Characteristics, Software Crisis, Software Engineering Processes, Similarity and Differences from Conventional Engineering Processes, Software life cycle models: Build and Fix, Waterfall, Prototype, Iterative Enhancement Model, Evolutionary and Spiral model, V Model & RAD Model.

UNIT NUMBER	COURSE CONTENTS
UNIT-II	**SOFTWARE REQUIREMENTS & QUALITY ASSURANCE** Requirement Engineering Process: Elicitation, Analysis, Documentation, Review and Management of User Needs, Feasibility Study, Information Modelling, Data Flow Diagrams, Entity Relationship Diagrams, Decision Tables, SRS Document, IEEE Standards for SRS. Software Quality Assurance (SQA): Verification and Validation, SQA Plans, Software Quality Frameworks, ISO 9000 Models, SEI-CMM Model.
UNIT-III	**SOFTWARE DESIGN CONCEPT** Basic Concept of Software Design, Architectural Design, Low Level Design: Modularization, Design Structure Charts, Pseudo Codes, Flow Charts, Coupling and Cohesion Measures, Design Strategies: Function Oriented Design, Object Oriented Design, Top-Down and Bottom-Up Design. Software Measurement and Metrics: Various Size Oriented Measures: Halestead's Software Science, Function Point (FP) Based Measures, Cyclomatic Complexity Measures: Control Flow Graphs.
UNIT-IV	**SOFTWARE TESTING** Software Testing: Testing functions, Test case design, White Box testing: cyclomatic complexity, Black box testing: Boundary value Analysis, Equivalence class partitioning, Unit testing, Integration Testing, System testing, Alpha Testing, Beta Testing and Acceptance Testing..
UNIT-V	**SOFTWARE MAINTENANCE & RELIABILITY ISSUES** Need for Maintenance, Categories of Maintenance, The Maintenance Process, Maintenance Models: Quick fix, Iterative Enhancement, Reuse Oriented. Reverse Engineering, Software RE-engineering, Configuration Management. Software Reliability: Failure and Faults, Software reliability Vs Hardware reliability, Classification of Failures, Software reliability metrics.

TEXT BOOKS
Richard Fairley, "Software Engineering Concepts", McGraw Hill, 2017
Roger S. Pressman, "Software Engineering A Practitioner Approach" 4th edition , McGraw Hill, 1999
REFERENCE BOOKS
Ian Sommerville, Software engineering, Pearson education Asia, 6th edition, 2000
Pankaj Jalote- An Integrated Approach to Software Engineering, Springer Verlag, 1997.
Shooman, Software Engineering, McGraw Hill, 1983.

NEURAL NETWORKS & FUZZY LOGIC	
Course Code: 24EEPEXX	Continuous Evaluation: 40 Marks
Pre-Requisite : Soft Computing Course	End Semester Examination: 60 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVES
1. To provide in depth detail for perceptron.
2. To get familiar with the principles of RBF, RNN, unsupervised learning.
3. To learn fuzzy set theory, fuzzy logic and understand the role of uncertainty in real-time applications.

COURSE LEARNING OUTCOMES (CLO)
The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course the students will be able to:
1. Understand the mathematics behind the design of perceptron.
2. Correlate the need of extension of MLP to CNN.
3. Design and analyse the importance of kernel functions, RNN and memories.
4. Differentiate between fuzzy sets and crisp sets.
5. Apply and analyse the applications of fuzzy to reasoning and clustering

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

	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓	✓			
CO2			✓		
CO3				✓	✓

COURSE CONTENTS

UNIT NUMBER	**COURSE CONTENTS**
UNIT-I	**INTRODUCTION TO ARTIFICIAL NEURAL NETWORKS (ANN) & SINGLE LAYER PERCEPTRON (SLP)** ANN, Modelling of Human Brain and ANN, Types of ANN, activation function, learning tasks and rules. SLP : Basics of Perceptron, McCulloch Pitt NN, Perceptron Convergence Theorem in both Discrete and Continuous Domain, Linearity and Non-Linearity Problem.

UNIT-II	**MULTI- LAYER FEED FORWARD NETWORKS** Basics of MLP, Generalized Delta Rule, Training Algorithm for MLP, Batch learning, Online Learning, Cross-validation in Back Propagation, Detail Study on Convolution Neural Networks. Basics and need of RBF, Interpolation Problem, RBF networks,
UNIT-III	**RECURRENT NETWORKS & ASSOCIATIVE MEMORIES** Paradigms of Associative Memory, Pattern Mathematics, Hebbian Learning, General Concepts of Associative Memory, Bidirectional Associative Memory (BAM) Architecture, Architecture of Hopfield Network: Discrete and Continuous Neural network applications, Boltzman Machine, R-CNN, LSTM, Unsupervised Learning of clusters.
UNIT-IV	**FUZZY SETS, RELATIONS & LOGIC** Classical & Fuzzy Set Theory, Fuzzy Relation, Fuzzy Inference System, Fuzzy Logic and approximate reasoning. Fuzzy control System Design Problem, Industrial Applications.
UNIT-V	**FUZZY ARITHMETIC & OPTIMIZATION** Functions of fuzzy sets, extension principle, fuzzy mapping, interval analysis, vertex method and DSW algorithm. One dimensional fuzzy optimization, fuzzy concept variables and casual relations, fuzzy cognitive maps, agent based models.

TEXT BOOKS
J.M. Zurada, “Introduction to artificial neural systems”, Jaico Pub.
Simon Haykin, “Neural Networks”, PHI
S. N. Sivanandam and S.N. Deepa, “*Principles of Soft Computing,*” 2nd Ed., Wiley India.

REFERENCE BOOKS
Laurene Fausett, "Fundamentals of Neural Networks", Pearson Education, 2004
Simon Haykin, "Neural Networks- A comprehensive foundation", Pearson Education, 2003
S. Rajasekharan and G. A. Vijayalakshmi Pai, "Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications", PHI Publication, 2004.
Timothy J. Ross, " Fuzzy Logic With Engineering Applications", Tata McGraw-Hill Inc. 2000

BUSINESS INTELLIGENCE	
Course Code: 24EEPEXX	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVES
1. To provide an overview of an exciting field of business intelligence.
2. To introduce IBM Cognos Analytics and its position within an analytics solution.
3. To teach the fundamental techniques and principles in achieving big business intelligence with scalability and streaming capability.
4. 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 the completion of course the students will be able to:
1. Understand the vision of Business Intelligence from a global context.
2. Understand and apply IBM Cognos Analytics in Market perspective of Business Intelligence.
3. Apply and analyse various prompt types and conditionally render objects in reports .
4. Evaluate query models, connect them to the report layout and combine data containers based on relationships from different queries.
5. Build and create Active Report connection. Creating projects using dashboards, stories and exploration to find business insights.

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

	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	✓

COURSE CONTENTS

UNIT NUMBER	CONTENTS
UNIT-I	BUSINESS INTELLIGENCE

	Definition with Real Time Examples, How business intelligence can turn data into insight, Use of Business Intelligence- how it can help to combat fraud and understand social sentiments., Future of business intelligence and analytics.
UNIT-II	**IBM COGNOS ANALYTICS FOR COUNSUMERS** Why IBM Cognos Analytics? What is IBM Cognos? List v/s Crosstab, Examine detail filters and summary filters, Introduction to visualization, Traditional visualization v/s RAVE visualization.
UNIT-III	**IBM COGNOS ANALYTICS:AUTHOR REPORT FUNDAMENTALS** Concepts and types of prompts, expressions using functions, reuse object, drill - through reports, analyse multi-lingual reports, Highlight exceptional data
UNIT-IV	**IBM COGNOS ANALYTICS:AUTHOR REPORT ADVANCED** Theory, query models, SQL statements, distribute reports using bursting, Analyze reports by joining queries, dynamic headers and titles that reflect report data, tooltips that clarify report data, send emails using links in a report.
UNIT-V	**IBM COGNOS ANALYTICS:AUTHOR ACTIVE REPORTS** Active Reports, debug active report, Examine Active Report controls, Active Report variables, Create a simple Active Report using Static and Data-driven controls, decks and data decks to display traditional charts creation and analysis of Dashboard.
UNIT-VI	**PROJECT** Analysis for real case studies using dashboard, stories and exploration with IBM Cognos.

TEXT/REFERENCE BOOKS
- IBM Courseware

Further suggested Readings
- IBM Courseware

CYBER SECURITY	
Course Code: 24EEPEXX	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVES
1. To aware the students about the cyber security and its implications. 2. To provide students with a practical and theoretical knowledge of cryptography and network security. 3. To provide the students' knowledge of different types of attacks on the Network. 4. To aware the student about data privacy.

COURSE LEARNING OUTCOMES (CLO)
The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course the students will be able to:
1. Define the concept of ethical hacking and its associated applications in Information Communication Technology (ICT) world.
2. Underline the need of digital forensic and role of digital evidences.
3. Explain the methodology of incident response and various security issues in ICT world, and identify digital forensic tools for data collection.
4. Recognize the importance of digital forensic duplication and various tools for analysis to achieve adequate perspectives of digital forensic investigation in various applications /devices like Windows/Unix system.
5. Apply the knowledge of IDS to secure network and performing router and network analysis.

MAPPING BETWEEN COURSE OBJECTIVES (COS) AND COURSE LEARNING OUTCOMES (CLOS)

	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓	✓			
CO2		✓	✓		
CO3			✓	✓	
CO4				✓	✓

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**INTRODUCTION** Cyber-attacks, types of attacks, Introduction to cyber security, objectives of security, elements of cyber security, Introduction to Information Security, Introduction to Data and Network Security, Finding vulnerabilities and exploits.

UNIT-II	**INTRUSION DETECTION SYSTEMS** Overview of intrusions, system intrusion process, dangers of system intrusions, anomaly detection, misuse detection, types of IDS, the limitations and open problems of intrusion detection systems, Statistical and machine approaches to detection of attacks on computers, Techniques for studying the Internet attacks, network based attacks, host based attacks.
UNIT-III	**SECURITY IN CLOUD COMPUTING** What is Cloud Computing, Essential Characteristics, Cloud security challenges, Software as a service security, secure software development life cycle, data usage, data privacy, identity access management, physical security.
UNIT-IV	**DATA PRIVACY** Fundamental Concepts, Definitions, Data Privacy Attacks, Data linking and profiling, access control models, role based access control, privacy in different domains- medical, financial, etc.
UNIT-V	**CRYPTOGRAPHY** Services, mechanisms and attacks, the OSI security architecture, Network security Model, classical Encryption techniques, Private and Public Key Cryptography.

TEXT BOOKS

1. Michael T. Goodrich and Roberto Tamassia, "Introduction to Computer Security", Addison Wesley, 2011.
2. B. Raghunathan, "The Complete Book of Data Anonymization: From Planning to Implementation", Auerbach Pub, 2013.
3. John W. Rittinghouse, "Cloud Computing: Implementation Management & Security", CRC Press.
4. Roberto Di Pietro, Luigi V. Mancini, "Intrusion Detection System", Springer ,2008
5. William Stallings-"Cryptography and Network Security", Pearson education, 6th edition, SBN 10: 0133354695, 2013

REFRENCE BOOKS

1. Russell Dean Vines and Ronald L. Krutz ,"Cloud Security: A Comprehensive Guide To Secure Cloud Computing", Wiley India Pvt Ltd, 2010.
2. Anderson, James P., "Computer Security Threat Monitoring and Surveillance," Washing, PA, James P. Anderson Co., 1980.
3. L. Sweeney, "Computational Disclosure Control: A Primer on Data Privacy Protection", MIT Computer Science, 2002.

NASSCOM ASSOCIATE ANALYTICS - II	
Course Code: 24EEPEXX	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVES
• To provide knowledge of the tools, technologies & programming languages which is used in day to day business analytics cycle.

COURSE LEARNING OUTCOMES (CLO)
The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course the students will be able to:
1. Understand the tools, technologies & programming languages which is used in day to day analytics cycle.
2. Analyze and use the best tools to make sense from available raw data.

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**Data Management & Introduction to Big Data Tools (NOS 2101)** Design Data Architecture and manage the data for analysis, understand various sources of Data like Sensors/signal/GPS etc. Export all the data onto Cloud ex. AWS/Rackspace etc. Introduction to Big Data tools like Hadoop, Spark, Impala etc., Data ETL process, Identify gaps in the data and follow-up for decision making.
UNIT-II	**Big Data Analytics & Machine Learning Algorithms (NOS 2101)** Run descriptive' s to understand the nature of the available data, collate all the data sources to suffice business requirement, Run descriptive statistics for all the variables and observer the data ranges, Outlier detection and elimination. Hypothesis testing and determining the multiple analytical methodologies, Train Model on 2/3 sample data using various Statistical/Machine learning algorithms, Test model on 1/3 sample for prediction etc.
UNIT-III	**Data Visualization (NOS 2101)**

	Prepare the data for Visualization, Use tools like Tableau, QlickView and D3, Draw insights out of Visualization tool.
UNIT-IV	**Maintain Healthy, Safe & Secure Working Environment (NOS 9003)** Introduction, workplace safety, Report Accidents & Emergencies, Protect health & safety as your work, course conclusion, assessment
UNIT-V	**Provide Data/Information in Standard Formats (NOS 9004)** Introduction, Knowledge Management, Standardized reporting & compliances, Decision Models, course conclusion. Assessment

TEXT/REFERENCE BOOKS
- NASSCOMM

SOFTWARE PROJECT MANAGEMENT	
Course Code: 24EEPEXX	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVES
1. To provide an in-depth understanding of various concepts of Software project phases. 2. To understood the basics of the project management techniques. 3. To learn the feasible solution and optimum solution for the resource management. Learnt the time estimation and critical path for project. 4. To learn the various quality models and risk management in the resource planning.

COURSE LEARNING OUTCOMES (CLO)
The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course, students will be able to:
1. Gain knowledge and understanding of basic concepts related to software project phases, estimation and scheduling. 2. Apply basic concepts related to software project planning, scope and feasibility. 3. Analyse of various project management activities such as tracking, project procurement, configuration management, monitoring. 4. Acquire knowledge about quality assurance, quality control, and risk management.

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

	CLO1	CLO2	CLO3	CLO4
CO1	✓	✓		
CO2		✓	✓	
CO3			✓	
CO4				✓

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**Introduction and Software Project Planning:** Fundamentals of Software Project Management (SPM), Need Identification, Vision and Scope document, Project Management Cycle, SPM Objectives, Management Spectrum, SPM Framework, Software Project Planning, Planning Objectives, Project Plan, Types of project plan, Structure of a Software Project Management Plan, Software project estimation, Estimation methods, Estimation

	models, Decision process.
UNIT-II	**Project Organization and Scheduling Project Elements:** Work Breakdown Structure (WBS), Types of WBS, Functions, Activities and Tasks, Project Life Cycle and Product Life Cycle, Ways to Organize Personnel, Project schedule, Scheduling Objectives, Building the project schedule, Scheduling terminology and techniques, Network Diagrams: PERT, CPM, Bar Charts: Milestone Charts, Gantt Charts. (SPI), Interpretation of Earned Value Indicators, Error Tracking, Software Reviews, Types of Review: Inspections, Deskchecks, Walkthroughs, Code Reviews, Pair Programming.
UNIT-III	**Project Monitoring and Control:** Dimensions of Project Monitoring & Control, Earned Value Analysis, Earned Value Indicators: Budgeted Cost for Work Scheduled (BCWS), Cost Variance (CV), Schedule Variance (SV), Cost Performance Index (CPI), Schedule Performance Index (SPI), Interpretation of Earned Value Indicators, Error Tracking, Software Reviews, Types of Review: Inspections, Deskchecks, Walkthroughs, Code Reviews, Pair Programming.
UNIT-IV	**Software Quality Assurance and Testing Objectives:** Testing Principles, Test Plans, Test Cases, Types of Testing, Levels of Testing, Test Strategies, Program Correctness, Program Verification & validation, Testing Automation & Testing Tools, Concept of Software Quality, Software Quality Attributes, Software Quality Metrics and Indicators, The SEI Capability Maturity Model CMM), SQA Activities, Formal SQA Approaches: Proof of correctness, Statistical quality assurance, Cleanroom process.
UNIT-V	**Project Management and Project Management Tools Software Configuration Management:** Software Configuration Items and tasks, Baselines, Plan for Change, Change Control, Change Requests Management, Version Control, Risk Management: Risks and risk types, Risk Breakdown Structure (RBS), Risk Management Process: Risk identification, Risk analysis, Risk planning, Risk monitoring, Cost Benefit Analysis, Software Project Management Tools: CASE Tools, Planning and Scheduling Tools, MS-Project.

TEXT BOOKS
Bob Hughes, Mikecotterell, “Software Project Management”, Third Edition, Tata McGraw Hill, 2004.
REFERENCE BOOKS
M. Cotterell, Software Project Management, Tata McGraw-Hill Publication.
Royce, Software Project Management, Pearson Education
Kieron Conway, Software Project Management, Dreamtech Press
S. A. Kelkar, Software Project Management, PHI Publication

GRID COMPUTING	
Course Code: 24EEPEXX	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVES
1. To understand how Grid computing helps in solving large scale scientific problems. 2. To gain knowledge on the concept of virtualization that is fundamental to cloud computing. 3. To learn how to program the grid environment. 4. To understand the security issues in the grid environment.

COURSE LEARNING OUTCOMES (CLO)
The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course the students will be able to:
1. Understand the genesis & know the applications of grid computing. 2. Understand the technology and tool kits for facilitating grid computing. 3. Evaluate enabling technologies such as high-speed links and storage area networks for building computer grids. 4. Design a grid computing application in one of the key application areas e.g. Computer Animation, E-Research. 5. Implement a grid computing environment; develop communications skills and accept the code of professional conduct and security practice through short presentations and group work.

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

	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓	✓		
CO3				✓	
CO4					✓

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**INTRODUCTION AND OVERVIEW OF GRID COMPUTING** Early Grid Activities, Current Grid Activities, An Overview of Grid Business Areas, Grid Applications, Grid Infrastructure
UNIT-II	**WEB SERVICES AND RELATED TECHNOLOGIES** Oriented Architecture, Web Service Architecture, XML, Related Technologies and Their Relevance to Web services, XML Messages and

	Enveloping, Service Message Web Service Interoperability and the Role of the WS-I Organization
UNIT-III	**OGSA** Introduction to Open Grid Services Architecture (OGSA), Commercial Data Center- National Fusion Collaboratory, OGSA Platform Components
UNIT-IV	**OGSI** Introduction-Grid Services, A High-Level Introduction to OGSI, Introduction to Service Data Concepts, Grid Service: Naming and Change Management Recommendations.
UNIT-V	**SECURITY** Trust models for Grid security environment, Authentication and Authorization methods, Grid security infrastructure, and Identity and access management architecture.

TEXT BOOKS
Bart Jacob (Editor), "Introduction to Grid Computing", IBM Red Books, Vervante, 2005.
Ian Foster, Carl Kesselman, "The Grid: Blueprint for a New Computing Infrastructure", 2nd Edition, Morgan Kaufmann.
Frederic Magoules and Jie Pan, "Introduction to Grid Computing" CRC Press, 2009.
REFERENCE BOOKS Barry Wilkinson, "Grid Computing: Techniques and Applications", Chapman and Hall, CRC, Taylor and Francis Group, 2010. Daniel Minoli, "A Networking Approach to Grid Computing", John Wiley Publication, 2005.

OBJECT ORIENTED ANALYSIS & DESIGN	
Course Code: 24EEPEXX	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVES
1. To introduce the concepts of OOP and behavioural modelling.
2. To understand the architectural design methods.
3. To learn the application, methodology in a software design.
4. To understand and learn design patterns.
5. To familiarize with the knowledge of design testing in DPIM.

COURSE LEARNING OUTCOMES (CLO)

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

1. Demonstrate knowledge of structural and behavioral modeling techniques.
2. Demonstrate knowledge of a model-based software development methodology.
3. Create application of the methodology and the modeling techniques in a significant software design project.
4. Demonstrate knowledge of design patterns and their application in a software design project.
5. Demonstrate knowledge of Design and Testing Process Improvement Models.

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

	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**INTRODUCTION** Introduction to OOP concepts, OO model, analysis, design and implementation.

UNIT NUMBER	COURSE CONTENTS
	Types of models: Unified Modeling Language(UML) views and basic features, Object-oriented design methodologies, the rational unified process, Object-oriented CASE tools. Introduction to six-level improvement process of design process improvement model (DPIM).
UNIT-II	**STRUCTURAL & BEHAVIOURAL MODELLING** Structural Modeling Techniques Basic Building Blocks -- objects and classes, Structural Composition Techniques, Design Scaling Issues, **Behavioural Modelling :** Use Case Diagrams, Interaction Diagrams, Event State Diagrams, Action Matrices, Business Lifecycle Diagrams, Activity Diagrams, Collaboration Diagrams, Rule Specification Techniques, Behavioral Model-Based Reference Architecture for Component Specification.
UNIT-III	**ARCHITECTURAL MODELLING** Deployment: Common Modelling technique; Modelling processors and devices, modelling distribution of artifacts. Collaboration: Modeling roles, modelling the realization of a Use Case, modelling the realization of an operation, modelling a mechanism
UNIT-IV	**Design Standards Architectural Patterns**: Design Patterns, Program Patterns, Behavioral Design Units Component-Based Specification Techniques **DPIM - Level One** : Requirements Analysis Techniques, Ad Hoc Approach to Design **DPIM - Levels Two, Three and Four**: Design Methodology, Deployment Design Quality Control Properties and Analysis Techniques, Automatic Convertability, Traceability, Standardizability (Design Units/Reusable Patterns), Modularity Changeability (Change Management) ,Scalability of Design Reliability
UNIT-V	**DPIM - Levels Five and Six** : Design Process Management and Optimization Design Metric Models Testing Maturity Model Extended V-Model Testing Techniques **OO Testing:** Introduction, Object Oriented testing process, testing of analysis and design model, testing of classes.

TEXT BOOKS
S. R Schach, Introduction to Object Oriented analysis and Design, Mc Graw Hill, 2003
Ali Bahrami , "Object Oriented System Development", McGraw Hill International Edition, 1999.
Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data" by EMC Education Services
REFERENCE BOOKS
Booch G., "Object Oriented Analysis and Design", Addison Wesley Publishing Company, 2nd Edition, 2000.

	Rambaugh.J, Blaha. M. Premerlani.W, Eddy F and Loresen W, “Object Oriented Modeling andDesign”,Prentice Hall of India, 1997.
	Coad P, Yourdon E., “Object oriented analysis”, Yourdon Press, 1991.
	Bennett, S., “Schuam’s Outline of UML”. New York: McGraw-Hill 2004
	S. Perdita. “Using UML: Software Engineering with Objects and Components.” Addison-Wesley 2000
	R. Miles, “Learning UML 2.0”, O’REILLY 2006
	E. Gamma., “Design Patterns: Elements of Reusable Object-Oriented Software”, Addison-Wesley

DESIGN THINKING	
Course Code: 24EEPEXX	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVES
1. To provide an overview of an exciting field of design thinking and business processes.
2. To introduce the tools required for design thinking like IBM Blueworks live, IBM Mural
3. To immerse students into the world of innovation as a systematic process of tackling relevant business and/or social problems.
4. To provide a social and thinking space for the recognition of innovation challenges and the design of creative solutions.
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 will be able to:
1. Understand and critically apply the concepts and methods of business processes.
2. Understand and apply IBM Blueworks live and process designer tool concepts.
3. Understand and analyzing design thinking history and its various concepts.
4. Understand, analyzing and create models with users collaboration to apply design thinking concepts.
5. Build the process model that is used to implement process application and use different mural template to apply design thinking concepts for solving real world problem.

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

	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

COURSE CONTENTS

UNIT NUMBER	CONTENTS
UNIT-I	**INTRODUCTION TO BUSINESS PROCESS MANAGEMENT &AS-IS BUSINESS PROCESS** Define business process management (BPM), List and describe the phases in the BPM lifecycle procedure, Define process modeling., Describe how to use IBM Business Process Manager to accomplish process modeling goals, Explain how to create and modify process applications in the Process Center, Create a process application, Explain case management, Describe the purpose and function of Blue works Live, List and describe the core notation elements that are used in IBM Process Designer, Create a business process definition (BPD) from the process and nested process tasks and responsible, Explain how to create and modify process models with the Designer view of the IBM Process Designer.
UNIT-II	**PLAYBACK 0: MODELING PROCESS** List and describe gateways as they are used in IBM Process Designer, List and describe intermediate event types that are used in IBM Process Designer, Model a business process escalation path with an attached timer intermediate event, Describe the Playback 0 validation goals and requirements, Validate that a process model meets Playback 0 goals and Requirements, Describe IBM Business Process Manager product components, Identify the integrations with other IBM products.
UNIT-III	**ENTERPRISE DESIGN THINKING – HISTORY, OVERVIEW** Understand what came before Design Thinking, Identify who did what to bring it about, Learn how it built upon previous approaches, Get an overview of the whole approach to design thinking, Understand the principles, loop, and keys, Determine what is most important.
UNIT-IV	**ENTERPRISE DESIGN THINKING –7 KEY HABITS, THE LOOP, USER RESEARCH** Learn 7 key habits of effective thinkers design, Avoid common anti-patterns, Optimize for success with these habits, Understand the importance of iteration, Learn how to observe, reflect, & make, Get ready to drill down & do tomorrow, Understand the importance of user research, Appreciate empathy through listening, Learn key methods of user research.
UNIT-V	**ENTERPRISE DESIGN THINKING – MAKE, USER FEEDBACK:-** Understand how Make fits into the Loop ,Learn how to leverage Observe information, Learn Ideation, Storyboarding, & Prototyping, Understand user feedback and the Loop, Learn the different types of user feedback, Learn how to carry out getting feedback.

UNIT NUMBER	CONTENTS
UNIT-VI	**PROJECT** Creating Discovery Map, Process Model In Blueworks Live. Adding And Viewing Process Details In Blueworks Live Enterprise Design Thinking - User Research, Reflect, Ideation, Storyboarding, Crafting Hills, Prototyping In Mural.

TEXT/REFERENCE BOOKS
IBM SKILLS ACADEMY

INTERNET OF THINGS	
Course Code: 24EEPEXX	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVES
1. To understand and learn about various protocols of IoT, sensors and their types.
2. To develop schemes for the applications of IoT in real time scenarios.
3. To design business Intelligence and Information Security for IoT

COURSE LEARNING OUTCOMES (CLO)
The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course the students will be able to:
1. Understand the vision of IoT and communication protocols from a global context.
2. Understand and apply IoT protocols.
3. Apply and analyze sensor networks and their components to IoT domain.
4. Design portable IoT using appropriate boards.
5. Evaluate the applications of IoT in agriculture, healthcare, smart grid, factory.
6. Build and create state of the art architecture in IoT.

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

	CLO1	CLO2	CLO3	CLO4	CLO5	CLO6
CO1	✓	✓				
CO2			✓	✓		
CO3					✓	✓

COURSE CONTENTS

UNIT NUMBER	CONTENTS
UNIT-I	**Introduction to IoT:** Definition, Characteristics, Applications, Connectivity Layers, Addressing, Networking, Sensing: Sensors and Transducers, Sensor Classes, Sensor Types, Actuation: Actuator Basics, Actuator Types

UNIT NUMBER	CONTENTS
	Basics of IoT Networking: IoT Components, Inter-dependencies, SoA, Wireless Networks, Protocol Classification, MQTT, Secure MQTT, CoAP, XMPP,AMQP (Advanced Message Queuing Protocol).
UNIT-II	**IoT Protocols:** Protocol Standardization for IoT-M2M and WSN Protocols. **Connectivity Technologies:** IEEE 802.15.4, ZigBee, 6LoWPAN, RFID, HART, NFC, Bluetooth, Zwave, ISA100.11a
UNIT-III	**Sensor Networks:** Basic Concepts, Wireless Sensor Networks, Sensor Nodes, Node Behaviour, Social Sensing, Application Examples, Target Tracking, Wireless Multimedia Sensor Networks, Coverage, Mobile Wireless Sensor Networks and their Applications, UAV (Unmanned Aerial Vehicle) Networks, Machine to Machine Communication, Interoperability in Internet of Things
UNIT-IV	**Introduction to Arduino**: Basic Concepts of Arduino Platform, Examples of Arduino Programming, Integration of Sensors and Actuators with Arduino, **Introduction to Raspberry Pi**, Implementation of IoT with Raspberry, Software Defined Networking, Software Defined IoT Networking
UNIT-V	**Cloud Computing:** Fundamentals, Service Models, Service Management and Security, Case Studies, Open Source Platform, Sensor Cloud, Fog Computing, **Application Domains of IoT :** Smart Cities: Need for Smart Cities, Challenges in Building Smart Cities, Some Technical Issues behind Enabling Smart Cities, Smart Homes: Home Area Networks (HANs), Connected Vehicles, Smart Grid, Industrial IoT, Data Handling and Analytics, Case Study: Agriculture, Healthcare, Activity Monitoring,
UNIT-VI	**PROJECT** Research Activities on IoT with projects and research letters.

TEXT BOOKS
Honbo Zhou, ”The Internet of Things in the Cloud:A Middleware Perspective” –– CRC Press-2012
Arshdeep Bahga, Vijay Madisetti, “Internet of Things (A Hands-On-Approach)”, VPT, 2014.
Dieter Uckelmann, Mark Harrison, “Architecting the Internet of Things”, Springer-2011.
Olivier Hersent, David Boswarthick, Omar Elloumi, “The Internet of Things – Key applications and Protocols”, Wiley, 2012.
The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press)

REFERENCE BOOKS
Raspberry Pi Cookbook, Software and Hardware Problems and solutions, Simon Monk, O'Reilly (SPD), 2016, ISBN 7989352133895
Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014, ISBN: 9789350239759

DISTRIBUTED OPERATING SYSTEM	
Course Code: 24EEPEXX	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVES
1. To know about basic concepts of Distributed operating system.
2. To provide hardware and software issues in modern distributed systems.
3. To get knowledge in distributed architecture and accessibility of resources in distributed file systems.
4. To learn how to store data in Distributed File System and Distributed Share memory.
5. To understand naming, synchronization, consistency and replication, fault tolerance, security in DFS.

COURSE LEARNING OUTCOMES (CLO)
The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course the students will be able to:
1. Gain knowledge of distributed operating system architecture. 2. Implement distributed client server applications using remote method invocation. 3. Have knowledge of Synchronization and Deadlock. 4. Have sufficient knowledge about file access. 5. Understand Shared Memory Technique, security, and distributed file systems.

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

	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓			
CO3			✓		
CO4				✓	
CO5					✓

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENT
UNIT-I	**INTRODUCTION TO DISTRIBUTED SYSTEM** Definition, Characteristics of Distributed system, Design issues, Resource sharing and the Web Challenges, System models - Architectural and fundamental models -Networking and internetworking Communication in distributed system: Layered protocols, ATM networks, Client –Server model, Remote Procedure Calls and Group Communication.
UNIT-II	**CONCURRENCY CONTROL** Clock synchronization, Mutual Exclusion, Election algorithm, the Bully algorithm, a Ring algorithm, Transactions - Nested transactions - Locks - Optimistic concurrency control - Timestamp ordering - Comparison - Flat and nested distributed transactions - Atomic commit protocols - Concurrency control in distributed transactions
UNIT-III	**DEADLOCK** Deadlock in Distributed Systems, Distributed Deadlock Prevention, Distributed Deadlock Detection, Threads, System models, Processors Allocation, Scheduling in Distributed System, Real Time Distributed Systems.
UNIT-IV	**DISTRIBUTED FILE SYSTEM** Distributed file systems: Distributed file system Design, Distributed file system Implementation, Trends in Distributed file systems. Distributed Shared Memory: What is shared memory, Consistency models, Page based distributed shared memory, shared variables distributed shared memory. Replication in DFS
UNIT-V	**SECURITY** Overview of security techniques, Cryptographic algorithms ,Digital signatures , Cryptography pragmatics, Replication , System model and group communications, Fault tolerant services, Highly available services , Transactions with replicated data

TEXT BOOKS
Andrew S. Tanenbaum, Maartenvan Steen, Distibuted Systems, —Principles and Pardigms, Pearson Education, 2002.
George Coulouris, Jean Dollimore and Tim Kindberg, Distributed Systems Concepts and Design, 3rd Edition, Pearson Education, 2002.
REFERENCE BOOKS
Tanenbaum and Steen, Distributed Systems PHI, 2002.
Sape Mullender, Distributed Systems 2nd Edition.
Albert Fleishman, Distributed Systems: Software Design and Implementation, Springer Verlag, 1994.

DATA WAREHOUSING & DATA MINING	
Course Code: 24EEPEXX	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVES

1. To teach the basic principles, concepts and applications of data warehousing and data mining.
2. To familiarize Conceptual, Logical, and Physical design of Data Warehouses OLAP applications and OLAP deployment.
3. To introduce the task of data mining as an important phase of knowledge recovery process.
4. To impart knowledge of the fundamental concepts that provide the foundation of data mining.
5. To perform classification and prediction of data.

COURSE LEARNING OUTCOMES (CLO)

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

1. Understand the functionality of the various data mining and data warehousing component.
2. Design data warehouse with dimensional modelling and apply OLAP operations.
3. Compare and evaluate different data mining techniques like classification, prediction, clustering and association rule mining.
4. Describe complex data types with respect to spatial and web mining.
5. Extract knowledge using data mining techniques.
6. Apply the Data Mining principles and techniques for real time applications.

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

	CLO1	CLO2	CLO3	CLO4	CLO5	CLO6
CO1	✓					
CO2		✓				
CO3			✓	✓		
CO4					✓	
CO5						✓

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**DATA WAREHOUSING AND BUSINESS ANALYSIS:** Data warehousing Components, Building a Data warehouse, Data Warehouse Architecture, DBMS Schemas for Decision Support, Data Extraction, Cleanup, and Transformation Tools, Metadata, reporting, Query tools and Applications, Online Analytical Processing (OLAP), OLAP and Multidimensional Data Analysis.
UNIT-II	**DATA MINING:** Data Mining Functionalities, Data Preprocessing, Data Cleaning, Data Integration and Transformation, Data Reduction, Data Discretization and Concept Hierarchy Generation, Architecture Of A Typical Data Mining Systems, Classification Of Data Mining Systems. Association Rule Mining: Efficient and Scalable Frequent Item set Mining Methods, Mining Various Kinds of Association Rules, Association Mining to Correlation Analysis, Constraint-Based Association Mining.
UNIT-III	**CLASSIFICATION AND PREDICTION:** Issues Regarding Classification and Prediction, Classification by Decision Tree Introduction to Bayesian Classification, Rule Based Classification, Classification by Back propagation, Support Vector Machines, Associative Classification, Lazy Learners, Other Classification Methods, Prediction, Accuracy and Error Measures, Evaluating the Accuracy of a Classifier or Predictor, Ensemble Methods, Model Section.
UNIT-IV	**CLUSTER ANALYSIS:** Types of Data in Cluster Analysis, A Categorization of Major Clustering Methods, Partitioning Methods, Hierarchical methods, Density-Based Methods, Grid-Based Methods, Model-Based Clustering Methods, Clustering High-Dimensional Data, Constraint-Based Cluster Analysis, Outlier Analysis.
UNIT-V	**MINING OBJECT, SPATIAL, MULTIMEDIA, TEXT AND WEB DATA:** Multidimensional Analysis and Descriptive Mining of Complex Data Objects, Spatial Data Mining, Multimedia Data Mining, Text Mining, Mining the World Wide Web.

TEXT BOOKS

- Data Warehousing In the Real World; Sam Anahory & Dennis Murray; 1997, Pearson.
- Data Mining- Concepts & Techniques; Jiawei Han & Micheline Kamber- 2001, Morgan Kaufmann.
- Data Mining Techniques; Arun Pujari; 2001, University Press; Hyderbad.

REFERENCE BOOKS

- Data Mining; Pieter Adriaans & Dolf Zantinge; 1997, Pearson,
- Data Warehousing, Data Miniing and OLTP; Alex Berson, 1997, Mc Graw Hill.
- Data warehousing System; Mallach; 2000, Mc Graw Hill.
- Building the Data Warehouse; W.H. Inman, 1996, John Wiley & Sons.
- Developing the Data Warehouses; W.H Ionhman,C.Klelly, John Wiley & Sons.
- Managing the Data Warehouses; W.H.Inman, C.L.Gassey, John Wiley & Sons.

NASSCOM ASSOCIATE ANALYTICS - III	
Course Code: 24EEPEXX	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVES
This course provides knowledge of the advanced concepts of tools, technologies & programming languages which is used in day to day business analytics cycle.

COURSE LEARNING OUTCOMES (CLO)
The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course, students will be able to:
1. Understand the tools, technologies & programming languages which is used in day to day analytics cycle.
2. Analyze and use the best tools to make sense from available raw data.

COURSE CONTENTS

UNIT NUMBER	CONTENTS
UNIT-I	**Introduction to Predictive Analytics & Linear Regression (NOS 2101)** What and Why Analytics, Introduction to Tools and Environment, Application of Modelling in Business, Databases & Types of data and variables, Data Modelling Techniques, Missing imputations etc. Need for Business Modelling, Regression – Concepts, Blue property-assumptions-Least Square Estimation, Variable Rationalization, and Model Building etc.
UNIT-II	**Logistic Regression Objective Segmentation (NOS 2101)** Model Theory, Model fit Statistics, Model Conclusion, Analytics applications to various Business Domains etc. Regression Vs Segmentation – Supervised and Unsupervised Learning, Tree Building – Regression, Classification, Overfitting, Pruning and complexity, Multiple Decision Trees etc.
UNIT-III	**Time Series Methods/Forecasting, Feature Extraction (NOS 2101)** Arima, Measures of Forecast Accuracy, STL approach, Extract features from generated model as Height, Average, Energy etc and Analyze for prediction.

UNIT-IV	**Working with Documents (NOS 0703)** Standard Operating Procedures for documentation and knowledge sharing, Defining purpose and scope documents, Understanding structure of documents – case studies, articles, white papers, technical reports, minutes of meeting etc., Style and format, Intectual Property and Copyright, Document preparation tools – Visio, PowerPoint, Word, Excel etc., Version Control, Accessing and updating corporate knowledge base, Peer review and feedback.
UNIT-V	**Develop Knowledge, Skill and Competences (NOS 9005)** Introduction to Knowledge skills & competences, Training & Development, Learning & Development, Policies and Record keeping, etc.

TEXT/REFERENCE BOOKS
- NASSCOMM

NETWORK SECURITY & CRYPTOGRAPHY	
Course Code: 24EEPEXX	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVES

1. To know the various art of the security exploitation
2. To learn secure programming techniques
3. To understand the mathematics behind cryptography
4. To know the standard algorithms used to provide confidentiality, integrity and authenticity
5. To learn the public key infrastructure that will be used for security practices

COURSE LEARNING OUTCOMES (CLO)

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

1. Present the exploitation present in the security.
2. Discuss various types of attacks and their characteristics.
3. Illustrate the basic concept of encryption and decryption for secure data transmission.
4. Analyze various cryptography techniques and its applications.
5. Develop solutions for security problems.

MAPPING BETWEEN COURSE OBJECTIVES (COS) AND COURSE LEARNING OUTCOMES (CLOS)

	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓	✓			
CO2		✓	✓		
CO3			✓		
CO4				✓	✓
CO5					✓

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	FUNDAMENTALS

UNIT NUMBER	COURSE CONTENTS
	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.
UNIT-II	**SYMMETRIC KEY 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.
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.
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
UNIT-V	**SECURITY PRACTICE AND SYSTEM SECURITY** Electronic Mail security – PGP, S/MIME – IP security – Web Security - SYSTEM SECURITY: Intruders – Malicious software – viruses – Firewalls.

TEXT BOOKS
- Jon Erickson, “Hacking: The Art of Exploitation”, 2nd Edition, Starch Press, 2008. - William Stallings, “Cryptography and Network Security: Principles and Practices”, Sixth Edition, Pearson Education, 2014.

REFERENCE BOOKS
• “The Shellcoder's Handbook: Discovering and Exploiting Security Holes”, 2nd Edition by Chris Anley et al.
• N. Ferguson, B. Schneier, and T. Kohno. “Cryptography Engineering: Design Principles and Practical Applications”. Wiley, 2010. • Neil Daswani, Christoph Kern, and Anita Kesavan, “Foundations of Security: What Every Programmer Needs to Know”, Frist Edition, Apress, 2007. • SNMP: A Guide to Network Management (MGH). • Telecom Network Management by H.H. Wang (MGH). • Network Management by U. Dlack (MGH).

SOFTWARE TESTING	
Course Code: 24EEPEXX	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVES

1. To understand the basics of Software testing
2. To recognize the various types of software testing techniques
3. To analyse the various levels of software testing
4. To explore software automation process
5. To understand Basic software debugging methods.

COURSE LEARNING OUTCOMES (CLO)

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

1. Demonstrate the fundamentals of software testing using real world examples
2. Identify and apply relevant testing techniques suitable for a real world scenario
3. Investigate the different levels in testing
4. Investigate the reason for bugs and analyse the principles in software testing to prevent and remove bugs.
5. Use practical knowledge to test software and understand the trade-offs between testing techniques
6. Implement Test Automation process and experiment with testing tools.

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

	CLO1	CLO2	CLO3	CLO4	CLO5	CLO6
CO1	✓					
CO2		✓			✓	
CO3			✓		✓	
CO4						✓
CO5				✓		

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**INTRODUCTION** What is software testing and why it is so hard? Basic Definitions: Error, Fault, Failure, Incident, Test Cases, Testing Process, Limitations of Testing.
UNIT-II	**TESTING TECHNIQUES**

UNIT NUMBER	COURSE CONTENTS
	White –Box &Black –Box Testing, Boundary Value Analysis, Equivalence Class Testing, Decision table based Testing, Cause-Effect Graph Technique, Cyclomatic Complexity Analysis.
UNIT-III	**REDUCING THE NUMBER OF TEST CASES** Prioritization guidelines, Priority category, Scheme, Risk Analysis, Regression Testing, Slice based testing, Regression Testing **Testing Activities:** Unit Testing, Levels of Testing, Integration Testing, Debugging, Domain Testing.
UNIT-IV	**SYSTEM TESTING** Verification and Validation Testing, Alpha Testing, Beta Testing, Stress Testing, Load Testing, Volume Testing, Usability testing, Bug, Bug life cycle.
UNIT-V	**TESTING TOOLS** Test Automation: Scope of Automation, Process Model for Automation, Challenges in Automation, Static Testing Tools, Dynamic Testing Tools, Characteristics of Modern Tools.

TEXT BOOKS

- Software Testing: Principles and Practices, Srinivasan Desikan, Gopalaswamy Ramesh, Pearson Education, 2008.
- Software Testing: Principle, Techniques and Tools, M. G. Limaye, Tata McGraw Hill, 2009.
- Effective Methods for Software Testing, William E. Perry, John Wiley and Sons,

REFERENCE BOOKS

- An Integrated Approach to Software Engineering, Pankej Jalote, Narosa Publishing House, New Delhi 1997.
- The Art of Software Testing, Glenford J.Myers, John Wiley & Sons, 1979.
- Software Testing: A Craftman's Approach, P. C. Jorgensen, CRC Press, 1995.
- Software Testing Techniques, Boris Beizer, Dreamtech, 2006.
- Effective Software Testing: 50 Specific Ways to Improve Your Testing, Dustin, Pearson Education, 2002.

OPEN SOURCE SOFTWARE	
Course Code: 24EEPEXX	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVES
1. To introduces concepts, principles and applications of open source software. 2. To discuss about open source software development process. 3. To understand the difference between open source software and commercial software. 4. To familiarize with Linux operating system. 5. To understand and development of web applications using open source web technologies like Apache, MySql and PHP (LAMP/XAMP).

COURSE LEARNING OUTCOMES (CLO)
The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course, students will be able to:
1. Understand the difference between open source software and commercial software.
2. Identify, install and run Linux operating system.
3. Install and manage applications.
4. Identify, install open source web technologies Apache, MySql, PHP.
5. Develop web applications using LAMP.
6. Write session control PHP code for a website.

MAPPING BETWEEN COURSE OBJECTIVES (COS) AND COURSE LEARNING OUTCOMES (CLOS)

	CLO1	CLO2	CLO3	CLO4	CLO5	CLO6
CO1	✓	✓				
CO2		✓	✓			
CO3			✓	✓		
CO4				✓	✓	
CO5					✓	✓

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**UNIT I OPEN SOURCE**: Introduction to Open Source – Open Source vs. Commercial Software – What is Linux? - Free Software – Where I can use Linux? Linux Kernel – Linux Distributions.

UNIT NUMBER	COURSE CONTENTS
UNIT-II	**UNIT II LINUX**: Introduction to Linux Essential Commands - Filesystem Concept - Standard Files 1. The Linux Security Model - Vi Editor - Partitions creation - Shell Introduction 2. String Processing - Investigating and Managing Processes - Network Clients - Installing Application.
UNIT-III	**UNIT III APACHE**: Apache Explained - Starting, Stopping, and Restarting Apache - Modifying the Default Configuration - Securing Apache - Set User and Group - Consider Allowing Access to Local Documentation - Don't Allow public html Web sites - Apache control with .htaccess.
UNIT-IV	**UNIT IV MYSQL**: Introduction to MYSQL - The Show Databases and Table - The USE command - Create Database and Tables - Describe Table - Select, Insert, Update, and Delete statement - Some Administrative detail - Table Joins - Loading and Dumping a Database.
UNIT-V	**UNIT V PHP**: Introduction- General Syntactic Characteristics - PHP Scripting - Commenting your code - Primitives, Operations and Expressions - PHP Variables - Operations and Expressions Control Statement - Array - Functions - Basic Form Processing - File and Folder Access - Cookies - Sessions - Database Access with PHP - MySQL - MySQL Functions - Inserting Records - Selecting Records - Deleting Records - Update Records.

TEXT BOOK

- James Lee and Brent Ware, "Open Source Web Development with LAMP using Linux, Apache, MySQL, Perl and PHP", Dorling Kindersley (India) Pvt. Ltd, 2008.

REFERENCE BOOK

- Eric Rosebrock, Eric Filson,"Setting Up LAMP: Getting Linux, Apache, MySQL, and PHP and working Together", Published by John Wiley and Sons, 2004.
- Philosophy of GNU URL: http://www.gnu.org/philosophy/.
- Version control system, URL: http://git-scm.com/
- SVN version control, URL: http://svnbook.red-bean.com

WIRELESS ADHOC AND SENSOR NETWORK	
Course Code: 24EEPEXX	Continuous Evaluation: 40 Marks
Pre-Requisite : NIL	End Semester Examination: 60 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVES
1. To cover major aspects of ad hoc and sensor networking, from design through performance issues to application requirements.
2. To start with the design issues and challenges associated with implementations of ad hoc and sensor network applications. This includes mobility, disconnections, and battery power consumption.
3. To provide a detailed treatment of proactive, reactive, and hybrid routing protocols in mobile wireless networks. It also covers the IEEE 802.11 Wireless LAN and Bluetooth standards and discusses their characteristics and operations.
4. To cover wireless sensor networks (architecture, design, protocols, and applications).
5. To give students hands-on experience in designing a mobile ad hoc network using the NS2 network simulator.

COURSE LEARNING OUTCOMES (CLO)
The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course, students will be able to:
1. Understand the principles of mobile ad hoc networks (MANETs) and what distinguishes them from infrastructure-based networks. To specify and identify deficiencies in existing wireless protocols for MAC layer and Network layer, and then go onto formulate new and better protocols.
2. Familiarize with the mechanisms for implementing security and trust mechanisms in MANETs and WSNs.
3. Enhance the basic knowledge about the principles and characteristics of wireless sensor networks (WSNs).
4. Understand how proactive and reactive protocols function and their implications on data transmission delay and bandwidth consumption along with design issues in wireless communication.
5. Understand the congestion control mechanism at transport layer and to acquire skills to design and implement a basic mobile ad hoc or wireless sensor network via simulations or programming of PDAs.

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

	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓				
CO2		✓	✓		
CO3				✓	

CO4				✓	✓
CO5					✓

COURSE CONTENTS

UNIT NUMBER	CONTENTS
UNIT-I	**AD HOC Wireless** Introduction, Mobile Ad Hoc Networks, Technologies for Ad Hoc Network, Issues in Ad hoc wireless Networks IEEE 802.11 Architecture and protocols. Protocol for AD HOC Wireless Networks. Issues and classification of MAC protocol, Dynamic Source Routing (DBR), Adhoc Distance Vector (AoDV) routing, Routing Protocols, Application of Ad Hoc and sensor networks
UNIT-II	**Transport Layer & Security Protocols** Issues in designing transport layer protocols, classification of transport layer solutions, TCP over Ad Hoc Wireless Networks, Network Security requirements and Attacks
UNIT-III	**Wireless Sensor Networks** Basic Sensor Network Architectural Elements, Applications of Sensor Networks, Comparison with Ad Hoc Wireless Networks, Challenges and Hurdles. Architecture of WSNs Hardware components, Operating systems and execution environments, some examples of sensor nodes, Network Architecture, Sensor networks scenarios, Optimization goals and figures of merit Design principles for WSNs.
UNIT-IV	**Communication Protocols** Physical Layer and Transceiver design considerations in WSNs, Fundamentals of (wireless) MAC protocol, Address and name management in wireless sensor networks, Localization and positioning Routing protocols Data Dissemination and Gathering, Routing Challenges and Design Issues in Wireless, Routing Strategies in Wireless Sensor Networks
UNIT-V	**Transport & QoS in WSN** Data-Centric and Contention-Based Networking – Transport Layer and QoS in Wireless Sensor Networks – Congestion Control in network processing – Operating systems for wireless sensor networks – Examples
UNIT-VI	**PROJECT** Research Activities and hands-on experience in designing a mobile ad hoc network using the NS2 network simulator

TEXT BOOKS

- C. S. Ram Murthy, B. S. Manoj, Ad Hoc Wireless Networks: Architectures and Protocols, Prentice Hall of India , 2007.
- Andreas Willig and John H. Karl, Protocols & Architectures for Wireless Sensor Networks, Wiley, 2005

ADVANCED JAVA PROGRAMMING	
Course Code: 24EEPEXX	Continuous Evaluation: 40 Marks
Pre-Requisite : Core Java Programming	End Semester Examination: 60 Marks
L T P : 3 0 0	
Credits: 3	

COURSE OBJECTIVES
1. To develop graphical programs with networking functionality. Using Graphics, Animations and Multithreading for designing Simulation and Game based applications. 2. To design and develop GUI applications using Swing and Event Handling. 3. To design and develop Web applications. 4. To understand designing of distributed applications using Remote Method Invocation (RMI)

COURSE LEARNING OUTCOMES (CLO)
The syllabus has been prepared in accordance with National Education Policy (NEP). After the completion of course the students will be able to:
1. Learn the graphics and animation on the web pages, using Java Applets. 2. Learn and design a full set of Event driven UI widgets and other components, including windows, menus, buttons, checkboxes, text fields, scrollbars and scrolling lists, using Abstract Windowing Toolkit (AWT) & Swings Usage. 3. Learn Java Data Base Connectivity (JDBC) so as to retrieve and manipulate the information on any relational database through Java programs. 4. Learn and design the server side programming using Servlets and JSP 5. Use the invocation of the remote methods in an application using RMI.

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

	CLO1	CLO2	CLO3	CLO4	CLO5
CO1	✓	✓			
CO2			✓		
CO3				✓	
CO4					✓

COURSE CONTENTS

UNIT NUMBER	COURSE CONTENTS
UNIT-I	**INTRODUCTION TO ADVANCED JAVA** Java Streaming – Components and events handling – Threading concepts – Networking features – Byte code interpretation – Media Techniques.

UNIT NUMBER	COURSE CONTENTS
UNIT-II	**SWINGS** Introduction to swings, difference between AWT and Swings, java foundation classes, java swings classes.
UNIT-III	**ADVANCED NETWORKING** Client- Sever computing – Sockets – Content and Protocols handlers – Developing distributed applications – RMI – Remote objects – Object serialization
UNIT-IV	**REMOTE METHOD INVOCATION** Remote Method Invocation (RMI): RMI Architecture, Designing RMI application, Executing RMI application.
UNIT-V	**RELATED JAVA TECHNIQUES** 3D graphics – JAR file format and creation – Internationalization. **SERVLETS** Java Servlets: Servlet Interaction & Advanced Servlets, Life cycle of Servlet, Java Servlet Development Kit, Javax.servlet package, Reading Servlet Parameters, Reading Initialization Parameters, The javax.servlet. http Package, Handling HTTP.

TEXT BOOKS

- Jame Jaworski, "*Java Unleashed*", SAMS Techmedia Publications, 1999.
- H.M.Deitel and P.J.Deitel, "Java how to program with an Introduction to Visual J++", Pearson Education, 1998.
- Java: The Complete Reference, Ninth Edition Paperback by Herbert Schildt
- Advanced Java Programming, Uttam Kumar, Oxford Publications.

REFERENCE BOOKS

- Campione, Walrath and Huml, "*The Java Tutorial*", Addison Wesley, 1999.
- Duane A.Bailey, "*Java Structures*", McGraw-Hill Publications, 1999.
- Jeff Frentzen and Sobotka, '*Java Script*", Tata McGraw-Hill, 1999.
- Jamie Jaworski, "*Java Unleashed*", SAMS Techmedia Publication, 1999.
- Jason Blooberg. Jeff Kawski, and Paul Treffers, "*Web Page Scripting Techniques",*Hayden books, 1996.