KARNATAK LAW SOCIETY'S

GOGTE INSTITUTE OF TECHNOLOGY

UDYAMBAG, BELAGAVI-590008

(An Autonomous Institution under Visvesvaraya Technological University, Belagavi)

(APPROVED BY AICTE, NEW DELHI)

3rd & 4th Semester B.E.

(2022 Scheme)

DEPT OF ELECTRICAL & ELECTRONICS ENGINEERING

INSTITUTION VISION

Gogte Institute of Technology shall stand out as an institution of excellence in technical education and in training individuals for outstanding caliber, character coupled with creativity and entrepreneurial skills.

MISSION

To train the students to become Quality Engineers with High Standards of Professionalism and Ethics who have Positive Attitude, a Perfect blend of Techno-Managerial Skills and Problem solving ability with an analytical and innovative mindset.

QUALITY POLICY

- Imparting value added technical education with state-of-the-art technology in a congenial, disciplined and a research oriented environment.
- Fostering cultural, ethical, moral and social values in the human resources of the institution.
- Reinforcing our bonds with the Parents, Industry, Alumni, and to seek their suggestions for innovating and excelling in every sphere of quality education.

DEPARTMENT VISION
Department of Electrical and Electronics Engineering focuses on Training Individual aspirants for Excellent Technical aptitude, performance with outstanding executive caliber and industrial compatibility.

MISSION
To impart optimally good quality education in academics and real time work domain to the students to acquire proficiency in the field of Electrical and Electronics Engineering and to develop individuals with a blend of managerial skills, positive attitude, discipline, adequate industrial compatibility and noble human values.

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

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

1. Apply the concepts of Electrical and Electronics Engineering necessary to attend engineering problems in multidisciplinary domain with a blend of social and environmental aspects with technical and professional competence
2. Participate in the activities that lead to professional and personal growth with self-confidence to adapt to ongoing changes in technology and career development.
3. Develop managerial and entrepreneurship skills embedded with human and ethical values.

PROGRAM SPECIFIC OUTCOMES (PSOs):

1.To demonstrate an understanding of the basic concepts Electrical and Electronics technology with an adequate knowledge of mathematics and science during problem analysis, formulation of solutions, design and development activities.

2. To demonstrate an understanding of the concepts of the core Electrical Engineering aspects such as Electrical machines and Power systems during real time analysis, design and operation.

3.To demonstrate an understanding of the concepts of Electronics technology in the form of Analog and Digital Electronics, Microprocessors and embedded systems required in data acquisition, data processing, automation and control applications and demonstrate capability to comprehend the technological advancements and usage of modern tools keeping up lifelong learning attitude.

4. To demonstrate good managerial and entrepreneurship skills embedded with good communication skill, team work attitude professional ethics and the concern for societal and environmental goodness.

KLS Gogte Institute of Technology
3rd to 8th sem B.E.
Scheme of Teaching and Examination- 2022
Outcome-Based Education (OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2023-24)

Total credits for B.E. Program: 160

Credit definition:

Offline Courses	Online Courses
• 1-hour Lecture **(L)** per week = 1 Credit • 2 hours Tutorial **(T)** per week = 1 Credit, • 2 hours Practical /Drawing **(P)** per week = 1 Credit	04 weeks =1 Credit 08 weeks = 2 Credit 12 weeks = 3 Credit

Semester wise distribution of credits for B.E program

Year	Semester	Credits	Total/Year	Cumulative Credits
1st	I	20	40	40
	II	20		
2nd	III	20	40	80
	IV	20		
3rd	V	22	40	120
	VI	18		
4th	VII	24	40	160
	VIII	16		
Total			160	

Curriculum frame work:

Structure of Undergraduate Engineering program

S.No.	Category of courses	VTU Breakup of credits	KLSGIT Breakup of credits
1	Humanities and Social Sciences including Management courses (English, Kannada, Indian Constitution, Environmental Sciences, Health and Management)	9	10
2	Basic Science courses	22	22
3	Engineering Science courses including ETC, PLC & Drawing	24	24
4	Professional Core Courses	54	54
5	Professional Elective courses relevant to chosen specialization/branch	12	12
6	Open subjects – Electives from other technical, emerging, arts, commerce	9	9
7	Mini, Project, Major Project work and Seminar	10	10
8	Summer Internship and Research /Industrial Internship	10	10
9	Ability Enhancement Courses, including Research Methodology, NCC/NSS/ Sports/Ex- Curricular, Online Certification Course	8	7
10	Universal Human Values	2	2
	TOTAL	**160**	**160**

L-T-P Model for Courses

	Contact Hours				Credits	
S.No.	**L-T-P**	**Lecture**	**Tutorial**	**Practical**	**L-T-P**	**Total**
1	3 - 0 - 0	3	0	0	3 - 0 - 0	3
2	3 - 2 - 0	3	2	0	3 - 1 - 0	4
3	3 - 0 - 2	3	0	2	3 - 0 - 1	4
4	2 - 0 - 2	2	0	2	2 - 0 - 1	3
	1 - 0 - 4	1	0	4	1 - 0 - 2	3

Theory courses having the corresponding lab are converted to integrated type course. Also, the electives (if possible) can also be made integrated type.

Integrated courses (Professional Core/Electives): Integrated courses will have **Theory Syllabus with Practical Syllabus of the same course**. In such a course there could be **no Semester End Examination (SEE) for the practical syllabus** of the course, however, Continuous Internal Evaluation (CIE) will be conducted for the practical topics.SEE can include questions from practical topics.

SDA-Skill Development Activities, TD/PSB- Teaching Department / Paper Setting Board, ASC-Applied Science Course, ESC- Engineering Science Courses, ETC- Emerging Technology Course, AEC- Ability Enhancement Course, HSMS-Humanity and Social Science and Management Course, SDC- Skill Development Course,

KLS Gogte Institute of Technology

2nd Year B.E. Scheme of Teaching and Examination 2022

3rd Semester					Hours/week			Total contact hours/week	Credits	Examination		
S.No.	Course Type	Course Code	Course Title	Teaching Dept.	L	T	P			CIE	SEE	Total
1	BSC	22MATEE31	Transforms in Signals	Maths	3	0	0	03	3	100	100	200
2	IPCC	22EE32	Analog Electronics	EE	3	0	2	05	4	100	100	200
3	IPCC	22EE33	Logic Design	EE	3	0	2	05	4	100	100	200
4	PCC	22EE34	DC Machines & Transformers	EE	3	0	0	03	3	100	100	200
5	ESC	22EE35X	ESC/ETC/PLC	EE	3	0	0	03	3	100	100	200
6	UHV	22EE36	Social Connect and Responsibility		0	0	2	02	1	100	--	100
7	AEC/ SEC	**22AECEE37X**	Ability Enhancement Course/Skill Enhancement Course - III	EE	If the course is a Theory: 1	0	0	01	1	50	50	100
					If a course is a laboratory: 0	0	2	02				
8	MC	22EE381	National Service Scheme (NSS)	NSS coordinator	0	0	2		0	100	--	100
		22EE382	Physical Education (PE) (Sports and Athletics) and Yoga	Physical Education dept & Yoga instructor								
		22EE383	Clubs- Social, Cultural & Academic	Coordinators								
9	PCCL	22EEL39	DC Machines & Transformers Lab	EE	0	0	2	02	1	50	50	100
Total									**20**	**800**	**750**	**1450**

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **MC**: Mandatory Course (Non-credit), **AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course, **L:** Lecture, **T**: Tutorial, **P**: Practical, **S:**SDA: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. **ESC**: Engineering Science Course, **ETC**: Emerging Technology Course, **PLC**: Programming Language Course

ESC/ETC/PLC			
22EE351	Electrical Power Utilization	22EE353	Field Theory
22EE352	Electric Power Generation & Economics	22EE354	Electric Circuit Analysis

Ability Enhancement Course – III	
22DMATEE31*	Mathematics-I
22AECEE372	C Programming Lab
22AECEE373	Circuit Simulation Laboratory using P Spice

***ONLY FOR LATERAL ENTRY DIPLOMA STUDENTS**

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practicals of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2022-23 may please be referred.

National Service Scheme /Physical Education/Yoga/Clubs: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), Yoga(YOG) and Clubs with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, Yoga and Club activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.

4th Semester					Hours/week			Total contact hours/week	Credits	Examination		
S.No.	Course Type	Course Code	Course Title	Teaching Dept.	L	T	P			CIE	SEE	Total
1	PCC	22EE41	Power Electronics	EE	3	0	0	03	3	100	100	200
2	IPCC	22EE42	Microcontrollers	EE	3	0	2	05	4	100	100	200
3	IPCC	22EE43	Synchronous & Induction Machines	EE	3	0	2	05	4	100	100	200
4	ESC	22EE44X	ESC/ETC/PLC	EE	3	0	0	03	3	100	100	200
5	AEC/ SEC	22AECEE45X	Ability Enhancement Course/Skill Enhancement Course- IV	EE	If the course is Theory 1 If the course is a lab 0	0 0	0 2	01 02	1	50	50	100
6	BSC	22EE46	Biology For Engineers		3	0	0	03	3	100	100	200
7	UHV	22EE47	Universal human values course		1	0	0	01	1	50	50	100
8	MC	22EE481	National Service Scheme (NSS)	NSS coordinator	0	0	2		**0**	100	--	100
		22EE482	Physical Education (PE) (Sports and Athletics) and Yoga	Physical Education dept & Yoga instructor								
		22EE483	Clubs- Social, Cultural & Academic	Coordinators								
9	PCCL	22EEL49	Power Electronics Lab	EE	0	0	2	02	1	50	50	100
Total									**20**	**750**	**650**	**1400**

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **MC**: Mandatory Course (Non-credit), **AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course, **L:** Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation.

Engineering Science Course (ESC/ETC/PLC)			
22MATEE441	Mathematics course	22EE443	Transmission & Distribution of Electrical Power
22EE442	Electrical & Electronics Measurements	22EE444	OOP with C++
22INT42	PLC & SCADA		

Ability Enhancement Course / Skill Enhancement Course - IV	
22DMATEE41*	Mathematics-II
22AECEE452	Introduction to MATLAB & Simulink
22AECEE453	Python Programming Lab

***ONLY FOR LATERAL ENTRY DIPLOMA STUDENTS**

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practical of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2022-23.

National Service Scheme /Physical Education/Yoga/Clubs: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), Yoga(YOG) and Clubs with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, Yoga and Club activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.

K.L.S. GOGTE INSTITUTE OF TECHNOLOGY BELGAUM
अमृतं तू विद्या

Transforms in Signals

Course Code	22MATEE31	Course type	BSC	Credits L-T-P	3 – 0– 0
Hours/week: L-T-P	3 – 0 – 0			Total credits	3
Total Contact Hours	L = 40Hrs; T = 0Hrs;P = 0Hrs Total = 40Hrs			CIE Marks	100
Flipped Classes content	10 Hours			SEE Marks	100

Course learning objectives	
1.	Learn Fourier analysis of periodic and non-periodic systems.
2.	Get acquainted with discrete and continuous time functions and their Fourier Analysis.
3.	Study the frequency response for circuits using Laplace Transforms

Pre-requisites: Integration and differentiation.

Unit – I	Contact Hours = 8 Hours
Fundamentals and transmission through LTI: Signal (Examples and classification of singles). Basic operations on signals. Basic Continuous –Time Signals and Basic Discreet –Time Signals (Unit step function, Unit impulse function, Ramp function, Exponential signals, Sinusoidal signals, Exponentially damped sinusoidal signals and pulse signals.) System. Properties of system (Linearity, Causality, Time –invariance and Stability.)Response of a linear system(The Zero –input, Zero-state and total response)	

Unit – II	Contact Hours = 8 Hours
Fourier Analysis of continuous time signals: Classification of time functions – continuous, discrete, periodic and non-periodic functions. Fourier analysis of continuous time periodic functions using continuous time Fourier series (CTFS), properties of CTFS (proof not necessary), Numericals. Fourier analysis of continuous time non-periodic functions using continuous time Fourier transform (CTFT), properties of CTFT(proof not necessary), relationship between CTFS and CTFT, numericals pertaining to standard time functions (unit impulse, unit step, right sided and two-sided exponential functions, rectangular function, constant of magnitude, sinusoidal, complex exponential, signum function).	

Unit –III	Contact Hours = 8 Hours
Fourier Analysis of discrete time functions: Fourier analysis of discrete time periodic functions using discrete time Fourier series (DTFS), properties of DTFS(proof not necessary), Numericals. Fourier analysis of discrete time non-periodic functions using discrete time Fourier transform(DTFT), properties of DTFT(proof not necessary), relationship between DTFS and DTFT,Numericals pertaining to standard time functions (unit impulse, unit step, right sided and two-sided exponential functions, rectangular function, constant of magnitude, sinusoidal, complex exponential, signum function).	

Unit – IV	Contact Hours = 8 Hours
Laplace transforms: Definition of Laplace transforms. Region of convergence. Poles and Zeros of rational Laplace Transforms. Properties of Region of convergence. Laplace transforms for common signals. Properties of Laplace transforms (Linearity, time shifting, Shifting in s-domain, time scaling, time-domain integration, Differentiation if time-domain, differentiation in s-domain, convolution) Partial fraction expansion. Unilateral Laplace transform. Initial value theorem, Final value theorem. Waveform synthesis, Relationship between Laplace Transform and Fourier transform. Numerical pertaining to standard continuous time functions.	

Unit –V	Contact Hours = 8 Hours
Z- transforms: Definition: Z-transform and ROC of finite duration sequences (Right sided, Left-sided and double –sided sequences), z-transform and ROC of Infinite duration sequences (Positive-time, Negative-side and Double –sided exponential sequence), ROC and stability. Properties of z-transform. **Inverse Z-transforms:** Partial fraction expansion method, long division method and complex inverse integral. Linear constant coefficient difference equations. Relation between Z-transform and, discrete time Fourier transform and Laplace transform. Numerical pertaining to standard discrete time functions.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

Books	
	Text Books:
1.	DR. D. Ganesh Rao, "Signals and Systems", Sanguine Tech. Publ., 2011.
2.	H. Hsu and R. Ranjan, "SIGNALS AND SYSTEMS ", 2nd edition, Schaum's Outline Series,
3.	P. Z. Peebles, "Probability, Random Variables, and Random Signal Principles ", McGraw Hill, 4th edition, 2017 and onwards.
	Reference Books:
1.	Simon Haykin and Barry Van Veen, "Signals and Systems", 2nd edition, Wiley, 2003 and onwards.
2.	A. Anand Kumar, "Signals and Systems ", 3rd Edition, PHI Learning.
	E-resourses (NPTEL/SWAYAM.. Any Other)
2.	https://nptel.ac.in/courses/117105085 (**Fourier Analysis of discrete time functions**)

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)
3.	Flipped Classes	3.	Open Book Assignments (OBA)
4.	Online classes	4.	Course Seminar
		5.	Semester End Examination

Course Outcome (COs) At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	**Apply Fourier Analysis for periodic and non-periodic signals.**	Re,Un,Ap	1	
2.	**Apply DTFS and DTFT to deal with analysis of Discrete Signals.**	Re,Un,Ap	1	
3.	**Apply Laplace Transforms and Z transforms to analyze the signals.**	Re,Un,Ap	1	

Scheme of Continuous Internal Evaluation (CIE): Theory course

Components	Addition of two IA tests	Online Quiz	Addition of two OBAs/Math tools	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100

OBA- Open Book Assignment
Minimum score to be eligible for SEE: 40 OUT OF 100

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2.	**Minimum marks required in SEE to pass: 40 out of 100**
3.	Question paper contains three parts **A(30 marks),B(50 marks) and C (20 marks).**Student has to answer 1. From Part A answer any 5 questions each Question Carries 6 Marks. 2. From Part B answer any one full question from each unit and each question Carries 10 Marks. 3. From Part C answer any one full question and each Question Carries20 Marks.

CO-PO Mapping (Planned)													CO-PSO Mapping(Planned)		
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
1	√														
2	√														
3	√														
Mention the levels: 1, 2, 3															

Analog Electronic Circuits

Course Code	22EE32	**Course type**	IPCC	**Credits L-T-P**	3 - 0- 1
Hours/week: L-T-P	3 - 0 - 2			**Total credits**	4
Total Contact Hours	L = 40Hrs; T = 0 Hrs; P = 20Hrs Total = 60Hrs			**CIE Marks**	100
Flipped Classes content	07 Hours			**SEE Marks**	100

Course learning objectives	
1.	To understand the basic working of diode applications like clippers, clampers and rectifiers.
2.	To understand/analyze BJT and FET as an amplifier/Oscillator.
3.	To understand the basic operation and characteristics of Field Effect Transistor (FET). (JFET/MOSFET)
4	To understand basics of fabrication process of MOS Transistors.

Required Knowledge of: Basic Electronics, Engineering Mathematics.

Unit – I	**Contact Hours = 8 Hours**
Diode applications circuits: Design and analysis of Clamper, parallel clippers, rectifiers, Zener diode as a DC voltage regulator.	

Unit – II	**Contact Hours = 8 Hours**
Bipolar Junction Transistor (npn) : BJT as a switch, BJT input-output characteristic, Significance of DC Biasing of BJT, DC Biasing arrangement for CE Configuration, Analysis of Fixed Biased, Emitter Biased, Collector feedback, voltage divider biasing arrangement	

Unit – III	**Contact Hours = 8 Hours**
Capacitor coupling for BJT amplifiers, Transistor modeling, 'r_e' model for BJT Amplifiers (Fixed biased, Emitter Biased, Voltage divider) and Darlington Emitter Follower circuit, Frequency response of BJT Amplifier(Miller effect) BJT Oscillators: R-C phase shift oscillator using BJT.	

Unit – IV	**Contact Hours = 8 Hours**
Field Effect Transistor: Types of FET's, construction of JFET, Drain and transfer characteristics of JFET, **FET Biasing**: Fixed Bias arrangement for JFET, Self-Bias arrangement for JFET, Voltage divider Bias arrangement for D-MOSFET, Feedback Biasing arrangement for E-MOSFET, FET Crystal Oscillator	

Unit –V	Contact Hours = 8 Hours
Introduction to Integrated Circuit Technology, Basic MOS Transistor, Enhancement/Depletion Mode action , nMOS Fabrication, CMOS Fabrication (p-well process and n-well process),	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	1	1	1

List of Experiments

Unit No.	No. of Experiments	Topic(s) related to Experiment
1	1	Clippers
1	1	Clampers
2	1	BJT Characteristics
2,3	1	BJT Amplifier (DC Biasing, frequency response),
3	1	BJT Oscillators
4	1	FET Characteristics (Drain/Transfer Characteristics)
4,5	1	FET Amplifiers
4	1	FET Oscillators

Unit No.	Self-Study Topics
1	Rectifiers
2	Nil
3	Nil
4	Types of FET's,
5	n-Well process of CMOS Fabrication

Books	
	Text Books:
1.	Robert L. Boylestad, Louis Nashelsky, Electronics Devices and Circuit Theory, Pearson, Eleventh Edition onwards
2.	Douglas A. Pucknell, Kamran Eshraghian, Basic VLSI Design, pHI publication, Third Edition onwards.
Reference Books:	
1.	David A. Bell, "Electronic Devices and Circuits", PHI, 4th Edition and onwards.
2.	Jacob Millman & Christos C. Halkias, " Integrated Electronics", Tata- McGraw Hill, 2nd Edition, 2010 and onwards.
	E-resources:
1.	https://nptel.ac.in/courses/108102112
2.	https://archive.nptel.ac.in/courses/108/105/108105158/#

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Open Book Assignments (OBA)/ Lab Project
3.	Flipped Classes	3.	Lab Test
4.	Practice session/Demonstrations in Labs	4.	Semester End Examination
5.	Virtual Labs (if present)		

Course Outcome (COs) **Learning Levels:** **Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create**				
At the end of the course, the student will be able to		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Explain the operation of electronic solid state devices such as diode, transistor , FETs and circuit models of their applications namely clippers, clampers, rectifiers and regulators, amplifiers, oscillators and types, construction and fabrication process of such devices viz.MOS transistor	Un, Ap, An	1,2,5,9, 10,11,12	1,3,4
2.	Develop (construct) and Analyze circuit models of their applications namely clippers, clampers, rectifiers and regulators, amplifiers and oscillators.	Ap, An	1,2,5,9, 10,11,12	1,3,4
3.	Analyze and evaluate the performance of the application circuits and experimentally verify the performance.	An, Ev,Cr	1,5,9,10,11 ,12	1,3,4

Scheme of Continuous Internal Evaluation (CIE):

For integrated courses, a lab test also will be conducted at the end of the semester. The lab test (**COMPULSORY)**will be part of the CIE. **No SEE for Lab**. **THEORY (60 marks)**			**LAB (40 marks)**		Total
IA test 1	IA test 2	Assignment (OBA/Lab Project/ Industry assignment)	Conduction	Lab test	
25 marks	25 marks	10 marks	15 marks	25 marks	100 marks

IA Test:
1. No objective part in IA question paper
2. All questions descriptive

Conduct of Lab:
1. Conducting the experiment and journal: 5 marks
2. Calculations, results, graph, conclusion and Outcome: 5 marks
3. Viva voce: 5 marks

Lab test: (Batch wise with 15 students/batch)
1. Test will be conducted at the end of the semester
2. Timetable, Batch details and examiners will be declared by Exam section
3. Conducting the experiment and writing report: 5 marks
4. Calculations, results, graph and conclusion: 10 marks
5. Viva voce: 10 marks

Eligibility for SEE:
1. 40% and above (24 marks and above) in theory component
2. 40% and above (16 marks and above) in lab component
3. **Lab test is COMPULSORY**
4. Not eligible in any one of the two components will make the student **Not Eligible** for SEE

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2.	**Minimum marks required in SEE to pass: Score should be $\geq$ 35 &, however overall score of CIE + SEE should be $\geq$ 40%.**
3.	Question paper contains 3 parts - A,B & C, wherein students have to answer any 5 out of 7 questions in part A, 5 out of 10 questions choosing 1 question from each unit in part B & 1 out of 2 questions in part C.

CO-PO Mapping (planned)													CO-PSO Mapping(planned)			
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
1	✓	✓			✓				✓	✓		✓	✓		✓	✓
2	✓	✓			✓				✓	✓		✓	✓		✓	✓
3	✓				✓				✓	✓		✓	✓		✓	✓
Tick mark the CO, PO and PSO mapping																

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1	Design of diode application circuits, analysis of transistor circuits, Demonstration of circuits with Diode, Transistor and other active/passive elements.	IC design, VLSI, different fields involving electronics circuits	Junior Engineer, PCB design,

LOGIC DESIGN

Course Code	22EE33	Course type	IPCC	Credits L-T-P	3 - 0 - 1
Hours/week: L - T- P	3 - 0 - 2			Total credits	4
Total Contact Hours	L = 40 Hrs; T = 0 Hrs; P = 20 Hrs Total = 60 Hrs			CIE Marks	100
Flipped Classes content	10 Hours			SEE Marks	100

Course learning objectives	
1.	To Demonstrate an understanding of the principles of combinational logic with knowledge of Boolean algebra, switching equations, simplification of logic circuits.
2.	To Design and implement combinational logic circuits such as decoders, multiplexers, adders, subtractors etc.
3.	To Design and implement sequential logic circuits such as different types of latches, flip-flops, counters, registers.
4.	To Demonstrate an understanding of the concept of modelling the digital systems, design, construct and analyze state diagrams for synchronous sequential circuits.
5.	To Understand the design, operation and analysis of combinational and sequential logic circuits, simplification and realization of Boolean expressions using logic gates and universal gates.

Required Knowledge of : Basic electronics engineering, basics of digital circuits

Unit – I	Contact Hours = 8 Hours
Principles of Combinational Logic: Introduction to Boolean algebra, classification of Boolean equations (switching equations), SOP and POS equations, minterms, maxterms, standard SOP and POS equations, generation of switching equations from truth tables. Completely specified functions and incompletely specified functions. Simplification methods of switching equations. Karnaugh maps-3 and 4 variables, map entered variables.	

Unit – II	Contact Hours = 8 Hours
Design and Implementation of Combinational Logic: General approach, decoders-BCD decoders, encoders. Digital multiplexers- using multiplexers as Boolean function generators. Adders and subtractors - cascading full adders, look ahead carry, binary comparators.	

Unit – III	Contact Hours = 8 Hours
Principles of Sequential Circuits-I: Introduction to Sequential Circuits, basic bi-stable element, latches, SR latch, applications of SR latch, S' R' latch, gated SR latch, gated D latch. Master-slave flip-flops- pulse-triggered flip-flops, master-slave SR flip-flops, master-slave JK flip-flop. Edge triggered flip-flop- Positive edge-triggered D flip-flop, negative-edge triggered D flip-flop-characteristic equations, registers, classification and universal shift register.	

Unit – IV	Contact Hours = 8 Hours
Principles of Sequential Circuits-II: Counters - Binary ripple counters, synchronous binary counters, counters based on shift registers, design of a synchronous counters, design of a synchronous mod-6 counter using clocked JK flip-flops, design of a synchronous mod-6 counter using clocked D, T, or SR flip-flops.	

Unit – V	Contact Hours = 8 Hours
Design and analysis of Sequential Logic: Introduction, Mealy and Moore models, state machine notation, synchronous sequential circuit analysis and design. Analysis of clocked synchronous sequential circuits, excitation and output expressions, transition equations, transition tables, excitation tables, state tables, construction of state diagrams, counter design.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

List of Experiments

Unit No.	No. of Expts	Topic(s) related to Experiment
1	3	1. a) Logic gates/universal gates Truth Table Verification. b) BCD to excess-3 code conversion and vice versa. c) Realization of binary to gray code conversion and vice versa.
2	5	2. a) Design and implementation of arithmetic circuits namely half/full adder and half/full subtractors using logic gates. b. Realization of parallel adder/subtractors using IC 7483 chip. 3. Multiplexer and demultiplexer – use of ICs 74153, 74139 for the implementation of arithmetic circuits and code converter. 4. a) Realization of one/two bit comparator and study of 7485 magnitude comparator. b. Use of decoder chip to drive LED display.
3	1	5. SR Flip-Flop, JK Flip-Flop, D Flip-Flop and T Flip-Flop realization.
4 and 5	3	**6.** Realization of 3 bit counters as a sequential circuit and mod – N counter design and two bit UP/DOWN counter design (using ICs 7476, 7490, 74192, 74193). **7.** Shift left; Shift right, SIPO, SISO, PISO, PIPO operations using IC 7495. **8.** Ring counter design.

Unit No.	Self-Study Topics
4	Design of Synchronous counters

Books	
	Text Books:
1.	Sudhakar Samuel, “Logic Design”, Pearson/Sanguine, 2010.
2.	John M Yarbrough,“Digital Logic Applications and Design”, Thomson Learning, 2016.
	Reference Books:
1.	Donald D Givone, “Digital Principles and Design”, TMH publications, 2015.
	E-resources (NPTEL)
1.	https://nptel.ac.in/courses/117105080

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Open Book Assignments (OBA)/ Lab Project
3.	Flipped Classes	3.	Lab Test
4.	Practice session/Demonstrations in Labs	4.	Semester End Examination
5.	Virtual Labs (if present)		

Course Outcome (COs)
Learning Levels:
Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create

At the end of the course, the student will be able to		Learning Level	PO(s)	PSO(s)
1.	Explain and understand the principles of combinational Logic with knowledge of Boolean algebra, switching equations, decoders, multiplexers, adders, subtractors, different types of latches, flip flops, counters, registers.	Un, Ap, An	1,2,3,9,10, 12	1,3
2.	Develop(construct) and Analyze combinational logic circuits simplification techniques, minimization of logic circuits, latches, flip flops, counters, registers, modeling the digital systems, design, construct and analyze state diagrams for synchronous sequential circuits..	Ap, An	1,2,3,9,10, 12	1,3
3.	Analyze and evaluate the performance of the combinational and sequential logic circuits, simplification and realization of Boolean expressions using logic gates and universal gates.	An, Ev, Cr	1,2,3,9,10, 12	1,3

Scheme of Continuous Internal Evaluation (CIE):

For integrated courses, a lab test also will be conducted at the end of the semester. The lab test **(COMPULSORY)** will be part of the CIE. **No SEE for Lab**.

THEORY (60 marks)			**LAB (40 marks)**		Total
IA test 1	IA test 2	Assignment (OBA/Lab Project/ Industry assignment)	Conduction	Lab test	
25 marks	25 marks	10 marks	15 marks	25 marks	100 marks
IA Test: 1. No objective part in IA question paper 2. All questions descriptive					
Conduct of Lab: 1. Conducting the experiment and journal: 5 marks 2. Calculations, results, graph, conclusion and Outcome: 5 marks 3. Viva voce: 5 marks					
Lab test: (Batch wise with 15 students/batch) 1. Test will be conducted at the end of the semester 2. Timetable, Batch details and examiners will be declared by Exam section 3. Conducting the experiment and writing report: 5 marks 4. Calculations, results, graph and conclusion: 10 marks 5. Viva voce: 10 marks					
Eligibility for SEE: 1. 40% and above (24 marks and above) in theory component 2. 40% and above (16 marks and above) in lab component 3. **Lab test is COMPULSORY** 4. Not eligible in any one of the two components will make the student **Not Eligible** for SEE					

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2.	**Minimum marks required in SEE to pass: Score should be $\geq$ 35 &, however overall score of CIE + SEE should be $\geq$ 40%.**
3.	Question paper contains 3 parts - A,B & C, wherein students have to answer any 5 out of 7 questions in part A, 5 out of 10 questions choosing 1 question from each unit in part B & 1 out of 2 questions in part C.

CO-PO Mapping (planned)													CO-PSO Mapping (planned)			
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO4
1	✓	✓	✓						✓	✓		✓	✓		✓	
2	✓	✓	✓						✓	✓		✓	✓		✓	
3	✓	✓	✓						✓	✓		✓	✓		✓	
Tick mark the CO, PO and PSO mapping																

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1	Design of sequential circuits and analysis 2. design of counters and registers	Digital circuit design industries, Embedded systems and VLSI industries	Automation & Control Engineer

D.C. MACHINES AND TRANSFORMERS

Course Code	22EE34	Course type	PCC	Credits L-T-P	3 - 0 - 0
Hours/week: L - T- P	3 - 0 - 0			Total credits	3
Total Contact Hours	L = 40 Hrs; T = 0 Hrs; P = 0 Hrs Total = 40 Hrs			CIE Marks	100
Flipped Classes content	10 Hours			SEE Marks	100

Course learning objectives	
	To impart an ability to the students to
1	Understand and describe equivalent circuit models, performance calculations of various types of transformers and parallel operation of single phase transformers, connection of three phase transformers.
2	Explain principle of operation, construction, working, types, operating characteristics and performance calculations for DC machines.
3	Understand and analyze speed control techniques of dc motors and various methods of testing of DC machines and determine losses and efficiency.
4	Describe construction and applications of special machines.

Required Knowledge of: Basic electrical engineering.

Unit – I	**Contact Hours = 8 Hours**

a. **Single phase Transformers:** concept of ideal transformer, operation of practical transformer on no load and load (R, L, C loads with phasor diagrams), types of transformers based on applications (brief discussion), illustrative problems

b. **b. Performance analysis of single phase Transformers:** Transformer circuit parameters, equivalent circuit, losses, efficiency, condition for maximum efficiency, all day efficiency. Open circuit and short circuit tests, calculation of parameters of equivalent circuit. Voltage regulation, predetermination of efficiency, Sumpner's test, illustrative problems.

c. **Single phase Auto-transformers**-Introduction, saving in conductor material. Advantages and disadvantages, applications of auto-transformer.

Unit – II	Contact Hours = 8 Hours

a. **Parallel operation of transformers -** Polarity of transformers, polarity test, parallel operation of single phase transformers, necessity and desirable conditions for parallel operation, Load sharing in case of similar and dissimilar transformers (excluding derivations), illustrative problems.

b. **b. Three-phase Transformers:** Single unit three-phase transformer and bank of three single-phase transformers. Three phase transformer connections– star/star, delta/delta, star/delta, delta/star, open delta, Scott connection. Applications and factors affecting choice of connections. Conditions for parallel operation of three-phase transformers, conservator and breather.

Unit – III	Contact Hours = 8 Hours

a. **DC Generators**- Principle of operation of DC generator, construction of DC machine, classification of DC generator, types of armature windings, EMF equation (excluding derivation),illustrative problems, armature reaction, Commutation, Practical commutation process, methods of improving commutation (interlopes, compensating winding), applications of DC generators.

b. **DC Motors-** Principle of operation of DC motor, classification of DC motors, back EMF and its significance, torque equation (excluding derivation), characteristics of shunt &series motors, Applications of DC motors, illustrative problems.

Unit – IV	Contact Hours = 8 Hours

a. **Speed control of DC motors:** Methods of speed control of shunt, series DC motors, illustrative problems, starting of DC motors, three point starter, illustrative problems.

b. **Losses and efficiency:** Losses in DC machines, power flow diagram, efficiency, condition for maximum efficiency (excluding derivation), illustrative problems.

Unit –V	Contact Hours = 8 Hours

Special Electrical Machine: DC servomotors, brushless DC motors, permanent magnet DC motors, stepper motor (VR type only),Construction and applications of welding transformer, converter transformer, instrument transformers.

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	02	02	02	02	02

Unit No.	Self-Study Topics
01	Types of transformer based on application, voltage regulation, types of autotransformer
02	Factors affecting choice of connections, conservator and breather.
03	Methods of improving commutation
04	Starter, three point starter
05	BLDC motors, instrument transformers

	Books
	Text Books:
1.	V. K. Mehta &Rohit Mehta, **"Electrical Machines"**, S. Chand & Co. Ltd. Publications, second edition, 2012.
2.	Ashfaq Hussain, **"Electrical Machines"**, DhanpatRai& Co. Publications, third edition, 2015.
	Reference Books:
1.	I. J. Nagrath and D. P. Kothari, **"Electrical Machines"**, TMH, 4th Edition, 2010.
2.	A. E. Fitzgerald, Charles Kingsley Jr., S. D. Umans, **"Electrical Machines"**, TMH, 6th edition. 2006.
3.	P.S Bhimbra, Khanna Publishers, **"Electrical Machines"**, 2nd edition, 2001
	E-Resources: https://nptel.ac.in/course.php

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Open Book Assignments (OBA)/ Lab Project
3.	Flipped Classes	3.	Lab Test
4.	Practice session/Demonstrations in Labs	4.	Semester End Examination
5.	Virtual Labs (if present)		

Course Outcome (COs) **Learning Levels:** **Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create**				
At the end of the course, the student will be able to		**Learning Level**	**PO(s)**	**PSO(s)**
1.	**Analyze** equivalent circuit model of transformer, performance calculations of various types of transformers and **explain** parallel operation of single phase transformers, three phase transformer connection.	Ap,An	1, 2, 12	1,2
2.	**Explain** the principle of operation, construction, working, operating characteristics and performance **calculations** for DC machines.	Ap,An	1, 2, 12	1,2
3.	**Explain and analyze** the speed control techniques of dc motors and the methods of determining efficiency and voltage regulation.	Un,An	1, 2,12	1,2
4.	**Explain** construction and applications of special machines.	Un,Ap	1, 2,12	1,2

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OAs/ Course project	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100

OBA- Open Book Assignment
Minimum score to be eligible for SEE: 40 OUT OF 100

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be $\geq$ 35%, however overall score of CIE + SEE should be $\geq$ 40%.
3.	Question paper contains 3 parts - A,B & C, wherein students have to answer any 5 out of 7 questions in part A, 5 out of 10 questions choosing 1 question from each unit in part B & 1 out of 2 questions in part C.

CO-PO Mapping (planned)													CO-PSO Mapping(planned)			
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
1	✓	✓										✓	✓	✓		
2	✓	✓										✓	✓	✓		
3	✓	✓										✓	✓	✓		
4	✓	✓										✓	✓	✓		

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1.	Design of electrical machines, speed control, voltage control, testing of machines	Industrial sectors, Power Systems	Maintenance, automation & control Engineer

Electric Power Utilization & Illumination Engineering

Course Code	22EE351	**Course type**	**ESC**	**Credits L-T-P**	3 – 0- 0
Hours/week: L-T-P	3 – 0 – 0			**Total credits**	3
Total Contact Hours	L = 40 Hrs; T = 0 Hrs;P = 0 Hrs Total = 40 Hrs			**CIE Marks**	100
Flipped Classes content	5 Hours			**SEE Marks**	100

Course learning objectives	
1.	Study basics of lighting system and emerging light sources.
2.	Understand components of lighting system.
3.	Analyze energy efficient lighting.
4.	Design interior and exterior lighting system.

Pre-requisites : Basic principles of lighting system.

Unit – I	**Contact Hours = 8 Hours**
Electric Heating I: Modes of heat transfer, advantages and methods of electric of heating, resistance ovens, design of heating elements, failure of heating element, temperature control of resistance furnaces, induction heating	

Unit – II	**Contact Hours = 8 Hours**
Electric Heating II: Dielectric heating, the arc furnace, power supply and control, condition for maximum output, heating of building Electric welding, resistance and arc welding, control device and welding equipment, Ultrasonic welding, Electron beam welding	

Unit – III	**Contact Hours = 8 Hours**
Refrigeration and Air Conditioning: Introduction, terminology, refrigeration cycle and systems, refrigerants, domestic refrigerators, water cooler, desert cooler, air conditioning, types of a.c systems, room air conditioning, central a.c systems, calculation of rating of electrical equipment	

Unit – IV	**Contact Hours = 8 Hours**
Energy Efficient Lighting: Comparison between different light sources, comparison between different control gears, energy efficient lighting, payback calculation, life cycle costing, (problems on payback calculations, life cycle costing), solar lighting schemes.	

Unit –V	Contact Hours = 8 Hours
Interior Lighting: Industrial, residential, office departmental stores, indoor stadium, theater and hospitals, specific design problems on this aspect. **Exterior Lighting**: Flood, street, aviation and transport lighting, lighting for displays and signaling- neon signs, LED-LCD displays beacons and lighting for surveillance, specific design problems on this aspect.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	1	1	1	1	1

Books	
	Text Books:
1.	Joseph B. Murdoch , **"Illumination Engineering - from Edison's Lamp to the Laser",** Macmillan Publishing company, New York.
2.	Gilbert Held, **"Introduction to light emitting diode technology and applications",** CRC Press
3.	E. Fred Schubart, **" Light emitting diodes",** Cambridge University Press
4.	
	Reference Books:
1.	**"BIS, IEC Standards for Lamps, Lighting Fixtures and Lighting",** Manak Bhavan, New Delhi.
2.	**"IES Lighting Handbook",** (Application Volume 1987), Illuminating Engineering Society of North America

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)
3.	Flipped Classes	3.	Open Book Tests (OBT)
4.	Online classes	4.	Course Seminar
		5.	Semester End Examination

Course Outcome (COs)

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		Learning Level	PO(s)	PSO(s)
1.	**Explain** electric heating & welding processes.	Un	1,6,7	1
2.	**Design** a lighting scheme for interior and exterior lighting.	Ap	1,3,5,6,7,9,10,11,12	1
3.	**Model** and **design** energy efficient lighting schemes.	Ap	1,3,5,6,7,9,10,11,12	1

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OAs/ Course project	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100
OBA- Open Book Assignment **Minimum score to be eligible for SEE: 40 OUT OF 100**					

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥ 35%, however overall score of CIE + SEE should be ≥ 40%.
3.	Question paper contains 3 parts - A,B & C, wherein students have to answer any 5 out of 7 questions in part A, 5 out of 10 questions choosing 1 question from each unit in part B & 1 out of 2 questions in part C.

CO-PO Mapping (Planned)													**CO-PSO Mapping(Planned)**			
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
1	✓					✓	✓						✓			✓
2	✓		✓		✓	✓	✓		✓	✓	✓	✓	✓			✓
3	✓		✓		✓	✓	✓		✓	✓	✓	✓	✓			✓
Tick mark the CO, PO and PSO mapping																

Sl No	**Skill & competence enhanced after undergoing the course**	**Applicable Industry Sectors & domains**	**Job roles students can take up after undergoing the course**
1	Lighting Design, Energy Efficiency, Lighting Simulation and Analysis, Sustainable Lighting Practices,	**Electrical Engineering, O&M**	**Design engineer, entrepreneurship**
2	Project Management, Troubleshooting and Maintenance:	**Electrical Engineering, O&M**	**Design engineer, entrepreneurship**

ELECTRICAL POWER GENERATION & ECONOMICS

Course Code	22EE352	Course type	ESC	Credits L-T-P	3 – 0- 0
Hours/week: L-T-P	3 – 0 – 0			Total credits	3
Total Contact Hours	L = 40 Hrs; T = 0 Hrs;P = 0 Hrs Total = 40 Hrs			CIE Marks	100
Flipped Classes content	10 Hours			SEE Marks	100

Course learning objectives	
1.	Understand and explain the general layout of power system, standard voltages for generation, transmission and distribution levels, DC and AC transmission.
2.	Understand & explain the components of transmission systems, mechanical aspects, insulators, underground cables, corona, line parameters and performance calculations.
3.	Understand and explain general DC and AC distribution system, radial & ring main systems, estimation for concentrated loads and uniform loads.

Pre-requisites : Basic Electrical Engineering

Unit – I	Contact Hours = 8 Hours
Sources of Power Generation: Wind, solar, fuel cell, tidal, geo-thermal, hydro-electric, thermal-steam, diesel, gas, nuclear power plants (block diagram approach only) , Concept of co-generation. Combined heat and power distributed generation.	

Unit – II	Contact Hours = 8 Hours
(a) **Hydro Power Generation**: Selection of site. Classification of hydro-electric plants. General arrangement and operation. Hydroelectric plant power station structure and control, merits demerits. (b) **Thermal Power Generation**: Introduction, site selection. Main parts of a thermal power plant. Working. Plant layout, merits, and demerits.	

Unit – III	Contact Hours = 8 Hours
Nuclear Power Plants: Introduction, Economics of nuclear plants, Merits and demerits, selection of site, Nuclear reaction, Nuclear fission process, Nuclear chain reaction, Nuclear energy, Nuclear fuels, Nuclear plant and layout, Nuclear reactor and its control, Classification of reactors, power reactors in use, Effects of nuclear plants, Disposal of nuclear waste and effluent, shielding.	

Unit – IV	Contact Hours = 8 Hours
Substations: Substations: Introduction, types, Bus bar arrangement schemes, Location of substation equipment. Reactors and capacitors. Interconnection of power stations. **Grounding:** Grounding Systems: Introduction. Resistance grounding systems. Neutral grounding. Ungrounded system.	

Unit –V	Contact Hours = 8 Hours
Economics: Introduction, Effect of variable load on power system, classification of costs, Cost analysis. Interest and Depreciation, Methods of determination of depreciation, Economics of Power generation, different terms considered for power plants and their significance, load sharing. Choice of size and number of generating plants. Tariffs, objective, factors affecting the tariff, types. Types of consumers and their tariff. Power factor, disadvantages, causes, methods of improving power factor, Advantages of improved power factor, economics of power factor improvement and comparison of methods of improving the power factor. Choice of equipment.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

Books	
	Text Books:
1.	A. Chakrabarti, M. L. Soni, and P.V. Gupta, **"Power System Engineering",** Dhanpat Rai and Co., New Delhi.
2.	C. L. Wadhwa, **"Generation, Distribution and Utilization of Electrical Energy",** New Age International, 3rd Edition.
3.	V.K.Mehta, Rohit Mehta, **"Principles of Power System",** S Chand & Co, 2004 Edition
	Reference Books
1.	S. N. Singh, **"Electric Power Generation, Transmission and Distribution",** P.H.I., New Delhi, 2nd Edition.
2.	Dr. S. L. Uppal, "**Electrical Power",** Khanna Publications.
	E-Resource:
1.	https://nptel.ac.in/courses/108105067/3

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)
3.	Flipped Classes	3.	Open Book Tests (OBT)
4.	Online classes	4.	Course Seminar
		5.	Semester End Examination

Course Outcome (COs)

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

	Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create	**Learning Level**	**PO(s)**	**PSO(s)**
1.	Explain different sources of power generation & describe in detail the working of hydroelectric, thermal, nuclear power plants and state functions of major equipment of the power plants.	Re, Un	1, 2, 6, 7,12	1,2
2.	Classify various substations and explain the importance of grounding.	Un	1, 2, 6, 7,12	1,2
3.	Understand and analyse the economic aspects of power system operation and its effects.	Un, An	1, 2, 6, 7,12	1,2
4.	Explain the importance of power factor improvement& its application.	Un, Ap	1, 2, 6, 7,12	1, 2

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OAs/ Course project	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100

OBA- Open Book Assignment
Minimum score to be eligible for SEE: 40 OUT OF 100

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be $\geq$ 35%, however overall score of CIE + SEE should be $\geq$ 40%.
3.	Question paper contains 3 parts - A,B & C, wherein students have to answer any 5 out of 7 questions in part A, 5 out of 10 questions choosing 1 question from each unit in part B & 1 out of 2 questions in part C.

CO-PO Mapping (Planned)													CO-PSO Mapping(Planned)			
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
1	✓	✓				✓	✓					✓	✓	✓		
2	✓	✓				✓	✓					✓	✓	✓		
3	✓	✓				✓	✓					✓	✓	✓		
4	✓	✓				✓	✓					✓	✓	✓		
Tick mark the CO, PO and PSO mapping																

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1	Knowledge about Power Generation, Substations, Grounding & Economics	Power Sectors, Core Industries	Power System Design & Development Engineer

Field Theory

Course Code	22EE353	Course type	ESC	Credits L-T-P	3 – 0 - 0
Hours/week: L - T- P	3 – 0 – 0			Total credits	3
Total Contact Hours	L = 40 Hrs; T = 0 Hrs; P = 0 Hrs Total = 40 Hrs			CIE Marks	100
Flipped Classes content	10 Hours			SEE Marks	100

Course learning objectives	
1.	To understand different coordinate systems for understanding the concept of gradient, divergence and curl of a vector.
2.	To study the application of Coulomb's Law and Gauss Law for electric fields produced by different charge configurations.
3.	To evaluate the energy and potential due to a system of charges.
4.	To study the behavior of electric field across a boundary between a conductor and dielectric and between two different dielectrics.
5.	To study the magnetic fields, propagation of waves and magnetic materials.

Unit – I	Contact Hours = 8 Hours
Vector Analysis: Scalars and Vectors, Vector algebra, Cartesian co-ordinate system, Vector Components and unit vectors. Scalar field and Vector field. Dot product and Cross product, Gradient of a scalar field. Divergence and Curl of a vector field. Co – ordinate systems: cylindrical and spherical, relation between different coordinate systems. Expression for gradient, divergence and curl in rectangular, cylindrical and spherical co-ordinate systems. Numerical. **Electrostatics:** Coulomb's law, Electric field intensity and its evaluation for (i) point charge (ii) line charge (iii) surface charge (iv) volume charge distributions. Electric flux density, Gauss law and its applications. Maxwell's first equation (Electrostatics). Divergence theorem. Numerical.	

Unit – II	Contact Hours = 8 Hours
Energy and Potential: Energy expended in moving a point charge in an electric field. The line integral. Definition of potential difference and potential. The potential field of a point charge and of a system of charges. Potential gradient. The dipole. Energy density in the electrostatic field. Numerical. **Conductor and Dielectrics:** Current and current density. Continuity of current. Metallic conductors, conductor's properties and boundary conditions. Perfect dielectric materials, capacitance calculations. Parallel plate capacitor with two dielectrics with dielectric interface parallel to the conducting plates. Numerical.	

Unit – III	Contact Hours = 8 Hours
Poisson's and Laplace Equations: Derivations and problems, Uniqueness theorem. **Steady magnetic fields:** Biot - Savart's law, Ampere's circuital law. The Curl. Stokes theorem. Magnetic flux and flux density. Scalar and vector magnetic potentials. Numerical.	

Unit – IV	Contact Hours = 8 Hours
Magnetic forces: Force on a moving charge and differential current element. Force between differential current elements. Force and torque on a closed circuit. Numerical. **Magnetic Materials and Magnetism:** Nature of magnetic materials, magnetization and permeability. Magnetic boundary conditions. Magnetic circuit, inductance and mutual inductance. Numerical.	

Unit – V	Contact Hours = 8 Hours
Time Varying Fields and Maxwell's Equations: Faraday's law, Displacement current. Maxwell's equations in point form and integral form. Numerical. **Uniform plane wave:** Wave propagation in free space and in dielectrics. Pointing vector and power considerations. Propagation in good conductors, skin effect. Numerical.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

Books	
	Text Books:
1.	William H Hayt et al, 'Engineering Electromagnetics', McGraw Hill, 8th Edition, 2014.
2.	Matthew N. O. Sadiku, 'Principles of Electromagnetics', Oxford, 6th Edition, 2015.
	Reference Books:
1.	David K. Cheng, 'Fundamentals of Engineering Electromagnetics', Pearson, 2014.
2.	Rohit Khurana, 'Electromagnetic Field Theory', Vikas Publishing, 1st Edition,2014.
	E-resources
1.	https://onlinecourses.nptel.ac.in/noc23_ee97/preview

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)
3.	Flipped Classes	3.	Open Book Tests (OBT)
4.	Online classes	4.	Course Seminar
		5.	Semester End Examination

Course Outcome (COs) At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Explain different coordinate systems for understanding the concept of gradient, divergence and curl of a vector and Coulombs Law and Gauss Law.	Re, un	1,2	1,2
2.	Analyze the behavior of electric field across a boundary between a conductor and dielectric and between two different dielectrics and of magnetic fields and magnetic materials	Un, An	1,2,12	1,2
3.	Analyze the time varying fields and propagation of waves in different media	Un, An	1,2	1,2
4.	Determine the energy and potential due to a system of charges.	Un, Ap	1,2,12	1,2
5.	Apply the theory of magnetic fields and magnetic materials.	Un, Ap	1,2	1,2

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OAs/ Course project	Course Seminar	Total Marks
Marks	25+25 = 50	4* 5 marks = 20	10+10 =20	10	100
OBA - Open Book Assignment **Minimum score to be eligible for SEE: 40 OUT OF 100**					

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be $\geq$ 35%, however overall score of CIE + SEE should be $\geq$ 40%.
3.	Question paper contains 3 parts - A,B& C, wherein students have to answer any 5 out of 7 questions in part A, 5 out of 10 questions choosing 1 question from each unit in part B & 1 out of 2 questions in part C.

CO-PO Mapping (Planned)													CO-PSO Mapping (Planned)			
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
1	✔	✔											✔	✔		
2	✔	✔										✔	✔	✔		
3	✔	✔											✔	✔		
4	✔	✔										✔	✔	✔		
5.	✔	✔											✔	✔		
Tick mark the CO, PO and PSO mapping																

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1	Electromagnetic Field Theory & its applications	Electricity Supply Industries	HV Engineer Material Engineer

ELECTRIC CIRCUIT ANALYSIS

Course Code	21EE354	Course type	ESC	Credits L-T-P	3 – 0 - 0
Hours/week: L - T- P	3 – 0 – 0			Total credits	3
Total Contact Hours	L = 40 Hrs; T = 0 Hrs; P = 0 Hrs Total = 40 Hrs			CIE Marks	100
Flipped Classes content	10 Hours			SEE Marks	100

Course learning objectives	
1.	To understand the basic concepts and types of Electric networks, basic tools of network analysis and apply them for the real time problems.
2.	To understand the useful tools like network theorems and their applications in network analysis.
3.	To demonstrate an understanding of the concept and analysis of Series and Parallel resonant circuits and the practical applications.
4.	To understand the concept of switching, behavior of electric network parameters during switching, transient and steady state response of typical electric networks using Laplace transformation tools.
5.	To understand the modeling of Two port electric networks and applications

Pre-requisites : Calculus, Differential equations, Laplace transformation, Basic Electrical Engineering

Unit – I	Contact Hours = 8 Hours
Basic Concepts: Practical sources, Source transformations, Network reduction using Star – Delta transformation, Loop and Node analysis for linear DC and AC networks with dependent and independent sources, Concepts of super node and super mesh. Principle of duality	

Unit – II	Contact Hours = 8 Hours
Network Theorems – Superposition, Reciprocity and Millman's theorems Thevenin's and Norton's theorems, Maximum Power transfer theorem	

Unit – III	Contact Hours = 8 Hours
Resonant Circuits: Series resonance and parallel resonance, frequency- response of series and Parallel circuits, Q –factor, Bandwidth. **Transient behavior and initial conditions**: Behavior of circuit elements under switching condition and their Representation, evaluation of initial and final conditions in RL, RC and RLC circuits for AC and DC excitations	

Unit – IV	Contact Hours = 8 Hours
Laplace Transformation & Applications: Basic signals and waveform synthesis, Laplace transformations, Determination of time response of networks with step, ramp and impulse inputs, sinusoidal and synthesized inputs	

Unit – V	Contact Hours = 8 Hours
Two port network parameters: Definitions of z, y, h and transmission parameters, modeling of two port networks with these parameters, inter relationship between parameters sets.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

Books	
	Text Books:
1.	Roy Choudhury, "Networks and systems", New Age International Publications, 2nd edition,
2.	Hayt, Kemmerly and Durbin, "Engineering Circuit Analysis", TMH 7th Edition, 2010.
	Reference Books:
1.	M. E. Van Valkenburg, "Network Analysis", PHI / Pearson Education, 3rdEdition.
2.	A.Chakrabarti, Circuit Theory**(**Analysis and Synthesis**),** Dhanpat Rai & Co.,2010.
	E-resources (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://archive.nptel.ac.in/courses/108/105/108105159/

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)
3.	Flipped Classes	3.	Open Book Tests (OBT)
4.	Online classes	4.	Course Seminar
		5.	Semester End Examination

Course Outcome (COs) At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	**Apply**the basic concepts and basic tools of network analysis for the real time analysis problems in different types of Electric networks**.**	Ap	1,12	1
2.	**Apply** useful tools like network theorems for various **applications** of network analysis in Electric networks**.**	Ap	1,12	1
3.	**Analyze** Series and Parallel resonant circuits and apply for the practical applications.	An	1,12	1
4.	**Understand** and **analyze** transient and steady state response of typical electric networks for different types of input signals using Laplace transformation tools**.**	Un, An	1,2,12	1

Scheme of Continuous Internal Evaluation (CIE): Theory course

Components	Addition of two IA tests	Online Quiz	Addition of two OBAs	Course Seminar	Total Marks
Marks	25+25 = 50	4* 5 marks = 20	10+10 =20	10	100
OBA - Open Book Assignment **Minimum score to be eligible for SEE: 40 OUT OF 100**					

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2.	**Minimum marks required in SEE to pass: 40 out of 100**
3.	Question paper contains two questions from each unit each carrying 20 marks. Students have to answer one full question from each unit.

CO-PO Mapping (Planned)													CO-PSO Mapping (Planned)			
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
1	√											√	√			
2	√											√	√			
3	√											√	√			
4	√	√										√	√			
Tick mark the CO, PO and PSO mapping																

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1	Analysis of circuits & Power Systems	Core Industries, Design and Planning	Maintenance & Design Engineer

SOCIAL CONNECT AND RESPONSIBILITY

Course Code	21EE36	Course type	UHV	Credits L-T-P	0-0-1
Hours/week: L-T-P	0-0-2			Total credits	1
Total Contact Hours	16 Hours of engagement			CIE Marks	100
Flipped Classes content	--			SEE Marks	--

Course learning objectives	
1.	Bridging the gap between theory and practice through community engagement
2.	Interaction with the community for identification and solution to real life problems faced by the community
3.	Catalyzing acquisition of values and responsibilities for public service to make better citizens

Required Knowledge of: Interpersonal skills, Communication skills

Activities to be planned and conducted by the Department Associations are:

1. **Linking learning with the community through Knowledge Sharing**: In this the students can apply their knowledge and skills to improve the lives of the people. The knowledge available with the students can be shared to the school students of the local community. It can be in the form of engaging the classes, developing projects which can used by the students and teachers, training sessions on MS word, Excel, PPT for students and teachers etc.
2. **Creating Awareness about health and hygiene:** The students can arrange talks on Importance of cleanliness, health, and hygiene by taking help of Doctors, Public Health Organizations, NGOs etc.
3. **Including the Practitioners as teachers:** Arrange the invited talks by experts in agriculture for the farmers in the local community to create awareness about Organic farming, new methods of agriculture such as hydroponics, vertical farming etc.
4. **Environmental Sustainability:** Students can take initiatives to educate the local community regarding protecting our environment through tree plantations, preserving water bodies etc.
5. **Social Innovations for Rural development**

Course Outcome (COs)

Learning Levels:

Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create

At the end of the course, the student will be able to		Learning Level	PO(s)	PSO(s)
1.	Gain knowledge about the culture and societal realities	Un	6,9	
2.	Develop sense of responsibility and bond with the local community	Un	6,9	
3.	Make significant contributions to the local community and the Society at large	Ap	6,9	
4	Identify opportunities for contribution to the Socio-economic development	Ev	6,9	

Scheme of Continuous Internal Evaluation (CIE):

• Students must maintain the diary of the activities conducted. • The activities can be conducted in groups/batches. • Faculty members can design the evaluation system wherein weightage can be given to presentation of activities conducted & report writing.	50 marks

CO-PO Mapping (Planned)													CO-PSO Mapping(Planned)		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1						✓			✓						
2						✓			✓						
3						✓			✓						
4						✓			✓						
5															
Tick mark the CO, PO and PSO mapping															

Ability Enhancement Course 3rd SEMESTER

Mathematics I for EE/EC Stream

Course Code	22DMATEE31	Course type	AEC	Credits L-T-P	1-0-0
Hours/week: L-T-P	1-0-0			Total credits	1
Total Contact Hours	L = 20 Hrs; T = 0 Hrs; P = 0 Hrs Total = 20 Hrs			CIE Marks	50
Flipped Classes content	5 Hours			SEE Marks	50

Course learning objectives	
1.	Review basic differentiation
2.	Get acquainted with different applications of partial differentiation
3.	Get familiar with various topics in Linear Algebra.
5.	Understand the basic concepts of multiple integral.

Required Knowledge of: Basic Trigonometry, Calculus, Algebra

Unit– I: Calculus	Contact Hours =5Hours
Introduction to limits, continuity and differentiation: Polar Curves, angle between radius vector and tangent, angle between polar curves, Radius of curvature (Cartesian and polar form)	

Unit–II: Partial Differentiation	Contact Hours =5Hours
Definition and simple problems. Total Differentiation-Problems. Partial Differentiation of Composite functions – Problems. Maxima and minima of function of two variables. Jacobians.	

Unit – III: Linear Algebra I
Rank of a matrix by elementary transformation, consistency of system of linear equations-Gauss Jordan method and Gauss-Seidal method. Eigen value and Eigen vectors – Rayleigh's Power method.

Unit– IV: Multiple Integrals	Contact Hours =5Hours
Cylindrical and spherical polar coordinates. Evaluation of double and triple integrals, evaluation of double integrals by change of order of integration, changing into polar coordinates. Applications to find: Area and Volume by double integral. Problems	

Flipped Classroom Details

Unit No.	I	II	III	IV
No. for flipped Classroom Sessions	1	1	1	2

Books	
	Text Books:
1.	B.S. Grewal – Higher Engineering Mathematics, Khanna Publishers, 42nd Edition, 2012.
2.	Erwin Kreyszig –Advanced Engineering Mathematics, John Wiley & Sons Inc., 9th Edition, 2006.
3.	B. V.Ramana- Higher Engineering Mathematics, Tata McGraw-Hill Education Private Limited, Tenth reprint 2010 and onwards.
	Reference Books:
1.	Peter V. O' Neil – Advanced Engineering Mathematics, Thomson Brooks/Cole, 7th Edition, 2011.
2	Glyn James – Advanced Modern Engineering Mathematics, Pearson Education, 4th Edition, 2010.

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Open Book Assignments(OBA)/Lab Project
3.	Flipped Classes	3.	Lab Test
4.	Practice session/Demonstrations in Labs	4.	Semester End Examination
5.	Virtual Labs(if present)		

Course Outcome (COs) At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	**Review** basics of Differentiation and Integration	L1	1	1
2.	**Review** basic concepts of Calculus.	L1	1	1
3.	**Understand** basic Linear Algebra	L2	1	1
4.	**Understand** multivariable Calculus.	L1	1	1

CO-PO Mapping(planned)													**CO-PSO Mapping(planned)**		
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	√														
2	√														
3	√														
4	√														

Scheme of Continuous Internal Evaluation(CIE):Theory course(Non-Integrated)

Components	Addition of CIE components	Total Marks
Written Test	30	50
Two quizzes	20	

Scheme of Semester End Examination (SEE): Theory course (Non-Integrated)

Components	Total Marks
Written exams	50

C Programming Lab

Course Code	22AECEE372	Course type	AEC	Credits L-T-P	0 - 0 - 1
Hours/week: L - T- P	0 - 0 - 2			Total credits	1
Total Contact Hours	L = 0 Hrs; T = 0 Hrs; P = 20 Hrs Total = 20 Hrs			CIE Marks	50
Flipped Classes content	-			SEE Marks	50

Course learning objectives	
1.	To understand & implement pointers, structure and union application
2.	To understand & implement Data files applications
3.	To understand & implement stack and Queue applications
4.	To understand & implement Linked list and tree applications

Required Knowledge of : C programming

Lab Experiment – I	Contact Hours = 2 Hours
Structure and Union	
Lab Experiment – 2	**Contact Hours = 2 Hours**
Pointers	
Lab Experiment – 3	**Contact Hours = 2 Hours**
Data File handling	
Lab Experiment – 4	**Contact Hours = 2 Hours**
Stack application using array	
Lab Experiment – 5	**Contact Hours = 2 Hours**
Stack Application using pointer	
Lab Experiment – 6	**Contact Hours = 2 Hours**
Queue application using array and pointer	
Lab Experiment – 7	**Contact Hours = 2 Hours**
Linked List singly linked	
Lab Experiment – 8	**Contact Hours = 2 Hours**
Linked List doubly linked	
Lab Experiment – 9	**Contact Hours = 2 Hours**
Linked List circular linked	
Lab Experiment – 10	**Contact Hours = 2 Hours**
Tree	

Books	
	Text Books:
1.	**Tanenbaum,** Data Structures Using C, PHI, 2008 Edition
2.	**Narasimha Karumanchi,** Data structures and Algorithms made easy, Career monk publications, January 2016

Course delivery methods		Assessment methods	
1.	Practice session/Demonstrations in Labs	1.	Conduction of Experiments
2.	Virtual Labs (if present)	2.	Journal writing
3.	Chalk and Talk	3.	Lab project/ Open ended experiment
4.		4.	Lab Test
5.		5.	Semester End Examination

Course Outcome (COs)

Learning Levels:

Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create

At the end of the course, the student will be able to		Learning Level	PO(s)	PSO(s)
1.	Make use of pointers, structure and union application	Ap	1,2,5,12	3
2.	Make use of Data files applications	Ap	1,2,5,12	3
3.	Make use of stack and Queue applications	Ap	1,2,5,12	3
4.	Make use of Linked list and tree applications	An	1,2,5,12	3

Scheme of Continuous Internal Evaluation (CIE):

Conduction of experiments & viva-voce	Journal	Lab project/ Open ended experiment	Lab Test	Total
20 marks	5 marks	10 marks	15	50 marks

Conduct of Lab:

1. Conduction of the experiment: 15 marks + Viva voce: 5 marks = 20 marks
2. Calculations, results, graph, conclusion and Outcome recorded in Journal: 5 marks
3. Lab project/ Open ended experiment: 10 marks

3. Lab Test: 15 marks

Eligibility for SEE:

1. 40% and above (20 marks and above)
2. **Lab test is COMPULSORY**

Scheme of Semester End Examination (SEE):			
1.	It will be conducted for 50 marks of 2/3 hours duration.		
2.	**Minimum marks required in SEE to pass:** Score should be ≥35% , however overall score of CIE+SEE should be ≥40%.		
2.	One or Two experiments to be conducted.		
3.	Initial write up	10 marks	50 marks
	Conduct of experiments, results and conclusion	20 marks	
	One-mark question	10 marks	
	Viva- voce	10 marks	
4.	Viva-voce shall be conducted for individual student and not in a group.		

	CO-PO Mapping (planned)												CO-PSO Mapping (planned)			
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
1	✓	✓			✓							✓			✓	
2	✓	✓			✓							✓			✓	
3	✓	✓			✓							✓			✓	
4	✓	✓			✓							✓			✓	
Tick mark the CO, PO and PSO mapping																

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1	Develop Logic, Flowcharts, Source codes , Debugging, Designing SCADA systems	IT Industries, Automation	Software Engineer, Maintenance & Automation Engineer,

Circuit Simulation Laboratory using Pspice

Course Code:	**22AECEE373**	**Course type**	**AEC**	**Credits L-T-P**	0-0-1
Hours/week: L - T- P	0 - 0 - 2			**Total credits**	1
Total Contact Hours	L = 0 Hrs; T = 0 Hrs; P = 20 Hrs; Total = 20 Hrs			**CIE Marks**	50
Flipped Classes content	NIL			**SEE Marks**	50

Course learning objectives	
1.	To understand and demonstrate the Pspice software package
2.	Utilize the software package for designing the various electronics circuits.

Prerequisite: Basic Electrical Engineering

	List of Experiments	**Contact Hours = 20 Hours**
1.	To design and simulate an op-amp based inverting & non inverting amplifier using Pspice software simulation package	
2.	To design and simulate RC phase shift oscillator using op-amp by using Pspice software simulation package	
3.	To design and simulate RC coupled amplifier using op-amps by using Pspice software simulation package.	
4.	To design and simulate diode shunt clipper by using Pspice software simulation package.	
5.	To design and simulate diode clamper circuit simulation using Pspice software simulation package.	
6.	To design and simulate inverting Schmitt trigger circuit using Pspice Software simulation package.	
7.	To design and simulate non inverting Schmitt trigger circuit using Pspice software simulation package.	
8.	To design and simulate full wave bridge rectifier circuit using Pspice software simulation package.	

Books	
	Text Books:
1.	Ramakant Gayakwad “OP-AMPS and Linear Integrated Circuits” Fourth edition

Course delivery methods		Assessment methods	
1.	Conduction evaluation	1.	IA test
2.	Journal evaluation	2.	Conduction
3.	Open end experiment	3.	Journal
		4.	Open End Experiment
		5.	SEE

Course Outcome (COs)

Learning Levels:

Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create

At the end of the course, the student will be able to		Learning Level	PO(s)	PSO(s)
1.	Demonstrate and analyze the various electronics circuits	An	1,9,10,12	3
2.	Demonstrate and design the various electronics circuits	Ap	1,9,10,12	3

Scheme of Continuous Internal Evaluation (CIE):

Conduction of experiments & viva-voce	Journal	Lab project/ Open ended experiment	Lab Test	Total
20 marks	5 marks	10 marks	15	50 marks

Conduct of Lab:

1.Conduction of the experiment: 15 marks + Viva voce: 5 marks = 20 marks

2.Calculations, results, graph, conclusion and Outcome recorded in Journal: 5 marks

3.Lab project/ Open ended experiment: 10 marks

4.Lab Test: 15 marks

Eligibility for SEE:

1. 40% and above (20 marks and above)
2. **Lab test is COMPULSORY**

Scheme of Semester End Examination (SEE):			
1.	It will be conducted for 50 marks of 2/3 hours duration.		
2.	**Minimum marks required in SEE to pass:** Score should be ≥35% , however overall score of CIE+SEE should be ≥40%.		
2.	One or Two experiments to be conducted.		
3.	Initial write up	10 marks	50 marks
	Conduct of experiments, results and conclusion	20 marks	
	One-mark question	10 marks	
	Viva- voce	10 marks	
4.	Viva-voce shall be conducted for individual student and not in a group.		

CO-PO Mapping (planned)													CO-PSO Mapping (planned)			
CO	**PO1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
1	✓								✓	✓	✓	✓			✓	
2	✓								✓	✓	✓	✓			✓	
Tick mark the CO, PO and PSO mapping																

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1	Simulation & Analysis of Electric Circuits	Industrial, VLSI	Design Engineer

D.C. MACHINE AND TRANSFORMER LABORATORY

Course Code	22EEL39	**Credits**	1
Course type	PCCL	**CIE Marks**	50 marks
Hours/week: L-T-P	0-0-2	**SEE Marks**	50 marks
Total Hours:	36	**SEE Duration**	3 hours for 50 marks

Course learning objectives	
1.	To understand the specifications of Electrical machines.
2.	To explain and demonstrate the operation of the Electrical machines.
3.	To determine the performance characteristics the Electrical machines experimentally.
4.	To analyze the performance of the machines referring to the experimental results.

Required Knowledge of : Basic electrical engineering

Introduction	**Contact Hours = 2 Hours**
Safety measures, first aid safety, Do's and Don'ts and introduction to lab.	
Lab Experiment – 1	**Contact Hours = 2 Hours**
Load test on a D.C shunt motor- determination of speed-torque and HP-efficiency characteristics.	
Lab Experiment – 2	**Contact Hours = 2 Hours**
Speed control of D.C shunt motor by armature voltage control and flux control.	
Lab Experiment – 3	**Contact Hours = 2 Hours**
Field test on D.C. series motor.	
Lab Experiment – 4	**Contact Hours = 2 Hours**
Speed control of stepper motor.	
Lab Experiment – 5	**Contact Hours = 2 Hours**
Predetermination of efficiency and regulations by O.C. and S.C. test on single phase transformer.	
Lab Experiment – 6	**Contact Hours = 2 Hours**
Estimate the efficiency and regulation of transformer using Sumpner's test.	
Lab Experiment – 7	**Contact Hours = 2 Hours**
Determination of load sharing by two single phase transformers.	

Lab Experiment – 8	Contact Hours = 2 Hours
Determination of efficiency and voltage regulation of single phase transformers connected in star-delta connection.	

Books	
	Text Books:
1.	Ashfaq Hussain, **"Electrical Machines"**, Dhanpat Rai & Co. Publications, third edition.
2.	V. K. Mehta &Rohit Mehta**, "Electrical Machines",** S. Chand & Co. Ltd. Publications, second edition.

Course delivery methods		Assessment methods	
1.	Practice session/Demonstrations in Labs	1.	Conduction of Experiments
2.	Virtual Labs (if present)	2.	Journal writing
3.	Chalk and Talk	3.	Lab project/ Open ended experiment
4.		4.	Lab Test
5.		5.	Semester End Examination

Course Outcome (COs)

Learning Levels:

Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create

At the end of the course, the student will be able to		Learning Level	PO(s)	PSO(s)
1.	**Interpret** the specifications of electrical machines.	Un, An	1,2,9,10,11,12	2
2.	**Experiment with** electrical machines.	Ap	1,2,9,10,11,12	2
3.	**Demonstrate** and **determine** of performance characteristics the electrical machines experimentally.	Ap	1,2,9,10,11,12	2
4.	**Analyze** the performance of the machines referring the experimental results.	An	1,2,9,10,11,12	2

Scheme of Continuous Internal Evaluation (CIE):

Conduction of experiments& viva-voce	Journal	Lab project/ Open ended experiment	Lab Test	Total
20 marks	5 marks	10 marks	15	50 marks

Conduct of Lab:

1. Conductionof the experiment:15 marks + Viva voce: 5 marks = 20 marks
2. Calculations, results, graph, conclusion and Outcome recorded in Journal: 5 marks
3. Lab project/ Open ended experiment: 10 marks
3. Lab Test: 15 marks

Eligibility for SEE:
1. 40% and above (20 marks and above)
2. **Lab test is COMPULSORY**

Scheme of Semester End Examination (SEE):			
1.	It will be conducted for 50 marks of 2/3 hours duration.		
2.	**Minimum marks required in SEE to pass:** Score should be ≥35% , however overall score of CIE+SEE should be ≥40%.		
2.	One or Two experiments to be conducted.		
3.	Initial write up	10 marks	50 marks
	Conduct of experiments, results and conclusion	20 marks	
	One mark question	10 marks	
	Viva- voce	10 marks	
4.	Viva-voce shall be conducted for individual student and not in a group.		

CO-PO Mapping (planned)													**CO-PSO Mapping (planned)**			
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
1	✓	✓							✓	✓		✓		✓		
2	✓	✓							✓	✓		✓		✓		
3	✓	✓							✓	✓		✓		✓		
4	✓	✓							✓	✓		✓		✓		
Tick mark the CO, PO and PSO mapping																

Sl No	**Skill & competence enhanced after undergoing the course**	**Applicable Industry Sectors & domains**	**Job roles students can take up after undergoing the course**
1.	Design of electrical machines, speed control, voltage control, testing of machines	Industrial sectors, Power Systems	Maintenance, automation & control Engineer

4TH SEMESTER

POWER ELECTRONICS

Course Code	22EE41	Course type	PCC	Credits L-T-P	3 - 0 - 0
Hours/week: L - T- P	3 - 0 - 0			Total credits	3
Total Contact Hours	L = 40 Hrs; T = 0 Hrs; P = 0 Hrs Total = 40 Hrs			CIE Marks	100
Flipped Classes content	10 Hours			SEE Marks	100

Course learning objectives	
1.	To understand the ratings, characteristics and operation of power electronic devices used for conversion and control of electrical energy.
2.	To design of snubber circuits for power semiconductor devices.
3.	To analyze the operation of power electronic converters used in different power conversion applications for different loads.
4.	To evaluate the performance parameters of different power electronic converters.
5.	To identify the type of PE converters required in different industrial applications and UPS systems.

Required Knowledge of: Basic electrical and electronics Engineering

Unit – I	Contact Hours = 8 Hours
Power semiconductor devices: Introduction to power electronics and power semiconductor devices, types of power semiconductor devices with typical ratings, control characteristics of power semiconductor devices, block diagram of typical PE converter system **Power transistors:** Operation of power BJT as a switch, $\frac{di}{dt}$ and $\frac{dv}{dt}$ limitations and snubber circuits. **Thyristors:** Introduction, two transistor model, static characteristics, $\frac{di}{dt}$ and $\frac{dv}{dt}$ protection, series and parallel operation of thyristors. **Applications:** SCR applications in Battery charger, Static tap changer and welding.	

Unit – II	Contact Hours = 8 Hours
AC-DC Converters: Single phase semi-converters, full converters, single phase dual converter, Role of freewheeling diode, three-phase uncontrolled rectifiers, three-phase semi-converters and full converters (mathematical derivation of expression for average and rms values of output voltage in all types rectifiers excluded. Numerical based on final expression for average and rms values of output voltages and performance parameters included) **Applications:** Controlled Rectifiers applications in Electrolysis & DC drives.	

Unit – III	Contact Hours = 8 Hours
DC-DC converters: Introduction, principle of step-down and step-up chopper with R and R-L loads, performance parameters, classification of chopper (quadrant diagram). **AC-AC converters:** Introduction, principle of ON-OFF and phase control techniques, bidirectional controllers with resistive and R-L loads, concept of cyclo-converters. **Applications:** Speed control of AC drives using ACVC, Choppers application in SMPS.	

Unit – IV	Contact Hours = 8 Hours
DC-AC converters: Introduction, principle of operation, performance parameters, single-phase bridge inverters. three phase inverters-180˚and 120˚ conduction modes, voltage control of single-phase inverters – single pulse width, multiple pulse width and sinusoidal pulse width modulation, concept of multi-level inverters. **Applications:** HVDC power transmission, speed control of AC drives.	

Unit – V	Contact Hours = 8 Hours
Power Conditioners: Introduction, Power line disturbances- types of disturbances, sources of disturbances, effect on sensitive equipment, Power conditioners **Uninterrupted power supplies (UPS):** UPS configurations-online or inverter preferred, offline or line preferred, line interactive UPS systems, battery for UPS-capacity, efficiency, UPS calculations	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

Books	
	Text Books:
1.	M.H.Rashid, “Power Electronics”, Pearson, 3rd Edition, 2006 and onwards
2.	V. R. Moorthi, “Power electronics-devices, circuits and industrial applications”, Oxford university press, first edition, fifteenth impression 2015.
3.	Ned Mohan, Tore M. Undeland, and William P. Robins, “Power Electronics – Converters, Applications and Design”, Third Edition, John Wiley and Sons, 2008 and onwards
4.	M. D. Singh, K. B. Khanchandani, “Power Electronics”, Tata McGraw-Hill Publishing Company Limited, New Delhi, second edition and onwards
	Reference Books:
1.	L. Umanand, “Power Electronics Essentials and Applications”, Wiley India Pvt. Ltd., Reprint 2010 and onwards
2.	R.S. Ananda Murthy and V. Nattarasu, “Power Electronics: A Simplified Approach”, Pearson/Sanguine Technical Publishers
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://nptel.ac.in/courses/108105066/

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)
3.	Flipped Classes	3.	Open Book Tests
4.	Online classes	4.	Course seminar
		5.	Semester End Examination

Course Outcome (COs)

Learning Levels:

Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create

At the end of the course, the student will be able to		Learning Level	PO(s)	PSO(s)
1.	**Explain** the ratings, characteristics and operation of different power electronic devices.	Un	1, 9,10,12	1,3
2.	**Design** snubber circuits for power semiconductor devices.	Ap	1, 12	1,3
3.	**Analyze** the operation of different power electronic converters for different loads and determine the various performance parameters associated with it.	An	1, 2, 9,10,12	1,3
4.	**Analyze** the role of PE converters in industrial applications, power conditioning and UPS systems.	An	1, 9,10,12	1,2

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OBAs/ Course project	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100
OBA- Open Book Assignment **Minimum score to be eligible for SEE: 40 OUT OF 100**					

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be $\geq$ 35%, however overall score of CIE + SEE should be $\geq$ 40%.
3.	Question paper contains 3 parts - A,B & C, wherein students have to answer any 5 out of 7 questions in part A, 5 out of 10 questions choosing 1 question from each unit in part B & 1 out of 2 questions in part C.

CO-PO Mapping (Planned)													**CO-PSO Mapping(Planned)**		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	✓								✓	✓		✓	✓		✓
2	✓											✓	✓		✓
3	✓	✓							✓	✓		✓	✓		✓
4	✓												✓		✓
Tick mark the CO, PO and PSO mapping															

Sl No	**Skill & competence enhanced after undergoing the course**	**Applicable Industry Sectors & domains**	**Job roles students can take up after undergoing the course**
1	Knowledge of power electronic devices & their application in converters	Power conditioners, stabilizers, Inverters &UPS manufacturing industries and sales sector	Power Electronic Engineer/Design Engineer (Power electronics), Sales Engineer
2	Design of PE converters & snubber circuits for different applications & requirements	Renewable energy sector, drives & controls manufacturing industries & sales sectors	Power Electronic Engineer, System Engineer (power electronics), Sales/Marketing Engineer

MICROCONTROLLER AND EMBEDDED SYSTEM

Course Code	22EE42	Course type	IPCC	Credits L-T-P	3 - 0- 1
Hours/week: L-T-P	3 - 0 – 2			Total credits	4
Total Contact Hours	L = 40 Hrs; T = 0 Hrs; P = 20 Hrs Total = 60 Hrs			CIE Marks	100
Flipped Classes content	10 Hours			SEE Marks	100

Course learning objectives	
To impart an ability to the students to	
1.	Understand and explain 8051 Architecture and memory interfacing to 8051 and illustrate all the instructions of 8051 microcontroller instruction set, assembly language programming& demonstrate.
2.	Understand & demonstrate 8051 Timer/counter programming and basics of serial communication, explain 8051 interrupts and interrupts programming, 8051 interfacing with LCD, DAC, Stepper motor and DC motor interfacing and programming.
3.	Understand basics of embedded systems and ARM Cortex M3 processor& demonstrate.

Required Knowledge of: Digital Electronics, C programming concepts

Unit – I	Contact Hours = 8 Hours
8051 Microcontroller basics: Introduction to number system, inside the computer, Microcontroller processors. The architecture of 8051, PSW and flag bits, 8051 register banks and stack, internal memory organization of 8051, IO port usage in 8051, types of special function registers and their uses in 8051, pins of 8051, 8051/31 Interfacing with external ROM and RAM.	

Unit – II	Contact Hours = 8 Hours
a) Instruction set of 8051: Addressing modes, data transfer instructions, arithmetic instructions, logical instructions, and branch instructions, bit manipulation instructions, subroutine instructions and rotate instructions. JUMP and CALL program range, returns. **b) Assembly language programming in 8051:** assembler directives and introduction to 8051 assembly programming: assembling and running an 8051 program. I/O port programming. Time delay in 8051.	

Unit – III	Contact Hours = 8 Hours
a) 8051 Timer programming in Assembly: Programming 8051 timers, Counter programming. **b) 8051 Serial port programming in assembly and C:** Basics of serial communication, 8051 connection to RS232, 8051 serial port programming in assembly, and serial port programming in 8051 C.	

Unit – IV	Contact Hours = 8 Hours
a) 8051 Interrupts and interrupt programming: 8051 interrupts, programming timer, external hardware, and serial communication interrupt, and interrupt priority in 8051. **b) Interfacing:** LCD interfacing, DAC interfacing, Stepper motor interfacing and DC motor interfacing and PWM.	

Unit –V	Contact Hours = 8 Hours
a) Introduction of embedded system: Introduction of Embedded System, Embedded Vs General computing system, Classification of Embedded systems, Major applications and purpose of Embedded System. **b) ARM Cortex M3:** Introduction, Features of Cortex M3 32-bit, applications of ARM, Architecture of ARM Cortex M3, Various Units in the architecture, General Purpose Registers, Special Registers.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

List of Experiments

Unit No.	No. of Experiments	Topic(s) related to Experiment
2	**3**	Data Transfer Instructions Arithmetic Instructions Boolean & Logical Instructions (Bit manipulations).
3	**2**	Delay generation using Timers Serial communication
4	**2**	Interfacing of DC motor to 8051 DAC interfacing with 8051
5	**3**	Interfacing of stepper motor to ARM Cortex M3 ARM Cortex M3 32- bit microcontroller using LPC-1768 for External interrupt. LCD display using ARM Cortex M3 32- bit micro controller (LPC1768).

Unit No.	Self-Study Topics
1	Microcontroller processors
5	Register structure of arm cortex M3

Books	
	Text Books:
1.	Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay, **"The 8051 Microcontroller and Embedded Systems, using assembly and C++",** PHI, 2006 / Pearson, 2006.
2.	Kenneth J. Ayala Penram International, **"The 8051 Microcontroller Architecture, Programming & Applications",** 1996 / Thomson Learning 2005.
3.	Shibu K V, **"Introduction to Embedded Systems"**, TMH Education, 2nd Edition.
4.	Joseph Yiu, **"The Definitive Guide to the ARM Cortex-M3"**, 2nd Edition, Newnes, (Elsevier), 2010.
	Reference Books:
1.	V.Udayashankar and MalikarjunaSwamy, **"The 8051 Microcontroller",** TMH, 2009.
2.	Raj Kamal, **"Microcontrollers: Architecture, Programming, Interfacing and System Design",** Pearson Education, 2005.
	E-resources :
1.	https://swayam.gov.in/explorer?searchText=microcontoller
2.	https://nptel.ac.in/courses/108105102

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Open Book Assignments (OBA)/ Lab Project
3.	Flipped Classes	3.	Lab Test
4.	Practice session/Demonstrations in Labs	4.	Semester End Examination
5.	Virtual Labs (if present)		

Course Outcome (COs) **Learning Levels:** **Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create**				
At the end of the course, the student will be able to		**Learning Level**	**PO(s)**	**PSO(s)**
1.	**Explain** the fundamentals and architecture of 8051 and ARM cortex M3 processor.	Un	1,12	1,3
2.	E**xplain** the instruction set 8051 and **develop**assembly level programs on Timers/Counters and Interrupts of 8051.	Un, Ap	1,2,12	1,3
3.	E**xplain** and **develop** assembly level programs and embedded C programs for 8051 Serial port and interface of peripheral devices with 8051.	Un, Ap	1,2,12	1,3
4.	D**evelop** and **analyze** assembly level programs and C programs for 8051 and ARM cortex M3 processor with interfacing modules& demonstrate the same.	Ap, An	1,2,5,9,10,12	1,3

Scheme of Continuous Internal Evaluation (CIE):

For integrated courses, a lab test also will be conducted at the end of the semester. The lab test **(COMPULSORY)**will be part of the CIE. **No SEE for Lab**.

THEORY (60 marks)			**LAB (40 marks)**		Total
IA test 1	IA test 2	Assignment (OBA/Lab Project/ Industry assignment)	Conduction	Lab test	
25 marks	25 marks	10 marks	15 marks	25 marks	100 marks
IA Test: 1. No objective part in IA question paper 2. All questions descriptive					
Conduct of Lab: 1. Conducting the experiment and journal: 5 marks 2. Calculations, results, graph, conclusion and Outcome: 5 marks 3. Viva voce: 5 marks					
Lab test: (Batch wise with 15 students/batch) 1. Test will be conducted at the end of the semester 2. Timetable, Batch details and examiners will be declared by Exam section 3. Conducting the experiment and writing report: 5 marks 4. Calculations, results, graph and conclusion: 10 marks 5. Viva voce: 10 marks					

Eligibility for SEE:
1. 40% and above (24 marks and above) in theory component
2. 40% and above (16 marks and above) in lab component
3. **Lab test is COMPULSORY**
4. Not eligible in any one of the two components will make the student **Not Eligible** for SEE

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2.	**Minimum marks required in SEE to pass: Score should be ≥ 35 &, however overall score of CIE + SEE should be ≥ 40%.**
3.	Question paper contains 3 parts - A,B & C, wherein students have to answer any 5 out of 7 questions in part A, 5 out of 10 questions choosing 1 question from each unit in part B & 1 out of 2 questions in part C.

	CO-PO Mapping (planned)												**CO-PSO Mapping(planned)**			
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
1	✓											✓	✓		✓	
2	✓	✓										✓	✓		✓	
3	✓	✓										✓	✓		✓	
4	✓	✓			✓				✓	✓		✓	✓		✓	
Tick mark the CO, PO and PSO mapping																

Sl No	**Skill & competence enhanced after undergoing the course**	**Applicable Industry Sectors & domains**	**Job roles students can take up after undergoing the course**
1.	Enhancement of Programming skills, Interfacing of external devices to microcontroller, developing projects	Consumer Electronics Products, instrumentation and Process Control, Medical Instruments, Automotive industry etc.,	Embedded system Engineer

SYNCHRONOUS AND INDUCTION MACHINES

Course Code	22EE43	Course type	IPCC	Credits L-T-P	3 – 0 - 1
Hours/week: L - T- P	3 – 0 – 2			Total credits	3
Total Contact Hours	L = 40 Hrs; T = 0 Hrs; P = 20 Hrs Total = 60 Hrs			CIE Marks	100
Flipped Classes content	10 Hours			SEE Marks	100

Course learning objectives	
1.	Demonstrate an understanding of the principle of operation, types, construction, working, equivalent circuit models, phasor diagrams, performance calculations of synchronous machines.
2.	Describe the principle of synchronization, synchronizing methods, power flow equations, variable excitation and constant excitation operation
3.	Explain the principle of operation of synchronous motor, working, phasor diagrams, torque angle, effect of change in excitation and change in load, hunting and applications of synchronous motors.

Required Knowledge of : Basic electrical engineering

Unit – I	Contact Hours = 8 Hours

Synchronous Generators - Armature windings, distribution factor and chording (pitch) factor (only expressions no derivation), harmonics-causes, reduction and elimination. Leakage reactance, armature reaction, synchronous reactance, equivalent circuit and phasor diagram of non-salient type alternator.
Voltage Regulation: Voltage regulation by EMF, MMF, ZPF methods, definition and direct and quadrature axis reactances for Salient pole Alternator, Phasor diagram on load and voltage regulation

Unit – II	Contact Hours = 8 Hours

Synchronization of Alternators: Synchronizing to infinite bus, necessity and conditions for synchronization, synchronization using lamp methods and synchroscope, power angle characteristics, operation for fixed input and variable excitation(phasor diagrams), power flow equations including armature resistance(No derivations)

Synchronous Motors : Principle of operation, methods of starting synchronous motors, effect of change in excitation, V and inverted V curves, effect of change in load, causes of hunting, its effects and reduction and applications of synchronous motors.(No numerical problems)

Unit – III	Contact Hours = 8 Hours
Three Phase Induction Motors: (Review of working principle, types and construction), Power stages in induction motors, torque, torque-slip characteristic, motoring, generating and braking regions of operation and maximum torque. **Performance Analysis of Three Phase Induction Motor:** Equivalent circuit, phasor diagram of induction motor on no-load, and on load, losses and efficiency, no-load and blocked rotor tests, circle diagram and performance evaluation of the motor, cogging and crawling. **Induction generator**: Externally excited and self-excited, advantages and applications of induction generators	

Unit – IV	Contact Hours = 8 Hours
Starting and Speed Control of Three-phase Induction Motors: Need for starter, direct on line (DOL), Star-Delta and autotransformer starting, rotor resistance starting, soft(electronic) starters, speed control using voltage, frequency and rotor resistance. Applications of Induction motors **Single-phase Induction Motor:** Double revolving field theory and principle of operation, types of single-phase induction motors- split-phase, capacitor start, shaded pole motors and applications.	

Unit – V	Contact Hours = 8 Hours
Special Electric Motors: Construction,Principle of operation and workingofReluctance motors, hysteresis motors, repulsion motors and single phase AC series motor (universal motors), linear induction motors and applications.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

List of Experiments

Unit No.	No. of Experiments	Topic(s) related to Experiment
1	**3**	**Voltage regulation of synchronous generators by EMF, MMF and ZPF methods, Slip Test**
2	**2**	**i)Synchronization of synchronous generator with infinite bus.** **ii) V and inverted V curves of synchronous motor**
3	**3**	**i)Load test on 3 phase induction motor** **ii)Performance assessment of 3 phase induction motor using circle diagram** **iii) Slip ring IM**

Unit No.	Self-Study Topics
1	Phasor diagram for: on load and voltage regulation for salient pole
2	Applications of synchronous motors
3	Applications of induction generators
4	Applications of 3 phase and single-phase induction motors
5	Linear induction motors and applications.

Books	
	Text Books:
1.	Ashfaq Hussain, **"Electrical Machines"**, Dhanpat Rai & Co. Publications, third edition.
2.	V. K. Mehta & Rohit Mehta, **"Electrical Machines",** S. Chand & Co. Ltd. Publications, second edition.
	Reference Books:
1.	I. J. Nagrath and D. P. Kothari, **"Electric Machines",** TMH, 4th edition.
2.	A. E. Fitzgerald, Charles Kingsley Jr. S. D. Umans, "**Electric Machinery",** TMH, 6th edition.
3.	P.S Bhimbra, **"Electrical machinery",** Khanna Publishers, 2nd edition.

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Open Book Assignments (OBA)/ Lab Project
3.	Flipped Classes	3.	Lab Test
4.	Practice session/Demonstrations in Labs	4.	Semester End Examination
5.	Virtual Labs (if present)		

Course Outcome (COs) **Learning Levels:** **Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create**				
At the end of the course, the student will be able to		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Demonstrate an **understanding** of the principle of operation, types, construction, working, of 3 phase synchronous generator and motor , 3 phase induction motor and Special Electric AC machines .	Un	1,12	1
2.	**Develop** equivalent circuit models, phasor diagrams and **analyze,** performance parameters and characteristics of 3 phase synchronous generator and motor, 3 phase induction motor and Special Electric AC machines	Ap	1,2,12	1
3.	**Analyze** and **evaluate** the performance parameters 3 phase synchronous generator and motor and 3 phase induction motor and Special Electric AC machines and demonstrate the analysis and evaluation experimentally	An, Ev	1,2,12	1
4.	**Discuss** the **a**pplications of 3 phase synchronous machine, 3 phase induction motor and Special Electric AC machines in accordance with their performance characteristics	Ap, An	1,12	1

Scheme of Continuous Internal Evaluation (CIE):

For integrated courses, a lab test also will be conducted at the end of the semester. The lab test (**COMPULSORY)** will be part of the CIE. **No SEE for Lab**.

THEORY (60 marks)			**LAB (40 marks)**		Total
IA test 1	IA test 2	Assignment (OBA/Lab Project/ Industry assignment)	Conduction	Lab test	
25 marks	25 marks	10 marks	15 marks	25 marks	100 marks

IA Test:

1. No objective part in IA question paper
2. All questions descriptive

Conduct of Lab:

1. Conducting the experiment and journal: 5 marks
2. Calculations, results, graph, conclusion and Outcome: 5 marks
3. Viva voce: 5 marks

Lab test: (Batch wise with 15 students/batch) 1. Test will be conducted at the end of the semester 2. Timetable, Batch details and examiners will be declared by Exam section 3. Conducting the experiment and writing report: 5 marks 4. Calculations, results, graph and conclusion: 10 marks 5. Viva voce: 10 marks
Eligibility for SEE: 1. 40% and above (24 marks and above) in theory component 2. 40% and above (16 marks and above) in lab component 3. **Lab test is COMPULSORY** 4. Not eligible in any one of the two components will make the student **Not Eligible** for SEE

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2.	**Minimum marks required in SEE to pass: Score should be ≥ 35 &, however overall score of CIE + SEE should be ≥ 40%.**
3.	Question paper contains 3 parts - A,B & C, wherein students have to answer any 5 out of 7 questions in part A, 5 out of 10 questions choosing 1 question from each unit in part B & 1 out of 2 questions in part C.

CO-PO Mapping (planned)													**CO-PSO Mapping (planned)**			
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
1	✓											✓	✓	✓		
2	✓											✓	✓	✓		
3	✓											✓	✓	✓		
4	✓											✓	✓	✓		
5	✓											✓	✓	✓		
Tick mark the CO, PO and PSO mapping																

List the Skill & Competence enhanced after undergoing the course	**List the Applicable Sectors & Domains**	**List the Job roles students can take up after undergoing this course**
Design, Analyze, Select & Operate the machines	Industrial Sector & Power Systems	Machine design engineer, maintenance & control engineer.

Applied Probability Theory and random Processes for Communication and ML

Course Code	**22MATEE441**	**Course type**	**ESC**	**Credits L-T-P**	3 – 0 – 0
Hours/week: L - T- P	3 – 0 – 0			**Total credits**	3
Total Contact Hours	L = 40 Hrs; T = 0 Hrs; P = 0 Hrs Total = 40 Hrs			**CIE Marks**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
1.	Understand Random Variables and relevant terminology
2.	Get accustomed to , operations on single and pairs of random variable and their interpretation
3.	Get acquainted with multiple random variables
4.	Understand random and Markov processes.

Pre-requisites: Basic Linear Algebra, vector algebra and vector calculus, basic statistics

Unit – I	**Contact Hours = 8 Hours**
Random Variables, Distributions, and Density Functions: The Cumulative Distribution Function The Probability Density Function The Gaussian Random Variable. Other Important Random Variables Conditional Distribution and Density Functions Engineering Application: Reliability and Failure rate.	

Unit – II	**Contact Hours = 8 Hours**
Operations on a single random variable and pairs of random variable: Expected Value of a Random Variable Expected Values of Functions of Random Variables Moments. Central Moments Conditional Expected Values. Transformations of Random Variables Characteristic Functions . Probability-Generating Functions. Moment-Generating Functions Evaluating Tail Probabilities, Engineering Application—Scalar Quantization Engineering Application—Entropy and Joint Cumulative Distribution Functions Joint Probability Density Functions Joint Probability Mass Functions . Conditional Distribution, Density, and Mass Functions . Expected Values Involving Pairs of Random Variables. Independent Random Variables Jointly Gaussian Random Variables Joint Characteristic and Related Functions . Transformations of Pairs of Random Variables Complex Random Variables	

Unit – III	Contact Hours = 8 Hours
Multiple random Variables: Joint and Conditional PMFs, CDFs, and PDFs Expectations Involving Multiple Random Variables Gaussian Random Variables in Multiple Dimensions . Transformations Involving Multiple Random Variables Estimation and Detection Engineering Application: Linear Prediction of Speech	

Unit – IV	Contact Hours = 8 Hours
Random sums and sequences: Independent and Identically Distributed Random Variables . Convergence Modes of Random Sequences . The Law of Large Numbers The Central Limit Theorem . Confidence Intervals . Random Sums of Random Variables Engineering Application: A Radar System	

Unit – V	Contact Hours = 8 Hours
Random Processes and Markov Processes : Definition and Classification of Processes . Mathematical Tools for Studying Random Processes Stationary and Ergodic Random Processes Properties of the Autocorrelation Function Gaussian Random Processes . Poisson Processes Definition and Examples of Markov Processes Calculating Transition and State Probabilities in Markov Chains Characterization of Markov Chains . Continuous Time Markov Processes . Engineering Application: A Computer Communication Network . Engineering Application: A Telephone Exchange	

Books	
	Text Books:
1.	Scott L. Miller and Donald Childers, "Probability and Random Processes With Applications to Signal Processing and Communications". Academic Press, Elsevier Inc 2nd edition 2012 onwards.
2.	Henry Stark, John Woods "Probability and Random Processes with applications to signal Processing" PHI Learning Private Limited, Delhi ISBN: 978-81-203-4245-3 3 rd Edition onwards.
	Reference Books:
1.	Robert M Gray, "Probability and Random Processes and Ergodic Properties" Springer 2nd Edition onwards.

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)
3.	Flipped Classes	3.	Open Book Tests (OBT)
4.	Online classes	4.	Course Seminar
		5.	Semester End Examination

Course Outcome (COs) At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	**Understand** random variable and related statistic	Un	1	
2.	**Understand** the engg applications of single and pair of random variables.	Un	1	
3.	**Apply** the theory of multiple random variables in estimation and detection**.**	Ap	1	
4.	**Apply** theory of Random processes to communication network.	Ap	1	

Scheme of Continuous Internal Evaluation (CIE): Theory course

Components	Addition of two IA tests	Online Quiz	Addition of two OBAs\Math tools	Course Seminar	Total Marks
Marks	25+25 = 50	4* 5 marks = 20	10+10 =20	10	100
OBA- Open Book Assignment **Minimum score to be eligible for SEE: 40 OUT OF 100**					

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2.	**Minimum marks required in SEE to pass: 40 out of 100**
3.	Question paper contains three parts **A(30 marks),B(50 marks) and C (20 marks).**Student has to answer 1. From Part A answer any 5 questions each Question Carries 6 Marks. 2. From Part B answer any one full question from each unit and each question Carries 10 Marks. 3. From Part C answer any one full question and each Question Carries20 Marks.

CO-PO Mapping (Planned)													CO-PSO Mapping (Planned)		
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	✓														
2	✓														
3	✓														
4	✓														

Electrical Measurements & Instrumentation

Course Code	22EE442	Course type	ESC	Credits L-T-P	3 – 0- 0
Hours/week: L-T-P	3 – 0 – 0			Total credits	3
Total Contact Hours	L = 40 Hrs; T = 0 Hrs; P = 0 Hrs Total = 40 Hrs			CIE Marks	100
Flipped Classes content	--			SEE Marks	100

Course learning objectives	
1.	Understand the Measuring of resistance, inductance and capacitance using bridges and determine earth resistance.
2.	Explain the working of various meters used for measurement of Power, Energy & understand the adjustments, calibration & errors in energy meters.
3.	Understand methods of extending the range of instruments & instrument transformers.
4.	Explain the working of different electronic instruments, display and recording devices

Pre-requisites: Basic Electrical Engineering..

Unit – I	Contact Hours = 8 Hours
Measurement of Resistance: Wheatstone's bridge, sensitivity, limitations. Kelvin's double bridge. Earth resistance measurement by fall of potential method and by using Megger. **Measurement of Inductance and Capacitance:** Sources and detectors, Maxwell's inductance and capacitance bridge, Hay's bridge, Anderson's bridge, Desauty's bridge, Schering bridge. Shielding of bridges. Problems.	

Unit – II	Contact Hours = 8 Hours
Measurement of Power, Energy, Power Factor and Frequency: Torque expression, Errors and minimization, UPF and LPF wattmeter. Measurement of real and reactive power in 3 phases circuits. Errors, adjustments and calibration of single and three phase energy meters, Problems. Construction and operation of single-phase and three phase dynamometer type power factor meter. Weston frequency meter and phase sequence indicator.	

Unit – III	Contact Hours = 8 Hours
Extension of Instrument Ranges: Desirable features of ammeters and voltmeters. Shunts and multipliers. Construction and theory of instrument transformers, Desirable characterizes, Errors of CT and PT. Turns compensation, Illustrative examples, Silsbee's method of testing CT. **Magnetic measurements:** Introduction, measurement of flux/ flux density, magnetising force and leakage factor.	

Unit – IV	Contact Hours = 8 Hours
Electronic and Digital Instruments: Introduction. Essentials of electronic instruments, Advantages of electronic instruments. True rms reading voltmeter. Electronic multimeters. Digital voltmeters (DVM) - Ramp type DVM, Integrating type DVM and Successive - approximation DVM. Q meter. Principle of working of electronic energy meter (with block diagram), extra features offered by present day meters and their significance in billing.	

Unit –V	Contact Hours = 8 Hours
Display Devices: Introduction, character formats, segment displays, Dot matrix displays, Bar graph displays. Cathode ray tubes, Light emitting diodes, Liquid crystal displays, Nixes, Incandescent, Fluorescent, Liquid vapour and Visual displays. **Recording Devices:** Introduction, Strip chart recorders, Galvanometer recorders, Null balance recorders, Potentiometer type recorders, Bridge type recorders, LVDT type recorders, Circular chart and recorders. Digital tape recording, Ultraviolet recorders. Electro Cardio Graph (ECG)	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	Nil	Nil	Nil	Nil	Nil

Books	
	Text Books:
1.	Electrical and electronic Measurements and Instrumentation A.K. Sawhney Dhanpat Rai and Co 10th Edition
2.	A Course in Electronics and Electrical Measurements and Instrumentation J. B. Gupta Katson Books 2013 Edition

	Reference Books:
1.	Electrical and electronic Measurements and Instrumentation R.K. Rajput S Chand 5th Edition, 2012
2.	Electrical Measuring Instruments and Measurements S.C. Bhargava BS Publications 2013
3.	Modern Electronic Instrumentation and Measuring Techniques Cooper D and A.D. Heifrick Pearson First Edition, 2015
4.	Electronic Instrumentation and Measurements David A Bell Oxford University 3rd Edition, 2013
5.	Electronic Instrumentation H.S.Kalsi Mc Graw Hill 3rd Edition,2010

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)
3.	Flipped Classes	3.	Open Book Tests (OBT)
4.	Online classes	4.	Course Seminar
		5.	Semester End Examination

Course Outcome (COs) At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Measure resistance, inductance and capacitance using bridges and determine earth resistance.	Re, Un	1,6,9	1
2.	Explain the working of various meters used for measurement of Power, Energy & understand the adjustments, calibration & errors in energy meters.	Re, Un, An	1,2,5,7	1,3
3.	Understand methods of extending the range of instruments & instrument transformers.	Re, Un	1,2,3,10	1,3
4.	Explain the working of different electronic instruments, display and recording devices	Re, Un	1,2,7	1,3

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OAs/ Course project	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100
OBA- Open Book Assignment **Minimum score to be eligible for SEE: 40 OUT OF 100**					

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥ 35%, however overall score of CIE + SEE should be ≥ 40%.
3.	Question paper contains 3 parts - A,B & C, wherein students have to answer any 5 out of 7 questions in part A, 5 out of 10 questions choosing 1 question from each unit in part B & 1 out of 2 questions in part C.

	CO-PO Mapping (Planned)												CO-PSO Mapping(Planned)		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	√					√			√				√		
2	√	√			√		√						√		√
3	√	√	√							√			√		√
4	√	√					√						√		√
Tick mark the CO, PO and PSO mapping															

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1	Measurement Techniques	Electrical Engineering	Test Engineer
2	Instrumentation Knowledge	Power Generation and Distribution	Instrumentation Engineer
3	Calibration and Metrology	Electronics and Semiconductor Manufacturing, Telecommunications and Networking	Instrumentation Engineer, Research and Development Engineer, Quality Assurance Engineer
4	Transducers and Sensors	Industrial Automation and Control Systems	Field Service Engineer
5	Measurement System Design	Renewable Energy, Research and Development	Automation Engineer, Power Systems Engineer
6	Troubleshooting and Maintenance	Aerospace and Defense, Automotive Engineering, Quality Control and Compliance	Technical Sales Engineer, Consulting Engineer

TRANSMISSION & DISTRIBUTION OF ELECTRICAL POWER

Course Code	22EE443	Course type	ESC	Credits L-T-P	3 – 0- 0
Hours/week: L-T-P	3 – 0 – 0			Total credits	3
Total Contact Hours	L = 40 Hrs; T = 0 Hrs;P = 0 Hrs Total = 40 Hrs			CIE Marks	100
Flipped Classes content	10 Hours			SEE Marks	100

Course learning objectives	
1.	Understand and explain the general layout of power system, standard voltages for generation, transmission and distribution levels, DC and AC transmission.
2.	Describe the components of transmission systems, mechanical aspects, insulators, underground cables, corona, line parameters and performance calculations.
3.	Understand and explain general DC and AC distribution system, radial & ring main systems, estimation for concentrated loads and uniform loads.

Pre-requisites : Basic Electrical Engineering

Unit – I	Contact Hours = 8 Hours

Typical Transmission & Distribution Systems: General layout of power system, transmission and distribution, advantages of AC and DC high voltage transmission, effect of high voltage transmission on line efficiency and line drop, components of distribution system.

Overhead Transmission Lines: A brief introduction to types of supporting structures and line conductors Conventional conductors; Aluminum Conductor steel reinforced (ACSR), All – aluminum alloy conductor (AAAC) and All –aluminum conductor (AAC). High temperature conductors; Thermal resistant aluminum alloy (ATI),Super thermal resistant aluminum alloy (ZTAI), Gap type thermal resistant aluminum alloy conductor steel reinforced (GTACSR), Gap type super thermal resistant aluminum alloy conductor steel reinforced (GZTACSR). Bundle conductor and its advantages.

Unit – II	Contact Hours = 8 Hours

Mechanical Design of Overhead Transmission Lines-Types of supporting structures and line conductors used, sag and tension calculation- supports at the same and different levels, effect of wind and ice, sag at erection, stringing chart and line vibrators, numerical

Insulators: Introduction, ratings, types of insulators, voltage distribution across suspension insulators, string efficiency & methods to improve string efficiency

Unit – III	Contact Hours = 8 Hours
Line Parameters: Introduction to line parameters- resistance, inductance and capacitance. Calculation of inductance of single phase and three phase lines with equilateral spacing, unsymmetrical spacing, double circuit and transposed lines. Inductance of composite – conductors, geometric mean radius (GMR) and geometric mean distance (GMD). Advantages of single circuit and double circuit lines.). Calculation of capacitance of single phase and three phase lines with equilateral spacing, unsymmetrical spacing, double circuit and transposed lines. Capacitance of composite – conductor, geometric mean radius (GMR) and geometric mean distance (GMD). Advantages of single circuit and double circuit lines	

Unit – IV	Contact Hours = 8 Hours
Performance of Power Transmission Lines-Short transmission lines, medium transmission lines-nominal T, end condenser and π models, long transmission lines-, ABCD constants of transmission lines, Ferranti effect, line regulation, numerical. (No derivations) **Underground Cables**: Insulating materials, insulation resistance, grading of cables: Capacitance grading, intersheath grading, dielectric loss	

Unit –V	Contact Hours = 8 Hours
Distribution Systems-General DC and AC distribution system, radial & ring main systems, calculation for concentrated loads and uniform loading, numerical.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

Books	
	Text Books:
1.	A. Chakrabarti, M. L. Soni, and P.V. Gupta, **"Power System Engineering",** Dhanpat Rai and Co., New Delhi.
2.	C. L. Wadhwa, **"Generation, Distribution and Utilization of Electrical Energy",** New Age International, 3rd Edition.
3.	V.K.Mehta, Rohit Mehta, **"Principles of Power System",** S Chand & Co, 2004 Edition
	Reference Books
1.	S. N. Singh, **"Electric Power Generation, Transmission and Distribution",** P.H.I., New Delhi, 2nd Edition.
2.	Dr. S. L. Uppal, "**Electrical Power",** Khanna Publications.
	E-Resource:

1.	https://nptel.ac.in/courses/108105067/3

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)
3.	Flipped Classes	3.	Open Book Tests (OBT)
4.	Online classes	4.	Course Seminar
		5.	Semester End Examination

Course Outcome (COs)

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	**Analyze** the general layout of power system; list the standard voltages for generation, transmission, distribution levels, DC and AC transmission.	Re, An	1,2,12	1,2
2.	**Explain** the components of transmission systems, mechanical aspects, insulators, underground cables, corona, line parameters and performance **calculations**.	Un, Ap	1,2,12	1,2
3.	**Explain** general DC and AC Distribution system, radial & ring main systems, **calculation** for concentrated loads and uniform loading.	Un, Ap	1,2,12	1,2

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OAs/ Course project	Course Seminar	Total Marks
Marks	25+25= 50	4* 5 marks = 20	10+10 =20	10	100
OBA- Open Book Assignment **Minimum score to be eligible for SEE: 40 OUT OF 100**					

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be $\geq$ 35%, however overall score of CIE + SEE should be $\geq$ 40%.
3.	Question paper contains 3 parts - A,B & C, wherein students have to answer any 5 out of 7 questions in part A, 5 out of 10 questions choosing 1 question from each unit in part B & 1 out of 2 questions in part C.

CO-PO Mapping (Planned)													CO-PSO Mapping(Planned)			
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
1	✓	✓										✓	✓	✓		
2	✓	✓										✓	✓	✓		
3	✓	✓										✓	✓	✓		
Tick mark the CO, PO and PSO mapping																

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1	Knowledge about Transmission & Distribution systems, Conductors and line parameters	Power Sectors, Core Industries	Power System Engineer

OOP with C++

Course Code	22EE444	Course type	PLC	Credits L-T-P	2 - 0 - 1
Hours/week: L - T- P	2- 0 - 2			Total credits	3
Total Contact Hours	L = 30 Hrs; T = 0 Hrs; P = 10 Hrs Total = 40 Hrs			CIE Marks	100
Flipped Classes content	10 Hours			SEE Marks	100

Course learning objectives	
1.	To Understand Object-Oriented Programming concepts.
2.	To Understand the importance of inline and virtual functions.
3.	To study about constructor, destructor and its usage.
4.	To study the importance of inheritance, polymorphism in C++.

Required Knowledge of : C Programming

Unit – I	Contact Hours = 6 Hours
Introduction to Object Oriented Programming: Computer programming background, C++ overview, what is an object, Classes and methods, abstraction, encapsulation, inheritance and polymorphism., first C++program, C++ syntax, Tokens, Keywords, Identifiers, constants and Operators in C++, Scope resolution operator, Expressions and their types, Special assignment expressions.	

Unit – II	Contact Hours = 6 Hours
Functions in C++: – Functions, Inline function, function overloading, friend and virtual functions, specifying a class, C++ program with a class, arrays within a class, Constructors, Multiple constructors in a class, Copy constructor, Dynamic constructor, Destructors.	

Unit – III	Contact Hours =6 Hours
Inheritance: Derived Classes, Single inheritance, multiple inheritance, Hierarchical, Inheritance, Hybrid Inheritance, Pointers to objects and derived classes, this pointer.	

Unit – IV	Contact Hours = 6 Hours
Polymorphism: Polymorphism, Types of polymorphism, Function overloading, defining operator overloading, Overloading Unary and binary operators, Virtual and pure virtual functions.	

Unit – V	Contact Hours = 6 Hours
Exception Handling: Introduction to Exception, Benefits of Exception handling, Try and catch block, Throw statement, pre-defined exceptions in C++.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

List of Experiments

Unit No.	No. of Experiments	Topic(s) related to Experiment
1	**1**	Program to sort the elements in ascending and descending order.
1	**1**	Program to find the sum of all the natural numbers from 1 to n.
1	**1**	Program to swap 2 values by writing a function that uses call by reference technique.
2	**1**	Program to demonstrate function overloading.
2	**1**	Program to demonstrate Inheritance.
3	**1**	Program to demonstrate multilevel inheritance.
5	**1**	Program to demonstrate usage of try, catch and throw to handle exception.
5	**1**	Program function to demonstrate array of bounds exception .

Unit No.	Self-Study Topics
1	Escape Sequence in C++
2	Inline functions and Macros
3	Ambiguity in multiple inheritance
4	Run time polymorphism
5	Exceptions in Constructors and Destructors

Books	
	Text Books:
1.	Balagurusamy E, Object Oriented Programming with C++, Tata McGraw Hill Education Pvt.Ltd , Fourth Edition 2010
2.	Herbert Schildt, “The Complete Reference C++”, 4th Edition, Tata McGraw Hill.
	Reference Books:
1.	Robert Lafore ,“Object-Oriented Programming in C++”, Fourth Edition, Sams Publications.
2.	Stanley B.Lippmann, JoseeLajore, “C++ Primer”, 4th Edition, Pearson Education
	E-resources (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://onlinecourses.swayam2.ac.in/aic20_sp01/course
2.	https://onlinecourses.swayam2.ac.in/aic20_sp06/course

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Open Book Assignments (OBA)/ Lab Project
3.	Flipped Classes	3.	Lab Test
4.	Practice session/Demonstrations in Labs	4.	Semester End Examination
5.	Virtual Labs (if present)		

Course Outcome (COs)

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Explain the basic concepts of Object-Oriented programming	Re, Un	1,5	3
2.	Make use of the functions for modularity.	Un, Ap	1,2,5	3
3.	Implement the concepts of Object oriented programming such as polymorphism, Inheritance.	Un, Ap	1,2,3,4, 5	3
4.	Implement the concept of ExceptionHandling	Un, Ap	1,2,3,4, 5	3

Scheme of Continuous Internal Evaluation (CIE):

For integrated courses, a lab test also will be conducted at the end of the semester. The lab test **(COMPULSORY)** will be part of the CIE. **No SEE for Lab**.

THEORY (60 marks)			**LAB (40 marks)**		Total
IA test 1	IA test 2	Assignment (OBA/Lab Project/ Industry assignment)	Conduction	Lab test	
25 marks	25 marks	10 marks	15 marks	25 marks	100 marks
IA Test: 1. No objective part in IA question paper 2. All questions descriptive					
Conduct of Lab: 1. Conducting the experiment and journal: 5 marks 2. Algorithms, Sample Input/Output,, conclusion and Outcome: 5 marks 3. Viva voce: 5 marks					
Lab test: (Batch wise with 15 students/batch) 1. Test will be conducted at the end of the semester 2. Timetable, Batch details and examiners will be declared by Exam section 3. Conducting the experiment and writing report: 5 marks 4. Algorithms , Sample Input/output, results and conclusion: 10 marks 5. Viva voce: 10 marks					
Eligibility for SEE: 1. 40% and above (24 marks and above) in theory component 2. 40% and above (16 marks and above) in lab component 3. **Lab test is COMPULSORY** 4. Not eligible in any one of the two components will make the student **Not Eligible** for SEE					

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2.	**Minimum marks required in SEE to pass: 40 out of 100**
3.	Question paper contains two questions from each unit each carrying 20 marks. Students have to answer one full question from each unit.

CO-PO Mapping (planned)													CO-PSO Mapping (planned)			
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
1	√				√										√	
2	√	√			√										√	
3	√	√	√	√	√										√	
4	√	√	√	√	√										√	
Tick mark the CO, PO and PSO mapping																

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1	Develop Logic, Flowcharts, Source codes , Debugging, Designing SCADA systems	IT Industries, Automation	Software Engineer, Maintenance & Automation Engineer,

PLC & SCADA

Course Code	22INT42	Course type	ETC/PLC	Credits L-T-P	2 – 0 - 2
Hours/week: L-T-P	2 – 0 – 2			Total credits	3
Total Contact Hours	L = 25 Hrs; T = 0 Hrs; P = 15 Hrs Total = 40 Hrs			CIE Marks	100
Flipped Classes content	-			SEE Marks	100

Course learning objectives	
1.	Understand the PLC means and Technical definition of PLC.
2.	Understand different languages used in PLC programming. Block diagram of PLC.
3.	Explain and understand the different Logic gates, identification of Input and output addressing.
4.	Explain and understand SCAN time in PLC.
5.	Explain and understand types and functions of Timers and Counters.
6.	Explain and understand different functions and mathematical blocks.
7.	Explain and Understand different expansion modules and IO mapping / addressing.
8.	Definition of SCADA, generation of SCADA. SCADA systems used in different fields of Automation.

Pre-requisites: PLC Ladder software and videos.

Unit – I	Contact Hours = 8 Hours
What is A PLC, Technical Definition of PLC, What are its advantages, characteristics functions of A PLC, Block Diagram of PLC: Input/output (I/O) section, Processor Section, Power supply, Memory central Processing Unit: Different Languages of PLC. Equivalent Ladder diagram of AND gate OR Gate, OR Gate, NOT Gate XOR Gate, NAND Gate, NOR Gate.	

Unit – II	Contact Hours = 8 Hours
Bit Logic Instructions: introduction: Input and Output contact program symbols, Numbering system of inputs and outputs, Program format, introduction to logic: Ladder design, Sinking and sourcing. Experiment on Logic Gates / DOL starter **Case Study** - Design Thinking and Execution with practical experiments	

Unit – III	Contact Hours = 8 Hours
PLC Timers and Counters: Retentive and non-retentive timers. Timer instruction. PLC Counter: Operation of PLC Counter, Counter Parameters, Counters Instructions Overview Count up (CTU) Count down (CTD). Advanced instructions: Introduction: Comparison instructions, discussions on comparison Instructions, “EQUAL” or “EQU” instruction, “NOT EQUAL” or “NEQ” instruction, “LESS THAN” or “LESS” instruction, “LESS THANOR EQUAL’ or “LEQ” instruction, GREATER THAN” OR “GRT” instruction, “GREATER THAN OR EQUAL TO” or “GRO” instruction,	

"MASKED COMPARISON FOR EQUAL" or "MEQ" instruction, "LIMIT TEST" or "LIM" Instruction. Functional block diagram and sequential ladder diagram. Experiment on Timers / Counters. **Case Study** - Design Thinking and Execution with practical experiments.

Unit – IV	**Contact Hours = 8 Hours**
PLC input output (I/O) modules and power supply: Introduction: Classification of I/O, I/O system overview, practical I/O system and its mapping addressing local and expansion I/O. Types of Analog input modules, special input modules and Analog output module. Experiment on Parking, Analog Block **Case Study** - Design Thinking and Execution with practical experiments.	

Unit –V	**Contact Hours = 8 Hours**
SCADA SYSTEMS Introduction, definition of Supervisory Control and Data Acquisition, typical SCADA System Architecture, Communication Requirements, Desirable properties of SCADA system, Features, advantages, disadvantages and applications of SCADA. SCADA Architecture (First generation-Monolithic, Second Generation-Distributed, Third generation-Networked Architecture), SCADA systems in operation and control of interconnected power system, Water Purification System, Hydraulic Test Rig, Power System Automation, Petroleum Refining Process, Chemical Plant. SCADA of different projects done. Practical on how to develop small SCADA screen.	

Flipped Classroom Details

Unit No.	**I**	**II**	**III**	**IV**	**V**
No. for Flipped Classroom Sessions	**NIL**	**NIL**	**NIL**	**NIL**	**NIL**

Books	
	Text Books:
1.	Industrial handbooks, catalogue and data sheets for respective material/system of reputed make
2.	Beginners Guide to PLC programming- Neal Babcock
3.	Programmable Logic Controllers-Kelvin T Erickson.
	Reference Books:
1.	Programmable Controllers, An Engineers Guide-E. A Paar, newness, 3rd edition, 2003.
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	www.instrumentationtools.com

Course delivery methods		Assessment methods	
1.	PPT and Videos	1.	IA tests
2.	Factory Visits for Practical	2.	Online Quizzes (Surprise and Scheduled)
3.		3.	Open Book Tests (OBT)
4.		4.	Course Seminar
		5.	Semester End Examination

Course Outcome (COs) At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Explain PLC, Different Languages of PLC, Block diagram of PLC, advantages / disadvantages of PLC	Re, Un	1,2	1
2.	Logic Gates, Sink/Source, PNP/NPN functions, I/O addressing in the PLC, DOL/Logic Gates Practicals	Un, Ap, Ev, Cr	1,2,3,4,5,10,11	1,2,3
3.	Understand of Timers, Counters, Mathematical Instructions, Comparison Instructions, different Practicals	Un, Ap, Ev, Cr	1,2,3,4,5,10,11	1,2,3
4.	Addressing of PLC, Expansion I/O modules, Analog Modules, Power supply,	Re, Un	1,2	1
5.	What is SCADA, advantages of SCADA, different Generations of SCADA	Re, Un	1,2	1

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Addition of two OAs/ Course project	Course Seminar	Total Marks
Marks	25+25= 50	5* 2 marks = 10	10+10 =20	20	100
OBA- Open Book Assignment **Minimum score to be eligible for SEE: 40 OUT OF 100**					

Scheme of Semester End Examination (SEE):	
1.	SEE exam is practical; it will be conducted for 3 hours duration and for 50 marks.
2.	Minimum passing marks required to be scored in SEE; 20 out of 50 marks.
3.	Question paper will have 20 Quiz questions carrying 20 marks and 2 Practical questions carrying 15 marks each.
4.	Student can change the 1 practical question by deducting 5 marks.

CO-PO Mapping (Planned)													CO-PSO Mapping(Planned)		
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
1	√	√											√		
2	√	√	√	√	√						√	√	√	√	√
3	√	√	√	√	√						√	√	√	√	√
4	√	√											√		
5	√	√											√		
Tick mark the CO, PO and PSO mapping															

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1	PLC Programming	Manufacturing Industry	PLC Programmer/Engineer
2	Industrial Networking	Automotive Industry	Automation Engineer, Control Systems Engineer
3	HMI and SCADA Systems	Energy and Utilities, Oil and Gas Industry	SCADA Engineer, Instrumentation Engineer
4.	Control System Design	Pharmaceutical and Chemical Industry, Food and Beverage Industry	Field Service Engineer, Robotics Engineer, Process Control Engineer.
5.	Troubleshooting and Maintenance, Safety and Compliance	Water and Wastewater Treatment, Building Automation	Industrial Network Engineer, Project Engineer/Manager

Ability Enhancement Course 4th SEMESTER

Mathematics II for EC/EE stream

Course Code	22DMATEE41	Course type	AEC	Credits L-T-P	1-0-0
Hours/week: L-T-P	1-0-0			Total credits	1
Total Contact Hours	L = 20 Hrs; T = 0 Hrs; P = 0 Hrs Total = 20 Hrs			CIE Marks	50
Flipped Classes content	5 Hours			SEE Marks	50

Course learning objectives	
1.	Learn advanced linear algebra..
2.	Get familiar with Laplace transforms , and various properties associated with them.
3.	Learn Inverse and use Laplace Transform to solve differential equation
4.	Learn and use various concepts in vector differentiation and vector Integration.

Required Knowledge of: Basic Trigonometry, Calculus, Algebra

Unit– I: Linear algebra II	Contact Hours = 5 Hours
Diagonalization of a square matrix, Orthogonal matrix Quadratic form and reduction to Canonical forms by Orthogonal Transformation. Linear Transformation. Regular transformation. Special transformations	

Unit–II: Laplace Transforms	Contact Hours =5 Hours
Existence and Uniqueness of Laplace transform (LT), transform of elementary functions, region of convergence, Properties–Linearity, Scaling, t-shift property, s-domain shift, differentiation in the s- domain, division by t, differentiation and integration in the time domain, LT of special functions periodic functions (square wave, saw-tooth wave, triangular wave, full & half wave rectifier), Heaviside Unit step function, Unit impulse function	

Unit – III: Inverse Laplace Transform	Contact Hours = 5 Hours
Definition, properties, evaluation using different methods, convolution theorem (without proof),problems, and Applications to solve ordinary differential equations	

Unit– IV: Vector Calculus	Contact Hours =5Hours
Vector Differentiation: Scalar and vector fields. Gradient, directional derivative, curl and divergence - physical interpretation, solenoidal and irrotational vector fields. Problems. **Vector Integration:** Line integrals, Surface integrals. Applications to work done by a force and flux. Statement of Greens theorem and Stokes theorem. Problems	

Flipped Classroom Details

Unit No.	I	II	III	IV
No. for Flipped Classroom Sessions	1	1	1	2

Books	
	Text Books:
1.	B.S. Grewal – Higher Engineering Mathematics, Khanna Publishers, 42nd Edition, 2012.
2.	Erwin Kreyszig –Advanced Engineering Mathematics, John Wiley & Sons Inc., 9th Edition, 2006.
3.	B. V.Ramana- Higher Engineering Mathematics, Tata McGraw-Hill Education Private Limited, Tenth reprint 2010 and onwards.
	Reference Books:
1.	Peter V. O' Neil – Advanced Engineering Mathematics, Thomson Brooks/Cole, 7th Edition, 2011.
2	Glyn James – Advanced Modern Engineering Mathematics, Pearson Education, 4th Edition, 2010.

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Open Book Assignments(OBA)/Lab Project
3.	Flipped Classes	3.	Lab Test
4.	Practice session/Demonstrations in Labs	4.	Semester End Examination
5.	Virtual Labs(if present)		

Course Outcome (COs)

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	**Understand** advanced Linear Algebra.	L1	1	
2.	**Understand** concepts of Laplace Transforms.	L1	1	
3.	**Understand** concepts of Inverse Laplace transforms.	L2	1	
4.	**Understand** vector differentiation and Integration**.**	L2	1	

CO-PO Mapping(planned)													CO-PSO Mapping(planned)		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	√														
2	√														
3	√														
4	√														

Scheme of Continuous Internal Evaluation (CIE): Theory course (Non-Integrated)

Components	Addition of CIE components	Total Marks
Written Test	**30**	**50**
Two quizzes	**20**	

Scheme of Semester End Examination (SEE): Theory course(Non-Integrated)

Components	Total Marks
Written exams	**50**

Introduction to MATLAB/SIMULINK

Course Code	22AECEE452	Course type	AEC	Credits L-T-P	0 - 0 - 1
Hours/week: L - T- P	0 - 0 - 2			Total credits	1
Total Contact Hours	L = 0 Hrs; T = 0 Hrs; P = 20 Hrs Total = 20 Hrs			CIE Marks	50
Flipped Classes content				SEE Marks	50

Course learning objectives	
1.	To introduce MATLAB Programming and understand the basic concepts
2.	Implementation of MATLAB programming for basic circuits
3.	To introduce MATLAB SIMULINK platform and understand the common used block sets
4.	Design and simulation of PV and Wind systems using MATLAB SIMULINK
5.	Implementation of MATLAB programming and SIMULINK to typical hardware applications

Required Knowledge of :Basic Computer Knowledge, Electrical Machines, Basic Electronics

Lab Experiment – I	Contact Hours = 2 Hours
Array formation, matrix formation, matrix algebra, equation formation using MATLAB program.	
Lab Experiment – 2	**Contact Hours = 2 Hours**
Different types of graph plotting, Sinusoidal wave generation using MATLAB program.	
Lab Experiment – 3	**Contact Hours = 2 Hours**
Half wave and full wave rectifier performance analysis using MATLAB program.	
Lab Experiment – 4	**Contact Hours = 2 Hours**
Simple single phase and three phase power system modelling using using MATLAB Simulink.	
Lab Experiment – 5	**Contact Hours = 2 Hours**
Equation based Simulink modelling, Creating user defined blocks, user defined signal generator	
Lab Experiment – 6	**Contact Hours = 2 Hours**
Solar PV system modeling using MATLAB Simulink.	

Lab Experiment – 7	Contact Hours = 2 Hours
Wind power system modeling using MATLAB Simulink.	
Lab Experiment – 8	**Contact Hours = 2 Hours**
LED integration using MATLAB	

Books	
	Text Books:
1.	S. Sumathi, L. Ashok Kumar, P. Surekha, **"Solar PV and Wind Energy Conversion Systems",** Green Energy and Technology, Springer.
2.	Rupp Carriveau, **"Advances In Wind Power",** InTech publications, Croatia.
	Reference Books:
1.	Ari Rabl, **"Active Solar Collectors and Their Applications",** Oxford University Press Publications.
	E-resourses (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://www.mathworks.org/

Course delivery methods		Assessment methods	
1.	Practice session/Demonstrations in Labs	1.	Conduction of Experiments
2.	Virtual Labs (if present)	2.	Journal writing
3.	Chalk and Talk	3.	Lab project/ Open ended experiment
4.		4.	Lab Test
5.		6.	Semester End Examination

Course Outcome (COs)

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Understand & explain basic concepts of MATLAB Programming	Un, Ap	1, 2, 5, 10, 12	1, 2
2.	Develop MATLAB Simulation for basic circuits	Ap, An	1, 2, 5, 10,12	2, 3
3.	Design and simulate PV and Wind systems using MATLAB SIMULINK	Ap, An	1, 2, 5, 10, 12	2, 3
4.	Implement MATLAB programming and SIMULINK for typical hardware applications	Ap, An	1, 2, 5, 10, 12	1, 2, 3

Scheme of Continuous Internal Evaluation (CIE):

Conduction of experiments& viva-voce	Journal	Lab project/ Open ended experiment	Lab Test	Total
20 marks	5 marks	10 marks	15	50 marks
Conduct of Lab: 4. Conduction of the experiment:15 marks + Viva voce: 5 marks = 20 marks 5. Calculations, results, graph, conclusion and Outcome recorded in Journal: 5 marks 6. Lab project/ Open ended experiment: 10 marks 3. Lab Test: 15 marks				
Eligibility for SEE: 2. 40% and above (20 marks and above) 2. **Lab test is COMPULSORY**				

Scheme of Semester End Examination (SEE):			
1.	It will be conducted for 50 marks of 2/3 hours duration.		
2.	**Minimum marks required in SEE to pass:** Score should be ≥35% , however overall score of CIE+SEE should be ≥40%.		
2.	One or Two experiments to be conducted.		
3.	Initial write up	10 marks	50 marks
	Conduct of experiments, results and conclusion	20 marks	
	One mark question	10 marks	
	Viva- voce	10 marks	
4.	Viva-voce shall be conducted for individual student and not in a group.		

CO-PO Mapping (planned)													CO-PSO Mapping (planned)			
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
1	√	√			√					√		√	√	√		
2	√	√			√					√		√		√	√	
4	√	√			√					√		√		√	√	
5	√	√			√					√		√	√	√	√	
Tick mark the CO, PO and PSO mapping																

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1	Coding, Data structure handling Soft skill, managerial skill, etc	IT sector	Team Lead
2		Core companies	Developer, Project manager
3		Self-employment(Startup)	Entrepreneur

Python Programming

Course Code	22AECEE453	Course type	AEC	Credits L-T-P	0 - 0 - 1
Hours/week: L - T- P	0 - 0 - 2			Total credits	1
Total Contact Hours	L = 0 Hrs; T = 0 Hrs; P = 20 Hrs Total = 20 Hrs			CIE Marks	50
Flipped Classes content	Nil			SEE Marks	50

Course learning objectives	
1.	To introduce mechanism of Python Programming and understand the concepts of Data Types Basic Operators
2.	Understand the basics concept of python data structure and manipulate basic programs using Lists, Strings and Tuples
3.	Understand the basics concept of sets and Dictionary and implementing it in the basic programs.
4.	Understand the concept of conditional statements and their usage in the programming.

Required Knowledge of : Basics of programming, Basic python

Lab Experiment – I	Contact Hours = 2 Hours
Write a program in python to convert a given temperature in Celsius to Fahrenheit.	
Lab Experiment – 2	**Contact Hours = 2 Hours**
Write a program to compute whether a given year is leap year or not.	
Lab Experiment – 3	**Contact Hours = 2 Hours**
Write a program in to compute whether the given integer number is a palindrome.	
Lab Experiment – 4	**Contact Hours = 2 Hours**
Write a program to convert a given decimal number to its corresponding binary number.	
Lab Experiment – 5	**Contact Hours = 2 Hours**
Write a python program to compute sin(x) from the given series.	
Lab Experiment – 6	**Contact Hours = 2 Hours**
Write a python program to check the bigger of the two inputted strings.	

Lab Experiment – 7	Contact Hours = 2 Hours
Write a program to compute the sum of odd and even numbers for a given range in a list.	
Lab Experiment – 8	**Contact Hours = 2 Hours**
Write a program using Tuples to accept individual address details and display the same.	

Books	
	Text Books:
1.	Problem solving and Python programming by S.A.Kulkarni.
2.	Charles R. Severance, "Python for Everybody: Exploring Data Using Python 3", Create Space Independent Publishing Platform 2016, 1st Edition
3.	Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", Green Tea Press, 2015, 2nd Edition,
4.	
	E-resources (NPTEL/SWAYAM.. Any Other)- mention links
1.	YouTube: Code with harry; W3 Schools

Course delivery methods		Assessment methods	
1.	Practice session/Demonstrations in Labs	1.	Conduction of Experiments
2.	Virtual Labs (if present)	2.	Journal writing
3.	Chalk and Talk	3.	Lab project/ Open ended experiment
4.		4.	Lab Test
5.		7.	Semester End Examination

Course Outcome (COs)

Learning Levels:

Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create

At the end of the course, the student will be able to		Learning Level	PO(s)	PSO(s)
1.	Understand the fundamentals of Python Programming, Data Types and basic operators	Un	1,5,9,10,12	1
2.	Understand and Apply the concepts of python data structure and manipulate basic programs using Lists, Strings and Tuples.	Un-Ap	1,5,9,10,12	1,3
3.	Understand the concept of sets and Dictionary and implementing it in the basic programs.	Un-Ap	1,5,9,10,12	1,3
4.	Understand the concept of conditional statements and their usage in the programming.	Un-Ap	1,5,9,10,12	1,3

Scheme of Continuous Internal Evaluation (CIE):

Conduction of experiments& viva-voce	Journal	Lab project/ Open ended experiment	Lab Test	Total
20 marks	5 marks	10 marks	15	50 marks

Conduct of Lab:

1.Conduction of the experiment:15 marks + Viva voce: 5 marks = 20 marks

2.Calculations, results, graph, conclusion and Outcome recorded in Journal: 5 marks

3.Lab project/ Open ended experiment: 10 marks

4.Lab Test: 15 marks

Eligibility for SEE:

3. 40% and above (20 marks and above)

2. **Lab test is COMPULSORY**

Scheme of Semester End Examination (SEE):			
1.	It will be conducted for 50 marks of 2/3 hours duration.		
2.	**Minimum marks required in SEE to pass:** Score should be ≥35% , however overall score of CIE+SEE should be ≥40%.		
2.	One or Two experiments to be conducted.		
3.	Initial write up	10 marks	50 marks
	Conduct of experiments, results and conclusion	20 marks	
	One mark question	10 marks	
	Viva- voce	10 marks	
4.	Viva-voce shall be conducted for individual student and not in a group.		

CO-PO Mapping (planned)													**CO-PSO Mapping (planned)**			
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
1	✓				✓				✓	✓	✓	✓	✓			
2	✓				✓				✓	✓	✓	✓	✓		✓	
3	✓				✓				✓	✓	✓	✓	✓		✓	
4	✓				✓				✓	✓	✓	✓	✓		✓	
Tick mark the CO, PO and PSO mapping																

Sl No	**Skill & competence enhanced after undergoing the course**	**Applicable Industry Sectors & domains**	**Job roles students can take up after undergoing the course**
1	Python developer	Software Engineering	Data scientist, Data Analyst, Software Development, testing Engineer.

BIOLOGY FOR ENGINEERS

Course Code	22EE46	Course type	BSC	Credits L-T-P	3-0-0
Hours/week: L - T- P	3-0-0			Total credits	3
Total Contact Hours	L = 30 Hrs; T = 0 Hrs; P = 0 Hrs Total = 30 Hrs			CIE Marks	100
Flipped Classes content	-			SEE Marks	100

Course learning objectives	
1.	To familiarize the students with the basic biological concepts and their engineering applications.
2.	To enable the students with an understanding of biodesign principles to create novel devices and structures
3.	To provide the students an appreciation of how biological systems can be re-designed as substitute products for natural systems
4.	To motivate the students develop the interdisciplinary vision of biological engineering

Module-1	Contact Hours = 6 Hours
BIOMOLECULES AND THEIR APPLICATIONS (QUALITATIVE): Carbohydrates (cellulose-based water filters, PHA and PLA as bioplastics), Nucleic acids (DNA Vaccine for Rabies and RNA vaccines for Covid19, Forensics – DNA fingerprinting), Proteins (Proteins as food – whey protein and meat analogs, Plant based proteins), lipids (biodiesel, cleaning agents/detergents), Enzymes (glucose-oxidase in biosensors, lignolytic enzyme in bio-bleaching).	

Module-2	Contact Hours = 6 Hours
HUMAN ORGAN SYSTEMS AND BIO DESIGNS - 1 (QUALITATIVE): Brain as a CPU system (architecture, CNS and Peripheral Nervous System, signal transmission, EEG, Robotic arms for prosthetics. Engineering solutions for Parkinson's disease).Eye as a Camera system (architecture of rod and cone cells, optical corrections, cataract, lens materials, bionic eye).Heart as a pump system (architecture, electrical signalling - ECG monitoring and heart related issues, reasons for blockages of blood vessels, design of stents, pace makers, defibrillators).	

Module-3	Contact Hours = 6 Hours
HUMAN ORGAN SYSTEMS AND BIO-DESIGNS - 2 (QUALITATIVE): Lungs as purification system (architecture, gas exchange mechanisms, spirometry, abnormal lung physiology - COPD, Ventilators, Heart-lung machine).Kidney as a filtration system (architecture, mechanism of filtration, CKD, dialysis systems). Muscular and Skeletal Systems as scaffolds (architecture, mechanisms, bioengineering solutions for muscular dystrophy and osteoporosis)	

Module-4	Contact Hours = 6 Hours
NATURE-BIOINSPIRED MATERIALS AND MECHANISMS (QUALITATIVE):	

Echolocation (ultrasonography, sonars), Photosynthesis (photovoltaic cells, bionic leaf). Bird flying (GPS and aircrafts), Lotus leaf effect (Super hydrophobic and self-cleaning surfaces), Plant burrs (Velcro), Shark skin (Friction reducing swim suits), Kingfisher beak (Bullet train). Human Blood substitutes - hemoglobin-based oxygen carriers (HBOCs) and perflourocarbons (PFCs)

Module-5	**Contact Hours = 6 Hours**
TRENDS IN BIOENGINEERING (QUALITATIVE): Bioprinting techniques and materials, 3D printing of ear, bone and skin. 3D printed foods. Electrical tongue and electrical nose in food science, DNA origami and Biocomputing, Bioimaging and Artificial Intelligence for disease diagnosis. Selfhealing Bioconcrete (based on bacillus spores, calcium lactate nutrients and biomineralization processes) and Bioremediation and Biomining via microbial surface adsorption (removal of heavy metals like Lead, Cadmium, Mercury, Arsenic)	

Books	
Text Books:	
1.	Human Physiology, Stuart Fox, Krista Rompolski, McGraw-Hill eBook. 16th Edition, 2022 S., and Jaganthan M.K., Tata McGraw-Hill, New Delhi, 2012.
2.	Biology for Engineers, Thyagarajan S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W., Barathi
3.	Biology for Engineers, Arthur T. Johnson, CRC Press, Taylor and Francis, 2011
4.	Biomedical Instrumentation, Leslie Cromwell, Prentice Hall 2011.
5.	Biology for Engineers, Sohini Singh and Tanu Allen, Vayu Education of India, New Delhi, 2014.
6.	Biomimetics: Nature-Based Innovation, Yoseph Bar-Cohen, 1st edition, 2012, CRC Press.
7.	Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies, D. Floreano and C. Mattiussi, MIT Press, 2008.
8.	Bioremediation of heavy metals: bacterial participation, by C R Sunilkumar, N Geetha A C Udayashankar Lambert Academic Publishing, 2019.
9.	3D Bioprinting: Fundamentals, Principles and Applications by Ibrahim Ozbolat, Academic Press, 2016.
10.	Electronic Noses and Tongues in Food Science, Maria Rodriguez Mende, Academic Press, 2016
11.	Blood Substitutes, Robert Winslow, Elsevier, 2005
E-resources (NPTEL/SWAYAM.. Any Other)- mention links	
1	VTU EDUSAT / SWAYAM / NPTEL / MOOCS / Coursera / MIT-open learning resource
2	https://nptel.ac.in/courses/121106008
3	https://freevideolectures.com/course/4877/nptel-biology-engineers-other-non-biologists
4	https://ocw.mit.edu/courses/20-020-introduction-to-biological-engineering-design-spring 2009
5	https://ocw.mit.edu/courses/20-010j-introduction-to-bioengineering-be-010j-spring-2006
6	https://www.coursera.org/courses?query=biology
7	https://onlinecourses.nptel.ac.in/noc19_ge31/preview
8	https://www.classcentral.com/subject/biology
9	https://www.futurelearn.com/courses/biology-basic-concepts

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)

3.		3.	Open Assignment/Seminar
4.		4.	Semester End Examination

Course Outcome (COs) At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Elucidate the basic biological concepts via relevant industrial applications and case studies.	Un	1	
2.	Evaluate the principles of design and development, for exploring novel bioengineering projects.	Un	1	
3.	Corroborate the concepts of biomimetics for specific requirements.	Un	1	
4.	Think critically towards exploring innovative biobased solutions for socially relevant problems	Ap	1, 7	

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Online Quiz	Open Assignment	Seminar	Total Marks
Marks	25+25 = 50	4* 5 marks = 20	10+10 =20	10	100
OA - Open Assignment **Minimum score to be eligible for SEE: 40 OUT OF 100**					

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be $\geq$ 35%, however overall score of CIE + SEE should be $\geq$ 40%.
3.	Question paper contains 3 parts - A,B & C, wherein students have to answer any 5 out of 7 questions in part A, 5 out of 10 questions choosing 1 question from each unit in part B & 1 out of 2 questions in part C.

CO-PO Mapping (Planned)													**CO-PSO Mapping (Planned)**		
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
1	√														
2	√														
3	√														
4	√						√								
Tick mark the CO, PO and PSO mapping															

UNIVERSAL HUMAN VALUES

Course Code	22EE47	Course type	UHV	Credits L-T-P	1 – 0 - 0
Hours/week: L - T- P	1– 0 – 0			Total credits	1
Total Contact Hours	L = 16Hrs; T = 0Hrs;P = 0Hrs Total = 16Hrs			CIE Marks	50
				SEE Marks	50

Course objectives

1. To provide understanding of basic human values
2. To communicate the need of education for quality life

Knowledge required : English Language, Social Studies

Unit – I Human Values	8 Hours
Objectives, Morals , Values, Ethics, Integrity, Work ethics, Service learning, Virtues, Respect for others, Living peacefully, Caring, Sharing, Honesty, Courage ,Valuing time, Cooperation, Commitment, Empathy, Self-confidence, Challenges in the work place, Spirituality, Yoga for Professional Excellence and Stress Management.	

Unit – II Value Education	8 Hours
Introduction, Understanding Value Education, Basic Guidelines for Value Education, The content of Value Education, Education for Fulfilling Life, SkillEducation, Priority of Values over Skills. The Process of Value Education.	

Activities include - Illustrative case studies and Surveys related to Human values.

	Books
1.	Nagarazan R.S., Professional Ethics and Human Values, New Age International Publishers Pvt.Ltd. 2006
2	P.R.Gaur,R.Sangal,G.P.Bagaria: A Foundation Course in Human Values and Professional ethics.

Course delivery methods		Assessment methods	
1.	Lecture	1.	IA. test
2.	Presentation	2.	Activity
3.	Expert talks	3.	Quiz
		4.	SEE

Course Outcome (COs) At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Identify and practice the human values	Un	6	
2.	Understand the human values, work ethics, respect others and stress management.	Un, Ap	8	

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Quiz	Activities (Case study & Survey)	Total Marks
Marks	15+15 = 30	10	10	50
Minimum score to be eligible for SEE: 20 OUT OF 50				

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 50 marks of 1 hour duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥ 35%, however overall score of CIE + SEE should be ≥ 40%.
3.	The pattern of the **question paper is MCQ** (multiple choice questions).

CO-PO Mapping (Planned)													**CO-PSO Mapping(Planned)**		
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
1						✓									
2								✓							
Tick mark the CO, PO and PSO mapping															

POWER ELECTRONICS LAB

Course Code	22EEL49	Course type	PCCL	Credits L-T-P	0 - 0 - 1
Hours/week: L - T- P	0 - 0 - 2			Total credits	1
Total Contact Hours	L = 0 Hrs; T = 0 Hrs; P = 20 Hrs Total = 20 Hrs			CIE Marks	50
Flipped Classes content	00			SEE Marks	50

Course learning objectives	
1.	To understand the ratings, characteristics and operation of power electronic devices used for conversion and control of electrical energy.
2.	To understand the procedure of evaluating the performance parameters of different power electronic converters experimentally and interpreting the results.

Required Knowledge of : Power Electronics, basic electrical engineering

Lab Experiment – I	Contact Hours = 2 Hours
Static characteristics of SCR	
Lab Experiment – 2	**Contact Hours = 2 Hours**
Static characteristics of MOSFET & IGBT	
Lab Experiment – 3	**Contact Hours = 2 Hours**
SCR triggering circuits	
Lab Experiment – 4	**Contact Hours = 2 Hours**
Single-phase fully controlled semi converter	
Lab Experiment – 5	**Contact Hours = 2 Hours**
Speed control of a separately excited D.C. motor using full converters	
Lab Experiment – 6	**Contact Hours = 2 Hours**
Speed control of a separately excited D.C. motor using chopper	
Lab Experiment – 7	**Contact Hours = 2 Hours**
A.C. voltage controller to R and R-L loads.	
Lab Experiment – 8	**Contact Hours = 2 Hours**
Single-phase full-bridge inverter connected to R load.	

Books	
	Text Books:
1.	M.H.Rashid, “Power Electronics”, Pearson, 3rd Edition, 2006 and onwards
2.	V. R. Moorthi, “Power electronics-devices, circuits and industrial applications”, Oxford university press, first edition, fifteenth impression 2015.
3.	L. Umanand, “Power Electronics Essentials and Applications”, Wiley India Pvt. Ltd., Reprint 2010 and onwards
4.	M. D. Singh, K. B. Khanchandani, “Power Electronics”, Tata McGraw-Hill Publishing Company Limited, New Delhi, second edition and onwards
	E-resources (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://nptel.ac.in/courses/108105066/

Course delivery methods		Assessment methods	
1.	Practice session/Demonstrations in Labs	1.	Conduction of Experiments
2.	Virtual Labs (if present)	2.	Journal writing
3.	Chalk and Talk	3.	Lab project/ Open ended experiment
4.		4.	Lab Test
5.		8.	Semester End Examination

Course Outcome (COs)

Learning Levels:

Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create

At the end of the course, the student will be able to		Learning Level	PO(s)	PSO(s)
1.	**Explain the ratings, characteristics and operation of different power electronic devices.**	**Un**	**1, 9,10,12**	**1,3**
2.	**Develop the procedure to conduct experiments to determine the characteristics and or performance parameters of PE devices and converters.**	**Ap**	**1, 4,9,10,12**	**1,3**
3.	**Analyze the experimental observations and infer the results.**	**An**	**1, 4,9,10,12**	**1,3**

Scheme of Continuous Internal Evaluation (CIE):

Conduction of experiments & viva-voce	Journal	Lab project/ Open ended experiment	Lab Test	Total
20 marks	5 marks	10 marks	15	50 marks

Conduct of Lab:

7. Conduction of the experiment:15 marks + Viva voce: 5 marks = 20 marks
8. Calculations, results, graph, conclusion and Outcome recorded in Journal: 5 marks
9. Lab project/ Open ended experiment: 10 marks
3. Lab Test: 15 marks

Eligibility for SEE:

4. 40% and above (20 marks and above)
2. **Lab test is COMPULSORY**

Scheme of Semester End Examination (SEE):			
1.	It will be conducted for 50 marks of 2/3 hours duration.		
2.	**Minimum marks required in SEE to pass:** Score should be ≥35% , however overall score of CIE+SEE should be ≥40%.		
2.	One or Two experiments to be conducted.		
3.	Initial write up	10 marks	50 marks
	Conduct of experiments, results and conclusion	20 marks	
	One mark question	10 marks	
	Viva- voce	10 marks	
4.	Viva-voce shall be conducted for individual student and not in a group.		

	CO-PO Mapping (planned)												**CO-PSO Mapping (planned)**			
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
1	✓								✓	✓		✓	✓		✓	✓
2	✓			✓					✓	✓		✓	✓		✓	✓
3	✓			✓					✓	✓		✓	✓		✓	✓
Tick mark the CO, PO and PSO mapping																

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1	Design of PE converters & triggering circuits for different applications & requirements	Power conditioners, stabilizers, Inverters & UPS manufacturing industries, Renewable energy sector, drives & controls manufacturing industries	Power Electronic Engineer/ Design Engineer (Power electronics)
2	Demonstrating the PE converters operation & maintenance	Sales & marketing sector, operation & maintenance of control circuits	O & M Engineer

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