Sanjivani College of Engineering, Kopargaon
(An Autonomous Institute affiliated to SPPU, Pune)

DECLARATION

We, the Board of Studies (Electrical Engineering Department), hereby declare that, We have designed the four year structure of Electrical Engineering and curriculum of Semester III of Curriculum Pattern 2019 w.e.f. A.Y 2020-2021 as per the guidelines. So, we are pleased to submit and publish this FINAL copy of the curriculum for the information to all the concerned stakeholders.

Submitted by

BoS Chairman
Head of Dept.
Dept.of Electrical Engg.
Sanjivani College of Engineering
Kopargaon 423603

Approved by

Dean Academics

Director

COURSE STRUCTURE- 2019 PATTERN
SECOND YEAR B. TECH. ELECTRICAL ENGINEERING

SEMESTER-I

Course			Teaching Scheme Hours/week				Evaluation Scheme-Marks						
							Theory						
Cat.	Code	Title	L	T	P	Credits	ISE	ESE	CA	OR	PR	TW	Total
PROJ	EE201	First Year Internship	-	-	-	2	-	-	-	50	-	-	50
BSC	BS202	Vector Calculus and Differential Equations	3	1	-	4	30	50	20	-	-	-	100
PCC	EE203	Material Science	3	-	-	3	30	50	20	-	-	-	100
PCC	EE204	Electrical Measurements and Instrumentation	4	-	-	4	30	50	20	-	-	-	100
PCC	EE205	Analog and Digital Electronics	3	-	-	3	30	50	20	-	-	-	100
HSMC	HS206	Universal Human Values & Ethics	3	-	-	3	30	50	20	-	-	-	100
LC	EE207	Material Science Laboratory	-	-	2	1	-	-	-	-	50	25	75
LC	EE208	Electrical Measurements and Instrumentation Laboratory	-	-	2	1	-	-	-	-	50	25	75
LC	EE209	Analog and Digital Electronics Laboratory	-	-	2	1	-	-	-	-	50	25	75
MC	MC210	Mandatory Course-III	2	-	-	No	-	-	-	-	-	-	-
		Total	**18**	**1**	**6**	**22**	**150**	**250**	**100**	**50**	**150**	**75**	**775**

MC210	Mandatory Course-III	Constitution of India – Basic features and fundamental principles

List of Abbreviations

Abbreviation	Full Form	Abbreviation	Full Form
BSC	Basic Science Course	MC	Mandatory Course
ESC	Engineering Science Course	PCC	Professional Core Course
HSMC	Humanities/Social Sciences/Management Course	PEC	Professional Elective Course
IP	Induction Program	OEC	Open Elective Course
L	Lecture	LC	Laboratory Course
T	Tutorial	CA	Continuous Assessment
P	Practical	OR	End Semester Oral Examination
ISE	In-Semester Evaluation	PR	End Semester Practical Examination
ESE	End-Semester Evaluation	TW	Continuous Term Work Evaluation
Cat	Category	PROJ	Project

Sanjivani College of Engineering, Kopargaon

(An Autonomous Institute affiliated to SPPU, Pune)

DECLARATION

We, the Board of Studies (Electrical Engineering Department), hereby declare that, we have designed the four year structure of Electrical Engineering and curriculum of Semester IV of Curriculum Pattern 2019 w.e.f. A.Y 2020-2021 as per the guidelines. So, we are pleased to submit and publish this FINAL copy of the curriculum for the information to all the concerned stakeholders.

Submitted by

BoS Chairman

Head of Dept.
Dept.of Electrical Engg.
Sanjivani College of Engineering
Kopargaon 423603

Approved by

Dean Academics

Director

COURSE STRUCTURE- 2019 PATTERN
SECOND YEAR B. TECH. ELECTRICAL ENGINEERING

SEMESTER-II

Course			Teaching Scheme Hours/week				Evaluation Scheme-Marks						
							Theory						
Cat.	Code	Title	L	T	P	Credits	ISE	ESE	CA	OR	PR	TW	Total
PCC	EE211	Numerical Methods and Computer Programming	3	1	-	4	30	50	20	-	-	-	100
PCC	EE212	Network Analysis	3	1	-	4	30	50	20	-	-	-	100
PCC	EE213	Electrical Machines I	4	-	-	4	30	50	20	-	-	-	100
PCC	EE214	Power System I	3	-	-	3	30	50	20	-	-	-	100
LC	EE215	Numerical Methods and Computer Programming Laboratory	-	-	2	1	-	-	-	-	50	25	75
LC	EE216	Network Analysis Laboratory	-	-	2	1	-	-	-	-	-	25	25
LC	EE217	Electrical Machines I Laboratory	-	-	2	1	-	-	-	-	50	25	75
LC	EE218	Power System I Laboratory	-	-	2	1	-	-	-	50	-	-	50
PROJ	EE219	Seminar	-	-	2	1	-	-	-	50	-	-	50
PROJ	EE220	Mini Project / Choice based Subject	-	-	4	2	-	-	-	-	-	50	50
MC	MC221	Mandatory Course-IV	2	-	-	No Credits	-	-	-	-	-	-	-
		Total	**15**	**2**	**14**	**22**	**120**	**200**	**80**	**100**	**100**	**125**	**725**

MC221	Mandatory Course-IV	Innovation - Project based – Sc., Tech, Social, Design & Innovation

List of Abbreviations

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T	Tutorial	CA	Continuous Assessment
P	Practical	OR	End Semester Oral Examination
ISE	In-Semester Evaluation	PR	End Semester Practical Examination
ESE	End-Semester Evaluation	TW	Continuous Term Work Evaluation
Cat	Category	PROJ	Project

Total Credits: 44
Total Marks: 1500

Sanjivani College of Engineering, Kopargaon
(An Autonomous Institute affiliated to SPPU, Pune)

DECLARATION

We, the Board of Studies (Electrical Engineering Department), hereby declare that, We have designed the four year structure of Electrical Engineering and curriculum of Semester V of Curriculum Pattern 2019 w.e.f. A.Y 2021-2022 as per the guidelines. So, we are pleased to submit and publish this FINAL copy of the curriculum for the information to all the concerned stakeholders.

Submitted by

BoS Chairman
Head of Dept.
Dept.of Electrical Engg.
Sanjivani College of Engineering
Kopargaon 423603

Approved by

Dean Academics

Director

COURSE STRUCTURE- 2019 PATTERN
THIRD YEAR B. TECH. ELECTRICAL ENGINEERING

SEMESTER- V

Course			Teaching Scheme Hours/week				Evaluation Scheme- Marks						
							Theory			OR	PR	TW	Total
Cat.	Code	Title	L	T	P	Credits	ISE	ESE	CA				
PRJ	EE301	Professional Internship-II	-	-	-	2	-	-	-	50	-	-	50
PCC	EE302	Microcontrollers And Applications	3	-	-	3	30	50	20	-	-	-	100
PCC	EE303	Electrical Machines II	3	-	-	3	30	50	20	-	-	-	100
PCC	EE304	Power System II	3	-	-	3	30	50	20	-	-	-	100
PCC	EE305	Power Electronics	3	-	-	3	30	50	20	-	-	-	100
PEC	EE306	Professional Elective-I	3	-	-	3	30	50	20	-	-	-	100
LC	EE307	Microcontrollers And Applications Laboratory	-	-	2	1	-	-	-	-	25	-	25
LC	EE308	Electrical Machines II Laboratory	-	-	2	1	-	-	-	-	25	-	25
LC	EE309	Power System II Laboratory	-	-	2	1	-	-	-	25	-	-	25
LC	EE310	Power Electronics Laboratory	-	-	2	1	-	-	-	-	25	-	25
PRJ	EE311	Skill based Credit Course	1	-	-	1	-	-	-	-	-	50	50
MLC	MC312	Mandatory Learning Course-V	1	-	-	No	-	-	-	-	-	-	-
		Total	17	-	8	22	150	250	100	75	75	50	700

EE306	**Professional Elective-I**	A.	Signals and Systems
		B.	Power Generation Technologies
MC312	**Mandatory Learning Course-V**	A.	Electrical Energy Conservation and Auditing -

Sanjivani College of Engineering, Kopargaon

(An Autonomous Institute affiliated to SPPU, Pune)

DECLARATION

We, the Board of Studies (Electrical Engineering Department), hereby declare that, we have designed the four year structure of Electrical Engineering and curriculum of Semester VI of Curriculum Pattern 2019 w.e.f. A.Y 2021-2022 as per the guidelines. So, we are pleased to submit and publish this FINAL copy of the curriculum for the information to all the concerned stakeholders.

Submitted by

BoS Chairman

Head of Dept.
Dept.of Electrical Engg.
Sanjivani College of Engineering
Kopargaon 423603

Approved by

Dean Academics

Director

COURSE STRUCTURE- 2019 PATTERN
THIRD YEAR B. TECH. ELECTRICAL ENGINEERING

SEMESTER- VI

Course			Teaching Scheme Hours/week				Evaluation Scheme/Marks						
							Theory			OR	PR	TW	Total
Cat.	Code	Title	L	T	P	Credits	ISE	ESE	CA				
PCC	EE313	Feedback Control Systems	3	-	-	3	30	50	20	-	-	-	100
PCC	EE314	Power System Operation and Control	3	-	-	3	30	50	20	-	-	-	100
OE	EE315	Open Elective-I	4	-	-	4	30	50	20	-	-	-	100
PRJ	PR316	IPR & EDP	2	-	-	2	15	25	10	-	-	-	50
PRJ	PR317	IPR & EDP Lab	-	-	2	1	-	-	-	-	-	50	50
HSMC	HS318	Corporate Readiness	1	-	2	2	-	-	-	-	-	50	50
PEC	EE319	Professional Elective-II	2	-	-	2	30	50	20	-	-	-	100
LC	EE320	Feedback Control Systems Laboratory	-	-	2	1	-	-	-	-	50	-	50
LC	EE321	Power System Operation and Control Laboratory	-	-	2	1	-	-	-	50	-	-	50
LC	EE322	Professional Elective-II Laboratory	-	-	2	1	-	-	-	50	-	-	50
MLC	MC323	Mandatory Learning Course	1	-	-	No	-	-	-	-	-	-	-
		Total	**16**	**-**	**10**	**20**	**135**	**225**	**90**	**100**	**50**	**100**	**700**

EE315	Open Elective-I	A. Renewable Energy Sources
EE319	Professional Elective-II	A. Electrical Machine Design
		B. Electrical Drives
		C. Smart Grid
EE322	Professional Elective-II Laboratory	A. Electrical Machine Design Laboratory
		B. Electrical Drives Laboratory
		C. Smart Grid Laboratory
MC323	Mandatory Course-V	A. Installation & Maintenance of Electrical appliances

Sanjivani College of Engineering, Kopargaon
(An Autonomous Institute affiliated to SPPU, Pune)

Sanjivani College of Engineering * Dept of Electrical Engineering * Kopargaon-423603 *

DECLARATION

We, the Board of Studies (Electrical Engineering Department), hereby declare that, We have designed the four year structure of Electrical Engineering and curriculum of Semester VII of Curriculum Pattern 2019 w.e.f. A.Y. 2022-2023 as per the guidelines. So, we are pleased to submit and publish this FINAL copy of the curriculum for the information to all the concerned stakeholders.

Submitted by

BoS Chairman

Approved by

Dean Academics

Director

SANJIVANI COLLEGE OF ENGINEERING, KOPARGAON * Approved *

COURSE STRUCTURE- 2019 PATTERN
FINAL YEAR B. TECH. ELECTRICAL ENGINEERING

SEMESTER- VII

Course			Teaching Scheme Hours/week				Evaluation Scheme-Marks						
							Theory						
Cat.	Code	Title	L	T	P	Credits	ISE	ESE	CIA	OR	PR	TW	Total
PRJ	EE401	Professional Internship	-	-	-	2	-	-	-	50	-	-	50
PCC	EE402	Switch Gear and Protection	3	-	-	3	30	50	20	-	-	-	100
PCC	EE403	Control System Design	3	-	-	3	30	50	20	-	-	-	100
PEC	EE404	Professional Elective- III	3	-	-	3	30	50	20	-	-	-	100
OEC	EE405	Open Elective-II	3	-	-	3	-	75	25	-	-	-	100
OEC	EE406	Open Elective-III	2	-	-	2	-	30	20	-	-	-	50
LC	EE407	Switch Gear and Protection Laboratory	-	-	2	1	-	-	-	-	50	-	50
LC	EE408	Control System Design Laboratory	-	-	2	1	-	-	-	50	-	-	50
PRJ	EE409	Project Stage I	-	-	4	2	-	-	-	50	-	-	50
MLC	MC410	Mandatory Learning Course-VII	1	-	-	No Credit	-	-	-	-	-	-	-
		Total	15	-	8	20	90	255	105	150	50	00	650

EE404	Professional Elective- III	EE404A	Electric and Hybrid Vehicle
		EE404B	HVDC Transmission Systems
		EE404C	Digital Signal Processing
EE405	Open Elective-II	EE405A	Problem Solving Through Programming in C
		EE405B	Introduction to Industry 4.0 and Industrial IOT
		EE405C	Data Structure and Algorithm Using JAVA
		EE405D	Real-Time Digital Signal Processing
EE406	Open Elective-III	EE406A	Introduction to BMS
		EE406B	Real-Time Embedded Systems Concepts and Practices
		EE406C	Introduction to Data Science in Python
MC410	Mandatory Learning Course-VII	MC410A	Circuit Simulation and PCB Design

29/09/22

Dean Academics

SANJIVANI COLLEGE OF ENGINEERING, KOPARGAON Approved

Director

Sanjivani College of Engineering, Kopargaon

(An Autonomous Institute affiliated to SPPU, Pune)

Sanjivani College of Engineering Dept of Electrical Engineering Kopargaon-423603

DECLARATION

We, the Board of Studies (Electrical Engineering Department), hereby declare that, we have designed the four-year structure of Electrical Engineering and curriculum of Semester VIII of Curriculum Pattern 2019 w.e.f. A.Y 2022-2023 as per the guidelines. So, we are pleased to submit and publish this FINAL copy of the curriculum for the information to all the concerned stakeholders.

Submitted by

BoS Chairman

Approved by

Dean Academics

SANJIVANI COLLEGE OF ENGINEERING, KOPARGAON Approved

Director

COURSE STRUCTURE- 2019 PATTERN
FINAL YEAR B. TECH. ELECTRICAL ENGINEERING

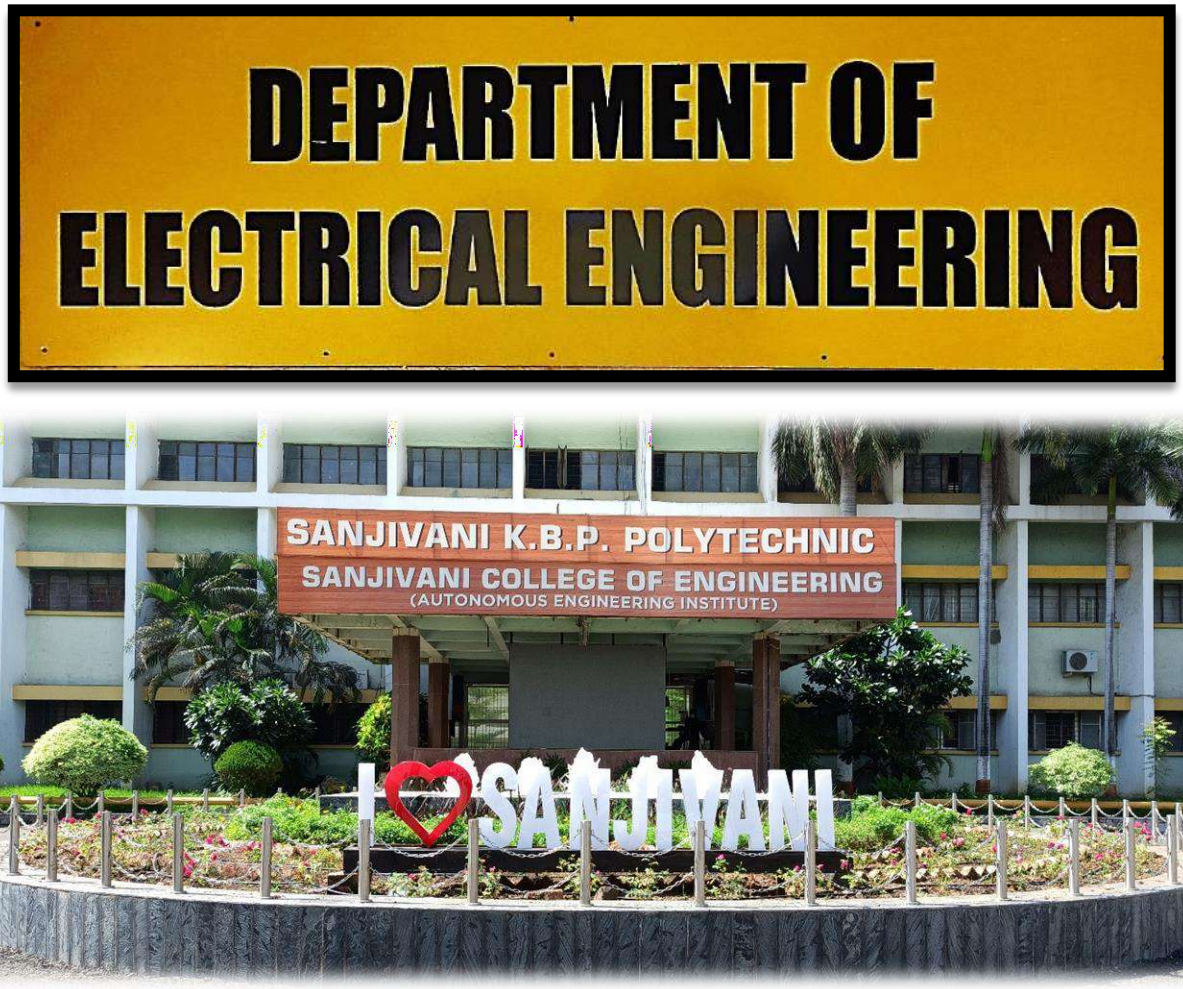
SEMESTER-VIII

Course			Teaching Scheme Hours/week				Evaluation Scheme-Marks						
							Theory						
Cat.	Code	Title	L	T	P	Credits	ISE	ESE	CIA	OR	PR	TW	Total
PROJ	EE411	Power Quality and FACTs	3	-	-	3	30	50	20	-	-	-	100
PCC	EE412	High Voltage Engineering	3	-	-	3	30	50	20	-	-	-	100
PCC	EE413	EHV and UHV AC Transmission	3	-	-	3	30	50	20	-	-	-	100
PEC	EE414	Professional Elective-IV A. Intelligent Systems with AI and ML B. IOT Applications C.VLSI Circuits	3	-	-	3	30	50	20	-	-	-	100
LC	EE415	Power Quality and FACTs Laboratory	-	-	2	1	-	-	-	50	-	-	50
LC	EE416	High Voltage Engineering Laboratory	-	-	2	1	-	-	-	-	50	-	50
PROJ	EE417	Project Stage II	-	-	8	4	-	-	-	50	-	100	150
MLC	MC418	Mandatory Learning Course-VIII A. Industrial Technology and Management	1	-	-	Non Credit	-	-	-	-	-	-	Pass/Fail
		Total	13	-	12	18	120	200	80	100	50	100	650

SANJIVANI RURAL EDUCATION SOCIETY'S

SANJIVANI COLLEGE OF ENGINEERING KOPARGAON

(An Autonomous Institute Affiliated to Savitribai Phule Pune University, Pune)



DEPARTMENT OF ELECTRICAL ENGINEERING

COURSE STRUCTURE - 2019 PATTERN

SECOND YEAR B. TECH.

w.e.f. 2020-21

SANJIVANI RURAL EDUCATION SOCIETY'S

SANJIVANI COLLEGE OF ENGINEERING KOPARGAON

(An Autonomous Institute Affiliated to Savitribai Phule Pune University, Pune)

DEPARTMENT OF ELECTRICAL ENGINEERING

Profile: The Electrical Engineering degree program offer the graduates to enter a dynamic and rapidly changing field with career opportunities in Electric Power System, Power Electronics, Robotics and Control, Microprocessors and Controllers, Integrated Circuits, Computer Software. The demand for electrical power and electronic systems is increasing rapidly and electrical engineers are in great demand to meet the requirements of the growing industry. Electrical Engineers are mainly employed in industries using Electrical Power, Manufacturing Electrical Equipment, Accessories, Electronic Systems, Research and Development departments which work on energy saving devices and Software Development.

Many of these disciplines overlap with other engineering branches, spanning a huge number of specializations including hardware engineering, electromagnetic and waves, microwave engineering, nanotechnology, electrochemistry, renewable energies, Artificial Intelligence, mechatronics, and electrical materials science. Identifying these areas today's Electrical Engineer needs to have the capacity of adaptability and creativity in these new technical eras, to meet the Industry 4.0.

Electrical Engineering Department of Sanjivani College of Engineering offers the B. Tech. course in Electrical Engineering with an intake of 60 students. The department has well qualified and dedicated faculty and is known for its high academic standards, well-maintained discipline and complete infrastructure facilities.

Vision of Department

To produce quality electrical engineers with the knowledge of latest trends, research technologies to meet the developing needs of industry & society

Mission of Department

M1: To impart quality education through teaching learning process

M2: To establish well-equipped laboratories to develop R&D culture in contemporary and sustainable technologies in Electrical Engineering

M3: To produce Electrical Engineering graduates with quest for excellence, enthusiasm for continuous learning, ethical behavior, integrity and nurture leadership

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, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, society, 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 modelling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society:** Apply reasoning in formed by the contextual knowledge to assess social, 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 the set of 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)

The PEOs of undergraduate programme in Electrical Engineering are broadly classified as follows:

PEO 1: Equip the student to analyze and solve real world problems to face the challenges of future.

PEO 2: Pursue higher education, research in Electrical Engineering or other allied fields of their interest for professional development.

PEO 3: Exhibit the leadership skills and ethical value for society

Program Specific Objectives (PSOs)

PSO 1: Apply the fundamentals of mathematics, science and engineering knowledge to identify, formulate, design and investigate complex engineering problems of electric circuits, analog and digital electronics circuits, control systems, electrical machines and Power system.

PSO 2: Apply the appropriate modern engineering hardware, and software tools in electrical engineering to engage in life-long learning and to successfully adapt in multi-disciplinary environments.

COURSE STRUCTURE- 2019 PATTERN
SECOND YEAR B. TECH. ELECTRICAL ENGINEERING

SEMESTER-I

Course			Teaching Scheme Hours/week				Evaluation Scheme-Marks						
							Theory						
Cat.	Code	Title	L	T	P	Credits	ISE	ESE	CA	OR	PR	TW	Total
PROJ	EE201	First Year Internship	-	-	-	2	-	-	-	50	-	-	50
BSC	BS202	Vector Calculus and Differential Equations	3	1	-	4	30	50	20	-	-	-	100
PCC	EE203	Material Science	3	-	-	3	30	50	20	-	-	-	100
PCC	EE204	Electrical Measurements and Instrumentation	4	-	-	4	30	50	20	-	-	-	100
PCC	EE205	Analog and Digital Electronics	3	-	-	3	30	50	20	-	-	-	100
HSMC	HS206	Universal Human Values & Ethics	3	-	-	3	30	50	20	-	-	-	100
LC	EE207	Material Science Laboratory	-	-	2	1	-	-	-	-	50	25	75
LC	EE208	Electrical Measurements and Instrumentation Laboratory	-	-	2	1	-	-	-	-	50	25	75
LC	EE209	Analog and Digital Electronics Laboratory	-	-	2	1	-	-	-	-	50	25	75
MC	MC210	Mandatory Course-III	2	-	-	No	-	-	-	-	-	-	-
		Total	**18**	**1**	**6**	**22**	**150**	**250**	**100**	**50**	**150**	**75**	**775**

MC210	Mandatory Course-III	Constitution of India – Basic features and fundamental principles

List of Abbreviations			
Abbreviation	**Full Form**	**Abbreviation**	**Full Form**
BSC	Basic Science Course	MC	Mandatory Course
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L	Lecture	LC	Laboratory Course
T	Tutorial	CA	Continuous Assessment
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ESE	End-Semester Evaluation	TW	Continuous Term Work Evaluation
Cat	Category	PROJ	Project

COURSE STRUCTURE- 2019 PATTERN
SECOND YEAR B. TECH. ELECTRICAL ENGINEERING

SEMESTER-II

Course			Teaching Scheme Hours/week				Evaluation Scheme-Marks						
							Theory						
Cat.	Code	Title	L	T	P	Credits	ISE	ESE	CA	OR	PR	TW	Total
PCC	EE211	Numerical Methods and Computer Programming	3	1	-	4	30	50	20	-	-	-	100
PCC	EE212	Network Analysis	3	1	-	4	30	50	20	-	-	-	100
PCC	EE213	Electrical Machines I	4	-	-	4	30	50	20	-	-	-	100
PCC	EE214	Power System I	3	-	-	3	30	50	20	-	-	-	100
LC	EE215	Numerical Methods and Computer Programming Laboratory	-	-	2	1	-	-	-	-	50	25	75
LC	EE216	Network Analysis Laboratory	-	-	2	1	-	-	-	-	-	25	25
LC	EE217	Electrical Machines I Laboratory	-	-	2	1	-	-	-	-	50	25	75
LC	EE218	Power System I Laboratory	-	-	2	1	-	-	-	50	-	-	50
PROJ	EE219	Seminar	-	-	2	1	-	-	-	50	-	-	50
PROJ	EE220	Mini Project / Choice Based Subject	-	-	4	2	-	-	-	-	-	50	50
MC	MC221	Mandatory Course-IV	2	-	-	No Credits	-	-	-	-	-	-	-
		Total	**15**	**2**	**14**	**22**	**120**	**200**	**80**	**100**	**100**	**125**	**725**

MC221	Mandatory Course-IV	Innovation - Project based – Sc., Tech, Social, Design & Innovation

List of Abbreviations			
Abbreviation	**Full Form**	**Abbreviation**	**Full Form**
BSC	Basic Science Course	MC	Mandatory Course
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P	Practical	OR	End Semester Oral Examination
ISE	In-Semester Evaluation	PR	End Semester Practical Examination
ESE	End-Semester Evaluation	TW	Continuous Term Work Evaluation
Cat	Category	PROJ	Project

Total Credits: 44
Total Marks: 1500

Semester I

EE201: FIRST YEAR INTERNSHIP

Teaching Scheme	Examination Scheme
Lectures: - Hrs./Week	**Oral Exam: 50 Marks**
Tutorials: - Hrs./ week	**Total: 50 Marks**
Credits: 2	

GUIDELINES FOR INTERNSHIP

An Internship is a professional learning experience that offers meaningful, practical work related to a student's field of study or career interest. An internship gives a student the opportunity for career exploration and development and learns new skills.

Hence Sanjivani College of Engineering offers a month-long exposure to the students in the form of internship in organizations/in house training/ online courses in the reputed institutes. Students are involved in this internship at the end of their even semester.

After completion of internship/online courses students has to produce *Certificate*. Students shall be awarded internship credits only when they will pass the oral (Viva) examination of 50 marks, based on experience or online certification.

Recommended online courses for FY B. Tech 'J' division students are as following

1. **Course Name:** Effective Communication, Writing, Design and Presentation- by University of Colorado Boulder (4 Course specialization)
2. **Course Name:** Introduction to Solar Cells- by Technical University of Denmark (DTU)

   Source: Coursera

   Duration: 6 Hours

   URL: https://www.coursera.org/learn/solar-cells
3. **Course Name:** Programming for Everybody (Getting started with Python) by University of Michigan.

   Source: Coursera

   Duration: 19 Hours (4 weeks)

   URL: https://www.coursera.org/learn/python/home/welcome
4. **Course Name:** Energy Production, Distribution and safety Specialization- by University at Buffalo, The State University Of New York

   Source: Coursera

   Duration: Approx. 40 Hours

   URL: https://www.coursera.org/learn/specializations/energy-industry
5. **Course Name:** Solar Energy Basics – by State University of New York (Suny)

   Source: Coursera

   Duration: 13 Hours

   URL: https://www.coursera.org/learn/solar-energy-basics

IMP NOTE: Course no. 1 is mandatory and any one course out of course no. 2,3,4 and 5.

BS202: VECTOR CALCULUS AND DIFFERENTIAL EQUATIONS

Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs./Week	**Continuous Assessment:**	**20 Marks**
Tutorial: 01 Hr/Week	**In-Sem Exam:**	**30 Marks**
	End-Sem Exam:	**50 Marks**
Credits: 4	**Total:**	**100 Marks**

Prerequisite Course: Basic of Mathematics

Course Objectives

1. To describe and recall basics of calculus.
2. To understand the concept and problem solutions of a curriculum.
3. To apply core concept for any applied problems in engineering.
4. To analyze the problem of which kind and use particular method for finding solution in engineering field.
5. To justify the statements for using specific method to applications problems in engineering field.
6. To organize the suitable problems in engineering field and present thoughts related to the problems.

Course Outcome (s)

After successful completion of the course, student will be able to

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	**Know** and **recall** core knowledge of calculus	**1**	**Remember**
CO2	**Understand** the concept and use in solving engineering problems.	**2**	**Understand**
CO3	**Apply** core concept for any applied problems in engineering.	**3**	**Apply**
CO4	**Analyse** the problem of which kind and use particular method for finding solution in engineering field.	**4**	**Analyse**
CO5	**Justify** the statements for using specific method to applications problems in engineering field.	**5**	**Evaluate**
CO6	**Organize** the suitable problems in engineering field and present thoughts related to the problems.	**6**	**Create**

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO6	3	2	-	-	-	-	-	-	-	-	-	-	-	-

Course Contents			
UNIT-I	**VECTOR DIFFERENTIATION**	**No.of Hours**	**COs**
	Scalar and vector point function, Derivative of a vector point function, Gradient of scalar function ∅, Directional derivative, Divergence and Curl of vector point function, Solenoidal and irrotational vector field and scalar potential, vector identities.	08	CO1 CO3 CO5
UNIT-II	**VECTOR INTEGRATION**	**No.of Hours**	**COs**
	Line integral, Greens theorem, Work done, Conservative field, surface integral, Stokes theorem, volume integral, Gauss Divergence theorem.	08	CO3 CO4 CO5
UNIT-III	**HIGHER ORDER DIFFERENTIAL EQUATION**	**No.of Hours**	**COs**
	Homogeneous and non-homogeneous linear differential equation of n^{th} order and its solution, Method of variation of parameter, operator method for particular integral, solution of certain types of linear differential equation:-Cauchy's and Legendre's differential equation.	08	CO1 CO2 CO3
UNIT-IV	**SERIES SOLUTION OF DIFFERENTIAL EQUATION**	**No.of Hours**	**COs**
	Linear differential equations with variable coefficients, solution about ordinary point, about singular point (Frobenius method) series solution of Bessel's equation, series solution of Legendre's equation,	08	CO3 CO4 CO6
UNIT-V	**PARTIAL DIFFERENTIAL EQUATION**	**No.of Hours**	**COs**
	Formation of partial differential equation, Partial differential equation of order one (linear and nonlinear), Charpit method, PDE of higher order with constant coefficient	08	CO2 CO3 CO5
UNIT-VI	**APPLICATIOS OF PARTIAL DIFFERENTIAL EQUATION**	**No.of Hours**	**COs**
	One dimensional heat equation, Wave equation, Two-dimensional heat equation (Laplace equation), Telephone equation, Radio equations	08	CO1 CO3 CO5

Text Books:

1. B. S. Grewal, Higher Engineering Mathematics, 42/e, Khanna Publishers, 2012, **ISBN-13: 978-8174091154.**
2. N. P. Bali and Manish Goyal, A Text Book of Engineering, Mathematics, 8/e, Lakshmi Publications, 2012. **ISBN: 9788131808320.**
3. H. K. Das, Engineering Mathematics, S Chand, 2006, **ISBN-8121905209**

Reference Books:

1. K.A. Stroud & D. S. Booth, Advanced Engineering Mathematics, Industrial Press, 5/e, 2011, **ISBN-9780831134495**
2. P. C. Matthews, Vector Calculus, Springer, 2/e, 2012, **ISBN-9783540761808**
3. Robert C. Wrede, Introduction to vector and tensor analysis, Dover, 2013,
4. W. E. Boyce, R. C. Diprima, Elementary differential equation and boundary value problems.
5. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, Narosa Publishing House, 2014. **ISBN-13: 978-1842653418.**
6. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley, 9/e, 2013

EE203: MATERIAL SCIENCE

Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs./Week	**Continuous Assessment:**	**20 Marks**
Tutorial: --- Hr/Week	**In-Sem Exam:**	**30 Marks**
	End-Sem Exam:	**50 Marks**
Credits: 3	**Total:**	**100 Marks**

Prerequisite Course: Students should have knowledge of various classes of materials like solid, liquid, gaseous, conducting, insulating and resistive along with their basic characteristics.

Course Objectives

1. To classify different materials from Electrical Engineering application point of view.
2. To understand various properties and characteristics of different classes of materials.
3. To select materials for applications in various electrical equipment.
4. To impart knowledge of Nano-technology, battery and solar cell materials.
5. To develop ability to test different classes of materials as per IS.

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Categorize and classify different materials from Electrical Engineering applications point of view.	3	Applying
CO2	Explain and summarize various properties and characteristics of different classes of materials.	2	Understanding
CO3	Choose materials for application in various electrical equipment	3	Applying
CO4	Explain and describe knowledge of nanotechnology, batteries and solar cell materials.	2	Understanding
CO5	Test different classes of materials as per IS.	4	Analysing
CO6	Use of theoretical knowledge in practical field application.	3	Applying

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	2	2	1	2	3	1	1	--	1	--	2	3	2
CO2	3	1	1	2	2	2	2	1	1	1	1	2	2	2
CO3	3	2	2	1	2	1	1	1	1	--	1	1	1	1
CO4	3	1	2	2	1	2	1	1	1	1	1	2	1	1
CO5	3	2	1	3	1	1	--	1	--	2	1	1	1	2
CO6	3	2	1	1	2	1	1	--	1	1	1	2	1	1

Course Contents			
UNIT-I	**DIELECTRIC & OPTICAL PROPERTIES OF INSULATING MATERIALS**	**No.of Hours**	**COs**
	Static Field, Parameters of Dielectric material [Dielectric constant, Dipole moment, Polarization, Polarizability], Introduction to Polar and Non- Polar dielectric materials. Mechanisms of Polarizations- Electronic, Ionic and Orientation Polarization (descriptive treatment only), Clausius Mossotti Equation, Piezo-Electric, Pyro-Electric & Ferro-Electric Materials, Dielectric loss and loss tangent, Concept of negative tan delta (δ). Introduction to fiber optics, materials used and its applications.	06	CO1
UNIT-II	**INSULATING MATERIALS & DIELECTRIC BREAKDOWN**	**No.of Hours**	**CO**
	Introduction, Characteristics of Good Insulating Material, Classification, Solid Insulating Materials-Paper, Press Board, Fibrous Materials, Ceramics, Mica, Asbestos, Resins, Amorphous materials Polymers, Ceramics, Enamels and its applications. Liquid Insulating Materials such as Transformer Oil, Varnish, Askarel. Insulating Gases like Air, SF_6 and its applications. Introduction, Concept of Primary and Secondary Ionization of Gases (descriptive treatment only), Breakdown Voltage, Breakdown Strength, Factors affecting Breakdown Strengths of Solid, Liquid and Gaseous dielectric materials.	06	CO2
UNIT-III	**MAGNETIC MATERIALS**	**No.of Hours**	**CO**
	Introduction, Parameters of Magnetic material [Permeability, Magnetic Susceptibility, Magnetization], Classification of Magnetic Materials, Diamagnetism, Para magnetism, Ferromagnetism, Ferri-magnetism, Ferro-magnetic behavior below Critical Temperature, Spontaneous Magnetization, Curie-Weiss law, Anti-ferromagnetism, Ferrites, Applications of Ferro-magnetic Materials, Magnetic materials for Electric Devices such as Transformer Core , Core of Rotating Machines, Soft Magnetic Materials, Hard Magnetic Materials, Magnetic Recording Materials, Compact Discs. Introduction to laser and magnetic strip technology.	06	CO3
UNIT-IV	**CONDUCTING MATERIALS**	**No.of Hours**	**CO**
	General Properties of Conductor, Electrical Conducting Materials - Copper, Aluminum and its applications, Materials of High & Low Resistivity-Constantan, Nickel-Chromium Alloy, Tungsten, Canthal, Silver & Silver alloys, Characteristics of Copper Alloys (Brass & Bronze), Materials used for Lamp Filaments, Transmission Lines, Electrical Carbon Materials, Materials for Super-capacitors. Material used for Solders, Metals & Alloys for different types of Fuses, Thermal Bimetal & Thermocouple. Introduction to Superconductivity and Super Conductors.	06	CO4

UNIT-V	NANOTECHNOLOGY AND BATTERIES	No.of Hours	CO
	Introduction, Concepts of Energy bands & various Conducting Mechanism in Nano-structures, Carbon Nano-structures, Carbon Molecules, Carbon Clusters, Carbon Nano-tubes and applications. Special Topics in Nano Technology such as Single Electron Transistor, Molecular Machines, BN Nanotubes, Nano wires. Materials used for Batteries: Lead Acid, Lithium-ion, Sodium-Sulphur, Nickel-Cadmium, Zero Emission Battery Research Activity (ZEBRA) Batteries. Batteries used in Electric Vehicle (EV) and Electric Hybrid Vehicle (EHV).	06	CO5
UNIT-VI	**TESTING OF MATERIALS**	**No.of Hours**	**CO**
	Explanation of following with objectives, equipment required, circuit diagrams and observations to be taken. 1. Measurement of Dielectric Loss Tangent (tan δ) by Schering Bridge-IS 13585-1994. 2. Measurement of Dielectric Strength of Solid Insulating Material-IS 2584. 3. Measurement of Dielectric Strength of Liquid Insulating Material – IS 6798. 4. Measurement of Dielectric Strength of Gaseous Insulating Material as per IS. Measurement of Flux Density by Gauss-meter.	06	CO6

Text Books:

[T1] Charles P. Poole, Jr. Frank & J. Ownes, "Introduction to Nanotechnology", Wiley Student Edition.
[T2] Electrical Engineering Materials", T.T.T.I, Madras.
[T3] K. B. Raina & S. K. Bhattacharya, "Electrical Engineering Materials", S. K. Kataria & Sons.
[T4] P.K. Palanisamy, "Material Science for Electrical Engineering", SciTech Pub. (India) Pvt. Ltd., Chennai.
[T5] S.P.Seth,"A Course in Electrical Engineering Materials", Dhanpat Rai and Sons publication.
[T6] RonaldM.DellandDavidA.J.Rand,"UnderstandingBatteries",Royal Society of Chemistry, 2001Publication.
[T7] JamesF.Shackelford & M.K. Muralidhara,"Introduction to Material Science for Engineering", Sixth Edition by Pearson Education.

References:

[R1] D. M. Tagare, "Electrical Power Capacitors-Design & Manufacture", Tata McGraw Hill Publication.
[R2] S. P. Chalotra & B. K. Bhatt, "Electrical Engineering Materials", Khanna Publishers, Nath Market.
[R3] C.S.Indulkar & S.Thiruvengadam,"Electrical Engineering Materials", S. Chand & Com. Ltd.
[R4] Kamraju & Naidu, "High Voltage Engineering", Tata McGraw Hill Publication.
[R5] "Insulation Technology Course Material of IEEMA Ratner", Pearson Education.
[R6] Rakosh Das Begamudre, "Energy Conversion Systems", New Age International Publishers.
[R7] Traugott Fischer, "Materials Science for Engineering Students",Elsevier publications.

EE204: ELECTRICAL MEASUREMENTS AND INSTRUMENTATION

Teaching Scheme	**Examination Scheme**	
Lectures: 04 Hrs./Week	**Continuous Assessment:**	**20 Marks**
Tutorial: -- Hr/Week	**In-Sem Exam:**	**30 Marks**
	End-Sem Exam:	**50 Marks**
Credits: 4	**Total:**	**100 Marks**

Prerequisite Course:

Course Objectives

1. To provide the knowledge of system of units, classification and essentials of measuring instruments.
2. To get the knowledge about the construction & operation of various electrical & non electrical measuring instruments.
3. To apply the knowledge to identify the measuring instruments & make use of it for quantifying measurements of electrical parameters.

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Understand various characteristics of measuring instruments, their classification and range extension technique.	2	Understanding
CO2	Classify resistance, apply measurement techniques for measurement of resistance, inductance.	3	Applying
CO3	Explain construction, working principle and use of dynamometer type wattmeter for measurement of power under balance and unbalance condition.	2	Understanding
CO4	Explain Construction, working principle of 1-phase and 3-phase induction, static energy meter and calibration procedures	2	Understanding
CO5	Use of CRO for measurement of various electrical parameters, importance of transducers, their classification, selection criterion and various applications.	3	Applying
CO6	Measurement of various physical parameters using transducers.	4	Analysing

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	2	2	2	2	1	1	1	1	-	-	2	1	2
CO2	3	2	2	2	2	1	2	1	1	-	-	1	1	2
CO3	3	2	2	2	2	1	1	1	1	-	-	1	1	2
CO4	3	2	1	2	2	1	1	1	1	1	-	2	1	2
CO5	3	2	2	2	1	1	2	1	1	1	-	2	1	2
CO6	3	2	2	2	1	1	2	1	1	1	-	2	1	2

Course Contents			
UNIT I:	**MEASURING INSTRUMENTS**	**Hrs.**	**CO**
	A. Classification of Measuring Instruments - Characteristics of measuring instruments: static and dynamic, accuracy, linearity, speed of response, dead zone, repeatability, resolution, span, reproducibility, drifts. Necessity of calibration, standards and their classification, absolute and secondary instruments, types of secondary instruments: indicating, integrating, and recording, analog / digital. **Ammeter and Voltmeter Theory:** Essentials of indicating instruments deflecting, controlling and damping systems. Construction, working principle, torque equation, advantages and disadvantages of Moving Iron (MI) (attraction and repulsion), and Permanent Magnet Moving Coil (PMMC), block diagram and operation of digital ammeter & voltmeter. **B. Range Extension:** PMMC ammeters and voltmeters using shunts, multipliers. Universal shunt, universal multiplier. Instrument Transformers: Construction, connection of CT & PT in the circuit, advantages of CT / PT over shunt and multipliers for range extension of MI Instruments, transformation ratio, turns ratio, nominal ratio, burden, ratio and phase angle error. (descriptive treatment only)	9	**CO1**
UNIT II:	**MEASUREMENT OF RESISTANCE & INDUCTANCE**	**Hrs.**	**CO**
	A. Measurement of Resistance: Measurement of low, medium and high resistance. Wheatstone bridge, Kelvin's double bridge, ammeter-voltmeter method, megger, loss of charge method. Earth tester for earth resistance measurement. **B. Measurement of Inductance**: Introduction, sources and detectors for A.C. bridge, general equation for bridge at balance. Measurement of inductance: Maxwell's inductance & Maxwell's inductance – Capacitance Bridge, Anderson's bridge.	8	**CO2**
UNIT III:	**MEASUREMENT OF POWER**	**Hrs.**	**CO**
	Construction, working principle, torque equation, errors and their compensation, advantages and disadvantages of dynamometer type wattmeter, low power factor wattmeter, poly-phase wattmeter. Active & reactive power measurement in three phase system for balanced and unbalanced load using three wattmeter method, two wattmeter method & one wattmeter method. Power analyzer, Multi meter.	8	**CO3**
UNIT IV:	**MEASUREMENT OF ENERGY**	**Hrs.**	**CO**
	Construction, working principle, torque equation, errors and adjustments of single phase conventional (induction type) energy meter. Calibration of energy meter. Block diagram and operation of electronic energy meter. Three phase energy meter, TOD meter.	7	**CO4**
UNIT V:	**MEASURING INSTRUMENTS-I**	**Hrs.**	**CO**
	A. Oscilloscope: Introduction, various parts, front panel controls, use of CRO for measurement of voltage, current, period, frequency. Phase angle & frequency by lissajous pattern & numerical. Introduction to DSO.	8	**CO5**

	B. Transducers: Introduction, classification, types: resistive, inductive, capacitive, basic requirements for transducers. **C. Pressure Measurement:** Introduction, classification of pressure as low, medium & high, absolute, gauge, vacuum, static, dynamic & head pressure. High pressure measurement using electric methods, low pressure measurement by McLeod gauge and pirani gauge, capacitive pressure transducer.		
UNIT VI:	**MEASURING INSTRUMENTS-II**	**Hrs.**	**CO**
	A. Level Measurement: Introduction and importance of level measurement, level measurement methods: mechanical, hydraulic, pneumatic, electrical, nucleonic and ultrasonic. **B. Displacement Measurement:** LVDT & RVDT – construction, working, application, null voltage, specifications, advantages & disadvantages, effect of frequency on performance. **C. Strain Gauge**: Introduction, definition of strain, types of strain gauge: Wire strain gauge, foil strain gauge, semiconductor strain gauge etc.; their construction, working, advantages and disadvantages.	8	**CO6**

Text Books:

[T1] A. K. Sawhney, "A Course in Electrical and Electronic Measurements & Instrumentation" Dhanpat Rai & Co.

[T2] J. B. Gupta, "A Course in Electronics and Electrical Measurements and Instrumentation" S. K. Kataria & Sons,

[T3] R. K. Jain, "Mechanical and Industrial Measurements" Khanna Publishers.

[T4] B. C. Nakra & K. K. Chaudhari, "Instrumentation Measurement and Analysis" Tata McGraw Hill.

Reference Books:

[R1] E. W. Golding & F. C. Widdies, "Electrical Measurements & Measuring Instruments", Reem Publications.

[R2] Dr. Rajendra Prasad, "Electronic Measurements & Instrumentation", Khanna Publishers

[R3] Arun K. Ghosh, "Introduction to Measurements and Instrumentation", PHI Publication

[R4] M. M. S. Anand, "Electronics Instruments and Instrumentation Technology", PHI Publication.

[R5] DAVID A BELL, "Electronic Instrumentation and Measurements", Oxford publication. [R7] Johnturner and Martyn Hill, "Instrumentation for Engineers & Scientist", Oxford publication

EE205: ANALOG AND DIGITAL ELECTRONICS

Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs./Week	**Continuous Assessment:**	**20 Marks**
Tutorial: -- Hr/Week	**In-Sem Exam:**	**30 Marks**
	End-Sem Exam:	**50 Marks**
Credits: 3	**Total:**	**100 Marks**

Prerequisite Course: Basic Electronics Engineering

Course Objectives

1. To Introduce students to the basic features of operational amplifier.
2. To provide knowledge and experience for implementing simple electronic circuits to meet or exceed design specifications.
3. To enable students for implementing combinational logic circuits for various applications.
4. To impart knowledge for implementing sequential circuits using flip-flops.
5. To analysis conventional rectifier and precision rectifier
6. To design desire voltage regulator

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Analysis of number system, perform binary arithmetic and reduce expressions by K-Map	3	Analyzing
CO2	Design of rectifier	3	Analyzing
CO3	Analyze various parameters of Op-amp and applications	3	Analyzing
CO4	Apply the knowledge of Op-amp as filter and waveform generator	4	Applying
CO5	Analyze BJT as amplifier with various configuration	3	Analyzing
CO6	Explain basics of various types of flipflops, counter and register	4	Applying

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	2	1	2	2	2	1	1	2	1	-	2	2	2
CO2	3	2	1	1	2	2	1	1	2	1	-	2	2	2
CO3	3	2	1	2	2	1	1	1	1	1	-	2	2	2
CO4	3	2	1	1	2	2	1	1	2	1	-	2	2	2
CO5	3	2	1	1	2	1	1	1	1	1	-	2	2	2
CO6	3	2	1	1	2	1	1	1	1	1	-	2	2	2

Course Contents			
UNIT-I	**NUMBER SYSTEM & BOOLEAN'S ALGEBRA**	**No.of Hours**	**COs**
	Numbering systems-binary, octal, decimal and hexadecimal and their conversion, codesBCD, Grey and excess3, Binary arithmetic: - addition and subtraction by 1's and 2's compliment. Booleans algebra, De-Morgan's theory etc. K-map: - structure for two, three and four Variables, SOP and POS form reduction of Boolean expressions by K-map.	08	CO1
UNIT-II	**DIODE & PRECISION RECTIFIERS:**	**No.of Hours**	**COs**
	Diode rectifier: Introduction, Single phase half wave rectifier with R, RL loads. Single phase full wave rectifier-Center tap and bridge rectifier. Three phase full wave bridge rectifier with R load. Comparison of single-phase half wave and full wave rectifiers, Precision rectifiers: Half wave and Full wave. Comparison of diode and precision rectifier.	08	CO2
UNIT-III	**OPERATIONAL AMPLIFIER & APPLICATIONS:**	**No.of Hours**	**COs**
	Op-Amp: Block diagrams of 741, ideal and practical parameters, open loop and close loop configuration of Op-Amp. Applications of Op-Amp- Comparator, Schmitt trigger, zero crossing detectors, V-I and I-V converters, Instrumentation amplifier, peak detector.	08	CO3
UNIT-IV	**FILTERS & REGULATORS & WAVEFORM GENERATOR:**	**No.of Hours**	**COs**
	Active filters-Its configuration with frequency response, Analysis of first order low pass and high pass filters, IC 555 –construction, working and modes of operation- astable and monostable multi vibrators, Sequence generator, voltage regulators using ICs 78xx, 79xx, LM 317. Waveform generation using Op-amp - sine, square, saw tooth and triangular generator	08	CO4
UNIT-V	**BJT & FET APPLICATIONS:**	**No.of Hours**	**COs**
	BJT amplifier, Introduction, Class A amplifier, single stage and multi stage BJT amplifier, direct coupled, RC coupled and transformer coupled, Darlington pair, push-pull amplifier, and differential amplifier, FET construction and characteristic	08	CO5
UNIT-VI	**COMBINATIONAL & SEQUENTIAL CIRCUITS**	**No.of Hours**	**COs**
	Concept of Combinational & Sequential circuits, Flip flops – R-S, Clocked S-R, D latches, Edge Triggered D flip-flops, Edge triggered JK flip flops, JK Master - slave flip flop, Register- Buffer registers, shift registers, controlled shift registers, ring counter, Counters – asynchronous Counters, synchronous counter, up - down counter , twisted ring counters, N –module Counters.	08	CO6

Text Books:

1. Sergio Franco, 'Design with Op-Amps and analog Integrated Circuits', TMH.
2. Allen Mottershed, 'Electronic Devices & Circuits', PHI.
3. A Anand Kumar, 'Fundamentals of Digital Circuits, PHI.
4. R.P. Jain "Digital Electronics "Tata McGraw Hill, New Delhi

Reference Books:

1. R.A. Gayakwad, 'Op-Amps & Linear Integrated Circuits', PHI, Fourth Edition, 2012.
2. Boylestad R. L. and Nashelsky Louis, 'Electronic Devices & Circuit Theory', Pearson, Tenth Edition, 2009.
3. M. Moris Mano and Michael Ciletti, 'Digital Design', Pearson Publications.
4. Tokheim, "Digital Electronics- Principles and application", 6th edition, Tata McGraw Hill, New Delhi

HS206: UNIVERSAL HUMAN VALUES AND PROFESSIONAL ETHICS

Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs./Week	**Continuous Assessment:**	**20 Marks**
	In-Sem Exam:	**30 Marks**
	End-Sem Exam:	**50 Marks**
Credits: 3	**Total:**	**100 Marks**

Prerequisite Course:

Course Objectives

1. To make the students aware about the concept and need of value education.
2. To help the students appreciate the essential complementarity between values and skills to ensure sustained happiness and prosperity.
3. To facilitate the development of a holistic perspective among the students towards life and profession.
4. To facilitate the understanding of harmony at various levels staring from self and going towards family, society and nature.
5. To make the students aware about the correlation between engineering ethics and social experimentation in various situations.
6. To highlight the importance of professional ethics in the wake of global realities.

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Recognize the concept of self-exploration as the process of value education.	2	Remember
CO2	Interpret the human being as the coexistence of self and body.	2	Understand
CO3	Apply the holistic approach for fulfilling human aspirations for the humans to live in harmony at various levels.	3	Apply
CO4	Organize the universal human order in correlation with professional ethics.	4	Analyse
CO5	Implement ethical practices in engineering profession.	3	Apply
CO6	Outline the importance of various ethical practices in the wake of global realities.	4	Analyse

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	-	-	-	-	-	2	-	3	-	1	-	2	-	-
CO2	-	-	-	-	-	2	-	3	-	1	-	2	-	-
CO3	-	-	-	-	-	3	2	3	-	1	-	2	-	-
CO4	-	-	-	-	-	3	-	3	-	1	-	2	-	-
CO5	-	-	-	-	-	3	-	3	-	1	-	2	-	-
CO6	-	-	-	-	-	2	-	3	-	1	-	2	-	-

Course Contents			
UNIT-I	**INTRODUCTION TO VALUE EDUCATION**	**No.of Hours**	**COs**
	Values, Morals and Ethics; Concept and need of value education; Self-exploration as the process for value education; Guidelines for value education; Basic human aspirations and their fulfilment	06	CO1
UNIT-II	**HARMONY IN HUMAN BEING**	**No.of Hours**	**COs**
	Human being as the coexistence of self and the body; Discrimination between the needs of the self and the body; The body as an instrument; Harmony in the self; Harmony of the self with the body	06	CO2
UNIT-III	**HARMONY IN THE FAMILY, SOCIETY AND NATURE**	**No.of Hours**	**COs**
	Harmony in the family- The basic unit of human interaction; Values in the human to human relationship; Harmony in the society; Vision for the universal human order; Harmony in the nature; Realizing existence as coexistence at all levels	06	CO3
UNIT-IV	**PROFESSIONAL ETHICS**	**No.of Hours**	**COs**
	Natural acceptance of human values; Definitiveness of ethical human conduct; Humanistic education and universal human order; Competence in professional ethics; Transition towards value-based life and profession	06	CO4
UNIT-V	**ENGINEERING ETHICS AND SOCIAL EXPERIMENTATION**	**No.of Hours**	**COs**
	Need of engineering ethics; Senses of engineering ethics; Variety of moral issues; Moral autonomy; Utilitarianism; Engineering as experimentation; Engineers as responsible experimenters; Codes of ethics	06	CO5
UNIT-VI	**GLOBAL ISSUES**	**No.of Hours**	**COs**
	Globalization and multi-national corporations; Cross-cultural issues; Business ethics; Environmental ethics; Computer ethics; Bio-ethics; Ethics in research; Intellectual property rights and plagiarism	06	CO6

Text Books:

1. R. R. Gaur, R. Sangal, G. P. Bagaria, "A Foundation Course in Human Values and Professional Ethics", Excel Books Pvt. Ltd.
2. R. S. Naagarazan, "A Textbook on Professional Ethics and Human Values", New Age International (P) Ltd. Publishers

Reference Books:

3. B. P. Banerjee, "Foundations of Ethics and Management", Excel Books Pvt. Ltd.
4. P. L. Dhar, R. R. Gaur, "Science and Humanism", Commonwealth Publishers
5. M. K. Gandhi, "The Story of my Experiments with Truth", Discovery Publisher

http://uhv.org.in/

Considering the specific nature of this course, the methodology is explorational and thus universally adaptable. In order to connect the content of this course with practice, minimum 6 group activities should be conducted with active involvement of the students. The teacher's assessment should be strictly based on the participation of the students in these activities.

EE207: MATERIAL SCIENCE LABORATORY

Teaching Scheme	**Examination Scheme**	
Lectures: -- Hrs./Week	**Oral:**	**-- Marks**
Tutorial: -- Hr/Week	**Practical:**	**50 Marks**
Practical: 02 Hr/Week	**Term Work:**	**25 Marks**
Credits: 1	**Total:**	**75 Marks**

Prerequisite Course: Students should have knowledge of various classes of materials like solid, liquid, gaseous, conducting, insulating and resistive along with their basic characteristics.

Course Objectives

1. To classify different materials from Electrical Engineering application point of view.
2. To understand various properties and characteristics of different classes of materials.
3. To select materials for applications in various electrical equipment.
4. To impart knowledge of Nano-technology, battery and solar cell materials.
5. To develop ability to test different classes of materials as per IS.

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Categorize and classify different materials from Electrical Engineering applications point of view.	3	Applying
CO2	Explain and summarize various properties and characteristics of different classes of materials.	2	Understanding
CO3	Choose materials for application in various electrical equipment	3	Applying
CO4	Explain and describe knowledge of nanotechnology, batteries and solar cell materials.	2	Understanding
CO5	Test different classes of materials as per IS.	4	Analysing
CO6	Use of theoretical knowledge in practical field application.	3	Applying

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	2	2	1	2	3	1	1	--	1	--	2	3	2
CO2	3	1	1	2	2	2	2	1	1	1	1	2	2	2
CO3	3	2	2	1	2	1	1	1	1	--	1	1	1	1
CO4	3	1	2	2	1	2	1	1	1	1	1	2	1	1
CO5	3	2	1	3	1	1	--	1	--	2	1	1	1	2
CO6	3	2	1	1	2	1	1	--	1	1	1	2	1	1

Course Contents			
Ex. No	**Name of Experiment**	**No.of Hours**	**COs**
1	To measure dielectric strength of solid insulating materials.	2	6,3
2	To measure dielectric strength of liquid insulating materials.	**2**	**6,3**
3	To measure dielectric strength of gaseous insulating materials using Sphere Gap-Unit.	2	6,3
4	To obtain Hysteresis Loop of the Ferro-Magnetic Material.	**2**	**4**
5	To understand the principle of thermocouple & to obtain characteristics of different thermocouples.	2	3,4
6	To measure Insulation Resistance & KVAr capacity of power capacitor.	**2**	**2,3**
7	To measure Resistivity of High Resistive Alloys.	2	3
8	To observe development of tracks due to ageing on different insulating materials e.g. Bakelite, Perspex, polyesters, Mica, Fibre glass etc.	**2**	**4,2**
9	Testing of resins and polymers.	2	3
10	Measurement of Tangent of Dielectric Loss Angle (tan δ) of solid/liquid dielectric materials.	**2**	**3,4**
11	Measurement of Flux Density by Gauss-meter.	2	6

Text Books:

[T1] Charles P. Poole, Jr. Frank & J. Ownes, "Introduction to Nanotechnology", Wiley Student Edition.

[T2] Electrical Engineering Materials", T.T.T.I, Madras.

[T3] K. B. Raina & S. K. Bhattacharya, "Electrical Engineering Materials", S. K. Kataria & Sons.

[T4] P.K. Palanisamy, "Material Science for Electrical Engineering", SciTech Pub. (India) Pvt. Ltd., Chennai.

[T5] S.P.Seth,"ACourseinElectricalEngineeringMaterials",DhanpatRaiandSons publication.

[T6] RonaldM.DellandDavidA.J.Rand,"UnderstandingBatteries",RoyalSociety of Chemistry, 2001Publication.

[T7] JamesF.Shackelford&M.K.Muralidhara,"IntroductiontoMaterialSciencefor Engineering", Sixth Edition by Pearson Education.

References:

[R1] D. M. Tagare, "Electrical Power Capacitors-Design & Manufacture", Tata McGraw Hill Publication.

[R2] S. P. Chalotra & B. K. Bhatt, "Electrical Engineering Materials", Khanna Publishers, Nath Market.

[R3] C.S.Indulkar&S.Thiruvengadam,"ElectricalEngineeringMaterials",S.Chand & Com. Ltd.

[R4] Kamraju & Naidu, "High Voltage Engineering", Tata McGraw Hill Publication.

[R5] "Insulation Technology Course Material of IEEMA Ratner", Pearson Education.

[R6] Traugott Fischer, "Materials Science for Engineering Students",Elsevier publications.

[R7] Rakosh Das Begamudre, "Energy Conversion Systems", New Age International Publishers.

EE208: ELECTRICAL MEASUREMENTS AND INSTRUMENTATION LABORATORY

Teaching Scheme	**Examination Scheme**	
Lectures: -- Hrs./Week	**Oral:**	**-- Marks**
Tutorial: -- Hr/Week	**Practical:**	**50 Marks**
Practical: 02 Hrs/week	**Term Work:**	**25 Marks**
Credits: 1	**Total:**	**75 Marks**

Prerequisite Course:

Course Objectives

1. To provide the knowledge of system of units, classification and essentials of measuring instruments.
2. To get the knowledge about the construction & operation of various electrical & non electrical measuring instruments.
3. To apply the knowledge to identify the measuring instruments & make use of it for quantifying measurements of electrical parameters.

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Understand various characteristics of measuring instruments, their classification and range extension technique.	2	Understanding
CO2	Classify resistance, apply measurement techniques for measurement of resistance, inductance.	3	Applying
CO3	Explain construction, working principle and use of dynamometer type wattmeter for measurement of power under balance and unbalance condition.	2	Understanding
CO4	Explain Construction, working principle of 1-phase and 3-phase induction, static energy meter and calibration procedures	2	Understanding
CO5	Use of CRO for measurement of various electrical parameters, importance of transducers, their classification, selection criterion and various applications.	3	Applying
CO6	Measurement of various physical parameters using transducers.	4	Analysing

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	2	2	2	2	1	1	1	1	-	-	2	1	2
CO2	3	2	2	2	2	1	2	1	1	-	-	1	1	2
CO3	3	2	2	2	2	1	1	1	1	-	-	1	1	2
CO4	3	2	1	2	2	1	1	1	1	1	-	2	1	2
CO5	3	2	2	2	1	1	2	1	1	1	-	2	1	2
CO6	3	2	2	2	1	1	2	1	1	1	-	2	1	2

Course Contents			
Ex. No	**Name of Experiment**	**No. of Hours**	**COs**
Compulsory Experiments (06):			
1	Demonstration of working parts of various types of meter by opening the instrument & explanation of symbols & notations used on instruments.	2	1
2	Extension of instrument range: ammeter, voltmeter, watt meter using CT & PT.	2	1
3	Measurement of active & reactive power in three phase circuit using two wattmeter methods (balanced & unbalanced loads).	2	3
4	Measurement of active & reactive power in three phase balanced circuit using one wattmeter method with two-way switch.	2	3
5	Calibration of single-phase static energy meter at different power factors.	2	4
6	Measurement of voltage, current, time period, frequency & phase angle using CRO.	2	5
Any four experiments are to be conducted of following experiments:			
1	Measurement of reactive power by one wattmeter with all possible connections of current coil and pressure coil.	2	3
2	Measurement of power in three phase, four wire system using three CTs & two wattmeter.	2	3
3	Calibration of single-phase wattmeter at different power factors.	2	4
4	i) Measurement of resistance by ammeter voltmeter method. ii) Measurement of low resistance using Kelvin's double bridge.	2	2
5	Measurement of inductance using Anderson's bridge/ Maxwell's bridge.	2	2

Text Books:

[T1] A. K. Sawhney, "A Course in Electrical and Electronic Measurements & Instrumentation" Dhanpat Rai & Co.

[T2] J. B. Gupta, "A Course in Electronics and Electrical Measurements and Instrumentation" S. K. Kataria & Sons,

[T3] R. K. Jain, "Mechanical and Industrial Measurements" Khanna Publishers.

[T4] B. C. Nakra & K. K. Chaudhari, "Instrumentation Measurement and Analysis" Tata McGraw Hill.

Reference Books:

[R1] E. W. Golding & F. C. Widdies, "Electrical Measurements & Measuring Instruments", Reem Publications.

[R2] Dr. Rajendra Prasad, "Electronic Measurements & Instrumentation", Khanna Publishers

[R3] Arun K. Ghosh, "Introduction to Measurements and Instrumentation", PHI Publication

[R4] M. M. S. Anand, "Electronics Instruments and Instrumentation Technology", PHI Publication.

[R5] DAVID A BELL, "Electronic Instrumentation and Measurements", Oxford publication.

[R6] Johnturner and Martyn Hill, "Instrumentation for Engineers & Scientist", Oxford publication

EE209: ANALOG AND DIGITAL ELECTRONICS LABORATORY

Teaching Scheme	**Examination Scheme**	
Lectures: -- Hrs./Week	**Oral:**	**-- Marks**
Tutorial: -- Hr/Week	**Practical:**	**50 Marks**
Practical: 02 Hr/Week	**Term Work:**	**25 Marks**
Credits: 1	**Total:**	**75 Marks**

Prerequisite Course: Basic Electronics Engineering

Course Objectives

1. To Introduce students to the basic features of operational amplifier.
2. To provide knowledge and experience for implementing simple electronic circuits to meet or exceed design specifications.
3. To enable students for implementing combinational logic circuits for various applications.
4. To impart knowledge for implementing sequential circuits using flip-flops.
5. To analysis conventional rectifier and precision rectifier
6. To design desire voltage regulator

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Analysis of number system, perform binary arithmetic and reduce expressions by K-Map	3	Analyzing
CO2	Design of rectifier	3	Analyzing
CO3	Analyze various parameters of Op-amp and applications	3	Analyzing
CO4	Apply the knowledge of Op-amp as filter and waveform generator	4	Applying
CO5	Analyze BJT as amplifier with various configuration	3	Analyzing
CO6	Explain basics of various types of flipflops, counter and register	4	Applying

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	2	1	2	2	2	1	1	2	1	-	2	2	2
CO2	3	2	1	1	2	2	1	1	2	1	-	2	2	2
CO3	3	2	1	2	2	1	1	1	1	1	-	2	2	2
CO4	3	2	1	1	2	2	1	1	2	1	-	2	2	2
CO5	3	2	1	1	2	1	1	1	1	1	-	2	2	2
CO6	3	2	1	1	2	1	1	1	1	1	-	2	2	2

Course Contents			
Ex. No	**Name of Experiment**	**No.of Hours**	**COs**
1	Design and implementation of half wave rectifier.	2	2
2	Design and implementation of full wave rectifier.	**2**	**2**
3	Study of shift register operation IC7495	2	6
4	Study of flip-flops and verification of truth table	**2**	**6**
5	Study of opamp comparator and ZCD	2	3,4
6	Study of active filter low pass and high pass	**2**	**2**
7	Study of decoders and multiplexers. & decade counters.	2	3
8	Study of op-amp as an inverting & non-inverting amplifier.	**2**	**4**
9	Study of op-amp as differentiator & integrator., zero crossing detector & peak detector.	4	3
10	Study of op-amp as Schmitt trigger, precision rectifier, & instrumentation amplifier.	**4**	**3,4**
11	Study of a stable and mono stable multi vibrator using IC 555 & power amplifiers	4	4

Text Books:

1. Sergio Franco, 'Design with Op-Amps and analog Integrated Circuits', TMH.
2. Allen Mottershed, 'Electronic Devices & Circuits', PHI.
3. A Anand Kumar, 'Fundamentals of Digital Circuits, PHI.
4. R.P. Jain "Digital Electronics "Tata McGraw Hill, New Delhi

Reference Books:

1. R.A. Gayakwad, 'Op-Amps & Linear Integrated Circuits', PHI, Fourth Edition, 2012.
2. Boylestad R. L. and Nashelsky Louis, 'Electronic Devices & Circuit Theory', Pearson, Tenth Edition, 2009.
3. M. Moris Mano and Michael Ciletti, 'Digital Design', Pearson Publications.
4. Tokheim, "Digital Electronics- Principles and application", 6th edition, Tata McGraw Hill, New Delhi

MC210: CONSTITUTION OF INDIA – BASIC FEATURES AND FUNDAMENTAL PRINCIPLES

Teaching Scheme	**Examination Scheme**	
Lectures: 2 Hrs./Week	**Term Work:**	**NA**
	Oral :	**NA**
	Practical:	**NA**
Credits: Non-Credit	**Total:**	**NA**

Course Objectives

1. To study the historical background, salient features and preamble of Indian constitution
2. To study the provision of fundamental right in the Indian constitution.
3. To study the directive principle of state policy and fundamental duties.
4. To study the system of government through parliamentary and federal system.
5. To understand the formation, structure and legislative framework of central government.
6. To understand the formation, structure and legislative framework of state government.

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Describe background, salient features of constitution of India	1	Remembering
CO2	Explain the system of government, it's structure and legislative framework.	2	Understanding
CO3	Apply the fundamental rights and duties in their life	3	Applying

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	--	--	--	--	--	1	--	--	--	---	--	--	--	--
CO2	--	--	--	--	--	2	--	---	--	---	--	--	--	---
CO3	--	--	--	--	--	2	--	---	--	--	--	--	--	---

Course Contents

UNIT-I	**INTRODUCTION TO CONSTITUTION OF INDIA**	**Hrs.**	**COs**
	a. Historical background b. Salient features c. Preamble of constitution	7	1
UNIT-II	**FUNDAMENTAL RIGHTS**	**Hrs.**	**COs**
	a. Features of fundamental rights b. Basic rights 1. Right to equality; 2. Right to freedom; 3. Right against exploitation; 4. Right to freedom of religion; 5.	5	2

	Cultural and educational rights; 6. Right to property; 7. Right to constitutional remedies		
UNIT-III	**DIRECTIVE PRINCIPLE OF STATE POLICY AND FUNDAMENTAL DUTIES**	**Hrs.**	**COs**
	Directive principle of state policy: a. Features of directive principle b. Classification of directive principle c. Criticism of directive principle d. Utility of directive principle e. Conflict between Fundamental rights and directive principle **Fundamental duties:** a. List of fundamental duties b. Features of fundamental duties c. Criticism of fundamental duties d. Significance of fundamental duties e. Swaran Singh Committee Recommendations	5	3
UNIT-IV	**SYSTEM OF GOVERNMENT**	**Hrs.**	**COs**
	a. Parliamentary system: Features of parliamentary government, Features of presidential government, merits and demerit of Parliamentary system b. Federal system: Federal features of constitution, unitary features of constitution c. Centre and state relation: Legislative relation, administrative relations and financial relation. d. Emergency provision: National emergency, Financial emergency and criticism of emergency provision	5	4
UNIT-V	**CENTRAL GOVERNMENT**	**Hrs.**	**COs**
	a. President: Election of president, powers and functions of president, and Veto power of president b. Vice-president: Election of vice-president, powers and functions of vice-president c. Prime minister: Appointment of PM, powers and functions of PM, relationship with president d. Central council of ministers: Appointment of ministers, responsibility of ministers, features of cabinet committees, functions of cabinet committees e. Parliament: Organization of parliament, composition of the two houses , duration two houses, membership of parliament, session of parliament, joint sitting of two houses, budget in parliament. f. Supreme court (SC): Organization of supreme court, independence of supreme court, jurisdiction and powers of supreme court	5	5
UNIT-VI	**STATE GOVERNMENT**	**Hrs.**	**COs**
	a. Governor: Appointment of governor, powers and functions of governor, constitutional position	5	6

	b. Chief minister: Appointment of CM, powers and functions of CM, relationship with governor c. State council of ministers: Appointment of ministers, responsibility of ministers, cabinet. d. High court (HC): Organization of HC, independence of HC, jurisdiction and powers of HC e. Sub-ordinate court: Structure and jurisdiction, LokAdalats, Family court, Gram Nyayalayas		

Text Books:

1. Indian Polity for Civil Service Examination, M Laxmikanth, Mc GrawHill Education, Fifth Edition.

2. Introduction to the Constitution of India, Durga Das Basu, LexisNexis, 22nd Edition

Semester II

EE211: NUMERICAL METHODS AND COMPUTER PROGRAMMING

Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs./Week	**Continuous Assessment:**	**20 Marks**
Tutorial: 01 Hr/Week	**In-Sem Exam:**	**30 Marks**
	End-Sem Exam:	**50 Marks**
Credits: 4	**Total:**	**100 Marks**

Prerequisite Course: Engineering Mathematics

Course Objectives

1. Study of various methods of numerical analysis of linear and non-linear problems
2. Use of method for solving the problems in engineering
3. Developing algorithm, flow-chart and computer program in any language
4. Use of modern computing tool

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Develop algorithms and implement programs for various numerical methods using modern computing tool	3	Applying
CO2	Demonstrate types of errors in computation and their causes of occurrence	2	Understanding
CO3	Identify various types of equations and apply appropriate numerical method to solve different nonlinear equations	3	Applying
CO4	Apply different numerical methods for interpolation, differentiation and numerical integration	3	Applying
CO5	Apply and compare various numerical methods to solve first and second order ODE, PDE and least square approximations	3	Applying
CO6	Apply and compare various numerical methods to solve linear simultaneous equations	3	Applying

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	3	1	1	1	1	-	1	2	2	-
CO2	3	3	1	2	1	1	1	1	1	-	1	1	1	-
CO3	2	2	1	2	1	1	1	1	1	-	1	1	1	-
CO4	2	2	1	2	2	1	1	1	1	-	1	1	1	-
CO5	2	2	1	2	2	1	1	1	1	-	1	1	1	-
CO6	2	2	1	2	1	1	1	1	1	-	1	1	1	-

Course Contents			
UNIT I:	**Computer Arithmetic**	**Hrs.**	**CO**
	Floating Point representation, Arithmetic operations with normalized floating-point numbers, errors in numbers, Truncation error, round off error, inherent error, absolute and relative error.	**4**	CO2
UNIT II:	**Solution of Non-Linear Equations**	**Hrs.**	**CO**
	Bisection method, false position method, Secant Method and Newton-Raphson method, Method of successive approximation, rate of convergence.	**6**	CO1 CO3
UNIT III:	**Interpolation and Numerical Differentiation**	**Hrs.**	**CO**
	Lagrange's interpolation, difference table, Newton's Interpolation, iterated linear interpolation technique, Stirling's and Bessel's central difference formulae, The Cubic Spline Method	**8**	CO1 CO4
UNIT IV:	**Solution of Ordinary Differential Equation(ODE) And Numerical Integration**	**Hrs.**	**CO**
	A) Solution of First order Ordinary Differential Equation (ODE) using Taylor's series method, Euler's, Modified Euler's methods. Runge-Kutta second and fourth order methods. **Solution of Second order ODE** using 4th order Runge-Kutta method. **Numerical Integration:** Trapezoidal and Simpson's rules as special cases of NewtonCote's quadrature technique for single and double integrals.	**8**	CO1 CO4 CO5
UNIT V:	**Solution of Linear Simultaneous Equation**	**Hrs.**	**CO**
	A) Solution of simultaneous equation: Direct methods - Gauss and Gauss-Jordan elimination methods, concept of pivoting – partial and complete. Iterative methods – Jacobi and Gauss Seidel methods. **B) Matrix Inversion** using Jordon method and Eigen values using Power method. And their convergence	**8**	CO1 CO6
UNIT VI:	**Numerical Solution of Partial Differential Equation and Least Square Approximation of Functions**	**Hrs.**	**CO**
	Finite difference, approximation to derivatives. Laplace equation, Iterative methods for the solution of equations. Linear regression, Polynomial regression, fitting exponential and trigonometric functions.	**8**	CO1 CO5
Text Books:			
[T1] V. Rajaraman," Computer Oriented Numerical Method", Prentice Hall of India. [T2] S. S. Sastry," Introductory methods of numerical analysis", Prentice Hall of India [T3] C. Woodford, C. Phillips," Numerical Methods with Worked Examples: MATLAB Edition", Springer, Second Edition [T4] A. Quarteroni, F. Saleri, and P. Gervasio, Scientific computing with MATLAB and Octave, Third edition, (Springer, 2010).			

References:

[R1] Thomas Richard Mecalla," Introduction to numerical Methods and FORTRAN programming", Willey International Edition.

[R2] Steven C. Chapra and Raymond P. Canale, "Numerical methods for Engineers", Mc-Graw Hill Publication,2007.

[R3] W.Y. Yang, W. Cao, T.-S. Chung and J. Morris, Applied Numerical methods using MATLAB, (John Wiley, 2005).

[R4] B.S. Grewal," Numerical Methods in Engineering & Science", Khanna Publishers.

EE212: NETWORK ANALYSIS

Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs./Week	**Continuous Assessment:**	**20 Marks**
Tutorial: 01 Hr/Week	**In-Sem Exam:**	**30 Marks**
	End-Sem Exam:	**50 Marks**
Credits: 4	**Total:**	**100 Marks**

Prerequisite Course: Basic Electrical Engineering

Course Objectives

1. To develop the strong foundation for Electrical Networks.
2. To develop analytical qualities in Electrical circuits by application of various theorems
3. To understand the behavior of circuits by analyzing the transient response using classical methods and Laplace Transform approach.
4. To understand basic concept of Graph theory.
5. To apply knowledge of Network theory for analysis of 2-port networks.
6. To apply knowledge of Network theory for designing Low-pass and high pass filter.

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Demonstrate strong basics for network theory	3	Applying
CO2	Use the knowledge of problem-solving technique for networks by application of theorems for DC and AC circuits.	3	Applying
CO3	Analyse the behaviour of the network by transient response	4	Analysing
CO4	Demonstrate of Standard test inputs and transformed network.	3	Applying
CO5	Understand the behaviour of the network by analysing two port analysis	2	Understanding
CO6	Apply network for designing and synthesis of Filters	4	Analysing

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	2	-	-	-	2	2	-	-	2	2
CO2	3	3	-	-	2	-	-	-	2	2	-	-	2	2
CO3	3	3	-	-	2	-	-	-	2	2	-	-	2	2
CO4	3	3	-	-	2	-	-	-	2	2	-	-	2	2
CO5	3	3	-	-	1	-	-	-	2	2	-	-	2	2
CO6	3	2	-	-	1	-	-	-	2	1	-	-	2	2

Course Contents			
UNIT I:	**Basic Network Concept**	**Hrs.**	**CO**
	Types of Sources, Source transformation, Series, parallel concept for resistance, capacitance and inductance, coupled circuits and dot conventions, Kirchhoff's voltage and current law, mesh analysis, nodal analysis, Concept of duality and dual networks. Graph of network: Concept of tree branch, tree link, tie set and cut set.	**8**	CO1
UNIT II:	**Network Theorems**	**Hrs.**	**CO**
	Superposition, Thevenin, Norton, Maximum Power Transfer Theorem, Reciprocity theorem, Millman theorems applied to both ac/dc circuits.	**8**	CO2
UNIT III:	**Transient Phenomena**	**Hrs.**	**CO**
	Initial and Final Condition of network, General and Particular Solution, time constant. Transient response of R-L, R-C and R-L-C network in time domain .	**8**	CO3
UNIT IV:	**Laplace Domain Analysis**	**Hrs.**	**CO**
	Standard test inputs: Step, Ramp, Impulse, Their Laplace transform, Representation of R,L,C in S domain, transformed network, Application of Laplace transform to solve series and parallel R-L, R-C and R-L-C circuits (Source free, Source driven).	**8**	CO4
UNIT V:	**Network functions Two port Network concept**	**Hrs.**	**CO**
	Network functions for one and two port, calculation of network functions, poles and zeros of network functions, restrictions on poles and zeros, time domain behavior from the pole and zero location, Necessary conditions for stable driving point function and transfer function, two port parameters: Z, Y, H and transmission parameter	**8**	CO5
UNIT VI:	**Application: Filter Design**	**Hrs.**	**CO**
	Classification of filters: Low pass, High Pass, Band pass, Band stop, Symmetrical networks : characteristic impedance , propagation constant, Design of constant K- low pass and constant K- high pass filters using symmetrical networks	**8**	CO6

Text Books:

1. M. E. Van Valkenburg, "Network Analysis", Prentice Hall of India Private Limited, Third Edition.
2. D Roy Choudhary, "Network and Systems", New age international publishers.
3. 3. Abhijit Chakrabarti, "Circuit Theory", DhanpatRai and Company, 7th edition..

References:

1. William H. Hayt, Jr. Jack E. Kemmerly, "Engineering Circuit Analysis" McGrawHill Publication.
2. N.C. Jagan, "Network Analysis", BS Publication, Hyderabad, Second Edition.
3. John O' Malley, "Schaum's outline of Theorems and Problems of Basic Circuit Analysis", McGrawHill Publication

EE213: ELECTRICAL MACHINES I

Teaching Scheme	**Examination Scheme**	
Lectures: 04 Hrs./Week	**Continuous Assessment:**	**20 Marks**
Tutorial: --- Hr/Week	**In-Sem Exam:**	**30 Marks**
	End-Sem Exam:	**50 Marks**
Credits: 4	**Total:**	**100 Marks**

Prerequisite Course: Basic Electrical Engineering

Course Objectives

1. Understanding the concepts of magnetic circuits.
2. Analysis of single phase and three phase transformers circuits.
3. Understanding the operation of dc machines.
4. Analysis of differences in operation of different dc& induction machine configurations.

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Understand basic laws & concepts of magnetic circuits.	2	Understanding
CO2	Apply energy conversion principles to Single phase transformer, its equivalent circuit & operations	3	Applying
CO3	Understand basic connections of three phase transformer and parallel operation of transformer and comparison	2	Understanding
CO4	Identify and demonstrate the components of D.C. machine and its working as motor to test the various machine for performance calculation.	2	Understanding
CO5	Understand Characteristics and applications of D.C. Shunt and Series Motors and process of commutation.	2	Understanding
CO6	Understand Induction motors & its operation on the basis of Speed, Slip, Torque, Power and efficiency.	2	Understanding

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	--	--	--	--	--	--	--	1	2	3	2
CO2	3	2	2	1	1	--	--	1	--	--	2	2	3	2
CO3	3	2	1	1	1	--	--	1	--	--	1	2	3	2
CO4	3	2	1	1	1	--	--	1	--	--	1	2	3	2
CO5	3	2	1	1	1	--	--	1	--	--	1	2	3	2
CO6	3	2	1	2	2	--	--	1	--	--	2	2	3	2

Course Contents			
UNIT-I	**MAGNETIC FIELDS AND MAGNETIC CIRCUITS**	**No.of Hours**	**Cos**
	Review of magnetic circuits - MMF, flux, reluctance, inductance; review of Ampere Law and BiotSavart Law; Visualization of magnetic fields produced by a bar magnet and a current carrying coil -through air and through a combination of iron and air; influence of highly permeable materials on the magnetic flux lines. B-H curve of magnetic materials; flux-linkage vs. current characteristic of magnetic circuits; energy stored in the magnetic circuit.	08	CO1
UNIT-II	**TRANSFORMERS**	**No.of Hours**	**CO**
	Single phase Transformer: Concept of ideal transformer. Corrugated core transformer. Toroidal core Transformer Useful and leakage flux, its effects. Resistance, leakage reactance and leakage impedance of transformer windings & their effects on voltage regulation and efficiency. Exact and approximate equivalent circuits referred to L.V. and H. V. side of the transformer. Phasor diagrams for no-load and on load conditions. Transformer ratings. Losses in a transformer, their variation with load, voltage & Frequency on no load losses Efficiency and condition for maximum efficiency. All day Efficiency. Open circuit and short circuit tests, determination of equivalent circuit parameters from the test data and determination of voltage regulation and efficiency. Autotransformers, their ratings and applications. Comparison with two winding transformer with respect to saving of copper and size.	08	CO2
UNIT-III	**SINGLE PHASE & THREE PHASE TRANSFORMERS**	**No.of Hours**	**CO**
	a) Single Phase Transformers: Polarity test. Parallel operation of single phase transformers, conditions to be satisfied, load sharing under various conditions. Cooling of transformers. **b) Three Phase Transformers**: Standard connections of three phase transformers and their suitability for various applications, voltage Phasor diagrams and vector groups. Descriptive treatment of Parallel operation of three phase transformers Scott connection and V-V connections. Three winding (tertiary windings) transformers.	08	CO3
UNIT-IV	**D.C. MACHINES**	**No.of Hours**	**CO**
	Construction, main parts, magnetic circuits, poles, yoke, field winding, armature core, Armature windings: Simple lap and wave winding, commutator and brush assembly. Generating action, E.M.F equation, magnetization curve, Flashing of Generator. Motoring action. Types of DC motors, significance of back E.M.F torque equation, working at no-load and on-load. Losses, power flow diagram and efficiency. Descriptive treatment of armature reaction.	08	CO4

UNIT-V	D.C. MACHINES	No.of Hours	CO
	a) Characteristics and applications of D.C. Shunt and Series Motors, Starting of DC motors, study of starters for series and shunt motor, solid state starters, speed control of various types of DC motors. b) **Commutation:** Process of commutation, time of commutation, reactance voltage, straight line commutation, commutation with variable current density, under and over commutation, causes of bad commutation and remedies, inter poles, compensating windings. (Descriptive treatment only)	08	CO5
UNIT-VI	**THREE PHASE INDUCTION MOTOR**	**No.of Hours**	**CO**
	Production of rotating mmf by 3-phase balanced voltage fed to a symmetrical 3-phasewinding. Construction: Stator, Squirrel cage & wound rotors. Principle of working, simplified theory with constant air gap flux; slip, frequency of rotor emf and rotor currents, mmf produced by rotor currents, its speed w.r.t. rotor and stator mmf. Production of torque, torque-slip relation, condition for maximum torque, torque-slip Characteristics, effect of rotor resistance on torque-slip characteristics. Relation between starting torque, full load torque and maximum torque. Losses in three phase induction motor, power-flow diagram. Relation between rotor input power, rotor copper loss & gross mechanical power developed,efficiency.	08	CO6

Text Books:

[T1] Edward Hughes "Electrical Technology", ELBS, Pearson Education.
[T2] Ashfaq Husain, "Electrical Machines", DhanpatRai& Sons.
[T3] S. K. Bhattacharya, "Electrical Machine", Tata McGraw Hill publishing Co. Ltd,2nd Edition.
[T4] Nagrath & Kothari, "Electrical Machines", Tata McGraw Hill.
[T5] Bhag S Guru, Husein R. Hiziroglu, "Electrical Machines", Oxford University Press.
[T6] K Krishna Reddy, "Electrical Machines- I and II", SCITECH Publications (India)Pvt. Ltd. Chennai.

References:

[R1] A.E. Clayton and N. N. Hancock, "Performance and Design of Direct CurrentMachines", CBS Publishers, Third Edition.
[R2] A.E. Fitzgerald, Charles Kingsley, Stephen D. Umans, "Electrical Machines", Tata McGraw Hill Publication Ltd., Fifth Edition.
[R3] A.S. Langsdorf, "Theory and performance of DC machines", Tata McGraw Hill.
[R4] M.G. Say, "Performance and Design of AC. Machines", CBS Publishers andDistributors.
[R5] Charles I Hubert, "Electrical Machines Theory, Application, & Control", Pearson Education, New Delhi, Second Edition.
[R6] Smarajit Ghosh, "Electrical Machines", Pearson Education, New Delhi.
[R7] P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.

EE214: POWER SYSTEM-I

Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs./Week	**Continuous Assessment:**	**20 Marks**
Tutorial: --- Hr/Week	**In-Sem Exam:**	**30 Marks**
	End-Sem Exam:	**50 Marks**
Credits: 3	**Total:**	**100 Marks**

Prerequisite Course: Students should have knowledge of Basics Electrical Engineering.

Course Objectives

1. To make students understand basic structure and requirements of any electric power system.
2. To understand various electrical terms related with power system and understand various types of tariffs.
3. To understand specifications and applications of major electrical equipment present in power plant.
4. It is aimed to impart knowledge about nature of power systems engineering and the profession impact.
5. To develop a skill to establish background for further studies in power systems.

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Understand basic structure and requirements of any electric power system & various electrical terms related with power system and understand various types of tariffs.	2	Understanding
CO2	Understand major electrical equipment's in power stations	2	Understanding
CO3	Explain various parameters of mechanical design of overhead lines power system.	2	Understanding
CO4	Analyze working of various equipment & transmission line parameters used in power system.	3	Applying
CO5	Evaluate transmission line performance and economic operation of power system	4	Analysing
CO6	Classify types of feeders, cables, voltage and P.F. control methods	2	Understanding

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	1	1	1	1	1	1	1	1	3	3
CO2	3	2	1	1	1	1	1	1	1	1	1	1	3	3
CO3	3	2	1	1	1	1	1	1	1	1	1	1	2	2
CO4	2	3	3	2	2	1	1	1	1	1	1	1	2	2
CO5	2	3	3	2	2	1	1	1	1	1	1	1	2	2
CO6	2	2	1	1	2	2	2	1	1	1	1	1	2	2

Course Contents			
UNIT-I	**BASIC STRUCTURE OF POWER SYSTEM**	**No.of Hours**	**COs**
	Structure of Electrical Power System, Interconnected grid system, Different factors associated with generating stations such as Connected load, Maximum Demand, Demand Factor, average load, load factor, diversity factor, plant capacity factor, reserve capacity, plant usefactor, Load curve, load duration curve, concept of base load and peakload stations, Introduction of Tariff, Tariff setting principles, desirable characteristics of Tariff, various consumer categories and implemented tariff such as two part, three part.	08	CO1
UNIT-II	**MAJOR ELECTRICAL EQUIPMENT'S IN POWER STATIONS**	**No.of Hours**	**CO**
	Features & use of alternators, necessity of exciters, various excitation systems such as dc excitation, ac excitation and static excitation systems, transformers, voltage regulators, bus-bars, current limiting reactors, circuit breakers, protective relays, current transformers, Potential transformers, Lightning arresters, Earthing switches, isolators, carrier current equipment (P.L.C.C.), Control panels, battery rooms, metering and other control room equipment in generating stations	08	CO2
UNIT-III	**COMPONENTS OF OVERHEAD AND UNDERGROUND TRANSMISSION LINES**	**No.of Hours**	**CO**
	Main components of overhead lines, Line supports, conductor spacing, length of span, calculation of sag for equal and unequal supports and effect of ice and wind loadings. Underground Cables: Classification, Construction of cable, XLPE cables, insulation resistance, dielectric stress in single core cable, capacitance of single core and three core cable. Grading of cables, inter sheath grading, capacitance grading.	08	CO3
UNIT-IV	**TRANSMISSION LINE PARAMETERS**	**No.of Hours**	**CO**
	Resistance of transmission line, skin effect and its effects, Ferranti effect, proximity effect, internal & external flux linkages of single conductor, calculation of inductance and capacitance of single phase two wire line, calculation of inductance and capacitance of three phase line with symmetrical and unsymmetrical spacing, concept of G.M.R. and G.M.D, necessity of transposition, calculation of inductance and capacitance of three phase double circuit line with symmetrical and unsymmetrical spacing, inductance of bundled conductors.	08	CO4
UNIT-V	**PERFORMANCE OF TRANSMISSION LINES**	**No.of Hours**	**CO**
	Classification of lines based on length and voltage levels such as short, medium and long lines. Performance of short transmission line	08	CO5

	with voltage current relationship and phasor diagram, Representation of medium lines as 'Nominal Pi' and 'Nominal Tee' circuits using R, L and C parameters. Ferranti effect, Representation of 'Tee' and 'Pi' models of lines as two port networks, evaluation and estimation of generalized circuit constants (ABCD) for short and medium lines, Estimation of Efficiency & regulation of short & medium lines.		
UNIT-VI	**VOLTAGE AND POWER FACTOR CONTROL**	**No.of Hours**	**CO**
	Methods of voltage control, AVRs, tap changing transformers, causes of low power factor, effects of low power factor, Shunt capacitors, calculation of reactive power injection and power factor correction. Ferranti effect, Surge impedance loading, power flow through transmission lines.	08	CO6

Text Books:

[T1] J. B. Gupta, "Transmission and Distribution", S. K. Kataria& Sons, New Delhi.
[T2] V. K. Mehta, Rohit Mehta, "Principles of Power System", S. Chand Publication
[T3] J. B. Gupta, "Generation and Economic Considerations", S. K. Kataria& Sons, New Delhi.
[T4] Dr. B. R. Gupta, "Generation of Electrical Energy",S. Chand Publication
[T5] A Chakraborty, M. L. Soni, P. V. Gupta, U.S. Bhatnagar, "A text book on Power System Engineering", Dhanpatrai& Co. Delhi.

References:

[R1] Nagrath & Kothari, "Power System Engineering", Tata McGraw Hill Publications.
[R2] D. Das, "Electrical Power System", New Age Publication.
[R3] W.D. Stevenson, "Power System Analysis", Tata McGraw Hill Publications.
[R4] Allen J Wood Bruce F. Wollenberg Gerald "Power generation operation and control" IEEE Wiley
[R5] Alexandra Von Meier "Electric Power Systems: A Conceptual Introduction Willy Survival Guides in Engineering & Science

EE215: NUMERICAL METHODS AND COMPUTER PROGRAMMING LABORATORY

Teaching Scheme	**Examination Scheme**	
Lectures: -- Hrs./Week	**Oral:**	**-- Marks**
Tutorial: -- Hr/Week	**Practical:**	**50 Marks**
Practical: 02 Hr/Week	**Term Work:**	**25 Marks**
Credits: 1	**Total:**	**75 Marks**

Prerequisite Course: Engineering Mathematics

Course Objectives

1. Study of various methods of numerical analysis of linear and non-linear problems
2. Use of method for solving the problems in engineering
3. Developing algorithm, flow-chart and computer program in any language
4. Use of modern computing tool

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Develop algorithms and implement programs for various numerical methods using modern computing tool	3	Applying
CO2	Demonstrate types of errors in computation and their causes of occurrence	2	Understanding
CO3	Identify various types of equations and apply appropriate numerical method to solve different nonlinear equations	3	Applying
CO4	Apply different numerical methods for interpolation, differentiation and numerical integration	3	Applying
CO5	Apply and compare various numerical methods to solve first and second order ODE, PDE and least square approximations	3	Applying
CO6	Apply and compare various numerical methods to solve linear simultaneous equations	3	Applying

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	3	1	1	1	1	-	1	2	2	-
CO2	3	3	1	2	1	1	1	1	1	-	1	1	1	-
CO3	2	2	1	2	1	1	1	1	1	-	1	1	1	-
CO4	2	2	1	2	2	1	1	1	1	-	1	1	1	-
CO5	2	2	1	2	2	1	1	1	1	-	1	1	1	-
CO6	2	2	1	2	1	1	1	1	1	-	1	1	1	-

Course Contents			
Ex. No	**Name of Experiment**	**No.of Hours**	**COs**
1	Introduction to Computing Software (Scilab/MATLAB)	2	1
2	Solution of Non-linear equations using Bi-section methods	**2**	**1,3**
3	Solution of Non-linear equations using False position methods	2	1,3
4	Solution of Non-linear equations using Newton-Raphson method	**2**	**1,3**
5	Solution of Non-linear equations using Iteration Method	2	1,3
6	Study of Newton Forward Interpolation method	**2**	**1,4**
7	Solution of simultaneous algebraic equations using Gauss Elimination method	2	1,6
8	Solution of simultaneous algebraic equations using Gauss Seidel method	**2**	**4,2**
9	Numerical Integration using Trapezoidal rule	2	1,4,5
10	Numerical Integration using Simpson's 1/3 Rule	**2**	1,4,5
11	Solution of first order ODE using 4th order RK method or Modified Euler method	2	1,4,5
12	First order curve fitting using Least square approximation	2	1,5

LAB INSTRUCTIONS:

The students have to write an algorithm, flow-chart for the problem statement given. The students should develop program and execute it on the computer system and get its printout with output.

Text Books:

[T1] V. Rajaraman," Computer Oriented Numerical Method", Prentice Hall of India.
[T2] S. S. Sastry," Introductory methods of numerical analysis", Prentice Hall of India
[T3] C. Woodford, C. Phillips," Numerical Methods with Worked Examples: MATLAB Edition", Springer, Second Edition
[T4] A. Quarteroni, F. Saleri, and P. Gervasio, Scientific computing with MATLAB and Octave, Third edition, (Springer, 2010).

References:

[R1] Thomas Richard Mecalla," Introduction to numerical Methods and FORTRAN programming", Willey International Edition.
[R2] Steven C. Chapra and Raymond P. Canale, "Numerical methods for Engineers", Mc-Graw Hill Publication,2007.
[R3] W.Y. Yang, W. Cao, T.-S. Chung and J. Morris, Applied Numerical methods using MATLAB, (John Wiley, 2005).
[R4] B.S. Grewal," Numerical Methods in Engineering & Science", Khanna Publishers.

EE216: NETWORK ANALYSIS LABORATORY

Teaching Scheme	**Examination Scheme**	
Lectures: -- Hrs./Week	**Oral:**	**-- Marks**
Tutorial: -- Hr/Week	**Practical:**	**-- Marks**
Practical: 02 Hr/Week	**Term Work:**	**25 Marks**
Credits: 1	**Total:**	**25 Marks**

Prerequisite Course:

Course Objectives

1. To develop the strong foundation for Electrical Networks.
2. To develop analytical qualities in Electrical circuits by application of various theorems
3. To understand the behaviour of circuits by analysing the transient response using classical methods and Laplace Transform approach.
4. To understand basic concept of Graph theory.
5. To apply knowledge of Network theory for analysis of 2-port networks.
6. To apply knowledge of Network theory for designing Low-pass and high pass filter.

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Demonstrate strong basics for network theory	3	Applying
CO2	Use the knowledge of problem solving technique for networks by application of theorems for DC and AC circuits.	3	Applying
CO3	Analyse the behaviour of the network by transient response	4	Analysing
CO4	Demonstrate of Standard test inputs and transformed network.	3	Applying
CO5	Understand the behaviour of the network by analysing two port analysis	2	Understanding
CO6	Apply network for designing and synthesis of Filters	4	Analysing

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	2	-	-	-	2	2	-	-	2	2
CO2	3	3	-	-	2	-	-	-	2	2	-	-	2	2
CO3	3	3	-	-	2	-	-	-	2	2	-	-	2	2
CO4	3	3	-	-	2	-	-	-	2	2	-	-	2	2
CO5	3	3	-	-	1	-	-	-	2	2	-	-	2	2
CO6	3	2	-	-	1	-	-	-	2	1	-	-	2	2

Course Contents			
Ex.No	**Name of the Experiment**	**No.of Hours**	**COs**
1	Study of mesh, nodal analysis	2	1
2	Study of Graph network Theory	2	1
3	Verification of Superposition theorem in D.C &A.C. circuits.	2	2
4	Verification of Thevenin's theorem in DC &A.C. circuits.	2	**2**
5	Verification of Reciprocity theorem in DC&A.C. circuits	2	2
6	Verification of Millmans' theorem.	2	**2**
7	Verification of Maximum Power Transfer theorem.	2	2
8	Study of time response of R-L,R-C circuit to a step D.C. voltage input.	2	**3**
9	Study of R-L,R-C circuit to a step D.C. voltage input using laplace domain	2	4
10	Study determination of parameter of Two Port Network.	2	5
11	Study the Frequency response of constant K- low pass filters	2	**6**
12	Study the Frequency response of constant K- high pass filters.	2	6

Text Books:

1. M. E. Van Valkenburg, "Network Analysis", Prentice Hall of India Private Limited, Third Edition.
2. D Roy Choudhary, "Network and Systems", New age international publishers.
Abhijit Chakrabarti, "Circuit Theory", DhanpatRai and Company, 7th edition

References:

1. William H. Hayt, Jr. Jack E. Kemmerly, "Engineering Circuit Analysis" McGraw Hill Publication.
2. N.C. Jagan, "Network Analysis", BS Publication, Hyderabad, Second Edition.

John O' Malley, "Schaum's outline of Theorems and Problems of Basic Circuit Analysis", McGraw Hill Publication..

EE217: ELECTRICAL MACHINES I LABORATORY

Teaching Scheme	**Examination Scheme**	
Lectures: -- Hrs./Week	**Oral:**	**-- Marks**
Tutorial: -- Hr/Week	**Practical:**	**50 Marks**
Practical: 02 Hr/Week	**Term Work:**	**25 Marks**
Credits: 1	**Total:**	**75 Marks**

Prerequisite Course: Basic Electrical Engineering

Course Objectives

1. Understanding the concepts of magnetic circuits.
2. Analysis of single phase and three phase transformers circuits.
3. Understanding the operation of dc machines.
4. Analysis of differences in operation of different dc& induction machine configurations.

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Understand basic laws & concepts of magnetic circuits	2	Understanding
CO2	Apply energy conversion principles to Single phase transformer, its equivalent circuit & operations	3	Applying
CO3	Understand basic connections of three phase transformer and parallel operation of transformer and comparison	2	Understanding
CO4	Identify and demonstrate the components of D.C. machine and its working as motor to test the various machine for performance calculation.	2	Understanding
CO5	Understand Characteristics and applications of D.C. Shunt and Series Motors and process of commutation.	2	Understanding
CO6	Understand Induction motors & its operation on the basis of Speed, Slip, Torque, Power and efficiency.	2	Understanding

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	--	--	--	--	1	--	--	1	2	3	2
CO2	3	2	2	1	1	--	--	1	--	--	2	2	3	2
CO3	3	2	1	1	1	--	--	1	--	--	1	2	3	2
CO4	3	2	1	1	1	--	--	1	--	--	1	2	3	2
CO5	3	2	1	1	1	--	--	1	--	--	1	2	3	2
CO6	3	2	1	2	2	--	--	1	--	--	2	2	3	2

Course Contents			
Ex. No	**Name of Experiment**	**No.of Hours**	**Cos**
1	O.C. and S.C. test on single phase Transformer.	2	6,3
2	Polarity test on single phase and three phase transformer	**2**	**6,3**
3	Parallel operation of two single phase transformers and study of their load sharing under various conditions of voltage ratios and leakage impedances.	2	6,3
4	Speed control of D.C. Shunt motor and study of starters.	**2**	**4**
5	Brake test on D.C. Shunt mot	2	3,4
6	Load characteristics of D.C. series motor	**2**	**2,3**
7	Load test on 3-phase induction motor.	2	3
8	No load & blocked-rotor test on 3-phase induction motor : a) Determination of parameters of equivalent circuit. b) Plotting of circle diagram.	**2**	**4,2**
9	Calculation of motor performance from (a) & (b) above.	2	3
10	Determination of sequence impedance of the transformer.	**2**	**3,4**

Text Books:

[T1] Edward Hughes "Electrical Technology", ELBS, Pearson Education.

[T2] Ashfaq Husain, "Electrical Machines", DhanpatRai& Sons.

[T3] S. K. Bhattacharya, "Electrical Machine", Tata McGraw Hill publishing Co. Ltd,2nd Edition.

[T4] Nagrath & Kothari, "Electrical Machines", Tata McGraw Hill.

[T5] Bhag S Guru, Husein R. Hiziroglu, "Electrical Machines", Oxford University Press.

[T6] K Krishna Reddy, "Electrical Machines- I and II", SCITECH Publications (India)Pvt. Ltd. Chennai.

References:

[R1] A.E. Clayton and N. N. Hancock, "Performance and Design of Direct Current Machines", CBS Publishers, Third Edition.

[R2] A.E. Fitzgerald, Charles Kingsley, Stephen D. Umans, "Electrical Machines", Tata McGraw Hill Publication Ltd., Fifth Edition.

[R3] A.S. Langsdorf, "Theory and performance of DC machines", Tata McGraw Hill.

[R4] M.G. Say, "Performance and Design of AC. Machines", CBS Publishers and Distributors.

[R5] Charles I Hubert, "Electrical Machines Theory, Application, & Control", Pearson Education, New Delhi, Second Edition.

[R6] Smarajit Ghosh, "Electrical Machines", Pearson Education, New Delhi.

[R7] P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.

EE218: POWER SYSTEM-I LABORATORY

Teaching Scheme	**Examination Scheme**	
Lectures: -- Hrs./Week	**Oral:**	**50 Marks**
Tutorial: -- Hr/Week	**Practical:**	**-- Marks**
Practical: 02 Hr/Week	**Term Work:**	**-- Marks**
Credits: 1	**Total:**	**50 Marks**

Prerequisite Course: Students should have knowledge of Basics of Electrical Engineering.

Course Objectives

1. To make students understand basic structure and requirements of any electric power system.
2. To understand various electrical terms related with power system and understand various types of tariffs.
3. To understand specifications and applications of major electrical equipment present in power plant.
4. It is aimed to impart knowledge about nature of power systems engineering and the profession impact.
5. To develop a skill to establish background for further studies in power systems.

Course Outcomes (COs):

After successful completion of the course, student will be able to

	Course Outcome (s)	**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Understand basic structure and requirements of any electric power system & various electrical terms related with power system and understand various types of tariffs.	2	Understanding
CO2	Understand major electrical equipment's in power stations	2	Understanding
CO3	Explain various parameters of mechanical design of overhead lines power system.	2	Understanding
CO4	Analyze working of various equipment & transmission line parameters used in power system.	3	Applying
CO5	Evaluate transmission line performance and economic operation of power system	4	Analysing
CO6	Classify types of feeders, cables, voltage and P.F. control methods	2	Understanding

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	1	1	1	1	1	1	1	1	3	3
CO2	3	2	1	1	1	1	1	1	1	1	1	1	3	3
CO3	3	2	1	1	1	1	1	1	1	1	1	1	2	2
CO4	2	3	3	2	2	1	1	1	1	1	1	1	2	2
CO5	2	3	3	2	2	1	1	1	1	1	1	1	2	2
CO6	2	2	1	1	2	2	2	1	1	1	1	1	2	2

Course Contents			
Ex. No	**Name of Experiment**	**No.of Hours**	**COs**
1	Visit to Local Substation	2	2
2	Study of different types of cables	2	3
3	Study of different components of transmission lines.	2	3
4	Study the Ferranti Effect of a Transmission line.	2	4
5	Study the Skin Effect of a Transmission line.	2	4
6	Calculate inductance and capacitance of single phase two wire line.	2	4
7	Calculate inductance and capacitance of 3 phase line.		
8	Determine A, B, C, D parameters of short transmission line.	2	5
9	Determine A, B, C, D parameters of medium transmission line.	2	5
10	Calculate Efficiency, Regulation & ABCD parameters of Short Transmission line.	2	5
11	Calculate Efficiency, Regulation & ABCD parameters of Short Transmission line.	2	5
12	Study the various methods to control voltage and power factor of transmission line.	2	6
13	Study the Per unit representation of a power system.	2	1
LAB INSTRUCTION:			
	At least eight experiments should be performed.		

Text Books:

[T1] J. B. Gupta, "Transmission and Distribution", S. K. Kataria & Sons, New Delhi.
[T2] V. K. Mehta, Rohit Mehta, "Principles of Power System", S. Chand Publication
[T3] J. B. Gupta, "Generation and Economic Considerations", S. K. Kataria & Sons, New Delhi.
[T4] Dr. B. R. Gupta, "Generation of Electrical Energy's. Chand Publication
[T5] A Chakraborty, M. L. Soni, P. V. Gupta, U.S. Bhatnagar, "A text book on Power System Engineering", Dhanpatrai & Co. Delhi.

References:

[R1] Nagrath & Kothari, "Power System Engineering", Tata McGraw Hill Publications.
[R2] D. Das, "Electrical Power System", New Age Publication.
[R3] W.D. Stevenson, "Power System Analysis", Tata McGraw Hill Publications.
[R4] Allen J Wood Bruce F. Wollenberg Gerald "Power generation operation and control" IEEE Wiley
[R5] Alexandra Von Meier "Electric Power Systems: A Conceptual Introduction" Willy Survival Guides in Engineering & Science

EE219: SEMINAR

Teaching Scheme	**Examination Scheme**	
Lectures: -- Hrs./Week	**Oral:**	**50 Marks**
Tutorial: -- Hr/Week	**Practical:**	**-- Marks**
Practical: 02 Hr/Week	**Term Work:**	**-- Marks**
Credits: 1	**Total:**	**50 Marks**

Prerequisite Course:

Course Objectives:

1. Gaining of actual knowledge (terminology, classification, methods and advanced trends)
2. Learning fundamental principles, generalization or theories
3. Discussion and critical thinking about topics of current intellectual importance
4. Developing specific skills, competencies, and points of view needed by professionals in the field most closely related to the course.

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Identify advanced technical areas in the fields of science and technology	2	Understanding
CO2	Relate with the current technologies and innovations in Electrical engineering	3	Applying
CO3	Apply theoretical knowledge to actual industrial and research activity	3	Applying
CO4	Discuss and critically analyse about topics of current intellectual importance	4	Analysing
CO5	Document technical report	3	Applying
CO6	Present technical documentation and presentation	5	Evaluating

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	--	--	2	--	--	2	2	--	2	1	1	1
CO2	2	2	--	--	2	--	--	2	2	--	2	1	1	1
CO3	2	2	--	--	2	--	--	2	2	--	2	1	1	1
CO4	2	2	--	--	2	--	--	2	2	--	2	1	1	1
CO5	2	2	--	--	2	--	--	2	2	--	2	1	1	1
CO6	2	2	--	--	2	--	--	2	2	--	2	1	1	1

Course Contents

A. Guidelines for Students:

1. Seminar group shall consist of not more than 3 students per group
2. Individual student have to present seminar topic.
3. Seminar topic should be innovative, emerging and current issues addressed.
4. Student should collect all information related with topic with authentic and validate proofs.
5. Students should work according to the directions given by guides.

B. Domains for Seminar may be from the following, but not limited to:

- Power Systems
- Power/Smart Grid
- Electric automobile
- Computer/Communication Networking
- IOT
- AI in Electrical Engineering
- Microcontroller based/Embedded systems
- Power electronics and drives
- High Voltage Engineering
- Agriculture Engineering
- Battery Technology's
- Robotics/Mechatronics/Process Automation
- Energy efficiency technique
- Green / Clean energy

C. Monitoring: Suggested Plan for various activities to be monitored by the teacher.

Week 1 & 2: Finalization of seminar topic with broad literature survey
Week 3 & 4: Preparation of brief Introduction and abstract
Week 5 to 6: Finalization of topics and subtopics for chapters
Week 6 to 7: Intermediate review of the seminar topic
Week 8 & 9: Preparation of conclusions and summary
Week 10 & 11: Preparation of report and presentation
Week 12 & 13: Present seminar

Note: - Log book for all these activities shall be maintained. It is mandatory to submit the seminar report.

D. Report writing: A report with following contents shall be prepared:

Contents

1. Cover Page & Title Page
2. Certificate
3. Abstract
4. Acknowledgments
5. List of figures
6. List of tables
7. Abbreviations

8. Contents
9. Chapters
10. Appendix
11. References

Journals to Refer like but not limited to :

- IEEE transactions
- IEEE magazines/ newsletters/ proceedings
- IET Proceedings/ journals/ magazines
- Elsevier journals and magazines
- Electrical power components and systems journal – (ISSN 1532-5016, 1532-5008), published by Taylor and Francis group, USA.
- Cogeneration and distributed generation journal – (ISSN 1066-8683, 1545-7575), published by Fairmont press Inc. USA.
- Digital technical journal – (ISSN 0898-901X), published by Digital equipment corporation, USA.
- Journal of Institution of Engineers India – Electrical Engineering
- The Journal of the Institute of Electrical Engineers of Japan
- The Transactions of the Institute of Electrical Engineers of Japan
- Japanese journal of Applied physics
- Circuits, Systems & Signal Processing –Springer ISSN 0278-081X
- Energy Efficiency – Springer ISSN 1570-646X
- Electrical Engineering · Archiv für Elektrotechnik – Springer ISSN 0948-7921
- Engineering with Computers · An International Journal for Simulation-Based
- Engineering – Springer ISSN 0177-0667
- Journal of Control Theory and Applications –Springer ISSN 1672-6340
- Journal of Dynamical and Control Systems - Springer ISSN 1079-2724
- Journal of Real-Time Image Processing - Springer ISSN 1861-8200
- Mathematics of Control, Signals, and Systems – Springer ISSN 0932-4194

EE220: MINI PROJECT / CHOICE BASED SUBJECT

Teaching Scheme	Examination Scheme	
Practical: 04 Hr/Week	**Term Work:**	**50 Marks**
Credits: 02 Credits	**Total:**	**50 Marks**

Course Contents

Mini Project:

Mini Project may be from the following, but not limited to:

- Power Systems
- Power/Smart Grid
- Electric automobile
- Computer/Communication Networking
- IOT
- AI in Electrical Engineering
- Microcontroller based/Embedded systems
- Power electronics and drives
- High Voltage Engineering
- Agriculture Engineering
- Battery Technology's
- Robotics/Mechatronics/Process Automation
- Energy efficiency technique
- Green / Clean energy

Choice Based Subject:

Students have to do skilled technical certified online courses od their choice of at least 16-20 hours. After completion of online courses, students have to produce Certificate. Students shall be awarded credits only when they will complete the courses and submit the 20 pages report on the same. 50 marks will be evaluated based on report, online certification and assignments.

The following platforms / software's are recommended:

Sr no.	Platform
1.	NPTEL
2.	edX
3.	Coursera
4.	Udemy
5.	Sill Battle
6.	IBM
7.	Persistent
8.	Infosys Headstart
9.	MATLAB Software
10.	ETAP Software
11.	NEPLAN Simulation Software
12.	LabVIEW Software
13.	AUTOSAR methodologies
14.	Protheus Software
15.	PSIM Software

MC221: INNOVATION - PROJECT BASED – SCIENCE AND TECHNOLOGY, SOCIAL, DESIGN & INNOVATION

Teaching Scheme	**Examination Scheme**	
Lectures: 02 Hrs./Week	**Oral:**	**NA**
Tutorial: -- Hr/Week	**Practical:**	**NA**
Practical: -- Hr/Week	**Term Work:**	**NA**
Credits: No Credits	**Total:**	**NA**

Prerequisite Course:

Course Objectives

1. To develop strategic thinking to solve social problems
2. Understand the role of innovation and technical change in enterprise and national level economic performance
3. Understand the technological, human, economic, organizational, social and other dimensionsof innovation
4. Understand the effective management of technological innovation requires the integration ofpeople, processes and technology
5. Recognize opportunities for the commercialization of innovation

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Understand the role of innovation and technical change in enterprise and national level economic performance	2	Understanding
CO2	Develop strategic thinking to solve social problems	3	Applying
CO3	Recognize opportunities for the commercialization of innovation	6	Create

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	--	--	--	--	--	--	--	---	--	--	--	--
CO2	--	--	3	2	--	--	--	---	--	---	--	--	--	--
CO3	--	--	--	--	2	2	3	3	3	2	2	2	--	--
CO4	2	2	--	--	--	--	--	--	--	---	--	--	--	--
CO5	--	--	3	2	--	--	--	---	--	---	--	--	--	--

Course Contents

Many students, when they enter engineering, are full of enthusiasm to understand new areas, to build systems and to experiment and play with them. This enthusiasm is to be tapped and to direct it to exploration and sustained pursuit by the student, which may result in development of a working system, a prototype, or a device or material, etc. They are expected to come up with novel and useful ideas on social problems. Students may be encouraged to take up projects which are aimed at providing solutions to societal problems, reduce drudgery and improving efficiency in rural work, green technologies, utilization of rural and urban waste, sanitation and public health, utilizing nonconventional energy sources, technologies for the benefit of the differently abled people and technologies ready to be implemented in the Institute.

Two types of activities may be undertaken under this

(a) Exposure to social problems (which are amenable to technological solutions)

(b) Design & Innovation (to address above problems)

After this student, be encouraged to undertake technology projects of social relevance

SANJIVANI RURAL EDUCATION SOCIETY'S

SANJIVANI COLLEGE OF ENGINEERING KOPARGAON

(An Autonomous Institute Affiliated to Savitribai Phule Pune University, Pune)

DEPARTMENT OF ELECTRICAL ENGINEERING

COURSE STRUCTURE - 2019 PATTERN

THIRD YEAR B. TECH

Academic Year 2021-22

SANJIVANI RURAL EDUCATION SOCIETY'S

SANJIVANI COLLEGE OF ENGINEERING KOPARGAON

(An Autonomous Institute Affiliated to Savitribai Phule Pune University, Pune)

DEPARTMENT OF ELECTRICAL ENGINEERING

Profile: The Electrical Engineering degree program offer the graduates to enter a dynamic and rapidly changing field with career opportunities in Electric Power System, Power Electronics, Robotics and Control, Microprocessors and Controllers, Integrated Circuits, Computer Software. The demand for electrical power and electronic systems is increasing rapidly and electrical engineers are in great demand to meet the requirements of the growing industry. Electrical Engineers are mainly employed in industries using Electrical Power, Manufacturing Electrical Equipment, Accessories, Electronic Systems, Research and Development departments which work on energy saving devices and Software Development.

Many of these disciplines overlap with other engineering branches, spanning a huge number of specializations including hardware engineering, electromagnetic and waves, microwave engineering, nanotechnology, electrochemistry, renewable energies, Artificial Intelligence, mechatronics, and electrical materials science. Identifying these areas today's Electrical Engineer needs to have the capacity of adaptability and creativity in these new technical eras, to meet the industry 4.0.

Electrical Engineering Department of Sanjivani College of Engineering offers the B. Tech. course in Electrical Engineering with an intake of 60 students. The department has well qualified and dedicated faculty and is known for its high academic standards, well-maintained discipline and complete infrastructure facilities.

Vision of Department

To produce quality electrical engineers with the knowledge of latest trends, research technologies to meet the developing needs of industry & society

Mission of Department

M1: To impart quality education through teaching learning process

M2: To establish well-equipped laboratories to develop R&D culture in contemporary and sustainable technologies in Electrical Engineering

M3: To produce Electrical Engineering graduates with quest for excellence, enthusiasm for continuous learning, ethical behavior, integrity and nurture leadership

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, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, society, 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 modelling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society:** Apply reasoning in formed by the contextual knowledge to assess social, 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 the set on 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)

The PEOs of undergraduate programme in Electrical Engineering are broadly classified as follows:

PEO 1: Equip the student to analyze and solve real world problems to face the challenges of future.

PEO 2: Pursue higher education, research in Electrical Engineering or other allied fields of their interest for professional development.

PEO 3: Exhibit the leadership skills and ethical value for society

Program Specific Objectives (PSOs)

PSO 1: Apply the fundamentals of mathematics, science and engineering knowledge to identify, formulate, design and investigate complex engineering problems of electric circuits, analog and digital electronics circuits, control systems, electrical machines and Power system.

PSO 2: Apply the appropriate modern engineering hardware, and software tools in electrical engineering to engage in life-long learning and to successfully adapt in multi-disciplinary environments.

COURSE STRUCTURE- 2019 PATTERN
THIRD YEAR B. TECH. ELECTRICAL ENGINEERING

SEMESTER- V

Course			Teaching Scheme Hours/week				Evaluation Scheme-Marks						
							Theory						
Cat.	Code	Title	L	T	P	Credits	ISE	ESE	CA	OR	PR	TW	Total
PRJ	EE301	Professional Internship-II	-	-	-	2	-	-	-	50	-	-	50
PCC	EE302	Microcontrollers And Applications	3	-	-	3	30	50	20	-	-	-	100
PCC	EE303	Electrical Machines II	3	-	-	3	30	50	20	-	-	-	100
PCC	EE304	Power System II	3	-	-	3	30	50	20	-	-	-	100
PCC	EE305	Power Electronics	3	-	-	3	30	50	20	-	-	-	100
PEC	EE306	Professional Elective-1	3	-	-	3	30	50	20	-	-	-	100
LC	EE307	Microcontrollers And Applications Laboratory	-	-	2	1	-	-	-	-	25	-	25
LC	EE308	Electrical Machines II Laboratory	-	-	2	1	-	-	-	-	25	-	25
LC	EE309	Power System II Laboratory	-	-	2	1	-	-	-	25	-	-	25
LC	EE310	Power Electronics Laboratory	-	-	2	1	-	-	-	-	25	-	25
PRJ	EE311	Skill Based Credit Course	1	-	-	1	-	-	-	-	-	50	50
MLC	MC312	Mandatory Learning Course-V	1	-	-	No	-	-	-	-	-	-	-
		Total	**17**	**-**	**8**	**22**	**150**	**250**	**100**	**75**	**75**	**50**	**700**

EE306	**Professional Elective-I**	A.	Signals and Systems
		B.	Power Generation Technologies
MC312	**Mandatory Learning Course-V**	A.	Electrical Energy Conservation and Auditing -

COURSE STRUCTURE- 2019 PATTERN
THIRD YEAR B. TECH. ELECTRICAL ENGINEERING

SEMESTER- VI

Course			Teaching Scheme Hours/week				Evaluation Scheme-Marks						
							Theory						
Cat.	Code	Title	L	T	P	Credits	ISE	ESE	CA	OR	PR	TW	Total
PCC	EE313	Feedback Control Systems	3	-	-	3	30	50	20	-	-	-	100
PCC	EE314	Power System Operation and Control	3	-	-	3	30	50	20	-	-	-	100
OE	EE315	Open Elective-I	4	-	-	4	30	50	20	-	-	-	100
PRJ	PR316	IPR & EDP	2	-	-	2	15	25	10	-	-	-	50
PRJ	PR317	IPR & EDP Lab	-	-	2	1	-	-	-	-	-	50	50
HSMC	HS318	Corporate Readiness	1	-	2	2	-	-	-	-	-	50	50
PEC	EE319	Professional Elective-II	2	-	-	2	30	50	20	-	-	-	100
LC	EE320	Feedback Control Systems Laboratory	-	-	2	1	-	-	-	-	50	-	50
LC	EE321	Power System Operation and Control Laboratory	-	-	2	1	-	-	-	50	-	-	50
LC	EE322	Professional Elective-II Laboratory	-	-	2	1	-	-	-	50	-	-	50
MLC	MC323	Mandatory Learning Course	1	-	-	No	-	-	-	-	-	-	-
		Total	**16**	**-**	**10**	**20**	**135**	**225**	**90**	**100**	**50**	**100**	**700**

EE315	**Open Elective-I**	A. Renewable Energy Sources
EE319	**Professional Elective-II**	A. Electrical Machine Design
		B. Electrical Drives
		C. Smart Grid
EE322	**Professional Elective-II Laboratory**	A. Electrical Machine Design Laboratory
		B. Electrical Drives Laboratory
		C. Smart Grid Laboratory
MC323	**Mandatory Course-V**	A. Installation & Maintenance of Electrical appliances

Total Credits: 42
Total Marks: 1400

SEMESTER V

EE301: PROFESSIONAL INTERNSHIP II	
Teaching Scheme	**Examination Scheme**
Lectures: - Hrs./Week	**Oral Exam: 50 Marks**
Tutorials: - Hrs./ week	**Total : 50 Marks**
Credits: 2	

GUIDELINES FOR INTERNSHIP

An Internship is a professional learning experience that offers meaningful, practical work related to a student's field of study or career interest. An internship gives a student the opportunity for career exploration and development and learns new skills. Hence Sanjivani College of Engineering offers a month-long exposure (4-6 Weeks) to the students in the form of internship in organizations/in house training/ online courses in the reputed institutes. Students are involved in this internship at the end of their even semester. After completion of internship/online courses students has to produce Certificate. Students shall be awarded internship credits only when they will pass the oral (Viva) examination of 50 marks, based on experience or online certification.

Following are the intended objectives of internship training:

- Will expose technical students to the industrial environment, which cannot be simulated in the classroom and hence creating competent professionals for the industry.
- Provide possible opportunities to learn, understand and sharpen the real time technical/managerial skills required at the job.
- Exposure to the current technological developments relevant to the subject area of training.
- Experience gained from the 'Industrial Internship' will be used in classroom discussions.
- Create conditions conducive to quest for knowledge and its applicability on the job.
- Learn to apply the technical knowledge in real industrial situations.
- Gain experience in writing technical reports/projects.
- Expose students to the engineer's responsibilities and ethics.
- Familiarize with various materials, processes, products and their applications along with relevant aspects of quality control.
- Promote academic, professional and/or personal development.
- Expose the students to future employers.
- Understand the social, economic and administrative considerations that influence the working environment of industrial organizations
- Understand the psychology of the workers and their habits, attitudes and approach to problem solving.

Recommended Internship (Online/Offline) organizations and platforms as follows but not limited to

1. Government Organizations such as MSEDCL, MAHATRANSCO, MAHAGENCO, LDC Center's etc.
2. Government and Private Industries such as BHEL, BEL, Indian Railways, MMRDA, BOSCH, L&T, Crompton Greaves, Kirloskar Industries, RCSS Enerzies Pvt Ltd. etc…
3. Government and Private Institutions such as IITs, NITs, IIITs, IISc, IISER, NCL, NAL, BITs Pilani, etc
4. International Universities such as UrFU, Russia etc.
5. Online Platforms such as Coursera, EDx, NPTEL, Internshala, etc.
6. In-house Training and Projects.

EE302: MICROCONTROLLERS AND APPLICATIONS

Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs./Week	**Continuous Assessment:**	**20 Marks**
Tutorial: --- Hr./Week	**In-Sem Exam:**	**30 Marks**
	End-Sem Exam:	**50 Marks**
Credits: 3	**Total:**	**100 Marks**

Prerequisite Course: Analog and Digital Electronics

Course Objectives

1. To understand the differences between microcontrollers and microprocessors learn microcontroller architecture & describe the features of a typical microcontroller.
2. To use the 8051 addressing modes and instruction set and apply this knowledge to perform programs - arithmetic & logic operations, data & control transfer operations, input & output operations.
3. To define the protocol for serial communication and understand the microcontroller development systems.
4. To build and test a microcontroller-based system; interface the system to switch, keypad, and display.
5. To understand Arduino Board and its applications
6. To understand Embedded systems terminologies in terms of electrical Engineering

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Describe basics of 8051 and its instruction set	2	Understanding
CO2	Solve assembly language programs based on the instruction set of 8051.	3	Applying
CO3	Illustrate 8051 based hardware system and so to study LED, keyboard and different motors interfacing	4	Analysing
CO4	Understand Arduino Board and Interfacing	2	Understanding
CO5	Evaluate programs and interface different component with Arduino board	5	Evaluating
CO6	Formulate Real life applications using Advance controllers	6	Creating

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	2	2	1	2	1	-	1	1	1	1	1	1	1
CO2	3	2	2	2	2	1	-	1	1	1	1	1	1	2
CO3	3	2	2	3	2	3	2	1	2	2	2	2	1	2
CO4	3	2	2	1	2	1	1	1	1	1	1	1	1	1
CO5	3	2	2	2	2	2	2	2	2	2	2	1	1	2
CO6	3	2	2	3	2	3	2	2	2	3	3	2	1	2

Course Contents			
UNIT-I	**Introduction to Microcontroller**	**No.of Hours**	**COs**
	Introduction to concept of microcontroller, comparison of Microprocessor and microcontroller, Comparison of all 8-bit microcontrollers,Criteria for selecting a microcontroller, Intel 8051 microcontroller architecture, Pin diagram, Memory organization of 8051, special function registers, Internal structure of I/O ports, operation of I/O ports.	7	CO1, CO2
UNIT-II	**Programming of 8051 - I**	**No.of Hours**	**CO**
	Addressing modes of 8051, Instruction set of 8051, Stack and Stack Related instruction, Data exchange, byte level logical operations, bit level logical operations, rotate and swap operations, instruction affecting flags, incrementing, decrementing, arithmetic operations, jump and recall instruction, Call and return subroutines.	6	CO2
UNIT-III	**Programming of 8051- II and Interfacing**	**No.of Hours**	**CO**
	Addressing modes of 8051, Instruction set of 8051, Stack and Stack Related instruction, Data exchange, byte level logical operations, bit level logical operations, rotate and swap operations, instruction affecting flags, incrementing, decrementing, arithmetic operations, jump and recall instruction, Call and return subroutines. Interfacing of 8051 with 8-bit ADC (0809) and DAC (0808).	6	CO3
UNIT-IV	**Introduction to Arduino Board**	**No.of Hours**	**CO**
	Role of embedded systems, open-source embedded platforms, Atmega 328P- features, architecture, sensors and actuators, data acquisition systems, introduction to Arduino IDE- features, IDE overview, programming concepts: variables, functions, conditional statements	6	CO4
UNIT-V	**Interfacing of Arduino**	**No.of Hours**	**CO**
	Concept of GPIO in Atmega 328P based Arduino board, digital input and output, UART concept, timers, interfacing with LED, LCD and keypad, serial communication using Arduino IDE, Concept of ADC in Atmega 328P based Arduino board, interfacing with temperature sensor (LM35), LVDT, strain gauge, accelerometer, concept of PWM, DC motor interface using PWM	8	CO5
UNIT-VI	**Advance Microcontrollers**	**No.of Hours**	**CO**
	Introduction, survey of different microcontrollers, Specifications, features, applications of different microcontrollers NodeMCU,Raspberry pi, ARM 7,9,11, Concept of SOC.	8	CO6
Text Books:			

1. Muhammad Ali Mazidi, Janice G. Mazidi and Rolin D. McKinlay, "The Microcontroller and Embedded Systems", Second Edition, Pearson, 2012.
2. Ayala K. J., "8051 Microcontroller: Architecture, Programming and applications "Second Edition, Penram international.
3. Subrata Ghoshal, "8051 microcontroller", Pearsons Publishers.
4. Started with Arduino by Massimo Banzi and Michael Shiloh Published by Maker Media, Inc.
5. Arduino microcontroller processing for everyone-Steven F Barret, Morgan and Claypool Publisher.

References:

1. V Udayashankara and M S MallikarjunaSwamy, "8051 Microcontroller, Hardware, software and applications", TATA McGraw Hill.
2. Scott Mackenzie, "8051 Microcontroller", Pearson Education.
3. Ajay Deshmukh, "Microcontroller 8051" –TATA McGraw Hill.
4. Getting Started With Arduino: A Beginner's Guide by by Brad Kendall (Author), Justin Pot (Editor), Angela Alcorn (Editor)
5. Arduino Cookbook, 2nd Edition by Michael Margolis published by O'Reilly Media

EE303: ELECTRICAL MACHINES II

Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs./Week	**Continuous Assessment:**	**20 Marks**
Tutorial: --- Hr./Week	**In-Sem Exam:**	**30 Marks**
	End-Sem Exam:	**50 Marks**
Credits: 3	**Total:**	**100 Marks**

Prerequisite Course:

1. Basic Electrical Engineering
2. Electrical Machines I

Course Objectives

1. Learn construction & working principle of three phase synchronous machines.
2. Define regulation of alternator & calculate it by direct and indirect methods.
3. Study the methods of starting 3- phase synchronous motor, & its operation under Different conditions.
4. Learn Speed control methods of three phase induction motor.
5. Develop phasor diagram & circle diagram of a c series motor.
6. Develop equivalent circuit of single-phase induction motor.

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Illustrate the operation of induction motor as generalized transformer, its equivalent circuit to select machine for specific applications.	3	Applying
CO2	Analyse Speed control methods of three phase induction motor, and the operation of different special purpose motor.	4	Analysing
CO3	Analyse circle diagram of AC series motor & Examine applications of Universal motor.	4	Analysing
CO4	Understand the construction, operation of cylindrical & sailent pole Synchronous motor	2	Understanding
CO5	Estimate operation of synchronous motor at constant load and variable excitation (v curves & ∧ curves) & constant excitation and variable load.	5	Evaluating
CO6	Determine the voltage regulations of 3ph synchronous generator and analyse the parallel operation of 3ph alternator	4	Analysing

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	2	2	1	1	2	1	1	1	1	2	3	3	2
CO2	3	2	1	2	1	2	1	1	1	1	2	2	3	2
CO3	3	2	2	1	2	1	1	1	1	1	1	1	3	1
CO4	2	1	2	2	1	1	1	1	-	1	1	2	3	2
CO5	3	2	1	3	1	2	1	1	1	1	2	1	3	1
CO6	3	2	1	1	1	2	1	1	1	1	2	2	3	2

Course Contents			
UNIT-I	**Three Phase Induction Motor**	**Hrs.**	**CO**
	Induction motor as a generalized transformer; phasor diagram. Exact & approximate equivalent circuit. No load and blocked rotor tests to determine the equivalent circuit parameters and plotting the circle diagram. Computation of performance characteristics from the equivalent circuit and circle diagram. Performance curves. Necessity of starter for 3-phase induction motors. Starters for slip-ring and cage rotor induction motors; stator resistance starter, auto transformer starter, star delta starter and rotor resistance starter. D.O.L. starter and soft starting, with their relevant torque and current relations. Comparison of various starters, testing of three phase induction motor as per IS 12615.	8	CO1
UNIT-II	**Induction Machines and Special Purpose Motors**	**Hrs.**	**CO**
	a) Speed control of three phase induction motor by various methods (Stator side and rotor side controls). Action of 3-phase induction motor as induction generator, applications of induction generator. Introduction to Energy Efficient three phase Induction Motor and Super conducting Generator. b) Construction of single phase induction motor, double field revolving theory. Equivalent circuit and torque-slip characteristics on the basis of double revolving field theory. Methods of self-starting. Types of single phase induction motors. Comparison of 1-phase induction motor with 3-phase induction motor. c) Special Purpose Motors (Descriptive Treatment Only): Construction, principle of working, characteristics ratings and applications of Brushless D.C. motors, Stepper rotors (permanent magnet and variable reluctance type only), Permanent Magnet motor (A.C. & D.C.) and linear induction motors.	8	CO2
UNIT-III	**A.C. series motor**	**Hrs.**	**CO**
	a) Operation of D.C. series motor on a.c. supply, nature of torque developed, problems associated with AC. operation and remedies. b) **Compensated series motor:** Compensating winding, conductively and inductively compensated motor. Use of compoles for improving commutation. Ratings and applications of Compensated Series motors. c) **Universal motors:** ratings, performance and applications, comparison of their performance on A.C. and D.C. supply.	8	CO3
UNIT-IV	**Three phase Synchronous machines**	**Hrs.**	**CO**
	a) Three phase Synchronous machines: Construction, rotating-field type and rotating-armature type, salient-pole	8	CO4

	type and non-salient-pole type and their comparison. Excitation Methods. b) **Three phase Synchronous generator (cylindrical rotor type):** Principle of operation. Emf equation and winding factors, rating of generator. Generator on no-load and on balanced load. Armature reaction and its effect under different load power factors. Voltage drop due to armature resistance, leakage flux and synchronous reactance. Per phase equivalent circuit and Phasor diagram. Power - power angle relation. c) **Three phase Synchronous generator (salient pole type):** Armature reaction as per Blondel's two reaction theory for salient-pole machines, Direct-axis and quadrature-axis synchronous reactance's and their determination by slip test. Phasor diagram of Salient-pole generator and calculation of voltage regulation.		
UNIT-V	**Three phase synchronous motor**	**Hrs.**	**CO**
	Principle of operation. Methods of starting. Equivalent circuit, significance of torque angle, Losses, efficiency and Power flow chart. Operation of 3-phase Synchronous motor with constant excitation and variable load, Operation with constant load and variable excitation ('V' Curves and 'inverted V' curves). Phenomenon of hunting and its remedies. Applications of 3-phase synchronous motors. Introduction to synchronous – induction motor. Comparison of 3 phase synchronous motor with 3-phase induction motor.	8	CO5
UNIT-VI	**Voltage regulation of Three phase Synchronous generator**	**Hrs.**	**CO**
	a) Performance of open circuit and short circuit test on synchronous generator, determination of voltage regulation by emf, mmf, and Potier triangle methods. Determination of voltage regulation by direct loading. Short circuit ratio. b) **Parallel operation of 3-phase alternators:** Necessity, conditions, Load sharing between two alternators in parallel (Descriptive treatment only). Process of synchronizing alternator with infinite bus-bar by lamp method (one dark & two equally bright lamp method) and by the use of synchroscope, Synchronizing current, power and torque (no numerical).	8	CO6

Text Books:

[T1] Nagrath and Kothari, Electrical Machines, 2nd Ed., Tata McGraw Hill.
[T2] S. K. Bhattacharya, Electrical Machines, Tata McGraw Hill.
[T3] A.S. Langsdorf, Theory of Alternating Current Machinery, Tata McGraw Hill
[T4] P. S. Bimbhra, Electric Machinery, Khanna Publications.
[T5] B.R. Gupta and Vandana Singhal -Fundamentals of Electric Machines, New Age International (P) Ltd.
[T6] E. Openshaw Taylor, Performance and design of a.c. commutator motors, Wheeler Publishing.
[T7] V. K. Mehta and Rohit Mehta, Principles of Electrical Machines, S Chand Publications
[T8] Krishna Reddy –Electrical Machines vol.II and III, SCITECH publications.

[T9] Ashfaq Husain, Electrical Machines, Dhanpat Rai and Co.
[T10] M V Deshpande, Electrical Machines, Prentice Hall of India

References:

[R1] M.G. Say, Performance and Design of A.C. Machines (3rd Ed.), ELBS
[R2] J B Gupta - Theory and performance of Electrical Machines, S K Kataria Publications
[R3] Samarjit Ghosh, Electrical Machines, Pearson Publication.
[R4] Bhag S Guru and Huseyin R Hiziroglu, Electrical Machinary and Transformer, 3rd Edition, Oxford University Press.
[R5] E G Janardanan, Special Electrical Machines, Prentice Hall of India.
[R6] Suvarnsingh Kalsi Application of high Temperature super conductors to electric power equipments (Rotating Machines) Wiley publication.

EE304: POWER SYSTEM II

Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs./Week	**Continuous Assessment:**	**20 Marks**
Tutorial: --- Hr./Week	**In-Sem Exam:**	**30 Marks**
	End-Sem Exam:	**50 Marks**
Credits: 3	**Total:**	**100 Marks**

Prerequisite Course:

1. Power System I
2. Electrical Machine

Course Objectives

1. This course provides the knowledge of Power System and its stability.
2. It is aimed to impart knowledge of Real Time system
3. To understand use of per unit system and fault analysis
4. This course provides the knowledge of Power flow study

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Demonstrate various parameters in a circle diagram with line parameters.	3	Applying
CO2	Formulate per unit system to solve various problems.	6	Creating
CO3	Calculate currents and voltages in a faulted power system under both symmetrical and asymmetrical faults, and relate fault currents to circuit breaker ratings.	3	Applying
CO4	Evaluate different types of faults for balanced and unbalanced systems	5	Evaluating
CO5	Analyze various types of electricity market operation and control issues under congestion management.	4	Analysing
CO6	Planning for the distribution system and to understand the need of automation and control of distribution system.	2	Understanding

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	1	1	1	1	1	1	1	2	2
CO2	2	2	1	1	1	1	1	1	1	1	1	2	2	2
CO3	3	2	1	1	1	1	1	1	1	1	1	1	2	2
CO4	3	2	2	2	2	2	1	1	2	2	2	2	2	2
CO5	3	2	2	2	2	2	1	1	2	2	1	2	2	2
CO6	2	2	1	1	1	1	1	1	1	1	1	1	2	2

Course Contents			
UNIT 1	**Transmission Line Performance**	**Hrs.**	**CO**
	Evaluation of ABCD constants and equivalent circuit parameters of Long transmission line. Concept of complex power, power flow using generalized constants, surge impedance loading, Line efficiency, Regulation and compensation, basic concepts. Numerical based on: ABCD constants of Long transmission line, Power flow	06	CO1
UNIT 2	**Per Unit System and Load Flow Analysis**	**Hrs.**	**CO**
	Per unit system: Single line diagram, Impedance and reactance diagrams and their uses, per unitquantities, relationships, selection of base, change of base, reduction to common base, advantages andapplication of per unit system. Numerical based on network reduction by using per unit system. **Load Flow Analysis:** Network topology, driving point and transfer admittance, concept of Z-bus and formulation of Y-bus matrix using bus incidence matrix method, Numerical based on Y bus Matrix,power- flow equations generalization to n bus systems, classification of buses, Newton- Raphson method (polar method) Decoupled and Fast decoupled load flow (descriptive treatment only).	06	CO2
UNIT 3	**Symmetrical Fault Analysis**	**Hrs.**	**CO**
	3-phase short-circuit analysis of unloaded alternator, sub-transient, transient and steady state current and impedances, D.C. Offset, and effect of the instant of short-circuit on the waveforms, estimation of fault current without pre-fault current for simple power systems, selection of circuit-breakers and current limiting reactors and their location in power system (Descriptive treatment Only) Numerical Savitribai Phule Pune University TE Electrical (2019 course) 27 Based on symmetrical fault analysis.	08	CO3
UNIT 4	**Unsymmetrical Fault Analysis**	**Hrs.**	**CO**
	Symmetrical components, transformation matrices, sequence components, power in terms of symmetrical components, sequence impedance of transmission line and zero sequence networks of transformer, solution of unbalances by symmetrical components,L-L, L-G, and L-L-G fault analysis of unloaded alternator and simple power systems with and without fault impedance. Numerical based on symmetrical components and unsymmetrical fault calculation.	08	CO4
UNIT 5	**Power Generation Pool & its Economics**	**Hrs.**	**CO**
	Basics of Power System Economics & Short-term Operation Planning of Power System, Load curves and load duration curves, Power Pools & Electricity Markets	06	CO5

	Inter-area transactions, multi-area power interchanges, Energy brokerage systems, Market design and auction mechanism, Pool versus bilateral markets and price formation, Role of independent generators and system operator.		
UNIT 6	**Distributed Generation**	**Hrs.**	**CO**
	Distributed Generation Standards, DG potential, Definitions and terminologies; current status and future trends, Technical and economic impacts, Definitions and terminologies; current status and future trends, Technical and economic impacts DG Technologies, DG from renewable energy sources, DG from non-renewable energy sources, distributed generation applications, Operating Modes, Base load; peaking; peak shaving and emergency power, Isolated, momentary parallel and grid connection	06	CO6

Text Books:

[T1]. J. Nagrath and D.P. Kothari – Modern Power System Analysis – Tata McGraw Hill, New Delhi.
[T2]. B R Gupta, “Power System Analysis and Design”, S. Chand.
[T3]. Ashfaq Hussain, “Electrical Power Systems”, CBS Publication 5th Edition.
[T4]. J.B.Gupta. “A course in power systems” S. K. Kataria Publications.
[T5]. P.S.R. Murthy, “Power System Analysis”, B. S. Publications
[T6]. Anthony J. Pansini “Electrical Distribution Engineering”, CRC Press.
[T7]. A. J. Wood and B. F. Wallenberg, “Power generation, operation and control”, Wiley-Interscience, 2nd Edition, 1996
[T8]. H Lee Willis, “Distributed Power Generation Planning and Evaluation”, CRC Press.

References:

[R1]. H. Hadi Sadat: Power System Analysis, Tata McGraw-Hill New Delhi.
[R2]. G. W. Stagg and El- Abiad – Computer Methods in Power System Analysis – Tata McGraw Hill, New Delhi.
[R3]. M. E. El-Hawary, Electric Power Systems: Design and Analysis, IEEE Press, New York.
[R4]. Rakash Das Begamudre, “Extra High voltage A.C. Transmission Engineering ", New age publication.
[R5]. M. A. Pai, Computer Techniques in Power System Analysis, Tata McGraw Hill Publication.
[R6]. Stevenson W.D. Elements of Power System Analysis (4th Ed.) Tata McGraw Hill, New Delhi.
[R7]. K. R. Padiyar: HVDC Transmission Systems, New Age International Publishers Ltd, New Delhi.
[R8]. Olle I. Elgard – Electric Energy Systems Theory – Tata McGraw Hill, New Delhi.
[R9]. V. K. Chandra, Power Systems, Cyber tech Publications.

EE305: POWER ELECTRONICS

Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs./Week	**Continuous Assessment:**	**20 Marks**
Tutorial: --- Hr./Week	**In-Sem Exam:**	**30 Marks**
	End-Sem Exam:	**50 Marks**
Credits: 3	**Total:**	**100 Marks**

Prerequisite Course: Students should have knowledge of Analog and Digital Circuits and Electronic Devices ar basic characteristics.

Course Objectives

To enable students to gain knowledge and depth of understanding in the following aspects

1. Fundamentals and important of Power semiconductor devices
2. Difference converters
3. Various controlling strategy
4. Design the single phase half controlled and fully controlled converter
5. Development of single phase and three phase inverter

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Compare different power electronics switches	5	Evaluating
CO2	Analysis of single phase controlled converters.	4	Analysing
CO3	Demonstrate three phase rectifier and AC voltage controller	3	Applying
CO4	Analysis of single phase half bridge and full bridge inverters.	4	Analysing
CO5	Design of single phase cyclo converter and three phase inverter.	6	Creating
CO6	Design a DC to DC converter	6	Creating

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	2	3	2	2	2	1	1	1	1	1	2	3	2
CO2	3	2	2	2	2	2	1	1	1	1	1	2	3	2
CO3	3	2	2	2	2	2	1	1	1	1	1	2	3	2
CO4	3	2	2	2	2	2	1	1	1	1	1	2	3	2
CO5	3	2	3	2	2	2	1	1	1	1	1	2	3	2
CO6	3	2	2	1	1	2	1	-	-	1	1	2	3	2

Course Contents			
UNIT-I	**Power Semiconductor Devices**	**No.of Hours**	**COs**
	Characteristics of switch, Rating of switches, protection and cooling of power semiconductor devices. Construction, Static and Dynamic Characteristics of Silicon Controlled Rectifier (SCR), Triggering Methods of SCR (R, RC, UJT), Importance of commutation. Gate Turn Off (GTO) Thyristor- Construction, Working and applications. MOSFET – Construction, Static and Dynamic Characteristics, Working and application. IGBT– Construction, Static and Dynamic Characteristics, Working and application	10	CO1
UNIT-II	**Single Phase AC to DC converter**	**No.of Hours**	**CO**
	Single phase half wave and single-phase full wave diode bridge. Single phase Half controlled Converter (semi controlled)- operation with R and RL load, derivation of average and RMS output , power factor and THD. Single phase Fully controlled Converter (rectification and inversion mode)- operation with R and RL load, derivation of average and RMS output , power factor and THD. Effect of source inductance. Single phase Dual converter with R and RL load	08	CO2
UNIT-III	**Three phase controlled converter and AC voltage Regulator**	**No.of Hours**	**CO**
	Three phase Converter : Half controlled converter (semi converter), operation with R and RL load, derivation of Average, RMS, power factor, THD. fully controlled converter (rectification and invertersion mode), operation with R and RL load, derivation of Average, RMS, power factor, THD. **AC voltage Regulator** : TRIAC- Introduction, Four Modes of Operation, DIAC, Trigger TRIAC using DIAC, Single phase AC voltage regulator with R and RL laod, with derivation. Single phase two stage AC voltage regualtor with R and RL load.	08	CO3
UNIT-IV	**Single phase DC to AC converter**	**No.of Hours**	**CO**
	Single phase full bridge voltage source inverter, derivation and waveforms. Current source inverter. PWM Techniques- Single pulse, multiple pulse and sinusoidal pulse modulation- Controlling Technique of Inverter, Speed control of Induction Motor.	06	CO4
UNIT-V	**Three phase DC to AC converter and Cyclo converters**	**No.of Hours**	**CO**
	Three phase Inverter: Three phase VSC using 120 and 180 degree modes of operation, comparison. Concet of Multilevel Inverter and Types (Natural point, flying capacitor and cascaded multilevel inverter. **Cyclo converter:** Single phase cyclo converter, comparison between AC voltage regulator and cyclo converter	08	CO5

UNIT-VI	DC to DC converter	No.of Hours	CO
	Principle of chopper, Types of chopper – Buck, Boost, Buck-Boost, classification on basis of quadrants (A, B, C, D, E), Control Techniques – Controlling Techniques -Current Limit Control and Time Ration control, Pulse Width Modulation control and Frequency Modulation control – Isolated DC to DC converter- Switched Mode Power Supply, UPS, Speed control DC motor, Regenerative Braking Method	08	CO6

Text Books:

1. M. H. Rashid - Power Electronics 2nd Edition, Pearson publication
2. Ned Mohan, T.M. Undeland, W.P. Robbins - Power Electronics, 3rd Edition, John Wiley and Sons
3. B.W. Williams: Power Electronics 2nd edition, John Wiley and sons
4. Ashfaq Ahmed- Power Electronics for Technology, LPE Pearson Edition.
5. Dr. P.S. Bimbhra, Power Electronics, Third Edition, Kha

References:

1. Vedam Subramanyam - Power Electronics , New Age International , New Delhi
2.. M. D. Singh and K. B. Khandchandani, Power Electronics, Tata McGraw Hill
3. M.H.Rashid - Power Electronics Handbook, Butterworth-Heinemann publication, 3 edition
4. V.R. Moorthi, Power Electronics Devices, circuits, and Industrial applications, Oxford University Press.
5.. NPTEL Web course and video course on Power Electronics by Dr.B.G.Fernandis,IIT,Mumbai.

EE306A: SIGNALS AND SYSTEMS

Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs./Week	**Continuous Assessment:**	**20 Marks**
Tutorial: --- Hr./Week	**In-Sem Exam:**	**30 Marks**
	End-Sem Exam:	**50 Marks**
Credits: 3	**Total:**	**100 Marks**

Prerequisite Course: Students should have knowledge of various types of basic signals like sine wave, square wave, triangular wave etc. and its mathematical modelling along with its nature.

Course Objectives

1. Development of the strong foundation of signals and systems
2. Development of strong foundation analytical mathematics
3. Understand the concepts of continuous time and discrete time systems.
4. Understand sampling theorem and its implications.
5. Analyse systems in complex frequency domain.
6. Detail analysis of LTI system

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Understand the classification of signal and systems	2	Understanding
CO2	Apply the Fourier transform on signal and systems	3	Applying
CO3	Apply the Laplace transform on signal and systems	3	Applying
CO4	Apply the Z transform on signal and systems	3	Applying
CO5	Assess Sampling theorem and its implications	4	Analysing
CO6	Analyse LTI system in discrete and continuous time domain	3	Applying

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	2	2	1	2	3	1	1	--	1	--	2	1	2
CO2	3	2	1	2	2	2	2	1	1	1	1	2	1	2
CO3	3	2	2	1	2	1	1	1	1	--	1	1	1	1
CO4	3	2	2	2	2	2	1	1	1	1	1	2	1	1
CO5	3	2	1	3	2	1	--	1	--	2	1	1	1	2
CO6	3	2	1	1	2	1	1	--	1	1	1	2	1	1

Course Contents			
UNIT-I	**Basics of signals and Systems**	**No.of Hours**	**COs**
	Continuous and discrete time signals: Classification of Signals: Periodic aperiodic, even and odd, energy and power signals, Deterministic and random signals, complex exponential and sinusoidal signals, periodicity, unit impulse, unit step, Transformation of independent variable of signals: time scaling, time shifting. System properties: Linearity, Causality, time invariance and stability. Shifting and scaling operations, Dirichlet's conditions, Determination of Fourier series coefficients of signal.	10	CO1
UNIT-II	**Signal Transformation: Fourier Transformation**	**No.of Hours**	**CO**
	Fourier transformation of continuous and discrete time signals and their properties. Laplace transformation- analysis with examples and properties. Parseval's theorem; Convolution in time (both discrete and continuous) and frequency domains with magnitude and phase response of LTI systems.	08	CO2
UNIT-III	**Signal Transformation: Laplace Transform**	**No.of Hours**	**CO**
	Recapitulation, Analysis and characterization of LTI systems using Laplace transform: Computation of impulse response and transfer function using Laplace transform.	06	CO3
UNIT-IV	**Signal Transformation: Z-Transforms**	**No.of Hours**	**CO**
	Basic principles of z-transform, z-transform definition, Relationship between z-transform and Fourier transform, region of convergence, properties of ROC, Properties of z-transform, Poles and Zeros, inverse z-transform using Contour integration, Residue Theorem, Power Series expansion and Partial fraction expansion.	06	CO4
UNIT-V	**Sampling Theorem**	**No.of Hours**	**CO**
	Representation of continuous time signals by its sample –Types of sampling, Sampling theorem. Reconstruction of a Signal from its samples, aliasing –sampling of band pass signals.	06	CO5
UNIT-VI	**Analysis of signals to systems**	**No.of Hours**	**CO**
	Definitions, distribution & density functions, mean values &moments, function of two random variables, concepts of correlation, random processes, spectral densities, response of LTI systems to random inputs. State Space Analysis: State Space Representation of Discrete-Time and continuous time LTI Systems and its solutions.	06	CO6

Text Books:

1. B.P.Lathi, “Signal Processing & Linear Systems”, Oxford, Third Edition.
2. P.Ramesh Babu & R.Anandanatarajan, “Signals and Systems”, Scitech, fourth edition
3. S Ghosh, “Signals and Systems”, Pearson.
4. S.Haykin&B.V.Veen, “Signals and Systems”, John Wiley.

References:

1. A.V.Oppenheim, A.S.Willsky and S.H.Nawab, “Signals & Systems”, Pearson.
2. A.NagoorKani, “Signals and Systems”, McGraw Hill.
3. H.P. Hsu, “Schaum’s outline of Signals and systems”, McGraw Hill Publication.

EE306B: POWER GENERATION TECHNOLOGIES

Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs./Week	**Continuous Assessment:**	**20 Marks**
Tutorial: --- Hr./Week	**In-Sem Exam:**	**30 Marks**
	End-Sem Exam:	**50 Marks**
Credits: 3	**Total:**	**100 Marks**

Prerequisite Course:

1. Fuel calorific value.
2. Semiconductor materials for PV cells.
3. Work, power and energy calculations

Course Objectives

1. To introduce conventional energy conversion system with steam, hydro based and nuclear based power plant.
2. To initiate non-conventional energy conversion system with solar, wind, fuel cell, tidal ocean, geothermal, biomass etc.
3. To commence interconnection of energy source to gird, stand alone and hybrid system.

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		Bloom's Taxonomy	
		Level	**Descriptor**
CO1	Analyse solar energy in thermal and electrical power generation considering energy crisis, environmental and social benefits.	4	Analysing
CO2	Understand operations of thermal power plant with all accessories and cycles	2	Understanding
CO3	Identify and demonstrate the components of hydro power plant and calculation of turbine required based on catchment area.	3	Applying
CO4	Analyse wind-based energy generation along with its design, operations and comparison.	4	Analysing
CO5	Use the knowledge of economics and policies of various energy resources	3	Applying
CO6	Understand the operation of electrical energy generation using biomass, tidal, geothermal, hydel plants, fuel cell and interconnection with grid	2	Applying

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	1	2	2	1	1	1	2	2	1	3
CO2	2	1	1	-	-	1	2	1	1	1	1	1	1	3
CO3	2	1	1	-	-	1	2	1	1	1	1	1	1	3
CO4	2	1	1	1	1	2	2	1	1	1	2	1	1	3
CO5	1	1	1	-	-	2	2	2	1	1	2	2	1	2
CO6	2	1	1	1	1	2	2	1	1	1	1	1	1	3

Course Contents			
UNIT I	**Solar Energy**	**Hrs.**	**CO**
	a) Principles of solar radiations, solar constant, cloudy index and concentration ratio, measurement of solar radiation. Solar energy collectors (solar thermal applications), principle of energy conversion, collection systems and their features, types of collectors with comparison. Solar thermal power plants. b) Over view of recent development of PV technologies. A Generic Photovoltaic Cell, The Simplest Equivalent Circuit for a Photovoltaic Cell From Cells to Modules to Arrays, The PV I–V Curve under Standard Test Conditions (STC), Impacts of Temperature and Insolation on I–V Curves, Shading Impacts on I–V curves, System: Introduction to the Major Photovoltaic System Types	8	CO 5
UNIT II	**Thermal Power Plant (Only Theoretical concepts)**	**Hrs.**	**CO**
	a) Basic thermodynamic cycles: Thermodynamic cycle of steam flow; Rankine cycle; Actual Rankine cycle; Reheat cycle; Carnot cycle, heat rate. **b) Thermal Power Plants**: Site selection, Main parts and its working. Types of boilers, Feed water and its treatment, Various boiler controls, Steam turbines types, selection and control of turbines. **c) Fuel Handling**: delivery of load, unloading, preparation, transfer, outdoor (dead) storage, indoor (live) storage, In-plant Handling, Coal weighing. **d) Ash disposal and dust collection**: Draught systems, electrostatic precipitator. Recent Development in thermal power plants.	9	CO 1
UNIT III	**Hydro Power Plant**	**Hrs.**	**CO**
	Site selection, Hydrology, storage and pondage, general arrangements and operation of hydro power plant, Hydraulic turbines, turbine size, pelton wheel turbine, Francis and Kaplan turbines, selection of turbines, Dams, Spillways, gates, intake and out take works, canals and layout of penstocks, water hammer and surge tank, simple numerical on hydrographs and number of turbine required. Control of hydro turbines. Small, mini and micro hydro power plant, Recent Development in hydro power plants.	8	CO 2
UNIT IV:	**Wind Energy Systems**	**Hrs.**	**CO**
	Historical Development of Wind Power, Types of wind turbine electrical generators, Power in the Wind, Impact of Tower Height, Maximum Rotor efficiency, Speed control for Maximum Power, Average Power in the wind, Wind turbine power converters (block diagrams), Wind Turbine Economics, Simple Estimates of Wind Turbine Energy, Environmental Impacts of Wind Turbines. Change in wind pattern and its effect on power generation. Control of wind turbine generator.	8	CO 4

UNIT V:	Economics and Policies of Energy Resources	Hrs	CO
	Net metring, Net Energy, Renewable energy mix and energy conservation, potential for energy efficiency, energy subsidies by state and central government, environmental externalities Green audit and carbon credit	8	CO5
UNIT VI:	**Forthcoming Renewable Technologies & Grid Connection**	**Hrs.**	**CO**
	a) Overview of Biomass as energy source, biomass as a fuel, physicochemical and thermal characteristics of biomass as fuel, biochemical conversion of biomass for energy production, liquid biofuel, energy plantation- overview on energy plantation, basis of selecting the plants for energy plantation, waste land utilization through energy plantation, b) Geothermal energy and Ocean energy and Fuel cell Energy storage requirements and selection criteria, (only working, layout, different components, advantages, limitations.) c) Standalone, hybrid stand alone and grid connected renewable systems and their requirements.	8	CO 6

Text Books:

[T1] P. K. Nag, “Power Plant Engineering”, Tata McGraw Hill Publications.

[T2] Dr. P. C. Sharma, “Power Plant Engineering”, S.K. Kataria Publications.

[T3] R. K. Rajput, “A text book on Power System Engineering”, Laxmi Publications (P) Ltd.

[T4] Chakrabarti, Soni, Gupta, Bhatnagar, “A text book on Power System Engineering”, DhanpatRai publication.

[T5] R.K. Rajput, “Non-Conventional Energy Sources and Utilization”, S. Chand Publications.

[T6] The Economics Of Renewable Energy, David Timmons, Jonathan M. Hrris, and Brian Roach, Global Development and Environmental Institute, Tufts University

[T7] Electricity from Renewable Resources, Status Prospectus and Impediments, National Academy of Engineering, ISBN ebook-978-0-309-15189-4

References:

[R1] Arora and Domkundwar, “A Course in Power Plant Engineering”, DhapatRai Publication.

[R2] Dr. S. P. Sukhatme, “Solar Energy”, Tata McGraw Hill Publication.

[R3] Mukund Patel, “Wind and Solar Power Plants”, CRC Press.

[R4] Gilbert Masters John, “Renewable Energy”, Wiley and sons’ publications.

[R5] Paul Gipe, “Wind Power, Renewable Energy for Home, Farm, and Business”.

[R6] Website :powermin.nic.in, www.mnre.gov.in

EE307: MICROCONTROLLERS AND APPLICATIONS LABORATORY

Teaching Scheme	**Examination Scheme**	
Lectures: -- Hrs./Week	**Oral:**	**-- Marks**
Tutorial: -- Hr/Week	**Practical:**	**25 Marks**
Practical: 02 Hr/Week	**Term Work:**	**--Marks**
Credits: 1	**Total:**	**25 Marks**

Prerequisite Course:

1. Analog and Digital Electronics
2. Basic Electrical and Electronics Engineering

Course Objectives

1. To understand the differences between microcontrollers and microprocessors learn microcontroller architecture & describe the features of a typical microcontroller.
2. To use the 8051 addressing modes and instruction set and apply this knowledge to perform programs - arithmetic & logic operations, data & control transfer operations, input & output operations.
3. To define the protocol for serial communication and understand the microcontroller development systems.
4. To build and test a microcontroller-based system; interface the system to switch, keypad, and display.
5. To understand Arduino Board and its applications
6. To understand Embedded systems terminologies in terms of electrical Engineering

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Understand the utilization of modern tools	2	Understand
CO2	Solve assembly language programs based on the instruction set of 8051.	4	Analyze
CO3	Create Assembly Language Program for various applications	6	Create
CO4	Implement 8051 based hardware system and for LED, keyboard and different motors interfacing	3	Apply
CO5	Execute programs and interface different component with Arduino board	5	Evaluate
CO6	Implement Real life applications using Advance controllers	6	Create

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	2	2	-	1	1	1	1	1	1	1	1	2	1
CO2	3	3	2	-	2	1	1	1	1	2	2	1	2	1
CO3	3	2	3	2	2	1	1	1	1	3	2	1	2	1
CO4	3	3	2	-	2	1	1	1	1	1	2	1	2	1
CO5	3	3	2	-	2	1	1	1	1	2	2	1	2	1
CO6	3	2	3	2	2	1	1	1	1	3	2	1	2	1

Course Contents			
Ex. No	**Name of Experiment**	**No.of Hours**	**COs**
1	Introduction to Keil IDE and Proteus	2	CO1
2	Assembly Language Program for arithmetic operation of 8 bit numbers	2	CO1 CO2
3	Assembly Language Program for rotate, bit, swap and logical operations etc.	2	CO1 CO2
4	Assembly Language program to arrange 8 bit numbers stored in array in ascending order and descending order	2	CO1 CO2 CO3
5	Interfacing of DAC 0800 with 8051 microcontroller.	2	CO1 CO2 CO4
6	Interfacing of LED, relay, DC motor or stepper motor with microcontroller. (Proteus simulation)	2	CO1 CO2 CO4
7	Interfacing of LED to blink after every 1 second using arduino board	2	CO1 CO2 CO5
8	Display data using serial communication.	2	CO1 CO2 CO5
9	Interfacing of temperature sensor (LM35) using Arduino Board	2	CO1 CO2 CO5
10	Interfacing of keypad/LCD using Arduino Board	2	CO1 CO2 CO5
11	Implementation of Real life applications using Advance Microcontroller.	2	CO1 CO2 CO6

Any 08 experiments to be performed from above list.

Text Books:

1. Muhammad Ali Mazidi, Janice G. Mazidi and Rolin D. McKinlay, “The Microcontroller and Embedded Systems”, Second Edition, Pearson, 2012.
2. Ayala K. J., “8051 Microcontroller: Architecture, Programming and applications”Second Edition, Penram international.
3. SubrataGhoshal, “8051 microcontroller”, Pearsons Publishers.
4. Started with Arduino by Massimo Banzi and Michael Shiloh Published by Maker Media, Inc.
5. Arduino microcontroller processing for everyone-Steven F Barret,Morgan and Claypool Publisher.

References:

1. V Udayashankara and M S MallikarjunaSwamy, “8051 Microcontroller, Hardware, software and applications”, TATA McGraw Hill.
2. Scott Mackenzie, “8051 Microcontroller”, Pearson Education.

3. Ajay Deshmukh, “Microcontroller 8051” –TATA McGraw Hill.
4. Getting Started With Arduino: A Beginner's Guide by by Brad Kendall (Author), Justin Pot (Editor), Angela Alcorn (Editor)
5. Arduino Cookbook, 2nd Edition by Michael Margolis published by O'Reilly Media

EE308: ELECTRICAL MACHINES II LABORATORY

Teaching Scheme	**Examination Scheme**
Lectures: -- Hrs./Week	**Oral: -- Marks**
Tutorial: -- Hr./Week	**Practical: 25 Marks**
Practical: 02 Hr./Week	**Term Work: -- Marks**
Credits: 1	**Total: 25 Marks**

Prerequisite Course:

1. Basic Electrical Engineering
2. Electrical Machines I

Course Objectives

1. Learn construction & working principle of three phase synchronous machines.
2. Define regulation of alternator & calculate it by direct and indirect methods.
3. Study the methods of starting 3- phase synchronous motor, & its operation under Different conditions.
4. Learn Speed control methods of three phase induction motor.
5. Develop phasor diagram & circle diagram of a c series motor.
6. Develop equivalent circuit of single-phase induction motor.

Course Outcomes (COs):

After successful completion of the course, student will be able to

	Course Outcome (s)	**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Analyze speed control methods of three phase induction motor, and understand the operation of different special purpose motor.	4	Analysing
CO2	Calculate various parameters of electrical machines	5	Evaluate
CO3	Examine the process and determine voltage regulation of electrical machines	4	Analysing
CO4	Analyze the response of synchronous motors and alternator	4	Analysing
CO5	Expose the concept of various types of electrical machines and applications of electrical machines in electrical power engineering and drives	3	Applying
CO6	Analyse power requirements , power capabilities, efficiencies, operating characteristics, control requirements and electrical demand of various machines	4	Analysing

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	1	1	1	1	1	1	1	2	2	3	2
CO2	3	2	2	1	1	1	1	1	1	1	2	2	3	2
CO3	3	2	2	1	1	1	1	1	1	1	2	2	3	2
CO4	3	2	2	1	1	1	1	1	1	1	2	2	3	2
CO5	3	2	2	1	1	1	1	1	1	1	2	2	3	2
CO6	3	2	2	1	1	1	1	1	1	1	2	2	3	2

Course Contents			
Ex. No	**Name of Experiment**	**No. of Hours**	**COs**
To perform any eight experiments from the following list.			
1	Speed control of three phase induction motor by V/F method	2	CO1 CO5 CO6
2	Speed control of three phase induction motor by rotor resistance control method.	2	CO1 CO5 CO6
3	Load test on Single -phase induction motor.	2	CO2 CO5 CO6
4	Determination of Regulation of alternator by direct loading.	2	CO3 CO5 CO6
5	Determination of regulation of cylindrical rotor alternator by following methods a) EMF method b) MMF method.	2	CO3 CO5 CO6
6	Determination of regulation of cylindrical rotor alternator by Potier method.	2	CO3 CO5 CO6
7	Load test on three phase synchronous motor.	2	CO2 CO5 CO6
8	Determination of regulation of salient pole alternator by slip test.	2	CO3 CO5 CO6
9	Load test on Single-phase series motor.	2	CO2 CO5 CO6
10	No load and blocked-rotor test on a single phase Capacitor-start induction motor and Determination of its equivalent circuit parameters.	2	CO2 CO5 CO6
11	Performance characteristics of single phase series motor using circle diagram.	2	CO2 CO5 CO6
12	Synchronization of three phase alternator by Lamp and Synchroscope methods.	2	CO4 CO5 CO6
13	Simulation of three phase induction motor on MATLAB to obtain its performance.	2	CO1 CO5 CO6
14	V and inverted V curve of synchronous motor at constant load.	2	CO4 CO5 CO6

Text Books:

[T1] Nagrath and Kothari, Electrical Machines, 2nd Ed., Tata McGraw Hill.
[T2] S. K. Bhattacharya, Electrical Machines, Tata McGraw Hill.
[T3] A.S. Langsdorf, Theory of Alternating Current Machinery, Tata McGraw Hill
[T4] P. S. Bimbhra, Electric Machinery, Khanna Publications.

[T5] B.R. Gupta and Vandana Singhal -Fundamentals of Electric Machines, New Age International (P) Ltd.
[T6] E. Openshaw Taylor, Performance and design of a.c. commutator motors, Wheeler Publishing.
[T7] V. K. Mehta and Rohit Mehta, Principles of Electrical Machines, S Chand Publications
[T8] Krishna Reddy –Electrical Machines vol.II and III, SCITECH publications.
[T9] Ashfaq Husain, Electrical Machines, Dhanpat Rai and Co.
[T10] M V Deshpande, Electrical Machines, Prentice Hall of India

References:

[R1] M.G. Say, Performance and Design of A.C. Machines (3rd Ed.), ELBS
[R2] J B Gupta - Theory and performance of Electrical Machines, S K Kataria Publications
[R3] Samarjit Ghosh, Electrical Machines, Pearson Publication.
[R4] Bhag S Guru and Huseyin R Hiziroglu, Electrical Machinary and Transformer, 3rd Edition, Oxford University Press.
[R5] E G Janardanan, Special Electrical Machines, Prentice Hall of India.
[R6] Suvarnsingh Kalsi Application of high Temperature super conductors to electric power equipments (Rotating Machines) Wiley publication.

EE309: POWER SYSTEM II LABORATORY

Teaching Scheme	**Examination Scheme**	
Lectures: -- Hrs./Week	**Oral:**	**25 Marks**
Tutorial: -- Hr./Week	**Practical:**	**-- Marks**
Practical: 02 Hr./Week	**Term Work:**	**-- Marks**
Credits: 1	**Total:**	**25 Marks**

Prerequisite Course:

1. Power System I

Course Objectives

1. This course provides the knowledge of Power System Operation
2. It is aimed to impart knowledge of Real Time system
3. To understand use of per unit system and fault analysis
4. This course provides the knowledge of Power flow study

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		**Course Outcome (s)**	
		Level	**Descriptor**
CO1	Explain various parameters in a circle diagram with line parameters.	2	Understanding
CO2	Develop per unit system to solve various problems.	3	Applying
CO3	Evaluate admittance matrix with and without mutual impedances	5	Evaluating
CO4	Evaluate different types of faults for balanced and unbalanced systems	5	Evaluating
CO5	Creating different types Symmetrical & Unsymmetrical Fault Analysis	6	Creating
CO6	Estimate static measurement of sub-transient and sequence reactance of a synchronous machine	2	Understanding

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	2	2	1	1	1	1	1	1	1	1	1	2	2
CO2	2	2	2	1	1	1	1	1	1	1	1	1	2	2
CO3	2	2	2	1	1	1	1	1	1	1	1	1	2	2
CO4	3	3	3	2	2	2	1	1	2	1	1	2	3	3
CO5	3	3	3	2	2	2	1	1	2	1	1	2	3	3
CO6	2	2	2	1	1	1	1	1	1	1	1	1	2	2

Course Contents			
Ex. No	**Name of Experiment**	**Hrs.**	**COs**
1	Measurement of ABCD parameters of a medium transmission line with magnitude and angle.	2	CO1
2	Measurement of ABCD parameters of a long transmission line with magnitude and angle.	2	CO1
3	Performance study of the effect of VAR compensation using capacitor bank on the transmission line.	2	CO1
4	Formulation and calculation of Y- bus matrix of a given system using software.	2	CO3
5	Static measurement of sub-transient reactance of a salient-pole alternator.	2	CO6
6	Measurement of sequence reactance of a synchronous machine (Negative and zero).	2	CO6
7	Plotting of receiving end circle diagrams to evaluate the performance of medium transmission lines.	2	CO1
8	Solution of a load flow problem using Newton-Raphson method using software.	2	CO2 CO3 CO4 CO5
9	Simulation of Symmetrical fault of single machine connected to infinite bus by using Software	2	CO2 CO4 CO5
10	Simulation of Unsymmetrical fault of single machine connected to infinite bus.	2	CO2 CO4 CO5
11	Solution of a load flow problem using Gauss-Seidel method using software.	2	CO2 CO4 CO5

Text Books:

[T1]. J. Nagrath and D.P. Kothari – Modern Power System Analysis – Tata McGraw Hill, New Delhi.
[T2]. B R Gupta, “Power System Analysis and Design”, S. Chand.
[T3]. Ashfaq Hussain, “Electrical Power Systems”, CBS Publication 5th Edition.
[T4]. J.B.Gupta. “A course in power systems” S. K. Kataria Publications.
[T5]. P.S.R. Murthy, “Power System Analysis”, B. S. Publications

References:

[R1]. H. Hadi Sadat: Power System Analysis, Tata McGraw-Hill New Delhi.
[R2]. G. W. Stagg and El- Abiad – Computer Methods in Power System Analysis – Tata McGraw Hill, New Delhi.
[R3]. M. E.El-Hawary, Electric Power Systems: Design and Analysis, IEEE Press, New York.
[R4]. Rakash Das Begamudre, “Extra High voltage A.C. Transmission Engineering ", New age publication.
[R5]. M. A. Pai, Computer Techniques in Power System Analysis, Tata McGraw Hill Publication.
[R6]. Stevenson W.D. Elements of Power System Analysis (4th Ed.) Tata McGraw Hill, New Delhi.
[R7]. K. R. Padiyar: HVDC Transmission Systems, New Age International Publishers Ltd, New Delhi.
[R8]. Olle I. Elgard – Electric Energy Systems Theory – Tata McGraw Hill, New Delhi.
[R9]. V. K. Chandra, Power Systems, Cyber tech Publications.

EE310: POWER ELECTRONICS LABORATORY

Teaching Scheme	**Examination Scheme**	
Lectures: -- Hrs./Week	**Oral:**	**-- Marks**
Tutorial: -- Hr./Week	**Practical:**	**25 Marks**
Practical: 02 Hr./Week	**Term Work:**	**-- Marks**
Credits: 1	**Total:**	**25 Marks**

Prerequisite Course: Students should have knowledge of Analog and Digital Circuits and Electron Device and t basic characteristics.

Course Objectives

To enable students to gain knowledge and depth of understanding in the following aspects

1. Fundamentals and important of Power semiconductor devices
2. Difference converters
3. Various controlling strategy
4. Design the single phase half controlled and fully controlled converter
5. Development of single phase and three phase inverter

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Demonstrate characteristics of power semiconductor	6	Create
CO2	Develop half controlled and fully controlled converter	5	Evaluate
CO3	Construct AC voltage regulator	3	Apply
CO4	Design DC to DC converter	6	Create
CO5	Develop voltage source inverter	4	Analyse
CO6	Develop single phase Cyclo-converter	4	Analyse

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	2	2	1	2	1	1	1	1	1	1	2	2	2
CO2	3	2	2	1	2	1	1	1	1	1	1	2	2	2
CO3	3	2	2	1	2	1	1	1	1	1	1	2	2	2
CO4	3	2	2	1	2	1	1	1	1	1	1	2	2	2
CO5	3	2	2	1	2	1	1	1	1	1	1	2	2	2
CO6	3	2	2	1	2	1	1	1	1	1	1	2	2	2

Course Contents			
Ex. No	**Name of Experiment**	**No.of Hours**	**COs**
	Group A : Hardware Experiments	-	-
1	Static VI characteristic of SCR /GTO	2	CO1
2	Static VI characteristic of MOSFET	2	CO1
3	Single phase Half controlled converter with R and RL load	2	CO2
4	Single Phase fully controlled converter with and without Free Wheeling diode with RL load	2	CO2
5	Single phase A.C. voltage regulator with R load	2	CO3
6	DC to DC step down chopper	2	CO4
	Group B: Software based Experiments	-	-
7	Three phase AC-DC fully controlled bridge converter R and RL load	2	CO2
8	Three phase voltage source inverter using 120 and 1800 degree mode	2	CO5
9	DC to DC step down chopper	2	CO4
10	Single phase A.C. voltage regulator R and RL load	2	CO3
11	Design of single phase voltage source converter	2	CO5
12	Design of single phase cyclo converter	2	CO6

Text Books:

1. M. H. Rashid - Power Electronics 2nd Edition, Pearson publication
2. Ned Mohan, T.M. Undeland, W.P. Robbins - Power Electronics, 3rd Edition, John Wiley and Sons
3. B.W. Williams: Power Electronics 2nd edition, John Wiley and sons
4. Ashfaq Ahmed- Power Electronics for Technology, LPE Pearson Edition.
5. Dr. P.S. Bimbhra, Power Electronics, Third Edition, Kha

References:

1. Vedam Subramanyam - Power Electronics , New Age International , New Delhi
2.. M. D. Singh and K. B. Khandchandani, Power Electronics, Tata McGraw Hill
3. M.H.Rashid - Power Electronics Handbook, Butterworth-Heinemann publication, 3 edition
4. V.R. Moorthi, Power Electronics Devices, circuits, and Industrial applications, Oxford University Press.
5.. NPTEL Web course and video course on Power Electronics by Dr.B.G.Fernandis,IIT,Mumbai.

EE311: SKILL BASED CREDIT COURSE

Teaching Scheme	**Examination Scheme**	
Lectures: 01 Hrs./Week	**Term Work:**	**50 Marks**
Credits: 1	**Total:**	**50 Marks**

Introduction

It aims towards building the skills of the student who has already acquired knowledge through classroom lectures and encourage them to experiment and apply those concepts to strengthen the learning process. In a skill-based classroom, teachers focus on imparting education through planning and practice. To help students to retain concepts, instructors plan, discuss ideas and provide constructive feedback so that students can reflect on the skills gained in classroom. The credit points give learners, employers and institutions a means of describing and comparing the learning outcomes achieved.

Course Objectives

1. Spark the creativity, and give a way to move beyond traditional methods and think innovatively.
2. Develops critical thinking
3. Enhances the collaborative problem solving
4. Builds effective written and oral communication
5. Develops the effective leadership skills.

Course Outcome (s)

After successful completion of the course, student will be able to

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	**Understand** the skills requirement to apply those concepts which has already acquired knowledge into experiments.	2	Understand
CO2	**Understand** the concept and use in solving engineering problems.	2	Understand
CO3	**Apply** core concepts of any applied problems in engineering.	3	Apply
CO4	**Analyse** the problem of which kind and use particular method for finding solution in engineering field.	4	Analyse
CO5	**Awareness** of how to give and receive professional constructive feedback	4	Analyse

Course Contents

Students have to do skilled technical certified online courses od their choice of at least 16-20 hours. After completion of online courses, students have to produce *Certificate*. Students shall be awarded credits only when they will complete the courses and submit the 20 pages report on the same. 50 marks will be evaluated based on report, online certification and assignments.

The following platforms / software's are recommended :

Sr no.	**Platform**
1.	NPTEL
2.	edX

3.	Coursera
4.	Udemy
5.	Sill Battle
6.	IBM
7.	Persistent
8.	Infosys Headstart
9.	MATLAB Software
10.	ETAP Software
11.	NEPLAN Simulation Software
12.	LabVIEW Software
13.	AUTOSAR methodologies
14.	Protheus Software
15.	PSIM Software

MC312A: ELECTRICAL ENERGY CONSERVATION AND AUDITING

Teaching Scheme	**Examination Scheme**	
Lectures: 01 Hrs./Week	**Continuous Assessment:**	--
Tutorial: --Hr./Week	**In-Sem Exam:**	--
	End-Sem Exam:	--
Credits: No Credits	**Total:**	--

Prerequisite Course: Power Systems, Electrical Machines

Course Objectives

1. Understand the current energy scenario and importance of energy conservation.
2. Understand the concepts of energy management.
3. Understand the methods of improving energy efficiency in different electrical systems.

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		Bloom's Taxonomy	
		Level	**Descriptor**
CO1	Understand the current energy scenario and importance of energy conservation	2	Understanding
CO2	Impart knowledge in the domain of Basics of Energy and its various forms	3	Applying
CO3	Understand the concepts of energy management.	2	Understanding
CO4	Bring out Energy Conservation Potential and Business opportunities across different user segments under innovative business models	4	Analyzing

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	2	1	-	2	1	1	1	1	1	1	2	1	2
CO2	3	2	1	-	2	2	1	2	1	1	1	2	1	2
CO3	3	2	1	-	2	1	1	1	1	1	1	2	2	2
CO4	3	2	1	-	2	2	1	2	1	1	2	2	1	2

Course Contents

Unit-I	**Energy Scenario**	**No.of Hours**	**COs**
	Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy security, energy conservation and its importance, Energy Conservation Act-2001 and its features.	--	CO1
Unit-II	**Basics of Energy and its various forms**	**No.of**	**COs**

		Hours	
	Electricity tariff, load management and maximum demand control, power factor improvement, Thermal Basics-fuels, temperature & pressure, heat capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity & heat transfer, units and conversion.	--	CO2
Unit-III	**Energy Management & Audit**	**No.of Hours**	**COs**
	Definition, energy audit, need, types of energy audit. Energy management (audit) approach and understanding energy costs, benchmarking, energy performance, maximizing system efficiencies, fuel & energy substitution, energy audit instruments. Material and Energy balance: methods for preparing process flow.	--	CO3
Unit-IV	**Energy Efficiency in Industrial Systems**	**No.of Hours**	**COs**
	Compressed Air System and Cooling Tower: Types, efficiency, efficient compressor operation, components, capacity assessment, leakage test, factors affecting the performance and saving opportunities in HVAC, Fans and blowers: Types, performance evaluation, efficient system operation, flow control strategies and conservation opportunities. Pumps and Pumping System: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities.	--	CO4

Text Books:

1.Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects (available online)
2. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-3, Electrical Utilities (available online)
3. S. C. Tripathy, "Utilization of Electrical Energy and Conservation", McGraw Hill, 1991.
4. Success stories of Energy Conservation by BEE, New Delhi (www.bee-india.org)

Reference Books:

1. W C Turner and Steve Doty:EnergyManagementHandbook,SeventhEdition,(FairmontPressInc.,2007)
2.Sumper Andreas and Baggini Angelo: Electrical Energy Efficiency: Technologies and applications (John Wiley 2012)
3. Frank Kreith: Handbook on Energy Efficiency and Renewable Energy(CRC Press, 2007)
4.GeorgePolimeros:EnergyCogenerationHandbook(IndustrialPress,Inc.,NewYork,1981)

Websites:

National Productivity Council (http://www.npcindia.gov.in)
Bureau of Energy Efficiency (https://www.beeindia.gov.in)
Petroleum Conservation Research Association (https://www.pcra.org)

SEMESTER VI

EE313: FEEDBACK CONTROL SYSTEMS

Teaching Scheme	Examination Scheme	
Lectures: 3 Hrs./Week	**Continuous Assessment:**	**20 Marks**
Tutorial: -- Hrs./Week	**In-Sem Exam:**	**30 Marks**
	End-Sem Exam:	**50 Marks**
Credits: 3	**Total:**	**100 Marks**

Prerequisite Course:

1. Knowledge of engineering mathematics, signals & systems, circuit analysis

Course Objectives

1. To introduce different types of system and identify a set of algebraic equations to represent and model a complicated system into a more simplified form to interpret different physical and mechanical systems in terms of electrical system to construct equivalent electrical models for analysis.
2. To employ time domain and frequency domain analysis to predict the performance parameters of the system for standard input functions.
3. Formulate different types of analysis in frequency domain to explain the nature of stability of the system.

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		Bloom's Taxonomy	
		Level	**Descriptor**
CO1	**Categorize** different types of system and **Apply** the knowledge of Laplace Transform to **Examine** the Transfer Function of Electro-Mechanical systems.	2 3 4	Categorize Apply Examine
CO2	**Evaluate** equivalent transfer function models of various control system blocks **using** block diagram reduction technique and concepts of signal flow graph.	5 3	Evaluate Apply
CO3	**Formulate** different types of **analysis** in time domain and explain the nature of stability of the system	6 4	Formulate Analysis
CO4	**Sketch** root locus of systems & **perform** stability analysis.	3	Perform
CO5	**Demonstration** and stability **analysis** of systems using Bode Polar &Nyquist plots.	3 4	Demonstration Analysis
CO6	**Examine** and able to write the state-space representation of systems and **perform** inter-conversion between state-space and transfer function representation.	4 3	Examine Perform

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO2	-	-	3	-	-	-	-	-	-	-	-	-	-	2
CO3	-	-	3	-	-	-	-	-	-	-	-	-	-	-
CO4	-	2	3	-	-	-	-	-	-	-	-	-	-	-
CO5	-	3	-	2	-	-	-	-	-	-	-	-	-	-
CO6	-	2	-	-	2	-	-	-	-	-	-	-	-	-

Course Contents			
UNIT-I	**Modelling of Physical Systems**	**Hrs.**	**COs**
	Laplace Transform review, The Transfer function, Electric network Transfer Function, Translational mechanical system transfer function, Rotational mechanical system transfer function, Electro-mechanical system transfer function, Electrical circuit analogy.	6hrs	CO1
UNIT-II	**Reduction of Multiple Systems**	**Hrs.**	**CO**
	Block diagrams, Analysis and design of feedback system, Signal flow graphs, Mason's rule, Signal flow graphs of state equations.	6hrs	CO2
UNIT-III	**Time Response and Stability of system**	**Hrs.**	**CO**
	Time Response Analysis Standard test signals. Poles, Zeros & System response, First Order System, Second Order System. Stability Concept of Stability. Routh-Hurwitz Criteria and its special cases (additional examples). Relative Stability analysis.	6hrs	CO3
UNIT-IV	**Root Locus Techniques**	**Hrs.**	**CO**
	Introduction, Root locus plots, Summary of general rules for constructing Root-Loci, Root locus analysis for control systems, Root loci for systems with transport lag	6hrs	CO4
UNIT-V	**Frequency Response Techniques**	**Hrs.**	**CO**
	Frequency-response analysis Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion. Relative stability using Nyquist criterion – gain and phase margin. Closed-loop frequency response.	6hrs	CO5
UNIT-VI	**Introduction to State Space Modelling**	**Hrs.**	**CO**
	The general state-space representation, Applying the state-space representation, Converting the transfer function to state-space, Converting from state-space to transfer function.	6hrs	CO6

Text Books:

[T1] Katsuhiko Ogata, "Modern control system engineering", Prentice Hall, 2010.
[T2] Nise N. S. "Control Systems Engineering", John Wiley & Sons, Incorporated, 2011

References:

[R1] I.J. Nagrath, M. Gopal, "Control System Engineering", New Age International Publishers, 5th edition, 2007
[R2] B. C. Kuo, "Automatic Control System", Prentice Hall, 1995
[R3] M. Gopal, "Control Systems: Principles and Design", McGraw Hill Education, 1997.

E-References

[1] https://nptel.ac.in/courses/107/106/107106081/

EE314: POWER SYSTEM OPERATION AND CONTROL

Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs./Week	**Continuous Assessment:**	**20 Marks**
Tutorial: --- Hr./Week	**In-Sem Exam:**	**30 Marks**
	End-Sem Exam:	**50 Marks**
Credits: 3	**Total:**	**100 Marks**

Prerequisite Course:
1. Basics of Power System

Course Objectives

1) To understand formulation of economic load dispatch tasks and solve it using optimization techniques
2) To develop ability to analyze and use various methods to improve stability of power systems
3) To illustrate the automatic frequency and voltage control strategies for single and two area case and analyze the effects, knowing the necessity of generation control.
4) To illustrate various ways of interchange of power between interconnected utilities and define reliability aspects at all stages of power system
5) To understand the need for generation and control of reactive power
6) To describe the need of computer control in operating power system.

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Analyze the control actions to be implemented on the system to meet the minute-to-minute variation of system demand	4	Analysing
CO2	Suggest the appropriate method of reactive power generation and control	3	Applying
CO3	Select the appropriate device of FACTS Technology in power System	3	Applying
CO4	Analyze the generation-load balance in real time operation and its effect on frequency and develop automatic control strategies with mathematical relations.	5	Evaluating
CO5	Formulate objective functions for optimization tasks such as unit commitment and economic load dispatch and get solution using computational techniques.	5	Evaluating
CO6	Gain knowledge on the need of real time system functions.	2	Understanding

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	1	1	1	1	1	1	1	3	3	3
CO2	3	3	3	2	1	1	1	1	1	1	1	2	2	3
CO3	3	2	2	2	1	1	1	1	1	1	1	2	3	3
CO4	3	3	3	3	2	1	1	1	1	2	1	2	3	3
CO5	3	3	3	3	3	1	1	1	1	2	1	2	3	3
CO6	3	3	3	2	3	2	1	1	1	2	1	2	3	3

Course Contents			
UNIT-I	**POWER SYSTEM STABILITY**	**Hrs.**	**COs**
	Introduction, dynamics of synchronous machines, power angle equation, Simple system, steady state stability, transient stability, equal area criterion (sudden change in mechanical input, effect of clearing time on stability, Sudden short circuit on one of parallel lines), point-by-by point of swing equation, Multimachine Stability	**09**	CO1
UNIT-II	**REACTIVE POWER MANAGEMENT**		
	Necessity of reactive power control, reactive power generation by a synchronous machine, effect of excitation, loading capability curve of a generator, compensation in power system: series and shunt compensation using capacitors and reactors, Problems with Series Compensation, synchronous condenser.	**08**	CO2
UNIT-III	**FACTS TECHNOLOGY**		
	Problems of AC transmission system, evolution of FACTs technology, Working principle, circuit diagram, VI characteristics, applications, advantages and limitations of SVC, TCSC, STATCOM and UPFC.	**06**	CO3
UNIT-IV	**AUTOMATIC GENERATION AND VOLTAGE CONTROL**		
	Concept of AGC, complete block diagram representation of load-frequency control of an isolated power system, steady state and dynamic response, control area concept, two area load frequency control. Schematic and block diagram of alternator voltage regulator scheme.	**06**	CO4
UNIT-V	**ECONOMIC LOAD DISPATCH AND UNIT COMMITMENT**		
	A. Economic load dispatch: Introduction, revision of cost curve of thermal and hydropower plant, plant scheduling method, equal incremental cost method, method of Lagrange multiplier (neglecting transmission losses), Bmn coefficient, economic scheduling of thermal plant considering effect of transmission losses, penalty factor, procedure of load dispatch at state level load dispatch center, Regional Load Dispatch Center, numerical on penalty factor, exact coordination equation. **B. Unit commitment:** Concept of unit commitment, constraints on unit commitment – spinning reserve, thermal and hydro constraints, methods of unit commitment – priority list and dynamic programming, Numerical on priority list method	**08**	CO5
UNIT-VI	**COMPUTER CONTROL OF POWER SYSTEMS**		
	Need of computer control of power systems, Energy management system (EMS), – Supervisory Control and Data Acquisition (SCADA) – Security Analysis and control – various operating states, power system security-security & contingency analysis (Descriptive Treatment only)	**06**	CO6
Text Books:			

[T1]. Abhijit Chakrabarti, Sunita Halder, "Power System Analysis Operation and Control", Prentice Hall of India.
[T2]. J. Nagrath, D. P. Kothari, "Modern Power System Analysis", 4th Edition, Tata McGraw Hill Publishing Co. Ltd.,
[T3]. P. S. R. Murthy, "Operation & Control in Power System", B. S. Publication, 2008.
[T4]. Allen J. Wood, Bruce F. Wollenberg "Power Generation, Operation, and Control", Wiley India Edition.
[T5]. P. Kundur, "Power System Stability and Control", Tata McGraw Hill Publishing Co. Ltd.

References:

[R1]. N.V.Ramana, Power system operation and control, Pearson Editions
[R2]. S. Sreenivasan, G. Sivanagaraju, Power System Operation and Control , Pearson Editions
[R3]. Narain G. Hingorani, Laszlo Gyugyi, "Understanding FACTs" IEEE Press.
[R4]. Olle I. Elgerd, "Electrical Energy System Theory", 2nd Edition, Tata McGraw Hill. Publishing Co. Ltd.

EE315A: RENEWABLE ENERGY SOURCES

Teaching Scheme	**Examination Scheme**	
Lectures: 4 Hrs./Week	**Continuous Assessment:**	**20 Marks**
Tutorial: -- Hrs./Week	**In-Sem Exam:**	**30 Marks**
	End-Sem Exam:	**50 Marks**
Credits: 4	**Total:**	**100 Marks**

Prerequisite Course:
1. Basic Mechanical Engineering & Basic Electrical Engineering

Course Objectives

1. To create awareness about the importance of renewable technology for sustainable future.
2. Impart the knowledge of solar power generation and wind power generation.
3. Introduce forth coming renewable technologies and storage systems in renewable generation

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Determine need of various power generation systems	2	Understanding
CO2	Relate solar power generation and its utilization.	3	Applying
CO3	Analyse wind power generation and its utilization.	4	Analysing
CO4	Explain biomass power generation and its utilization.	2	Understanding
CO5	Analyse trending renewable energy sources and energy storage systems.	4	Analysing
CO6	Relate principles of storage technologies and their applications	3	Applying

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2	1	1	3	3	-	-	-	1	3	2	3
CO2	3	2	1	2	1	2	2	-	-	-	1	2	2	3
CO3	3	2	1	2	1	2	2	-	-	-	1	2	2	3
CO4	3	2	1	2	1	2	2	-	-	-	1	2	2	3
CO5	3	1	1	1	1	1	1	-	-	-	1	1	2	2
CO6	3	1	1	1	1	1	1	-	-	-	1	1	2	2

Course Contents

UNIT-I	**Introduction to Renewable Energy Systems**	**Hrs.**	**COs**
	Energy sources: classification of energy sources, introduction to renewable energy, renewable energy trends, and key factors affecting renewable energy supply, advantages and disadvantages of RES and their uses.	6	CO1
UNIT-II	**Solar Energy**	**Hrs.**	**CO**
	PV power generation, basic principle of power generation in PV cell, technology for fabrication of photovoltaic devices, efficiency of PV cell,	8	CO2

	characteristics curves of PV cell, solar thermal power generation, solar thermal conversion: basics, solar concentrator and tracking system, flat plate collectors-liquid and air type, theory of flat plate collectors, selective coatings, advanced collectors: ETC, Solar Pond		
UNIT-III	**Wind Energy**	**Hrs.**	**CO**
	Power available in wind, wind turbine power & torque characteristics, types of rotors, characteristics of wind rotor, local effects, wind shear, turbulence & acceleration effects, measurement of wind, wind speed statistics, energy estimation of wind regimes, capacity factor, aerodynamics of wind turbines, airfoil, lift & drag characteristics, power coefficient & tip speed ratio characteristics, electrical generator machines in wind energy systems	8	CO3
UNIT-IV	**Biomass Energy**	**Hrs.**	**CO**
	Overview of biomass as energy source, biomass as a fuel, physicochemical and thermal characteristics of biomass as fuel, biochemical conversion of biomass for energy production, liquid biofuel, energy plantation- overview on energy plantation, basis of selecting the plants for energy plantation, waste land utilization through energy plantation.	8	CO4
UNIT-V	**Forthcoming Renewable Technologies**	**Hrs.**	**CO**
	Geothermal Energy Generation, ocean-thermal energy generation, tidal energy generation, magneto hydro dynamic power generation- working, layout, different components, advantages, limitations,	8	CO5
UNIT-VI	**Storage Technologies**	**Hrs.**	**CO**
	Introduction, need for storage for RES, basic thermodynamic and electrochemical principles, classification, traditional energy storage system-battery, fuel cell, principle of operation, types, applications for power generation.	8	CO6

Text Books:

[T1] Boyle, Godfrey, "Renewable Energy", (2nd edition), Oxford University Press, 2004.
[T2] G. S. Sawhney, "Non-Conventional Resources of Energy", PHI Publication 2012.
[T3] G.D. Rai, Non conventional energy sources, Khanna publication

References:

[R1] Gary-L. Johnson Wind Energy Systems Tata Mc-Graw-Hill Book Company.
[R2] S. P. Sukhatme, J. K. Nayak Solar Energy- Principles of Thermal Collection and Storage (3rd ed.), Tata McGraw-Hill Publication.
[R3] Paul Gipe Wind Power, Renewable Energy for Home, Farm, and Business.
[R4] G.N. Tiwari,Solar Energy: Fundamentals, Design, Modeling and Applications, Narosa Publication

E-References

[1] https://nptel.ac.in/courses/121/106/121106014/
[2] https://nptel.ac.in/courses/103/103/103103206/
[3] https://onlinecourses.swayam2.ac.in/nou22_ge17/course

PR316: INTELLECTUAL PROPERTY RIGHTS AND ENTREPRENEURSHIP DEVELOPMENT

Teaching Scheme	**Examination Scheme**	
Lectures: 02 Hrs./Week	**Continuous Assessment:**	**10 Marks**
Tutorial: --- Hr./Week	**In-Sem Exam:**	**15 Marks**
	End-Sem Exam:	**25 Marks**
Credits: 02	**Total:**	**50 Marks**

Prerequisite Course:

Course Objectives

1. To introduce student with IPR
2. To explain IPR procedure in India such as Patents, Designs and Trademarks
3. To make aware economic importance of IPRs.
4. To develop ability to search and analyse the IPRs.
5. To Instill a spirit of entrepreneurship among the student participants.
6. To give insights into the Management of Small Family Business.

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Understand patenting system	2	Create
CO2	Understand the procedure to file patent in India	2	Apply
CO3	Understanding of financial importance of IPR	2	Understand
CO4	Search and analyse the patents, designs and Trademarks	4	Analyse
CO5	Identify the Skill sets required to be an Entrepreneur.	4	Analyse
CO6	Understand the Role of supporting agencies and Governmental initiatives to promote Entrepreneurship.	4	Analyse

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	2	-	-	-	-		-	1	-
CO2	-	-	-	-	-	2	-	-	-	-		-	1	-
CO3	-	-	-	-	-	2	-	-	-	-		-	1	-
CO4	-	-	-	-	-	2	-	-	-	-		-	1	-
CO5	-	-	-	-	-	2	2	2	-	-	3	-	1	-
CO6	-	-	-	-	-	2	2	2	-	-	3	-	1	-

Course Contents			
UNIT-I	**Introduction to IPR**	**Hrs.**	**COs**
	• Concepts of IPR • The history behind development of IPR • Necessity of IPR and steps to create awareness of IPR • Concept of IP Management • Intellectual Property and Marketing • IP asset valuation • Introduction to the leading International Instruments concerning Intellectual Property Rights: the Berne Convention, Universal Copyright Convention, The Paris Convention, Patent Co-operation Treaty, TRIPS, The World Intellectual Property Organization (WIPO) and the UNESCO	04	CO1
UNIT-II	**Patents**		
	• Introduction to Patents • Procedure for obtaining a Patent • Licensing and Assignment of Patents i. Software Licensing ii. General public Licensing iii. Compulsory Licensing • Infringement of Patents • Software patent and Indian scenario	04	CO2
UNIT-III	**Designs**		
	• Registrable and non-Registrable Designs • Novelty & Originality • Procedure for Registration of Design • Copyright under Design • Assignment, Transmission, License • Procedure for Cancellation of Design • Infringement • Remedies	04	CO3
UNIT-IV	**Trademarks and Copy Rights**		
	A) **Trademarks** • Concept of trademarks • Importance of brands and the generation of "goodwill" • Trademark registration procedure • Infringement of trademarks and Remedies available • Assignment and Licensing of Trademarks **B) Copyright Right** • Concept of Copyright Right • Assignment of Copyrights	04	CO4

	• Registration procedure of Copyrights • Infringement (piracy) of Copyrights and Remedies • Copyrights over software and hardware		
UNIT-V	**Entrepreneurship: Introduction**		
	5.1 Concept and Definitions: Entrepreneur & Entrepreneurship, Entrepreneurship and Economic Development, A Typology of Entrepreneurs. **5.2 Entrepreneurial Competencies:** The Entrepreneur's Role, Entrepreneurial Skills: creativity, problem solving, decision making, communication, leadership quality; Self-Analysis, Culture & values, Risk-taking ability, Technology knowhow. **5.3 Factor Affecting Entrepreneurial Growth:** Economic & Non-Economic Factors, EDP Programmes. **5.4 Steps in Entrepreneurial Process:** Deciding Developing Moving Managing Recognizing.	04	CO5
UNIT-VI	**Resources for Entrepreneurship**		
	6.1 Project Report Preparation: Specimen Format of Project Report; Project Planning and Scheduling using PERT / CPM; Methods of Project Appraisal – Feasibility Study both Economic and Market Preparation projected financial statement. **6.2 Role of Support Institutions and Management of Small Business:** Director of Industries, DIC, SIDO, SIDBI, Small Industries Development Corporation (SIDC), SISI, NSIC, NISBUED, State Financial Corporation (SFC) EPC, ECGC. **6.3 Various Governmental Initiatives:** Make in India Start Up India Stand Up India Digital India Skill India	04	CO6

	6.4 Case Studies of Successful Entrepreneurs		

Text Books:

[T1]. Neeraj Pandey and Khushdeep Dharni, Intellectual Property Rights, PHI, New Delhi

[T2]. The Indian Patent act 1970.

[T3]. The copy right act 1957

[T4]. Manual of patent office practice and procedure of Govt. of India.

[T5]. Manual of Designs Practice and Procedure of Govt. India

[T6]. Manual of Trademarks Practice and Procedure of Govt. India

[T7]. Semiconductor Integrated Circuits Layout Design (SICLD) Act 2000 of Govt. India

[T8]. Intellectual Property Rights- A Primer, R. Anita Rao & Bhanoji, Rao, Eastern BookCo.

[T9]. The Dynamics of Entrepreneurial Development & Management by Desai, Vasant, Himalaya Publishing House, Delhi.

[T10]. Managing Small Business by Longenecker, Moore, Petty and Palich, Cengage Learning, India Edition.

[T11]. Cases in Entrepreneurship by Morse and Mitchell, Sage South Asia Edition.

[T12]. Entrepreneurship – Indian Cases on Change Agents by K Ramchandran, TMGH.

References:

[R5]. Handbook of Indian Patent Law and Practice,

[R6]. Entrepreneurship: New Venture Creation by David H. Holt

[R7]. Entrepreneurship Development New Venture Creation by Satish Taneja, S.L.Gupta

[R8]. Project management by K. Nagarajan.

PR317: INTELLECTUAL PROPERTY RIGHTS AND ENTREPRENEURSHIP DEVELOPMENT LABORATORY

Teaching Scheme	**Examination Scheme**
Practical: 02 Hrs./Week	**Term Work: 50 Marks**
Credits: 01	**Total: 50 Marks**

Prerequisite Course:

Course Objectives

1. To introduce student with IPR
2. To explain IPR procedure in India such as Patents, Designs and Trademarks
3. To make aware economic importance of IPRs.
4. To develop ability to search and analyse the IPRs.
5. To instill a spirit of entrepreneurship among the student participants.
6. To give insights into the Management of Small Family Business.

Course Outcomes (COs):

After successful completion of the course, student will be able to

	Course Outcome (s)	**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Understand patenting system	2	Create
CO2	Understand the procedure to file patent in India	2	Apply
CO3	Understanding of financial importance of IPR	2	Understand
CO4	Search and analyse the patents, designs and Trademarks	4	Analyse
CO5	Identify the Skill sets required to be an Entrepreneur.	4	Analyse
CO6	Understand the Role of supporting agencies and Governmental initiatives to promote Entrepreneurship.	4	Analyse

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	2			-	-		-	1	-
CO2	-	-	-	-	-	2			-	-		-	1	-
CO3	-	-	-	-	-	2			-	-		-	1	-
CO4	-	-	-	-	-	2			-	-		-	1	-
CO5	-	-	-	-	-	2	2	2	-	-	3	-	1	-
CO6	-	-	-	-	-	2	2	2	-	-	3	-	1	-

Course Contents

List of experiments: The term work shall consist following experiments/reports to be completed within the semester.

1. Searching of patent, design, trademarks, and copy rights at various databases and its report preparation.
2. Patent draft preparation for a sample invention
3. Design draft preparation for a sample design
4. Trademark draft preparation for a sample Trademark/Device
5. Copy right draft preparation for a sample documents/audio/video
6. Report preparation of patent Infringement
7. Preparation of Detailed project report for new business/industry/startup

Visit to industry to understand entrepreneurship and its report preparation

Text Books:

[T1]. Neeraj Pandey and Khushdeep Dharni, Intellectual Property Rights, PHI, New Delhi
[T2]. The Indian Patent act 1970.
[T3]. The copy right act 1957
[T4]. Manual of patent office practice and procedure of Govt. of India.
[T5]. Manual of Designs Practice and Procedure of Govt. India
[T6]. Manual of Trademarks Practice and Procedure of Govt. India
[T7]. Semiconductor Integrated Circuits Layout Design (SICLD) Act 2000 of Govt. India
[T8]. Intellectual Property Rights- A Primer, R. Anita Rao & Bhanoji, Rao, Eastern BookCo.
[T9]. The Dynamics of Entrepreneurial Development & Management by Desai, Vasant, Himalaya Publishing House, Delhi.
[T10]. Managing Small Business by Longenecker, Moore, Petty and Palich, Cengage Learning, India Edition.
[T11]. Cases in Entrepreneurship by Morse and Mitchell, Sage South Asia Edition.
[T12]. Entrepreneurship – Indian Cases on Change Agents by K Ramchandran, TMGH.

References:

[R1]. Handbook of Indian Patent Law and Practice,
[R2]. Entrepreneurship: New Venture Creation by David H. Holt
[R3]. Entrepreneurship Development New Venture Creation by Satish Taneja, S.L.Gupta
[R4]. Project management by K. Nagarajan.

HS318: CORPORATE READINESS

Teaching Scheme	**Examination Scheme**
Lectures: 01 Hrs./Week	**Term Work : 50 Marks**
Practical: 02 Hrs./Week	
Credits: 02	**Total: 50 Marks**

Prerequisite Course:
Quantitative aptitude, Verbal and Non-verbal communication

Course Objectives:

1. To develop clarity in the exploration process of student career and to match his skills and interests with a chosen career path.
2. To develop required aptitude skills.
3. To design the functional and chronological resume.
4. To demonstrate the importance of critical thinking ability and expression in group discussions
5. To prepare students for the various professional interviews.
6. To develop different soft skills necessary to get success in their profession.

Course Outcomes (COs):

After successful completion of the course, student will be able to:

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Remember placement processes of various organizations and modern job search approach.	**BTL 1**	Remember
CO2	Understand Industry Specific skill set with a view to design an Ideal Resume.	**BTL 2**	Understand
CO3	Apply the knowledge of GD & Presentation Skill during Industry Assessments for Placement/Internship/Industry Training/Higher Studies/Competitive Exams etc.	**BTL 3**	Apply
CO4	Analyse and apply the critical thinking ability as required during Aptitude/Technical Tests.	**BTL 4**	Analyse
CO5	Evaluate Technical/General Dataset to interpret insights in it.	**BTL 5**	Evaluate
CO6	Create an ideal personality that fits Industry requirement.	**BTL 6**	Create

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	--	--	--	--	--	--	--	02	00	02	01	01	--	--
CO2	--	--	--	--	--	--	--	02	03	03	03	01	--	--
CO3	--	--	--	--	--	--	--	01	03	03	02	01	--	--
CO4	01	01	--	--	--	--	--	--	--	01	01	--	--	--
CO5	01	01	--	--	--	--	--	--	--	--	--	--	--	--
CO6	--	--	--	--	--	--	--	02	03	03	02	03	--	--

Course Contents			
UNIT-I	**Placement Awareness**	**Hrs.**	**Cos**
	Discussion over Different Companies for recruitment, their eligibility criteria and placement procedures. Revision and Assessment of Quantitative Aptitude.	06 Hrs.	CO1
UNIT-II	**Resume Writing**	**Hrs.**	**CO**
	Keywords, resume examples for industry, professional font, active language, important achievements, Proofread and edit. Innovative resume building- video resume.	05 Hrs.	CO2
UNIT-III	**Group Discussion and Presentation skills**	**Hrs.**	**CO**
	Why GDs are implemented commonly, Aspects which make up a Group Discussion, **Tips on group discussion, do's and don'ts of GD and** Presentation skills.	05 Hrs.	CO3
UNIT-IV	**Logical Reasoning I**	**Hrs.**	**CO**
	Coding and Decoding (Visual Reasoning and series), Statement & Conclusions (Syllogisms), Relationships (Analogy), Data arrangements, Crypt arithmetic.	05 Hrs.	CO4
UNIT-V	**Logical Reasoning II**	**Hrs.**	**CO**
	Data Interpretation, Data Sufficiency	04 Hrs.	CO5
UNIT-VI	**Logical Reasoning III**	**Hrs.**	**CO**
	Blood relation and dices, Clocks and Calendar, Direction sense and cubes, Logical connectives, Puzzle.	05 Hrs.	CO6

Laboratory Course Contents			
Ex. No	**Name of Experiment**	**Hrs.**	**Cos**
1	Resume Writing/ Video Introduction.	2	CO2
2	Aptitude Assessment.	2	CO4, CO5, CO6
3	One page report submission on engagement with initiatives like LinkedIn, Job Portal, Alumni Connect, WhatsApp NSDC, CodeChef etc.	2	CO1, CO6
4	Mock Group Discussion.	2	CO3, CO6
5	Mock Personal Interview.	4	CO3, CO6

Text Books:

[T1]. A Modern Approach to Verbal & Non-Verbal Reasoning by R.S. Agarwal.
[T2]. Reasoning verbal and Non-Verbal by B. S. Sijwali.
[T3]. Master the Group Discussion & Personal Interview - Complete Discussion on the topics asked by reputed B-schools & IIMs by Sheetal Desarda.

References:

[R1]. Shortcuts in Reasoning (Verbal, Non-Verbal, Analytical).
[R2]. Analytical Reasoning by M. K. Panday.
[R3]. Logical and analytical reasoning by K. Gupta.
[R4]. Multi-dimensional reasoning by Mishra & Kumar Dr. Lal.

E-References
[1]. https://themech.in/quantitative-aptitude-and-logical-reasoning-books/.
[2]. https://www.thelocalhub.in/2021/01/reasoning-competitive-exams-pdf.html.
[3]. https://www.livecareer.com/resume/examples/web-development/e-learning-developer.
[4]. https://novoresume.com/career-blog/how-to-write-a-resume-guide.

EE319A: ELECTRICAL MACHINE DESIGN

Teaching Scheme	**Examination Scheme**	
Lectures: 02 Hrs./Week	**Continuous Assessment:**	**20 Marks**
Tutorial: --- Hr./Week	**In-Sem Exam:**	**30 Marks**
	End-Sem Exam:	**50 Marks**
Credits: 2	**Total:**	**100 Marks**

Prerequisite Course:

1. Knowledge of various materials used in electrical machines.
2. Knowledge of types, construction and working of transformer.
3. Knowledge of types, construction and working of three phase induction motor.

Course Objectives

1. To make student understand basic of Electrical Machine design.
2. To design transformer.
3. To understand determination of parameters of transformer.
4. To design Induction motor.
5. To understand determination of parameters of Induction motor.
6. To understand computer aided design of electrical machines

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Select proper commercial materials, their properties and selection criterions, IS standards used in electrical machine design.	2	Understanding
CO2	Calculate main dimensions and Design of single phase and three phase transformer.	6	Creating
CO3	Determine the parameters of transformer.	5	Evaluating
CO4	Calculate main dimensions and design of three phase Induction motor.	6	Creating
CO5	Determine parameters of three phase Induction motor.	5	Evaluating
CO6	Apply computer aided optimization techniques for design of electrical machines	3	Applying

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	1	1	1	1	-	1	1	1	3
CO2	3	3	3	3	3	1	1	1	1	-	2	1	1	1
CO3	3	3	3	3	3	1	1	1	1	-	2	1	1	1
CO4	3	3	3	3	3	1	1	2	2	-	2	1	1	1
CO5	3	3	3	3	3	1	1	1	1	-	2	1	1	1
CO6	3	3	3	3	3	1	1	2	2	-	2	1	3	1

Course Contents			
UNIT I	**Introduction**	**8 Hrs.**	**CO**
	Transformers and three phase induction motors - types, specifications, constructional features, conducting, magnetic and insulating materials, heating and cooling in electrical machines, magnetic circuit calculations.		CO1
UNIT II	**Transformer Design (Part I)**	**8 Hrs.**	**CO**
	Output equation with usual notations, optimum design of transformer for minimum cost and loss. Design of main dimensions, core, yoke and windings of transformer. Methods of cooling and tank design. Estimation of resistance and leakage reactance of transformer.		CO2
UNIT III	**Transformer Design (Part II)**	**8 Hrs.**	**CO**
	Estimation of no-load current, losses, efficiency and regulation of transformer. Calculation of mechanical forces developed under short circuit conditions, measures to overcome this effect. Introduction to Computer aided design of transformer, generalized flow chart for design of transformer.		CO3
UNIT IV	**Induction Motor Design (Part I)**	**8 Hrs.**	**CO**
	Output equation, specific electrical and magnetic loading, main dimensions, selection of slots, stator design, stator slots, turns per phase, selection of air gap, unbalanced magnetic pull estimation, harmonic minimization, squirrel cage and wound rotor design.		CO4
UNIT V	**Induction Motor Design (Part II)**	**8 Hrs.**	**CO**
	Calculation of magnetic circuit, MMF calculations, stator teeth, stator core, effect of saturation, magnetizing current, no load current and its core loss component, leakage fluxes and reactance calculations, performance calculations - losses, efficiency, temperature rise, maximum torque from circle diagram.		CO5
UNIT VI	**Computer Aided Design (CAD) of Electrical Machines**	**8 Hrs.**	**CO**
	Limitations and assumptions in traditional designs, need of CAD, analysis, synthesis and hybrid methods, design optimization methods, variables, constraints and objective function, problem formulation.		CO6

Text Books:

[T1] M.G. Say – Theory and Performance and Design of A.C. Machines, 3rd Edition, ELBS London.
[T2] A.K.Sawhney – A Course in Electrical Machine Design, 10th Edition, - Dhanpat Rai and sons New Delhi.
[T3] K. G. Upadhyay- Design of Electrical Machines, New age publication
[T4] R. K. Agarwal – Principles of Electrical Machine Design, S. K.Katariya and sons.
[T5] Indrajit Dasgupta – Design of Transformers – TMH

References:

[R1] K.L. Narang , A Text Book of Electrical Engineering Drawings, Reprint Edition : 1993 / 94 – Satya Prakashan, New Delhi.
[R2] A Shanmugasundaram, G. Gangadharan, R. Palani, - Electrical Machine Design Data Book, 3rd Edition, 3rd Reprint 1988 - Wiely Eastern Ltd., - New Delhi
[R3] Vishnu Murti, "Computer Aided Design for Electrical Machines", B.S. Publications.
[R4] Bharat Heavy Electricals Limited, Transformers - TMH.

E-References

[1] https://nptel.ac.in/courses/108/106/108106023/#

EE319B: ELECTRICAL DRIVES

Teaching Scheme	**Examination Scheme**	
Lectures: 02 Hrs./Week	**Continuous Assessment:**	**20 Marks**
Tutorial: --- Hr./Week	**In-Sem Exam:**	**30 Marks**
	End-Sem Exam:	**50 Marks**
Credits: 2	**Total:**	**100 Marks**

Prerequisite Course:

1. Construction, working and characteristic of different electrical motors and soft starting methods.
2. Power Electronic Applications such as converter, inverter, chopper etc.
3. Basic concept of control system.

Course Objectives

1. To understand motor load dynamics.
2. To analyze the operation of the converter fed and chopper fed dc drives.
3. To elaborate braking methods of D.C. and Induction motor drive.
4. To explain vector control of induction motor.
5. To differentiate synchronous and BLDC motor drive.
6. To identify classes and duty of motor.
   To describe the modes of operation of drive in various applications.

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Explain motor load dynamics and multi quadrant operation of drives	2	Understanding
CO2	Analyze operation of converter fed and chopper fed DC drives.	4	Analyzing
CO3	Describe braking methods of D.C. and induction motor drive.	2	Understanding
CO4	Explain vector control for induction motor drives	2	Understanding
CO5	Describe synchronous motor drive.	2	Understanding
CO6	Identify classes and duty cycles of motor and applications of drives in industries.	4	Analyzing

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	2	2	1	2	1	1	--	1	2	3	1
CO2	2	1	2	1	2	--	1	--	1	1	2	3	2	--
CO3	3	2	3	--	1	--	1	--	--	1	3	3	2	2
CO4	2	--	--	2	2	1	1	1	2	1	2	2	2	2
CO5	2	2	2	1	1	--	--	1	1	--	2	2	3	2
CO6	3	1	--	--	2	--	2	--	1	1	1	2	2	--

Course Contents			
UNIT-I	**Basics Of Electric Drives And Control**	**Hrs.**	**CO 1**
	Definition, Advantages of electrical drives, Components of Electric drive system, Selection Factors, status of Electrical Drives (DC & AC), speed control and drive classifications, close loop control of drives, phase locked loop (PLL) control.	**08 Hrs.**	**CO 1**
UNIT-II	**Dynamics Of Electrical Drives**	**Hrs.**	**CO**
	Motor-Load Dynamics, Speed Torque conventions and multi quadrant operation, Equivalent values of drive parameters. Load Torque Components, Nature and classification of Load Torques, Constant Torque and Constant Power operation of a Drive. Steady state stability, Load equalization.	**08 Hrs.**	**CO 2**
UNIT-III	**DC Motor Drives**	**Hrs.**	**CO**
	DC motors and their performance starting, transient analysis, speed control, ward Leonard drives, Controlled rectifier fed drives, [full controlled 3 phase rectifier control of dc separately excited motor], multi quadrant operation, Chopper controlled drives Closed loop speed control of DC motor.	**08 Hrs.**	**CO 3**
UNIT-IV	**Induction Motor Drives**	**Hrs.**	**CO**
	Induction motor analysis, starting and speed control methods- voltage and frequency control, current control, closed loop control of induction motor drives, rotor resistance control, Slip power recovery – Static Kramer and Scherbius Drive, Single phase induction motor starting, braking and speed control.	**06 Hrs.**	**CO 4**
UNIT-V	**Synchronous Motor And Brushless Dc Motor Drives**	**Hrs.**	**CO**
	Synchronous motor types, operation with fixed frequency, variable speed drives, PMAC and BLDC motor drives, Stepper motor drives, switch reluctance motor drives.	**06 Hrs.**	**CO 5**
UNIT-VI	**Selection of Motor Power Rating**	**Hrs.**	**CO**
	Thermal model of motor for heating and cooling, classes of motor duty, determination of motor ratings.	**06 Hrs.**	**CO 6**

Text Books:

[T1] G. K. Dubey, “Fundamentals of Electric Drives”, 2nd Edition, Narosa Publishing House
[T2] N. K. De, P. K. Sen, “Electric Drives”, Prentice Hall of India Eastern Economy Edition
[T3] S. K. Pillai, “Analysis of Thyristor Power Conditioned Motors”, University Press
[T4] R. Krishnan, “Electric Motor Drives – Modeling Analysis and Control”, PHI India
[T5] G.K. Dubey, “Power Semiconductor controlled drives”, PHI publication

References:

[R1] B. K. Bose, “Modern Power Electronics and AC Drives”, Pearson Education
Malcolm Barnes, “Practical Variable Speed Drives and Power Electronics”, Elsevier Newnes Publications
[R2] V. Subrahmanyam, “Electric Drives: Concepts and Application”, Tata Mc-Graw Hill (An imprint of Elsevier)
[R3] M.D. Singh and Khanchandani “Power Electronics”, Tata Mc-Graw Hill
Austin Huges, “Electrical motor and drives: Fundamental, types and applications”, Heinemann Newnes, London
[R4] Tyagi MATLAB for engineers oxford (Indian Edition)

EE319C: SMART GRID

Teaching Scheme	**Examination Scheme**	
Lectures: 2 Hrs./Week	**Continuous Assessment:**	**20 Marks**
Tutorial: --- Hr./Week	**In-Sem Exam:**	**30 Marks**
	End-Sem Exam:	**50 Marks**
Credits: 2	**Total:**	**100 Marks**

Prerequisites:

1. Basic knowledge of power systems and power electronics.
2. Basic knowledge of computer and communications networks, and some background in probability and random variables, linear algebra, and convex optimization will be helpful.

Course Objectives:

1. To explain the concept of Smart Grid, compare with conventional grid, and identify its opportunities and barriers.
2. To describe the concept of Smart Meter, Smart Appliances, Automatic Meter Reading, Outage Management System, Plug in Hybrid Electric Vehicles, Vehicle to Grid, Smart Sensors, Home and Building Automation, Phase Shifting Transformers.
3. To elaborate the concept of Substation Automation, Feeder Automation. Intelligent Electronic Devices, Wide Area Measurement System, Phase Measurement Unit. and communication infrastructure for smart grid.
4. To acquaint the concept of micro grid with role of Distributed Generations in Smart Grid.
5. To explain Modelling & analysis of AC/DC Smart grid.
6. To acquaint Power Quality issues of Grid connected Renewable Energy Sources, Demand side & Energy management.

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Know the knowledge to differentiate between Conventional and Smart Grid.	2	Understanding
CO2	Identify the need of Smart Grid, Smart metering, Smart storage, Hybrid Vehicles, Home. Automation, Smart Communication.	2	Understanding
CO3	Apply the communication technology in smart grid.	3	Applying
CO4	Concept of Micro grid and distributed generation	2	Understanding
CO5	Need of analysing the modelling to Smart grid	4	Analysing
CO6	To know & Solve the Power Quality problems in smart grid with demand side management.	3	Applying

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	2	1	-	-	-	-	1	-	-	1	-
CO2	2	2	1	-	1	-	-	-	-	-	-	-	-	-
CO3	1	2	1	2	-	-	-	-	-	-	-	-	1	-
CO4	2	2	1	-	1	1	-	-	-	1	-	-	1	-
CO5	2	2	1	1	1	1	-	-	-	-	-	-	1	-
CO6	2	2	1	1	1	-	-	-	-	1	-	-	-	-

Course Contents			
UNIT-I	**INTRODUCTION TO SMART GRID**	**Hrs.**	**COs**
	Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Functions of Smart Grid, Opportunities & Barriers of Smart Grid, Difference between conventional & smart grid, Present development and international policies in Smart Grid, Smart Cities, Pilot projects in India.	06	CO1
UNIT-II	**SMART METERS AND ADVANCE METERING INFRASTRUCTURE**	**Hrs.**	**CO**
	Introduction to Smart meter, Introduction, Smart metering, Evolution of electricity metering, Key components of smart metering, Real Time Prizing, Automatic Meter Reading (AMR), Outage Management System (OMS) Smart Sensors, Smart Appliances, Home and Building Automation, Distributed generation resources, Smart Grid components control elements, Smart Grid Technologies, Plug-in-Hybrid Vehicles (PHEV)	07	CO2
UNIT-III	**SMART GRID TECHNOLOGIES**	**Hrs.**	**CO**
	Smart Grid Monitoring, wide-area monitoring system (WAMS), PMU; Geographic Information System(GIS), Intelligent Electronic Devices(IED) Smart sensors/telemetry, advanced metering infrastructure (AMI),Smart Substations, Substation and Feeder Automation, application for monitoring, protection and control. Communication Technology for Smart Grid	06	CO3
UNIT-IV	**MICRO GRID AND DISTRIBUTED GENERATIONS**	**Hrs.**	**CO**
	Concept of micro grid, need & applications of micro grid, formation of micro grid, Integration of distributed energy sources; concept, operation, control and protection of Micro grid, Islanding detection, Islanding relays, Fault Detection, Isolation and Service Restoration. Digital relays for Smart Grid protections; relay co-ordination, Distributed Energy Resources: Small scale distributed generation, Distributed Generation Technology.	07	CO4
UNIT-V	**INTRODUCTION OF MODELLING TO SMART GRID**	**Hrs.**	**CO**
	Modelling of AC Smart Grid components, Modelling of DC Smart Grid components, Modelling of DC, Smart Grid components, Modelling of storage devices. Operation and control of AC Smart Grid, Operation and control of DC Smart Grid, Simulation and case study of AC microgrid, System analysis of AC/DC Smart Grid.	06	CO5
UNIT-VI	**POWER QUALITY AND DEMAND SIDE MANAGEMENT IN SMART GRID**	**Hrs.**	**CO**
	Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Demand side management of Smart Grid, Demand response analysis of Smart Grid, Energy Management, Design and Practical study of Smart Grid test bed.	06	CO6

Text Books:

[T1] Ali K., M.N. Marwali, Min Dai, "Integration of Green and Renewable Energy in Electric Power Systems", Wiley.

[T2] Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response",CRC Press

[T3] Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", Wiley Publications.

[T4] Stuart Borlase, "Smart Grids-Infrastructure, Technology and Solutions", CRC Press, Taylor and Francis group

[T5] James Momoh, "Smart Grid-Fundamentals of design and analysis", Wiley Publications

References:

[R1] Nikos Ziargyriour, "Micro grid, Architecture and Control", IEEE Press, Wiley Publications

[R2] Yang Xiao, "Communication and Networking in Smart Grids", CRC Press, Taylor and Francis group

[R3] Lars T. Berger and Krzysztof Iniewski, "Smart Grid-Applications, Communications and Security", Wiley Publications

[R4] Mladen Kezunovic, Mark G. Adamiak, Alexander P. Apostolov, Jeffrey George Gilbert "Substation Automation (Power Electronics and Power Systems)", Springer Publications.

[R5] Smart grid handbook for regulators and policy makers November 2017,ISGF

EE320: FEEDBACK CONTROL SYSTEMS LABORATORY

Teaching Scheme	**Examination Scheme**	
Lectures: -- Hrs./Week	**Oral:**	**-- Marks**
Tutorial: -- Hrs./Week	**Practical:**	**50 Marks**
Practical: 02 Hrs./Week	**Term Work:**	**-- Marks**
Credits: 1	**Total:**	**50 Marks**

Prerequisite Course:

1. Knowledge of engineering mathematics, signals & systems, circuit analysis

Course Objectives

1. To introduce different types of system and identify a set of algebraic equations to represent and model a complicated system into a more simplified form to interpret different physical and mechanical systems in terms of electrical system to construct equivalent electrical models for analysis.
2. To employ time domain and frequency domain analysis to predict the performance parameters of the system for standard input functions.
3. Formulate different types of analysis in frequency domain to explain the nature of stability of the system**.**

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Determine transfer function model of any physical system AND use modern computing tools.	3	Applying
CO2	Analyse time domain stability of linear system	4	Analysing
CO3	Determine frequency response of Lead-Lag Compensator	3	Applying
CO4	Analyse frequency response of linear system	4	Analysing
CO5	Transform transfer function to state space model	3	Applying

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	2	2	2	2	-	-	-	1	2	2	3
CO2	3	2	1	2	2	2	2	-	-	-	1	2	2	3
CO3	3	2	1	2	2	2	2	-	-	-	1	2	2	3
CO4	3	2	1	2	2	2	2	-	-	-	1	2	2	3
CO5	3	2	1	2	2	2	2	-	-	-	1	2	2	3

Course Contents			
A. Minimum three experiments should be conducted			
Ex. No	**Name of Experiment**	**Hrs.**	**COs**
1	Experimental determination of DC servo motor parameters for mathematical modelling, transfer function and characteristics	02	CO1
2	Experimental study of time response characteristics of R-L-C second order system: Validation using simulation.	02	**CO2**
3	Experimental analysis of D.C. Motor Position control System.	02	CO1
4	Experimental determination of frequency response of Lead Compensator	02	**CO4**
5	Experimental determination of frequency response of Lag compensator.	02	CO4
6	Experimental determination of transfer function of any one physical systems (AC servomotor/ Two Tank System/Temperature Control / Level Control)	02	**CO1**
B. Minimum five experiments should be conducted (perform using software)			
Ex. No	**Name of Experiment**	**Hrs.**	**COs**
7	To study the basic of MATLAB / Scilab, Different Toolboxes in MATLAB, and Introduction to Control Systems Toolbox	02	CO1
8	Study of basic MATLAB / Scilab commands and matrix constructors and operations	02	**CO1**
9	Time response of 2nd order system subjected to various test inputs	02	CO2
10	Plot unit step responses of given transfer function and find delay time, rise time, peak time and peak overshoot.	02	**CO2**
11	Effect of addition of pole-zero on root locus of second order system	02	CO2
12	Effect of addition of dominant and non - dominant poles on step response of second order system	02	**CO2**
13	Stability analysis using a) Root locus b) Bode Plot	02	CO4
14	Stability analysis using a)Polar Plot b) Nyquist Plot	02	**CO4**
15	Transformation of transfer function model to state space model and vice versa	02	CO5

Text Books:

[T1] I.J. Nagrath, M. Gopal, "Control System Engineering", New Age International Publishers, 5th edition, 2007.
[T2] Katsuhiko Ogata, "Modern control system engineering", Prentice Hall, 2010.
[T3] Nise N. S. "Control Systems Engineering", John Wiley & Sons, Incorporated, 2011

References:

[R1] M. Gopal, "Control Systems: Principles and Design", McGraw Hill Education, 1997.
[R2] B. C. Kuo, "Automatic Control System", Prentice Hall, 1995

E-References

[1] https://nptel.ac.in/courses/107/106/107106081/
[2] https://nptel.ac.in/courses/108/106/108106098/

EE321: POWER SYSTEM OPERATION AND CONTROL LABORATORY

Teaching Scheme	Examination Scheme	
Lectures: -- Hrs./Week	**Oral:**	**50 Marks**
Tutorial: -- Hrs./Week	**Practical:**	**-- Marks**
Practical: 02 Hrs./Week	**Term Work:**	**-- Marks**
Credits: 1	**Total:**	**50 Marks**

Prerequisite Course:

1. Physics

Course Objectives

1. Introduce the power system planning and operational studies
2. Explain in depth knowledge on network matrices.
3. Discuss the power flow studies using GS and NR method
4. Model and predict the behavior and operation of power system components
5. Demonstrate the economic dispatch and electromagnetic transients in the power system
6. Identify & formulate solutions to problems relevant to power system using software tools.

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		Bloom's Taxonomy	
		Level	**Descriptor**
CO1	Estimate the transmission line parameters and load flow analysis in power system.	5	Evaluate
CO2	Acquire knowledge on Formation of Bus Admittance and Impedance Matrices and Solution of Networks.	6	Create
CO3	To model and analyze the single area and two area power system	5	Evaluate
CO4	Solve the economic dispatch problem of power system with and without losses	4	Analyze
CO5	Examine the stability level of Single and Multi-machine system	5	Evaluate
CO6	Ability to employ different techniques to analyze different power system network conditions.	3	Apply

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	1	1	1	1	1	1	2	3	3
CO2	3	3	3	3	3	1	1	1	1	1	1	2	2	3
CO3	3	3	3	3	3	1	1	1	1	1	1	2	3	3
CO4	3	3	3	3	3	1	1	1	1	1	1	2	3	3
CO5	3	3	3	3	3	1	1	1	1	1	1	2	3	3
CO6	3	3	3	3	3	1	1	1	1	1	1	2	3	3

Course Contents			
Ex. No	**Name of Experiment**	**Hrs.**	**COs**
1	MATLAB Program to Solve Swing Equation using Point-by-Point Method	2	CO1
2	To study equal area criteria for transient stability analysis.	2	CO1 CO2
3	Simulink Model of Single Area Load frequency control without PI Controller	2	CO1 CO2
4	Simulink Model of Single Area Load frequency control with PI Controller	2	CO1 CO2
5	To plot exact dynamic response of two area load frequency control without integral action.	2	CO1 CO2
6	Simulink model for two area load frequency control with integral action.	2	CO1 CO3 CO5
7	Simulink model for evaluating transient stability of single machine connected to infinite bus	2	CO1 CO3 CO6
8	Economic Dispatch using Lambda iteration method	2	CO1 CO3 CO4
9	Modelling of IEEE excitation system, turbine and Governor system	2	CO1 CO5 CO6
10	Modeling of FACTS devices using Simulink	2	CO1 CO5 CO6
11	To see the effect of midpoint reactive power compensation on voltage through static var compensator (SVC) and static synchronous compensation (STATCOM)	2	CO1 CO5 CO6
12	Electromagnetic Transients in Power Systems: Transmission Line Energization	2	CO1 CO5 CO6
Any 08 experiments to be performed from above list.			

Text Books:

[T1]. Hemchandra Madhusudan Shertukde, "Power Systems Analysis Illustrated with MATLAB and ETAP", CRC Press Taylor & Francis Group

[T2]. Abhijit Chakrabarti, Sunita Halder, "Power System Analysis Operation and Control", Prentice Hall of India.

[T3]. J. Nagrath, D. P. Kothari, "Modern Power System Analysis", 4th Edition, Tata McGraw Hill Publishing Co. Ltd.,

[T4]. P. S. R. Murthy, "Operation & Control in Power System", B. S. Publication, 2008

References:

[R1]. S. Sreenivasan, G. Sivanagaraju, Power System Operation and Control , Pearson Editions

[R2]. Narain G. Hingorani, Laszlo Gyugyi, "Understanding FACTs" IEEE Press.

[R3]. Allen J. Wood, Bruce F. Wollenberg "Power Generation, Operation, and Control", Wiley India Ed.

E-references:

[E1]. http://vp-dei.vlabs.ac.in/ (Virtual Power Lab)

EE322A: ELECTRICAL MACHINE DESIGN LABORATORY

Teaching Scheme	**Examination Scheme**	
Lectures: -- Hrs./Week	**Oral:**	**50 Marks**
Tutorial: -- Hrs./Week	**Practical:**	**-- Marks**
Practical: 02 Hrs./Week	**Term Work:**	**-- Marks**
Credits: 1	**Total:**	**50 Marks**

Prerequisite Course:

1. Knowledge of various materials used in electrical machines.
2. Knowledge of types, construction and working of transformer.
3. Knowledge of types, construction and working of three phase induction motor.

Course Objectives

1. To make student understand basic of Electrical Machine design.
2. To design transformer.
3. To understand determination of parameters of transformer.
4. To design Induction motor.
5. To understand determination of parameters of Induction motor.
6. To understand computer aided design of electrical machines

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Select proper commercial materials, their properties and selection criterions, IS standards used in electrical machine design.	2	Understanding
CO2	Calculate main dimensions and Design of single phase and three phase transformer.	6	Creating
CO3	Determine the parameters of transformer.	5	Evaluating
CO4	Calculate main dimensions and design of three phase Induction motor.	6	Creating
CO5	Determine parameters of three phase Induction motor.	5	Evaluating
CO6	Apply computer aided optimization techniques for design of electrical machines	3	Applying

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	1	1	1	1	-	1	1	1	3
CO2	3	3	3	3	3	1	1	1	1	-	2	1	1	1
CO3	3	3	3	3	3	1	1	1	1	-	2	1	1	1
CO4	3	3	3	3	3	1	1	2	2	-	2	1	1	1
CO5	3	3	3	3	3	1	1	1	1	-	2	1	1	1
CO6	3	3	3	3	3	1	1	2	2	-	2	1	3	1

Course Contents			
Ex. No	**Name of Experiment**	**Hrs.**	**COs**
1	Design reports along with the drawing sheet on transformer parts.	2	CO 1
2	Design reports along with the drawing sheet on transformer Design.	**4**	**CO 2, CO 3**
3	Design reports along with the drawing sheet on Induction Motor parts.	2	CO 4
4	Design reports along with the drawing sheet on Induction Motor Design.	**4**	**CO 5**
5	Details and layout of AC winding with design report. (Sheet optional CAD or Drawing)	4	CO 6
6	Report based on Industrial visit to a manufacturing unit. (Transformer or Induction motor).	**--**	**CO 3, CO 6**

Text Books:

[T1] M.G. Say – Theory and Performance and Design of A.C. Machines, 3rd Edition, ELBS London.
[T2] A.K.Sawhney – A Course in Electrical Machine Design, 10th Edition, - Dhanpat Rai and sons New Delhi.
[T3] K. G. Upadhyay- Design of Electrical Machines, New age publication
[T4] R. K. Agarwal – Principles of Electrical Machine Design, S. K.Katariya and sons.
[T5] Indrajit Dasgupta – Design of Transformers – TMH

References:

[R1] K.L. Narang , A Text Book of Electrical Engineering Drawings, Reprint Edition : 1993 / 94 – Satya Prakashan, New Delhi.
[R2] A Shanmugasundaram, G. Gangadharan, R. Palani, - Electrical Machine Design Data Book, 3rd Edition, 3rd Reprint 1988 - Wiely Eastern Ltd., - New Delhi
[R3] Vishnu Murti, "Computer Aided Design for Electrical Machines", B.S. Publications.
[R4] Bharat Heavy Electricals Limited, Transformers - TMH.

E-References

[1] https://nptel.ac.in/courses/108/106/108106023/#

EE322B: ELECTRCAL DRIVES LABORATORY

Teaching Scheme	**Examination Scheme**	
Practical: -- 02 Hrs./Week	**Oral:**	**50 Marks**
Tutorial: --Hrs./Week	**Practical:**	**--- Marks**
Credits: 1	**Total:**	**50 Marks**

Prerequisite Course:

1. Construction, working and characteristic of different electrical motors and soft starting Methods.
2. Power Electronic Applications such as converter, inverter, chopper etc.
3. Basic concept of control system.

Course Objectives

1. To understand motor load dynamics.
2. To analyze the operation of the converter fed and chopper fed dc drives.
3. To elaborate braking methods of D.C. and Induction motor drive.
4. To explain vector control of an induction motor.
5. To differentiate synchronous and BLDC motor drives.
6. To identify classes and duty of motor.
7. To describe the modes of operation of drive in various applications.

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Explain motor load dynamics and multi quadrant operation of drives	2	Understanding
CO2	Analyze operation of converter fed and chopper fed DC drives.	4	Analyzing
CO3	Describe braking methods of D.C. and induction motor drive.	2	Understanding
CO4	Explain vector control for induction motor drives	2	Understanding
CO5	Describe synchronous motor drive.	2	Understanding
CO6	Identify classes and duty cycles of motors and applications of drives in industries.	4	Analyzing

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	2	2	1	2	1	1	--	1	2	3	1
CO2	2	1	2	1	2	--	1	--	1	1	2	3	2	--
CO3	3	2	3	--	1	--	1	--	--	1	3	3	2	2
CO4	2	--	--	2	2	1	1	1	2	1	2	2	2	2
CO5	2	2	2	1	1	--	--	1	1	--	2	2	3	2
CO6	3	1	--	--	2	--	2	--	1	1	1	2	2	--

Course Contents			
Ex. No	**Name of Experiment**	**Hrs.**	**COs**
1	Study of Electrical braking of D.C. Shunt motor (Rheostatic, Plugging).	02	01 04
2	Study speed control characteristics of single phase fully converter fed separately excited D.C. motor	02	02 04
3	Study speed control characteristics of 3-ph fully converter fed separately excited D.C. motor	02	03 04
4	Study of Chopper fed D.C. series/separately motor speed control characteristics.	02	04 01
5	Study of electrical braking of 3 phases Induction Motor (DC Dynamic Braking, Plugging).	02	05
6	Study of VSI fed 3 phase Induction motor (using V/f control PWM inverter) speed control characteristics	02	06 01
7	Study of Solid state stator voltage control of 3 phase Induction motor (Using AC voltage Regulator).	02	01
8	Study of constant torque and constant power characteristic of induction motors.	02	02 04
9	Simulation of starting characteristics of D.C. motor.	02	03
10	Simulation of starting characteristics of 3 phase Induction motor.	02	04
11	Study of Closed loop speed control of separately excited D.C. motor/ Induction Motor.	02	05 04
12	Simulation of an electric drive system for steady state and transient analysis.	02	06 01
13	Simulation of closed loop control of synchronous motor	02	01
14	Simulation of chopper controlled DC series motor.	02	02 04

Text Books:

[T1] G. K. Dubey, “Fundamentals of Electric Drives”, 2nd Edition, Narosa Publishing House
[T2] N. K. De, P. K. Sen, “Electric Drives”, Prentice Hall of India Eastern Economy Edition
[T3] S. K. Pillai, “Analysis of Thyristor Power Conditioned Motors”, University Press
[T4] R. Krishnan, “Electric Motor Drives – Modeling Analysis and Control”, PHI India
[T5] G.K. Dubey, “Power Semiconductor controlled drives”, PHI publication

References:

[R1] B. K. Bose, “Modern Power Electronics and AC Drives”, Pearson Education
Malcolm Barnes, “Practical Variable Speed Drives and Power Electronics”, Elsevier Newnes Publications
[R2] V. Subrahmanyam, “Electric Drives: Concepts and Application”, Tata Mc-Graw Hill (An imprint of Elsevier)
[R3] M.D. Singh and Khanchandani “Power Electronics”, Tata Mc-Graw Hill
Austin Huges, “Electrical motor and drives: Fundamental, types and applications”, Heinemann Newnes, London
[R4] Tyagi MATLAB for engineers oxford (Indian Edition)

EE322C: SMART GRID LABORATORY

Teaching Scheme	**Examination Scheme**
Lectures: -- Hrs./Week	**Oral: 50 Marks**
Tutorial: -- Hr./Week	**Practical: -- Marks**
Practical: 02 Hr./Week	**Term Work: -- Marks**
Credits: 1	**Total: 50 Marks**

Prerequisite Course: Power System, Smart Grid, Renewable Energy Resources

Course Objectives

1. To describe the developments of microgrid technology.
2. To analyze and access the Microgrid technology.
3. To describe various battery management systems for electrical energy with fundamental principles, terminology and key issues related to the BMS design requirements technologies.
4. To analyze the impact of power system controllers and the addition of renewable energy source on the power system performance.
5. To analyze sensor signal noise and apply proper hardware techniques to reduce it to acceptable levels.

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Understand the Grid integration of renewable resources such as PV, Wind etc.	2	Understanding
CO2	Understand the impacts of virtual inertia in autonomous mode with diesel generators.	2	Understanding
CO3	Analyze and evaluate the effect of additional sources (like micro turbine, ultra capacitors) in improving the system dynamics performance.	4	Analyzing
CO4	Chose and design an efficient controller for off-grid/grid fed Renewable Energy applications.	4	Analyzing

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	2	1	-	1	-	-	-	2	1	-	2	-	-
CO2	2	2	1	1	1	-	-	-	2	1	-	2	-	-
CO3	2	2	1	1	1	-	-	-	1	1	-	2	-	-
CO4	2	2	1	1	1	-	-	-	2	1	-	2	-	-

Course Contents

Ex. No	**Name of Experiment**	**No.of Hours**	**COs**
1	Study of different components of Smart Grid	**2**	**1**
2	Optimal PMU placements for proper monitoring of power system.	2	1

3	Study of different Smart Grid Technologies	2	3
4	Design of virtual PMU in MATLAB.	**2**	**4**
5	Data capturing from PMU using HIL- PMU setup using C-37 protocol.	2	4
6	PMU data-based power system health monitoring.	**2**	**2**
7	Programmable Relay design and operation of relay with PMU data extracted from PDC in HIL PMU environment.	2	4
8	Wide area control of Two area Kundur system	**2**	**2**
9	Real time wide area control of two area system.	2	2
10	Study of AC Smart Grid components	**2**	**2,3**
11	Case study on "Integrating Electric Vehicles to the Grid".	**2**	**2**
12	Study about basic requirements of grid interconnections.	**2**	**2**

LAB INSTRUCTIONS:

The students have to write an experiment, circuit diagram and tabulation for the validation. The students should develop Simulate/program and execute it on the computer system and get its printout with output.

Text Books:

1. Cutter, Ammond "The Complete Lab Manual For Renewable Energy" Delmar Cengage Learning, ISBN-10 : 1285185048, 2015
2. P.E Claire Soares, "Microturbines: Applications for Distributed Energy Systems", Elsevier Inc., 1st Edition, 2007.

Reference Books:

1. M. H. Nehrir, C. Wang, "Modeling and Control of Fuel Cells: Distributed Generation Applications", Wiley-IEEE Press, 1st Edition, 2009.
2. Rasel Mahmud, Arash Nejadpak, "Smart Microgrids: From design to Laboratory-Scale implementation, Springer International Publishing, 2019.

MC323A: INSTALLATION & MAINTENANCE OF ELECTRICAL APPLIANCES

Teaching Scheme	**Examination Scheme**	
Lectures: 01 Hrs./Week	**Continuous Assessment:**	--
Tutorial: -- Hr./Week	**In-Sem Exam:**	--
Practical: -- Hr./Week	**End-Sem Exam:**	--
Credits: No Credit	**Total:**	--

Prerequisite Course:

Course Objectives

1. To understand the basic concepts, design and estimation of distribution systems & substation
2. To enable candidate to design earthing system for residential and industrial premises
3. To understand practical aspects of condition monitoring and maintenance of various electrical equipment.
4. To learn testing methods of various electrical equipment.

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Classify distribution systems, its types and substations	2	Understanding
CO2	Develop different earthing systems for residential and industrial premises	3	Applying
CO3	Identify methods of condition monitoring and testing of various Electrical Equipment's.	3	Applying
CO4	Understand the testing of different electrical equipment	2	Understanding
CO5	Calculate the Estimation and Costing of residential and industrial premises.	5	Evaluating
CO6	Understand electrical safety	2	Understanding

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
-CO1	2	1	-	-	-	-	-	-	-	-	-	-	2	3
CO2	2	3	-	-	-	-	-	-	-	-	-	-	2	3
CO3	2	1	-	-	-	-	-	-	-	-	-	-	2	3
CO4	2	3	-	-	-	-	-	-	-	-	-	-	2	3
CO5	2	1	-	-	-	-	-	-	-	-	-	-	2	3
CO6	2	1	-	-	-	3	3	-	-	-	-	-	2	1

Course Contents			
UNIT I:	**Distribution Systems**	**Hrs.**	**CO 1**
	Classification of supply systems (State Only) (i)DC, 2-wire system, (ii) Single phase two wire ac system, (iii) Three phase three wire ac supply system, iv) Three phase four wire ac supply system. Comparison between overhead and underground systems on the basis of volume requirement for conductor. AC Distribution System: Types of primary and secondary distribution systems, calculation of voltage drops in ac distributors, Economics of power transmission: Economic choice of conductor (Kelvin's law) (Derivation and Numerical)	---	
UNIT II:	**Substation and Earthing**	**Hrs.**	**CO 2**
	Substation: Classification of substations, Various equipments used in substation with their specifications, Bus bar arrangements in the substation: Simple arrangements like single bus bar, sectionalized single bus bar, main and transfer bus bar system with relevant diagrams. Earthing: Necessity of Earthing, Types of earthing system (Equipment and Neutral), and Maintenance Free Earthing system. Methods of testing earth resistance, Different electrode configurations (Plate and Pipe electrode), Tolerable step and touch voltages, Steps involved in design of substation earthing grid as per IEEE standard 80 – 2000	---	
UNIT III:	**Maintenance and Condition Monitoring**	**Hrs.**	**CO 3**
	Importance and necessity of maintenance, different maintenance strategies like breakdown maintenance, planned/preventive maintenance and condition based maintenance. Planned and preventive maintenance of transformer, Induction motor and Alternators. Insulation stressing factors, Insulation deterioration, polarization index, dielectric absorption ratio. Concept of condition monitoring of electrical equipments. Advance tools and techniques of condition monitoring, Thermography.	---	
UNIT IV:	**Condition Monitoring and Testing of Electrical Equipment**	**Hrs.**	**CO 4**
	Failure modes of transformer, Condition monitoring of oil as per the IS/IEC standards, Filtration/reconditioning of insulating oil, Condition monitoring of transformer bushings, On load tap changer, dissolved gas analysis, degree of polymerization. Induction motor fault diagnostic methods – Vibration Signature Analysis, Motor Current Signature Analysis. Testing of Power cables – Causes of cable failure, fault location methods and Remedial actions. Testing of Transformer - Type tests and Routine tests.	---	
UNIT V:	**Estimation and Costing**	**Hrs.**	**CO 5**
	Introduction, HT, LT overhead lines and underground cables, cable sizing, price catalogue, labour rates, schedule of rates and estimating data (only theory), Estimation and conductor size calculations of internal wiring for Residential and Commercial (Numericals) installations and estimate for underground LT service lines.	---	
UNIT VI:	**Electrical Safety**	**Hrs.**	**CO 6**
	Causes of Accidents, Prevention of Accidents & precautions to be taken. Dangers arising as a result of faulty equipments and tools, chemicals, water, poor joints and insulation strains and moving machines. Contents of first aid box, treatment for cuts, burns and electrical shock. Procedures for first aid (e.g.	---	

	removing casualty from contact with live wire and administering artificial respiration). Various statutory regulations (Electricity supply regulations, factory acts and Indian electricity rules of Central Electricity Authority (CEA), Classification of hazardous area.		

Books:

Text Books:

1. B. R. Gupta- Power System Analysis and Design, 3rd edition, Wheelers publication.
2. S. Rao, Testing Commissioning Operation and Maintenance of Electrical Equipment, Khanna publishers.
3. S. L. Uppal - Electrical Power - Khanna Publishers Delhi.
4. Hand book of condition monitoring by B. K. N. Rao, Elsevier Advance Tech., Oxford (UK).
5. S. K. Shastri – Preventive Maintenance of Electrical Apparatus – Katson Publication House.
6. B. V. S. Rao – Operation and Maintenance of Electrical Equipment – Asia Publication.

References:

1. P.S. Pabla –Electric Power Distribution, 5th edition, Tata McGraw Hill.
2. S. L. Uppal, Electrical Wiring and Costing Estimation, Khanna Publishers, New Delhi.
3. Surjit Singh, Electrical wiring, Estimation and Costing, DhanpatRai and company, New Delhi.
4. Raina K.B. and Bhattacharya S.K., Electrical Design, Estimating and Costing, Tata McGraw Hill, New Delhi
5. B.D. Arora-Electrical Wiring, Estimation and Costing,- New Heights, New Delhi.
6. M.V. Deshpande, Elements of Power Station design and practice, Wheelers Publication.
7. S. Sivanagaraju and S. Satyanarayana, Electric Power Transmission and Distribution, Pearson Publication.

SANJIVANI RURAL EDUCATION SOCIETY'S

SANJIVANI COLLEGE OF ENGINEERING KOPARGAON

(An Autonomous Institute Affiliated to Savitribai Phule Pune University, Pune)

DEPARTMENT OF ELECTRICAL ENGINEERING

COURSE STRUCTURE - 2019 PATTERN

FINAL YEAR B. TECH

Academic Year 2022-23

SANJIVANI RURAL EDUCATION SOCIETY'S

SANJIVANI COLLEGE OF ENGINEERING KOPARGAON

(An Autonomous Institute Affiliated to Savitribai Phule Pune University, Pune)

DEPARTMENT OF ELECTRICAL ENGINEERING

Profile: The Electrical Engineering degree program offer the graduates to enter a dynamic and rapidly changing field with career opportunities in Electric Power System, Power Electronics, Robotics and Control, Microprocessors and Controllers, Integrated Circuits, Computer Software. The demand for electrical power and electronic systems is increasing rapidly and electrical engineers are in great demand to meet the requirements of the growing industry. Electrical Engineers are mainly employed in industries using Electrical Power, Manufacturing Electrical Equipment, Accessories, Electronic Systems, Research and Development departments which work on energy saving devices and Software Development.

Many of these disciplines overlap with other engineering branches, spanning a huge number of specializations including hardware engineering, electromagnetic and waves, microwave engineering, nanotechnology, electrochemistry, renewable energies, Artificial Intelligence, mechatronics, and electrical materials science. Identifying these areas today's Electrical Engineer needs to have the capacity of adaptability and creativity in these new technical eras, to meet the industry 4.0.

Electrical Engineering Department of Sanjivani College of Engineering offers the B. Tech. course in Electrical Engineering with an intake of 60 students. The department has well qualified and dedicated faculty and is known for its high academic standards, well-maintained discipline, and complete infrastructure facilities.

Vision of Department

To produce quality electrical engineers with the knowledge of latest trends, research technologies to meet the developing needs of industry & society

Mission of Department

M1: To impart quality education through teaching learning process

M2: To establish well-equipped laboratories to develop R&D culture in contemporary and sustainable technologies in Electrical Engineering

M3: To produce Electrical Engineering graduates with quest for excellence, enthusiasm for continuous learning, ethical behavior, integrity and nurture leadership

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, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, society, 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 modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning in formed by the contextual knowledge to assess social, 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 the set of 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)

The PEOs of undergraduate programme in Electrical Engineering are broadly classified as follows:

PEO 1: Equip the student to analyze and solve real world problems to face the challenges of future.

PEO 2: Pursue higher education, research in Electrical Engineering or other allied fields of their interest for professional development.

PEO 3: Exhibit the leadership skills and ethical value for society

Program Specific Objectives (PSOs)

PSO 1: Apply the fundamentals of mathematics, science and engineering knowledge to identify, formulate, design and investigate complex engineering problems of electric circuits, analog and digital electronics circuits, control systems, electrical machines and Power system.

PSO 2: Apply the appropriate modern engineering hardware, and software tools in electrical engineering to engage in life-long learning and to successfully adapt in multi-disciplinary environments.

COURSE STRUCTURE- 2019 PATTERN
FINAL YEAR B. TECH. ELECTRICAL ENGINEERING

SEMESTER-VII

Course			Teaching Scheme Hours/week				Evaluation Scheme-Marks						
							Theory						
Cat.	Code	Title	L	T	P	Credits	ISE	ESE	CIA	OR	PR	TW	Total
PRJ	EE401	Professional Internship	-	-	-	2	-	-	-	50	-	-	50
PCC	EE402	Switch Gear and Protection	3	-	-	3	30	50	20	-	-	-	100
PCC	EE403	Control System Design	3	-	-	3	30	50	20	-	-	-	100
PEC	EE404	Professional Elective- III	3	-	-	3	30	50	20	-	-	-	100
OEC	EE405	Open Elective-II	3	-	-	3	-	75	25	-	-	-	100
OEC	EE406	Open Elective-III	2	-	-	2	-	30	20	-	-	-	50
LC	EE407	Switch Gear and Protection Laboratory	-	-	2	1	-	-	-	-	50	-	50
LC	EE408	Control System Design Laboratory	-	-	2	1	-	-	-	50	-	-	50
PRJ	EE409	Project Stage I	-	-	4	2	-	-	-	50	-	-	50
MLC	MC410	Mandatory Learning Course-VII	1	-	-	No Credit	-	-	-	-	-	-	-
		Total	**15**	**-**	**8**	**20**	**90**	**255**	**105**	**150**	**50**	**00**	**650**

EE404	Professional Elective- III	**EE404A**	Electric and Hybrid Vehicle
		EE404B	HVDC Transmission Systems
		EE404C	Digital Signal Processing
EE405	Open Elective-II	**EE405A**	Problem Solving Through Programming in C
		EE405B	Introduction to Industry 4.0 and Industrial IOT
		EE405C	Data Structure and Algorithm Using JAVA
		EE405D	Real-Time Digital Signal Processing
EE406	Open Elective-III	**EE406A**	Introduction to BMS
		EE406B	Real-Time Embedded Systems Concepts and Practices
		EE406C	Introduction to Data Science in Python
MC410	Mandatory Learning Course-VII	**MC410A**	Circuit Simulation and PCB Design

COURSE STRUCTURE- 2019 PATTERN
FINAL YEAR B. TECH. ELECTRICAL ENGINEERING

SEMESTER-VIII

Course			Teaching Scheme Hours/week				Evaluation Scheme-Marks						
							Theory						
Cat.	Code	Title	L	T	P	Credits	ISE	ESE	CIA	OR	PR	TW	Total
PROJ	**EE411**	Power Quality and FACTs	3	-	-	3	30	50	20	-	-	-	100
PCC	**EE412**	High Voltage Engineering	3	-	-	3	30	50	20	-	-	-	100
PCC	**EE413**	EHV and UHV AC Transmission	3	-	-	3	30	50	20	-	-	-	100
PEC	**EE414**	Professional Elective-IV **A.** Intelligent Systems with AI and ML **B.** IOT Applications **C.**VLSI Circuits	3	-	-	3	30	50	20	-	-	-	100
LC	**EE415**	Power Quality and FACTs Laboratory	-	-	2	1	-	-	-	50	-	-	50
LC	**EE416**	High Voltage Engineering Laboratory	-	-	2	1	-	-	-	-	50	-	50
PROJ	**EE417**	Project Stage II	-	-	8	4	-	-	-	50	-	100	150
MLC	**MC418**	Mandatory Learning Course-VIII **A.** Industrial Technology and Management	1	-	-	Non Credit	-	-	-	-	-	-	Pass/Fail
		Total	**13**	**-**	**12**	**18**	**120**	**200**	**80**	**100**	**50**	**100**	**650**

SEMESTER VII

EE401: PROFESSIONAL INTERNSHIP III	
Teaching Scheme	**Examination Scheme**
Lectures: - Hrs./Week	**Oral Exam: 50 Marks**
Tutorials: - Hrs./ week	**Total : 50 Marks**
Credits: 2	

Course Outcome (s)		Bloom's Taxonomy	
		Level	Descriptor
CO1	Demonstrate content knowledge appropriate to job assignment.	3	Apply
CO2	Demonstrate abilities of a responsible professional and use ethical practices in day to day life.	3	Apply
CO3	Analyse various career opportunities and decide career goals.	4	Analyse

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	3	3	1	2	3	3	3	-	-
CO2	3	3	3	3	3	3	3	3	3	3	3	3	-	-
CO3	2	2	1	2	2	2	3	3	1	2	2	3	-	-

GUIDELINES FOR INTERNSHIP

An Internship is a professional learning experience that offers meaningful, practical work related to a student's field of study or career interest. An internship gives a student the opportunity for career exploration and development and learns new skills. Hence Sanjivani College of Engineering offers a month-long exposure (4-6 Weeks) to the students in the form of internship in organizations/in house training/ online courses in the reputed institutes. Students are involved in this internship at the end of their even semester. After completion of internship/online courses students has to produce Certificate. Students shall be awarded internship credits only when they will pass the oral (Viva) examination of 50 marks, based on experience or online certification.

Following are the intended objectives of internship training:

- Will expose technical students to the industrial environment, which cannot be simulated in the classroom and hence creating competent professionals for the industry.
- Provide possible opportunities to learn, understand and sharpen the real time technical/managerial skills required at the job.
- Exposure to the current technological developments relevant to the subject area of training.
- Experience gained from the 'Industrial Internship' will be used in classroom discussions.
- Create conditions conducive to quest for knowledge and its applicability on the job.
- Learn to apply the technical knowledge in real industrial situations.
- Gain experience in writing technical reports/projects.
- Expose students to the engineer's responsibilities and ethics.

- Familiarize with various materials, processes, products and their applications along with relevant aspects of quality control.
- Promote academic, professional and/or personal development.
- Expose the students to future employers.
- Understand the social, economic and administrative considerations that influence the working environment of industrial organizations
- Understand the psychology of the workers and their habits, attitudes and approach to problem solving.

Recommended Internship (Online/Offline) organizations and platforms as follows but not limited to

1. Government Organizations such as MSEDCL, MAHATRANSCO, MAHAGENCO, LDC Center's etc.
2. Government and Private Industries such as BHEL, BEL, Indian Railways, MMRDA, BOSCH, L&T, Crompton Greaves, Kirloskar Industries, RCSS Enerzies Pvt Ltd. etc…
3. Government and Private Institutions such as IITs, NITs, IIITs, IISc, IISER, NCL, NAL, BITs Pilani, etc
4. International Universities such as UrFU, Russia etc.
5. Online Platforms such as Coursera, EDx, NPTEL, Internshala, etc.
6. In-house Training like SAP, CELEBAL, Virtusa and Projects.

EE402: SWITCHGEAR AND PROTECTION

Teaching Scheme	**Examination Scheme**	
Lectures: 3 Hrs./Week	**Continuous Assessment:**	**20 Marks**
Tutorial: --- Hr/Week	**In-Sem Exam:**	**30 Marks**
	End-Sem Exam:	**50 Marks**
Credits: 3	**Total:**	**100 Marks**

Prerequisite Course:

1. Different type of faults in power system.
2. Various switchgears and their use in substation.
3. Principle and working of rotating machines and transformer with vector groups

Course Objectives

1. Acquaint about construction and working principle of different types of HVCBs.
2. Elaborate the Need of protective Relaying and operating principles of different types of relays.
3. Explain different type of faults in transformer, alternator and 3 phase Induction motor and various protective schemes related to them.
4. Impart knowledge about transmission line protection schemes and characteristics of different types of distance relays.

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Understand the different types of relay configuration.	2	Understanding
CO2	Derive expression for restriking voltage and RRRV in circuit breaker	4	Analysing
CO3	Explain construction and working of different high voltage circuit breakers such as ABCB, SF6 CB, and VCB.	2	Understanding
CO4	Classify and describe different type of relays such as over current relay, Reverse power relay, directional over current relay, Differential relay, Distance relay, Static relay and numerical relay.	2	Understanding
CO5	Describe various protection schemes used for transformer, alternator and busbar.	2	Understanding
CO6	Describe transmission line protection schemes.	2	Understanding

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	2	1	-	-	-	1	-	-	1	-	1	2
CO2	1	2	2	1	-	-	-	1	-	-	1	-	1	2
CO3	1	1	2	1	-	-	-	1	-	-	1	-	1	2
CO4	1	1	2	1	-	-	-	1	-	-	1	-	1	2
CO5	1	1	2	1	-	-	-	1	-	-	1	-	1	2
CO6	1	1	2	1	-	-	-	1	-	-	1	-	1	2

Course Contents			
UNIT-I	**Fundamentals of protective relaying**	**Hrs.**	**COs**
	Need for protective system, nature and causes of fault, types of faults, effects of faults, evolution of protective relaying, classification of relays, zones of protection, primary and backup protection, essential qualities of protective relaying. Trip circuit of circuit breaker, zone of protection. Various basic operating principles of protection- over current, (current graded and time graded), directional over current, differential, distance, induction type relay, torque equation in induction type relay, current and time setting in induction relay, Numericals on TSM , PSM and operating time of relay	8	1
UNIT-II	**Fundamentals of arc interruption**	**Hrs.**	**CO**
	Ionization of gases, deionization, Electric arc formation , Current interruption in AC circuit breaker, high and low resistance principles, arc interruption theories, arc voltage, recovery voltage, derivation and definition of restriking voltage and RRRV, current chopping, interruption of capacitive current, resistance switching, Numerical on RRRV, current chopping and resistance switching.	6	2
UNIT-III	**Circuit Breaker**	**Hrs.**	**CO**
	Different ratings of circuit breaker (like rated voltage, rated current, rated frequency, rated breaking capacity – symmetrical and unsymmetrical breaking, making capacity, rated interrupting duties, rated operating sequence, short time rating). Classification of high voltage circuit breaker. Working and constructional features of ACB, SF6 VCB-advantages, disadvantages and applications. Auto reclosing.	5	3
UNIT-IV	**Static and Digital Relaying and 3 Phase Induction Motor Protection**	**Hrs.**	**CO**
	A) Static and Digital Relaying Overview of Static relay, block diagram, operating principal, merits and demerits of static relay. Numerical Relays: -Introduction and block diagram of numerical relay, Sampling theorem, Anti –Aliasing Filter, Block diagram of PMU B) 3 Phase Induction Motor Protection Abnormal conditions and causes of failures in 3 phase Induction motor, single phasing protection, Overload protection, Short circuit protection.	5	4
UNIT-V	**Transformer Protection and Alternator Protection**	**Hrs.**	**CO**
	A) Transformer Protection Types of faults in transformer, Percentage differential protection in transformers, Restricted E/F protection, incipient faults, Buchholz relay, protection against over fluxing, protection against inrush current, B) Alternator Protection Various faults in Alternator, abnormal operating conditions-stator faults, longitudinal percentage differential scheme and transverse percentage differential scheme. Rotor fault abnormal operating conditions, inter turn fault, unbalance loading, over speeding, loss of excitation	6	5
UNIT-VI	**Transmission line protection**	**Hrs.**	**CO**
	Over current protection for feeder using directional and non directional over current relays, Introduction to distance protection, impedance relay, reactance relay, mho relay and Quadrilateral Relays, Introduction to PLCC, block diagram, advantages, disadvantages, three stepped distance protection, Realization of distance relays(impedance, reactance, and mho relay) using numerical relaying algorithm(flowchart, block diagram), Introduction to Wide Area Measurement (WAM) system.	6	6

Text Books:

[T1] S. Rao, "Switchgear Protection and Power Systems", Khanna Publications
[T2] Y. G. Paithankar, S. R. Bhide, "Fundamentals of Power System Protection", Prentice Hall of India
[T3] Bhavesh Bhalja,R.P. Maheshwari, N.G. Chothani," Protection and Switchgear", Oxford University Press, 2011 Edition.
[T4] J.B.Gupta " Switchgear and Protection", S.K. Kataria and Sons.

References:

[R1] Badri Ram, D. N. Vishwakarma, "Power System Protection and Switchgear" Tata McGraw Hill Publishing Co. Ltd.
[R2] J Lewis Blackburn , "Protective Relaying- Principles and Applications", Dekker Publications.
[R3] A.G. Phadke, J.S. Thorp ,Computer relaying for Power System , Research Studies Press LTD, England.(John Willy and Sons Inc New York)
[R4] Mason C.R., "Art and Science of Protective Relaying", Wiley Eastern Limited.
[R5] Arun Ingole, "Switchgear and Protection", Pearson.

E-References

[1] Prof. Dr S.A. Soman, IIT Mumbai, A Web course on "Digital Protection of power System"
http://www.cdeep.iitb.ac.in/nptel/Electrical%20Engineering/Power%20System %20Protection/Course_home_L27.html

EE403: CONTROL SYSTEM DESIGN

Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs./Week	**Continuous Assessment:**	**20 Marks**
Tutorial: --- Hr/Week	**In-Sem Exam:**	**30 Marks**
	End-Sem Exam:	**50 Marks**
Credits: 3	**Total:**	**100 Marks**

Prerequisite Course:

1. Control System Engineering
2. Matrix Algebra, Z-transform, and Laplace transform

Course Objectives

1. Make students identify various characteristics of nonlinear systems.
2. Develop skills for analysing nonlinear systems.
3. Make students study features and configurations of digital control systems.
4. Understand the practical controllers and compensators

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		Bloom's Taxonomy	
		Level	**Descriptor**
CO1	Understand the various nonlinearities and their behaviour observed in real world and analyse the nonlinear system using various techniques	2 4	Understanding Analyse
CO2	Analyse the system using state space approach	4	Analysing
CO3	Test controllability and observability properties of the system	5	Evaluating
CO4	Understand the concepts of Digital control systems	2	Understanding
CO5	Analyse system with P, I and D controller	4	Analysing
CO6	Evaluate the system performance and apply the compensator concepts	5	Evaluating

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	2	2	-	-	-	-	-	-	1	1	1
CO2	2	3	2	2	1	-	-	-	-	-	-	1	1	1
CO3	2	3	2	2	1	-	-	-	-	-	-	1	1	1
CO4	2	3	3	3	2	-	-	-	-	-	-	1	1	1
CO5	2	3	2	2	2	-	-	-	-	-	-	1	1	1
CO6	2	3	2	1	1	-	-	-	-	-	-	1	1	1

Course Contents			
UNIT-I	**Nonlinear Control Systems**	**Hrs.**	**COs**
	introduction to nonlinear systems, common nonlinearities, describing function method, describing function of an ideal relay, stability analysis with describing function, introduction to Lyapunov stability analysis (basic concepts, definitions, and stability theorem)	06	CO1
UNIT-II	**Introduction to State-Space**	**Hrs.**	**CO**
	Concept of state, state-space representation of dynamical systems in physical variable form, phase variable forms and Jordon / diagonal canonical form, conversion of the transfer function to state-space model and vice versa, state equation and its solution, state transition matrix and its properties, computation of state transition matrix by Laplace transform and Caley Hamilton method.	08	CO2
UNIT-III	**State-Space Design**	**Hrs.**	**CO**
	The concept of controllability and observability, Kalman's and Gilbert's tests for controllability and observability, effect of pole-zero cancellation, duality property, control system design using pole-placement using transformation matrix, direct substitution, and Ackermann's formula, State observers, design of a full- order observer.	08	CO3
UNIT-IV	**Introduction to Digital Control System**	**Hrs.**	**CO**
	Basic block diagram of the digital control system, sampling and reconstruction, Shannon's Sampling theorem, zero-order hold and its transfer function, First-order hold (no derivation), characteristics equation, mapping between s-plane and z-plane, stability analysis in z-plane.	06	CO4
UNIT-V	**P, I and D Controllers**	**Hrs.**	**CO**
	Introduction to Proportional (P), Integral (I) & Derivative (D)controller, individual effect on overall system performance, P-PI & PID control and effect on overall system performance, Numerical examples.	08	CO5
UNIT-VI	**Compensator Design in Frequency Domain**	**Hrs.**	**CO**
	Approach to control system design, cascade compensation networks, phase-lead and phase-lag compensator designs using bode plot, physical realization of compensators.	06	CO6

Text Books:

[T1] Norman S. Nise, Control System Engineering, Sixth Edition, John Wily and Sons, Inc. 2011.
[T2] Richard C. Dorf, Robert H. Bishop, Modern Control Systems, Twelfth Edition, Pearson Ed.
[T3] Benjamin C. Kuo, Digital Control System, Second Edition, Oxford University Press, 2003.
[T4] I. J. Nagarath, M. Gopal, Control System Engineering, Fourth Edition, New Age International (P) Limited, Publishers
[T5] A. Nagoor Kani, Advanced Control Theory, Third Edition, CBS Publishers and Distributes.

References:

[R1] M. Gopal, "Control Systems: Principles and Design", McGraw Hill Education, 1997.
[R2] B. C. Kuo, "Automatic Control System", Prentice Hall, 1995

E-Resources:

[E1] https://nptel.ac.in/courses/108102043
[E2] https://nptel.ac.in/courses/108102113

EE404A: ELECTRIC AND HYBRID VEHICLE

Teaching Scheme	**Examination Scheme**	
Lectures: 3 Hrs./Week	**Continuous Assessment:**	**20 Marks**
	In-Sem Exam:	**30 Marks**
	End-Sem Exam:	**50 Marks**
Credits: 3	**Total:**	**100 Marks**

Prerequisite Course:

1. Basic concept of Batteries
2. Electrical motors
3. Power electronic conversion

Course Objectives

1. To make students aware the need and importance of Electric, Hybrid Electric Vehicles and Fuel cell vehicle.
2. To differentiate and analyze the various energy storage devices and battery charging and management systems.
3. To impart knowledge about architecture and performance of Electric and Hybrid Vehicles
4. To classify the different drives and controls used in electric vehicles.

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Review history, Social and environmental importance of Hybrid and Electric vehicles.	2	Understanding
CO2	Describe the performance and selection of energy storage systems	2	Understanding
CO3	Analyze battery management system	4	Analysing
CO4	Distinguish between the performance and architecture of various drive trains	2	Understanding
CO5	Describe the different Instrumentation and Control used for electric vehicles	2	Understanding
CO6	Differentiate between Vehicle to Home, Vehicle to Vehicle and Vehicle to Grid energy systems concepts	2	Understanding

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	-	-	-	-	2	-	2	-	-	-	2	2
CO2	2	2	-	-	-	-	2	-	2	-	-	-	2	2
CO3	2	3	-	-	-	-	2	-	2	-	-	-	2	2
CO4	2	2	-	-	-	-	2	-	2	-	-	-	2	2
CO5	2	2	-	-	-	-	2	-	2	-	-	-	2	2
CO6	2	2	-	-	-	-	2	-	2	-	-	-	2	2

Course Contents			
UNIT-I	**Introduction**	**Hrs.**	**COs**
	Conventional Vehicle: Basic of Vehicle performance, vehicle power source characterization, transmission characterization. Need and importance of transportation development. History of Electric Vehicle, Hybrid Electric Vehicle and Fuel cell Vehicle. Social and environmental importance of Hybrid and Electric vehicles. Impact of modern drive-trains on energy supplies.	5	CO1
UNIT-II	**Energy Storage Systems**	**Hrs.**	**CO**
	Introduction to energy storage requirements in Hybrid and Electric vehicles, battery-based energy storage and its analysis, Fuel cell based energy storage and its analysis, Ultra capacitor based energy storage and its analysis, flywheel based energy storage and its analysis. Hybridization of energy sources for Hybrid and Electric vehicle: - Hybridization of drive trains in HEVs, Hybridization of energy storage in EVs. Selection of energy storage technology.	7	CO2
UNIT-III	**Battery charging and Management systems**	**Hrs.**	**CO**
	Introduction, charging algorithm, balancing method for battery pack charging. Battery management system representation: - battery module, measurement unit block, battery equalisation balancing unit, MCU estimation unit, display unit, fault warning block. SoC and SoH, estimation of SoC, battery balancing, Thermal monitoring of Battery unit.	6	CO3
UNIT-IV	**Hybrid and Electric vehicles**	**Hrs.**	**CO**
	Electric vehicles: - Components, configuration, performance, tractive efforts in normal driving, Advantages and challenges in EV design. Hybrid Electric vehicles: - Concept and architecture of HEV drive train (Series, parallel and series-parallel).Energy consumption of EV and HEV	5	CO4
UNIT-V	**Drives and control systems**	**Hrs.**	**CO**
	Drives: - Application of BLDC drives and Switched reluctance motor drive for HEV and EV, performance characteristics of drives. Instrumentation and control system related to Hybrid and Electric vehicles, speed control, acceleration characteristics, Electric steering, motion control, braking mechanism, Vehicle tracking through GPS, over speed indicating systems, Auto-parking systems	7	CO5
UNIT-VI	**Vehicle to Home, Vehicle to Vehicle and Vehicle to Grid energy systems**	**Hrs.**	**CO**
	Vehicle to Home(V2H): PHEV control Strategies to V2H applications, V2H with demand response. Vehicle to Vehicle (V2V): - Concept and structure of EV aggregator, control method for EV aggregator for dispatching a fleet of EV. Vehicle to Grid (V2G): - planning of V2G infrastructure in the smart grid, ancillary services provided by V2G, cost emission optimization.	6	CO6
Text Books:			
[T1] James Larminie and John Lowry, "Electrical Vehicle", John Wiley and Sons, 2012. [T2] Ronald K. Jurgen, "Electric and Hybrid-Electric Vehicles", SAE International Publisher. [T3] K T Chau, "Energy Systems for Electric and Hybrid Vehicles", The institution of Engineering and Technology Publication [T4] D.A.J Rand, R Woods, R M Dell, "Batteries for Electric Vehicles", Research studies press Ltd, New York, John Willey and Sons [T5] Electric and Hybrid Vehicles-Design Fundamentals, CRC press [T6] Mark Warner, The Electric Vehicle Conversion handbook –HP Books, 2011.			
References:			

[R1] Mehrdad Ehsani, Yimin Gao and Ali Emadi, "Modern Electrical Hybrid Electric and Fuel Cell Vehicles: Fundamental, Theory and design", CRC Press, 2009.
[R2] "Automotive handbook 5 th edition", Robert Bosch, SAE international publication.

E-References

[1] Junwei Lu, Jahangir Hossain,"Vehicle-to-Grid: Linking Electric Vehicles to the Smart Grid", IET Digital Library
[2] Automobile Electrical and Electronic systems, Tom Denton, SAE International publications.
[3] https://nptel.ac.in/courses/108/106/108106170/

EE404B: HVDC TRANSMISSION SYSTEMS

Teaching Scheme	**Examination Scheme**	
Lectures: 3 Hrs./Week	**Continuous Assessment:**	**20 Marks**
Tutorial: - Hrs/Week	**In-Sem Exam:**	**30 Marks**
	End-Sem Exam:	**50 Marks**
Credits: 3	**Total:**	**100 Marks**

Prerequisite Course: Power System-I, II, Control System-I & II, Power Electronics

Course Objectives

1. To introduce students with the concept of HVDC Transmission system.
2. To familiarize the students with the HVDC converters and their control system.
3. To expose the students to the harmonics and faults occur in the system and their prevention

Course Outcomes (COs):

After successful completion of the course, student will be able to

	Course Outcome (s)	**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Develop the knowledge of HVDC transmission and HVDC converters and the applicability and advantage of HVDC transmission over conventional AC transmission.	6	Develop
CO2	Formulate and solve mathematical problems related to rectifier and inverter control methods and learn about different control schemes as well as starting and stopping of DC links	3	Apply
CO3	Analyze the different harmonics generated by the converters and their variation with the change in firing angles.	4	Analyze
CO4	Develop harmonic models and use the knowledge of circuit theory to develop filters and assess the requirement and type of protection for the filters.	6	Develop
CO5	Study and understand the nature of faults happening on both the AC and DC sides of the converters and formulate protection schemes for the same.	2	Understand
CO6	Review the existing HVDC systems along with MTDC systems and their controls and recognize the need to follow the advancements in both the existing systems and HVDC systems and determine the most economic coexistence of both.	2	Understand

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	3	3	1	3	3	-	3	3	2	1	-	-
CO2	2	2	2	2	2	-	-	3	3	2	2	2	-	-
CO3	3	2	-	-	1	-	3	-	3	3	-	3	-	-
CO4	2	3	1	-	2	3	3	-	2	3	2	2	-	-
CO5	3	1	-	2	-	3	3	2	3	3	2	2	-	-
CO6	2	-	2	3	2	3	2	3	-	-	-	3	-	-

Course Contents			
UNIT I	**INTRODUCTION**	**Hrs.**	**CO**
	Introduction of DC power transmission technology, comparison of AC and DC transmission, limitation of HVDC transmission, reliability of HVDC systems, application of DC transmission, description of DC transmission system, planning for HVDC transmission, modern trends in DC transmission.	**6**	**CO1& CO6**
UNIT II	**ANALYSIS OF HDVC CONVERTERS**	**Hrs.**	**CO**
	Choice of converter configuration, simplified analysis of Graetz circuit, converter bridge characteristics, Characteristics of a twelve-pulse converter, detailed analysis of converters.	**6**	**CO1 & CO2**
UNIT III	**CONTROL OF HVDC CONVERTER AND SYSTEMS**	**Hrs.**	**CO**
	Necessity of control of a DC link, rectifier control, compounding of rectifiers, power reversal of DC link, voltage dependent current order limit(VDCOL) characteristics of the converter, inverter extinction angle control, pulse phase control, starting and stopping of DC link, constant power control, control scheme of HVDC converters	**6**	**CO2**
UNIT IV	**HARMONICS AND FILTERS**	**Hrs.**	**CO**
	Generation of harmonics by converters, characteristics of harmonics on DC side, characteristics of current harmonics, characteristic variation of harmonic currents with variation of firing angle and overlap angle, effect of control mode on harmonics, non-characteristic harmonic. Harmonic model and equivalent circuit, use of filter, filter configuration, design of band pass and high pass filter, protection of filters, DC filters, power line communication and RInoise, filters with voltage source converter HDVC schemes.	**8**	**CO2, CO3. CO4. CO5**
UNIT V	**FAULT AND PROTECTION SCHEMES IN HVDC SYSTEMS**	**Hrs.**	**CO**
	Nature and types of faults, faults on AC side of the converter stations, converter faults, fault on DC side of the systems, protection against over currents and over voltages, protection of filter units	**4**	**CO2, CO4. CO5**
UNIT VI	**MULTITERMINAL HVDC SYSTEMS**	**Hrs.**	**CO**
	Types of multiterminal (MTDC) systems, parallel operation aspect of MTDC. Control of power in MTDC. Multilevel DC systems. Power upgrading and conversion of AC lines into DC lines, Parallel AC/DC systems, FACTS and FACTS converters.	**6**	**CO5. CO6**

Text Books & Reference Books:

1. HVDC Transmission, S. Kamakshaiah& V. Kamaraju, Tata McGraw hill education
2. HVDC Power transmission system, K.R.Padiyar, Wiley Eastern Limited
3. High Voltage Direct Current Transmission, J. Arrillaga, Peter Pregrinu
4. Power System Stability and Control by PrabhaKundur, McGraw hill
5. Power System Analysis: Operation and Control, AbhijitChakrabarti and SunitaHalder, PHI Learning Pvt. Ltd

EE404C: DIGITAL SIGNAL PROCESSING

Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs./Week	**Continuous Assessment:**	**20 Marks**
Practical : -- Hr/Week	**In-Sem Exam:**	**30 Marks**
	End-Sem Exam:	**50 Marks**
Credits: 3	**Total:**	**100 Marks**

Prerequisite Course:

1. Knowledge of basic signals and systems

Course Objectives

1. To elaborate Sampling theorem
2. To classify discrete signals and systems
3. To analyze DT signals with Z transform, inverse Z transform and DTFT
4. To describe Frequency response of LTI system
5. To introduce Digital filters and analyze the response
6. To demonstrate DSP Applications in electrical engineering

Course Outcomes (COs):

After successful completion of the course, student will be able to

1. Sample and reconstruct any analog signal
2. Construct frequency response of LTI system
3. Evaluate Fourier Transform of discrete signals
4. Design IIR filter and its implementation
5. Design FIR filter and implementation
6. Develop block diagram for DSP applications to electrical engineering

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Sample and reconstruct any analog signal	2	Understanding
CO2	Construct frequency response of LTI system	6	Creating
CO3	Evaluate Fourier Transform of discrete signals	5	Evaluating
CO4	Design IIR filter and its implementation	3	Applying
CO5	Design FIR filter and implementation	3	Applying
CO6	Develop block diagram for DSP applications to electrical engineering	3	Applying

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	1	1	--	--	--	--	--	2	2	2
CO2	2	2	2	2	2	2	--	--	--	--	--	2	2	2
CO3	2	2	2	2	2	2	--	--	--	--	--	2	2	2
CO4	1	1	2	1	1	1	--	--	--	--	--	2	2	2
CO5	2	2	2	1	1	1	--	--	--	--	--	1	2	2
CO6	1	1	2	1	1	1	--	--	--	--	--	1	1	1

Course Contents			
UNIT-I	**Classification of Signals:**	**Hrs.**	**COs**
	Analog, Discrete-time and Digital signals, Basic sequences and sequence operations, Discrete-time systems, Properties of D. T. Systems and Classification, Linear Time Invariant Systems, impulse response, linear convolution and its properties, properties of LTI systems: stability, causality, parallel and cascade connection, Linear constant coefficient difference equations, Periodic Sampling, Sampling Theorem, Frequency Domain representation of sampling, reconstruction of a band limited Signal, A to D conversion Process: Sampling, quantization and encoding.	**(06 Hrs)**	CO1
UNIT-II	**Z-transform, Inverse Z-transform and its properties:**	**Hrs.**	**CO**
	Unilateral Z-transform, Z transform properties: Linearity, time shifting, multiplication by exponential sequence, differentiation, conjugation, time reversal, convolution, initial value theorem, Inverse z transform by inspection, partial fraction, power series expansion and complex inversion, solution of difference equation	**(06 Hrs)**	CO2
UNIT-III	**Discrete Time Fourier Transform** :	**Hrs.**	**CO**
	Representation of Sequences by Fourier Transform, Symmetry properties of D. T., F. T. theorems: Linearity, time shifting, frequency shifting, time reversal, differentiation, convolution theorem, Frequency response analysis of first and second order system, steady state and transient response	**(06 Hrs)**	CO3
UNIT-IV	**Discrete Fourier Transform :**	**Hrs.**	**CO**
	Sampling theorem in frequency domain. The Discrete Fourier Transform, Relation with z transform Properties of DFT: Linearity, circular shift, duality, symmetry, Circular Convolution, Linear Convolution using DFT, Effective computation of DFT and FFT, DIT FFT, DIF FFT, Inverse DFT using FFT	**(06 Hrs)**	CO4
UNIT-V	**Frequency Response of LTI Systems:**	**Hrs.**	**CO**
	Ideal frequency selective filters, Concept of filtering, specifications of filter, IIR filter design from continuous time filters: Characteristics of Butterworth, and Cheybyshev low pass filter, impulse invariant and bilinear transformation techniques, Design examples, Basic structures for IIR Systems: direct form, cascade form	**(06 Hrs)**	CO5
UNIT-VI	**FIR filter design using windows:**	**Hrs.**	**CO**
	specifications of properties of commonly used windows, Design Examples using rectangular, and hanning windows. Basic Structures for FIR Systems: direct form. Comparison of IIR and FIR Filters Applications: Measurement of magnitude and phase of voltage, current, power, frequency and power factor correction, harmonic Analysis and measurement, applications to machine control, DSP based protective relaying.	**(06 Hrs)**	CO6

Text Books:

[T1]	Proakis J., Manolakis D., "Digital signal processing", 3rd Edition, Prentice Hall, ISBN 81- 203-0720-8
[T2]	P. Ramesh Babu, "Digital Signal Processing", 4th Edition Scitech Publication
[T3]	nd Edition Wiley India Pvt. Ltd ISBN: 978-81-265-2142-5
[T4]	W.Rebizant, J.Szafran, A.Wiszniewski, "Digital Signal Processing in Power system Protection and Control", Springer 2011 ISBN 978-0-85729-801-0

References:

[R1]	Mitra S., "Digital Signal Processing: A Computer Based Approach", Tata McGraw-Hill, 1998, ISBN 0-07-044705-5

[R2]	A.V. Oppenheim, R. W. Schafer, J. R. Buck, ”Discrete Time Signal Processing”, 2nd Edition Prentice Hall, ISBN 978-81-317-0492-9
[R3]	Steven W. Smith, “Digital Signal Processing: A Practical Guide for Engineers and Scientists”,1st Edition Elsevier, **ISBN:** 9780750674447

E-References

1. Karplus, W. J., and Soroka, W. W. *Analog Methods*, 2nd ed., McGraw-Hill, New York, 1959, p. 117.
2. Mikami, N., Kobayashi, M., and Yokoyama, Y. "A New DSP-Oriented Algorithm for Calculation of the Square Root Using a Nonlinear Digital Filter," *IEEE Trans. on Signal Processing*, Vol. 40, No. 7, July 1992.
3. Heinen, P., and Neuvo, Y. "FIR-Median Hybrid Filters," *IEEE Trans. on Acoust. Speech, and Signal Proc.*, Vol. ASSP-35, No. 6, June 1987.
4. Oppenheim, A., Schafer, R., and Stockham, T. "Nonlinear Filtering of Multiplied and Convolved Signals," *Proc. IEEE*, Vol. 56, August 1968.
5. Pickerd, John. "Impulse-Response Testing Lets a Single Test Do the Work of Thousands," *EDN*, April 27, 1995

EE405A: PROBLEM SOLVING THROUGH PROGRAMMING IN C

Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs./Week	**Continuous Assessment:**	**25 Marks**
Tutorial: --- Hr/Week	**In-Sem Exam:**	**-- Marks**
	End-Sem Exam:	**75 Marks**
Credits: 3	**Total:**	**100 Marks**

Prerequisite Course: Fundamentals of Computer Programming

Course Objectives

1. To get acquainted with the fundamental rinciples, and concepts of Computer Hardware and Software
2. To understand basics of programming and problem solving
3. To build basic programs in C
4. To develop competency for the design, coding and debugging
5. To build the programming skills using C to solve real world problems
6. To learn and understand the basic concepts and use of system software and IDE

7. Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Formulate simple algorithms for arithmetic and logical problems	**3**	**Apply**
CO2	Execute the programs using arithmetic expressions and relational expression, logical operators, loops etc	**3**	**Apply**
CO3	Construct C programs to solve problems using various loop and arrays	**3**	**Apply**
CO4	Use arrays, Strings, functions and structures to formulate algorithms and programs	**3**	**Apply**
CO5	Apply programming to solve matrix addition, multiplication problems, searching, sorting problems	**3**	**Apply**
CO6	Apply programming to solve simple numerical method problems, namely rot finding of function, differentiation of function and simple integration	**3**	**Apply**

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	2	3	-	-	-	1	1	-	2	2	2
CO2	2	2	1	1	2	-	-	-	1	-	-	1	1	2
CO3	2	2	2	1	2	-	-	-	1	2	-	2	2	1
CO4	2	2	1	2	2	-	-	-	1	1	-	1	2	1
CO5	2	2	2	2	1	-	-	-	11	1	-	1	1	1
CO6	2	2	1	2	1	-	-	-		1	-	1	1	2

Course Contents			
UNIT-I	**BASICS**	**Hrs**	**COs**
	Introduction, Idea of Algorithms, Flow Chart and Pseudocode, Introduction to Programming Language Concepts, Variables and Memory, Types of Software and Compilers, Introduction to C Programming Language, Variables and Variable Types in C, Introducing Functions, Address and Content of Variables and Types.	**6**	**CO1**
UNIT-II	**THE DECISION CONTROL STRUCTURE**	**Hrs**	**CO**
	Assignment Statement and Operators in C, Arithmetic Expressions and Relational Expressions, Logical Operators and Change in Control Flow, Use of Logical Operators in Branching, branching: IF - ELSE Statement, Switch statement, Introduction to Loops, Implementing Repetitions (Loops), Implementation of Loops with for Statement.	**6**	**CO2**
UNIT-III	**THE LOOP CONTROL STRUCTURE**	**Hrs**	**CO**
	Example of If-Else, Example of Loops, Use of FOR Loops, Introduction to Arrays, Arrays, Program using Arrays, Array Problem	**6**	**CO3**
UNIT-IV	**ARRAYS, STRINGS AND FUNCTIONS**	**Hrs**	**CO**
	Linear Search, Character Array and Strings, String Operations, 2-D Array Operation, Introducing Functions, More on Functions, Scanf and Printf Functions; Function Prototype, Parameter Passing in Function Revision.	**6**	**CO4**
UNIT-V	**SEARCHING AND SORTING FUNCTIONS**	**Hrs**	**CO**
	Substitution of # include and Macro, “search" as a function, Binary Search, Sorting Methods, Bubble Sort, Use of Pointer in Function: Context Bubble Sort, Arrays at Strings, Data Representation, Bisection Method.	6	**CO5**
UNIT-VI	**APPLICATIONS**	**Hrs.**	**CO**
	Interpolation, Trapezoidal Rule and Runge-Kutta Method, Recursion, Structure, Structure with typedef, Pointer, Pointer in Structures, Dynamic Allocation and File.	6	**CO** 6

Text Books:

1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill
3. Yashwant Kanetkar, “Let Us C”, BPB Publication
4. Pradeep K. Sinha, “Computer Fundamentals”, BPB Publication

References:

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India
2. Henry Mullish , Herbert L. Cooper, “The Spirit Of C”, Thomson Learning
3. T. E. Bailey, “Program Design With Pseudocode”, Brooks/Cole Publisher

E-Resourses:

Problem Solving Through Programming In C, https://nptel.ac.in/courses/106105171, https://nptel.ac.in/courses/106105171

EE405B: INTRODUCTION TO INDUSTRY 4.0 AND INDUSTRIAL INTERNET OF THINGS

Teaching Scheme	**Examination Scheme**	
Lectures: 3 Hrs./Week	**Continuous Assessment:**	**25 Marks**
Tutorial: -	**In-Sem Exam:**	**-- Marks**
Practical: -	**End-Sem Exam:**	**75 Marks**
Credits: 3	**Total:**	**100 Marks**

Prerequisite Course:

1. Fundamentals of computer network, Network Security, internet technology.

Course Objectives

1. In this course, student will explore various components of Internet of things such as Sensors, internetworking and cyber space.
2. In the end they will also be able to design and implement IoT circuits and solutions.

Course Outcomes (COs):

After successful completion of the course, student will be able to

	Course Outcome (s)	**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Understand general concepts of Internet of Things	2	Understand
CO2	Recognize various devices, sensors and applications	1	Knowledge
CO3	Apply design concept to IoT solutions	3	Applying
CO4	Various types of M2M and IoT architectures can be Analysed	4	Analyzing
CO5	Design and Evaluation of issues in IoT applications	5	Evaluate
CO6	IoT solutions using sensors, actuators and Devices can be developed	6	Create

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	-	-	-	-	-	-	-	1	-
CO2	-	2	3	2	-	-	-	-	-	-	-	-	1	-
CO3	-	2	2	-	-	-	-	-	-	-	-	-	1	-
CO4	1	2	3	-	-	-	-	-	-	-	-	-	1	-
CO5	-	-	3	-	-	-	-	-	-	-	-	-	1	-
CO6	-	-	2	-	-	-	-	-	-	-	-	-	1	-

Course Contents			
UNIT-I	**Introduction to IoT and Industry 4.0**	**Hrs.**	**COs**
	Introduction to IoT : Sensing & actuation, Communication-Part I, Part II, Networking-Part I, Part II **Introduction to Industry 4.0:** Globalization and Emerging Issues, The Fourth Revolution, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories.	5	CO1
UNIT-II	**Cyber security**	**Hrs.**	**CO**
	Industry 4.0: Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artificial Intelligence, Big Data and Advanced Analysis. Cyber security in Industry 4.0, Basics of Industrial IoT: Industrial Processes-Part I, Part II, Industrial Sensing & Actuation, Industrial Internet Systems.	5	CO2
UNIT-III	**IoT An Architectural Overview**	**Hrs.**	**CO**
	Business Model and Referece Architerture: IIoT-Business Models-Part I, Part II, IIoT Reference Architecture-Part I, Part II. Industrial IoT- Layers: IIoT Sensing-Part I, Part II, IIoT Processing-Part I, Part II, IIoT Communication-Part I.	5	CO3
UNIT-IV	**IoT Protocols**	**Hrs.**	**CO**
	IIoT Communication-Part II, Part III, IIoT Networking-Part I, Part II, Part III. Big Data Analytics and Software Defined Networks: IIoT Analytics - Introduction, Machine Learning and Data Science - Part I, Part II, R and Julia Programming, Data Management with Hadoop.	5	CO4
UNIT-V	**Domain Specific Applications of IoT Part I**	**Hrs.**	**CO**
	Big Data Analytics and Software Defined Networks: SDN in IIoT-Part I, Part II, Data Center Networks, Industrial IoT: Security and Fog Computing: Cloud Computing in IIoT-Part I, Part II. Security and Fog Computing - Fog Computing in IIoT, Security in IIoT-Part I, Part II, Industrial IoT- Application Domains: Factories and Assembly Line, Food Industry.	5	CO5
UNIT-VI	**Domain Specific Applications of IoT Part II**	**Hrs.**	**CO**
	Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management. Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Real case studies (Milk Processing and Packaging Industries)	5	CO6
Text Books:			
[T1] S. Misra, C. Roy, and A. Mukherjee, 2020. *Introduction to Industrial Internet of Things and Industry*			
E-References			

[1] https://www.udemy.com/internet-of-things-iot-for-beginners-getting-started/
[2] http://playground.arduino.cc/Projects/Ideas

EE405C: DATA STRUCTURE AND ALGORITHM

Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs./Week	**Continuous Assessment:**	**25 Marks**
Tutorial: --Hr./Week	**In-Sem Exam:**	**-- Marks**
	End-Sem Exam:	**75 Marks**
Credits: 3 Credits	**Total:**	**100 Marks**

Prerequisite Course: This course requires that the students are familiar with programming language such as C/C++/Java, data structures and algorithms.

Course Objectives

1. Understanding of fundamental Data Structures including linked-lists, trees, binary search trees, AVL trees, stacks, queues, priority queues, and hash-tables and skiplists.
2. To teach efficient storage mechanisms of data for an easy access.
3. To design and implementation of various basic and advanced data structures.
4. To introduce various techniques for representation of the data in the real world.
5. To develop application using data structures.
6. To improve the logical ability

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		Bloom's Taxonomy	
		Level	**Descriptor**
CO1	Understanding of 1D and 2D matrices.	1	Understanding
CO2	Understanding of fundamental Data Structures stacks, queues, priority queues, and hash-tables.	1	Understanding
CO3	Ability to implement Java Binary trees and its variations.	3	Applying
CO4	Understanding graph and ability to implement	1	Understanding
CO5	Ability to study searching and implement sorting algorithms	3	Applying
CO6	Ability to implement Greedy algorithms, shortest path algorithms	3	Applying

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	3	1	3	-	-	-	-	-	-	1	-	-
CO2	1	2	3	1	3	-	-	-	-	-	-	1	-	-
CO3	1	2	3	1	3	-	-	-	-	-	-	1	-	-
CO4	1	2	3	1	3	-	-	-	-	-	-	1	-	-
CO5	1	2	3	1	3	-	-	-	-	-	-	1	-	-
CO6	1	2	3	1	3	-	-	-	-	-	-	1	-	-

Course Contents			
UNIT-I	**1D & 2D ARRAYS**	**No. of Hours**	**COs**
	1D array, list and vector, 2D matrices and tables of objects Java implementation of 1D and 2D arrays and its operations	7	CO1
UNIT-II	**STACK AND QUEUE**	**No. of Hours**	**COs**
	Linked lists and its various operations, stack and queue Java implementation of linked lists, stack and queue	7	CO2
UNIT-III	**BINARY TREE**	**No. of Hours**	**COs**
	Binary trees: Representation and operations. Variations of binary tree: Binary search tree, Height balanced search tree, Heap tree Java implementation of binary trees and its variations	7	CO3
UNIT-IV	**GRAPH**	**No. of Hours**	**COs**
	Graph: Structure, representation and operations Java implementations of graph data structures	8	CO4
UNIT V	**ALGORITHMS (PART I)**	**No. of Hours**	**COs**
	Algorithms (Part-I): Searching and sorting algorithms Java implementation of Part-I algorithms	8	CO5
UNIT-IV	**ALGORITHMS (PART II)**	**No. of Hours**	**COs**
	Algorithms (Part-II): Greedy algorithms, shortest path algorithms Java implementation of Part-II algorithms	8	CO6

Text Books:

1. Classic Data Structures (2nd Edition) Debasis Samanta, Prentice Hall India
2. Java: The Complete Reference Hebert Schildt, Mc Graw Hill
3. Object-Oriented Programming with C++ and Java Debasis Samanta, Prentice Hall India
4. Swayam-NPTEL online course entitles Programming in Java Debasis Samanta

Reference Books:

1. Data structures: A Pseudocode Approach with C, 2nd edition,
2. R.F. Gilberg and B.A. Forouzan, Cengage Learning.
3. Data structures and Algorithm Analysis in C, 2nd edition, M.A.Weiss, Pearson.
4. Data Structures using C, A.M.Tanenbaum,Y. Langsam, M.J.Augenstein, Pearson.
5. Data structures and Program Design in C, 2nd edition, R.Kruse, C.L.Tondo and B.Leung,Pearson

Websites:

National Programme on Technology Enhanced Learning
(https://onlinecourses.nptel.ac.in/noc22_cs92/preview)

EE405D: REAL-TIME DIGITAL SIGNAL PROCESSING

Teaching Scheme	Examination Scheme	
Lectures: 03 Hrs./Week	**Continuous Assessment:**	**25 Marks**
Practical : -- Hr/Week	**In-Sem Exam:**	**-- Marks**
	End-Sem Exam:	**75 Marks**
Credits: 3	**Total:**	**100 Marks**

Prerequisite Course:

1. Knowledge of basic signals and systems

Course Objectives

1. To elaborate Sampling theorem
2. To classify discrete signals and systems
3. To analyze DT signals with Z transform, inverse Z transform and DTFT
4. To describe Frequency response of LTI system
5. To introduce Digital filters and analyze the response
6. To demonstrate DSP Applications in electrical engineering

Course Outcomes (COs):

After successful completion of the course, student will be able to

1. Sample and reconstruct any analog signal
2. Construct frequency response of LTI system
3. Evaluate Fourier Transform of discrete signals
4. Design IIR filter and its implementation
5. Design FIR filter and implementation
6. Develop block diagram for DSP applications to electrical engineering

Course Outcome (s)		Bloom's Taxonomy	
		Level	**Descriptor**
CO1	Sample and reconstruct any analog signal	2	Understanding
CO2	Construct frequency response of LTI system	6	Creating
CO3	Evaluate Fourier Transform of discrete signals	5	Evaluating
CO4	Design IIR filter and its implementation	3	Applying
CO5	Design FIR filter and implementation	3	Applying
CO6	Develop block diagram for DSP applications to electrical engineering	3	Applying

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	1	1	--	--	--	--	--	2	2	2
CO2	2	2	2	2	2	2	--	--	--	--	--	2	2	2
CO3	2	2	2	2	2	2	--	--	--	--	--	2	2	2
CO4	1	1	2	1	1	1	--	--	--	--	--	2	2	2
CO5	2	2	2	1	1	1	--	--	--	--	--	1	2	2
CO6	1	1	2	1	1	1	--	--	--	--	--	1	1	1

Course Contents			
UNIT-I	**Introduction to Real-Time Signal Processing:**	**Hrs.**	**COs**
	Introduction to Real-Time Signal Processing, Analog Interface, DSP hardware, DSP System Design, Experiments and program examples.	07	CO1
UNIT-II	**Signal concepts:**	**Hrs.**	**CO**
	signal concepts, Introduction to random variables, Fixed point and Quantization effects, overflow and solutions, experiments and program examples.	08	CO2
UNIT-III	**Design and Implementation of filters:**	**Hrs.**	**CO**
	Design and Implementation of FIR filters Design and Implementation of IIR filters and structures: cascaded for implementation in hardware and quantization effects.	06	CO3
UNIT-IV	**Discrete Fourier Transform :**	**Hrs.**	**CO**
	Frequency analysis and DFT with practical applications of FFT, Spectrum Analysis, and implementation in filters, quantization effects. Cross correlation, autocorrelation and implementation	08	CO4
UNIT-V	**Digital Signal generation :**	**Hrs.**	**CO**
	Introduction to Random Process, LMS algorithm and implementation consideration and practical applications applications. Digital Signal generation and program examples	08	CO5
UNIT-VI	**Introduction to Digital Image processing :**	**Hrs.**	**CO**
	Implementation of Echo, reverberation, Graphic equalizer. Introduction to Digital Image processing, fast DCT implementation in hardware.	08	CO6

Text Books:

[T1] Real-Time Digital Signal Processing
[T2] FUNDAMENTALS, IMPLEMENTATIONS AND APPLICATIONS Third Edition
[T3] Sen M. Kuo Northern Illinois University, USA Bob H. Lee Ittiam Systems, Inc., USA Wenshun Tian Sonus Networks, Inc., USA

References:

[R1]	Mitra S., “Digital Signal Processing: A Computer Based Approach”, Tata McGraw-Hill, 1998, ISBN 0-07-044705-5
[R2]	A.V. Oppenheim, R. W. Schafer, J. R. Buck, ”Discrete Time Signal Processing”, 2nd Edition Prentice Hall, ISBN 978-81-317-0492-9
[R3]	Steven W. Smith, “Digital Signal Processing: A Practical Guide for Engineers and Scientists”,1st Edition Elsevier, **ISBN:** 9780750674447

E-References

1. Karplus, W. J., and Soroka, W. W. *Analog Methods*, 2nd ed., McGraw-Hill, New York, 1959, p. 117.
2. Mikami, N., Kobayashi, M., and Yokoyama, Y. "A New DSP-Oriented Algorithm for Calculation of the Square Root Using a Nonlinear Digital Filter," *IEEE Trans. on Signal Processing*, Vol. 40, No. 7, July 1992.
3. Heinen, P., and Neuvo, Y. "FIR-Median Hybrid Filters," *IEEE Trans. on Acoust. Speech, and Signal Proc.*, Vol. ASSP-35, No. 6, June 1987.
4. Oppenheim, A., Schafer, R., and Stockham, T. "Nonlinear Filtering of Multiplied and Convolved Signals," *Proc. IEEE*, Vol. 56, August 1968.
5. Pickerd, John. "Impulse-Response Testing Lets a Single Test Do the Work of Thousands," *EDN*, April 27, 1995.

EE406A: INTRODUCTION TO BMS

Teaching Scheme	**Examination Scheme**	
Lectures: 02 Hrs./Week	**Continuous Assessment:**	**20 Marks**
Tutorial: -- Hrs./Week	**In-Sem Exam:**	**-- Marks**
	End-Sem Exam:	**30 Marks**
Credits: 2	**Total:**	**50 Marks**

Prerequisite Course:

1. Basic Electrical and Electronics Engineering
2. Fundamentals of Chemistry

Course Objectives

1. Introduction to Li-ion batteries.
2. Introduction to Battery Management Systems (BMS) for LIB.
3. Understand the Battery Management System (BMS) components and function.
4. Understand how a battery-management system “measures” current, temperature and stored energy in a battery pack
5. Discuss the factors that influence battery performance and required protection schemes.
6. Identify electronic components that can provide protection and specify a minimum set of protections needed.

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		**Bloom’s Taxonomy**	
		Level	**Descriptor**
CO1	Identify the major components of a lithium-ion cell and their purpose.	2	Understanding
CO2	Introduction to Battery Management Systems (BMS) for LIB.	2	Understanding
CO3	Understand the Battery Management System (BMS) components and function.	2	Understanding
CO4	Understand how a battery-management system “measures” current, temperature and stored energy in a battery pack.	2	Understanding
CO5	Relate the factors that influence battery performance and required protection schemes.	4	Analysing
CO6	Identify electronic components that can provide protection and simulate battery packs.	3	Applying

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	1	1	1	-	-	1	-	1	1	2	2
CO2	3	2	2	1	2	2	-	-	-	1	2	2	2	2
CO3	3	1	1	2	2	2	-	-	-	1	3	2	2	2
CO4	3	2	2	1	2	2	-	-	1	1	2	2	2	2
CO5	3	2	2	1	2	2	1	-	-	1	3	2	2	2
CO6	3	2	2	1	2	2	-	1	2	1	2	2	2	2

Course Contents			
UNIT-I	**Components of a lithium-ion cell**	**Hrs.**	**COs**
	Fundamentals of Battery with its characteristics, need of battery management system, Comparison with other batteries on the basis of various parameters and cost. Various components in LIB.	6	CO1
UNIT-II	**Battery Management Systems (BMS) for Lithium-Ion Battery (LIB)**	**Hrs.**	**CO**
	Battery Management System (BMS) for Lithium-Ion Battery (LIB) with block diagram for any kind of application like EV, Voltage stabilizer, Power control or power system protection systems, Purpose of various- components with suitable applications in EV. Life span, recycling cost, environmental impacts.	6	CO2
UNIT-III	**Battery Management System (BMS) components**	**Hrs.**	**CO**
	Battery Management System (BMS) block diagram for any kind of application like EV, Voltage stabilizer, Power control or power system protection systems, Purpose of various -components with suitable applications in EV.	6	CO3
UNIT-IV	**State of the Battery**	**Hrs.**	**CO**
	Voltage: total voltage, voltages of individual cells, or voltage of periodic taps Temperature: average temperature, coolant intake temperature, coolant output temperature, or temperatures of individual cells Coolant flow: for liquid cooled batteries Current: current in or out of the battery Health of individual cells State of balance of cells	6	CO4
UNIT-V	**Battery performance and protection schemes**	**Hrs.**	**CO**
	Voltage: minimum and maximum cell voltage. State of charge (SoC) or depth of discharge (DoD), to indicate the charge level of the battery State of health (SoH), a variously-defined measurement of the remaining capacity of the battery as % of the original capacity State of power (SoP), the amount of power available for a defined time interval given the current power usage, temperature and other conditions State of Safety (SOS) Maximum charge current as a charge current limit (CCL) Maximum discharge current as a discharge current limit (DCL) Energy [kWh] delivered since last charge or charge cycle Internal impedance of a cell (to determine open circuit voltage) Charge [Ah] delivered or stored (sometimes this feature is called Coulomb counter Total energy delivered since first use Total operating time since first use Total number of cycles Temperature Monitoring. BMS protection for Over-current during charging, Over-current during discharge, Over-voltage during charging, especially important for lead–acid and Li-ion cells, Under-voltage during discharging Over-temperature, Charging while under temperature, Over-pressure (NiMH batteries), Ground fault or leakage current detection (system monitoring that the high voltage battery is electrically disconnected from any conductive object touchable to use like vehicle body)	6	CO5
UNIT-VI	**Simulating Battery Packs**	**Hrs.**	**CO**
	Equivalent-circuit models, state of charge, Simulating constant power and voltage, Series connected cell and parallel connected cell modules.	6	CO6
Text Books:			
[T1] Energy Storage: Fundamentals, Materials and Applications by Robert A. Huggins; Springer, 2010. [T2] Energy Storage Systems, by S. Kakac, BirolKilkis, 1989			
References:			
[R1] A. R. Pendse, "Energy Storage Science and Technology", SBS Publishers & Distributors Pvt. Ltd., New Delhi, (ISBN - 13:9789380090122), 2011. [R2] A.G.Ter-Gazarian, "Energy Storage for Power Systems", Second Edition, The Institution of Engineering and Technology (IET) Publication, UK, (ISBN - 978-1-84919-219-4), 2011.			

[R3] Energy Storage for Sustainable Microgrid, by David WenzhongGao, Academic Press Elsevier, 2015.

E-References

[1] https://www.coursera.org/learn/battery-management-systems
[2] https://diyguru.org/course/bms/
[3] http://mocha-java.uccs.edu/ECE5720/index.html

EE406B: REAL-TIME EMBEDDED SYSTEMS CONCEPTS & PRACTICES

Teaching Scheme	**Examination Scheme**	
Lectures: 02 Hrs./Week	**Continuous Assessment :**	**20 Marks**
Practical : -- Hr/Week	**In-Sem Exam:**	**-- Marks**
	End-Sem Exam:	**30 Marks**
Credits: 2	**Total:**	**50 Marks**

Prerequisite Course:

1. Knowledge of basic C programming.

Course Objectives

1. Understand the basic concepts, and building blocks of embedded System.
2. To learn the internal architecture and programming concept of 8051.
3. To introduce the advanced concepts on embedded system.
4. To learn the introduction on RTOS, and aspects required in developing a new embedded processor80386, 80486.
5. To introduce the microprocessor interfacing and related concepts.

Course Outcomes (COs):

After successful completion of the course, student will be able to

1. An ability to introduce the basic terminology in embedded system to meet desired needs within realistic constraints
2. Describe the 8051 internal architecture and programming.
3. An ability to design the embedded system.
4. Ability to understand the advanced processor architecture and concept of RTOS.
5. Describe the microprocessor interfacing and various protocols.

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	An ability to introduce the basic terminology in embedded system to meet desired needs within realistic constraints	2	Understanding
CO2	Describe the 8051 internal architecture and programming.	2	Understanding
CO3	An ability to design the embedded system.	3	Applying
CO4	Ability to understand the advanced processor architecture and concept of RTOS.	2	Understanding
CO5	Describe the microprocessor interfacing and various protocols.	2	Understanding

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	--	--	--	--	--	--	--	--	--	--	3	2
CO2	2	3	2	3	--	--	2	--	1	--	1	--	3	2
CO3	2	3	3	3	--	--	2	--	2	--	--	--	3	3
CO4	2	3	3	2	--	--	1	--	1	--	1	--	3	3
CO5	1	3	1	--	--	--	--	--	1	--	1	--	3	2

Course Contents			
UNIT-I	**Introduction**	**Hrs.**	**COs**
	• Course Introduction • Home Lab Set Up	6	CO1
UNIT-II	**Demonstration of RTES Terminology**	**Hrs.**	**CO**
	• Code Walkthroughs and Demonstrations • Scan and Question RTES Terminology	6	CO2
UNIT-III	**Real-Time Utility Curves & Practice Creating SRT & HRT Threads**	**Hrs.**	**CO**
	• Code Demonstration: SMP compared to AMP • Code Walkthrough: Starter code for AMP using thread affinity	6	CO3
UNIT-IV	**Measuring and Tracking Relative and Absolute Time on RT Embedded Systems**	**Hrs.**	**CO**
	• Code Walkthrough: RT Clock • Review of absolute time and date standards and resources • Peer-graded Assignment: CPU Core Affinity and RT Clock Code Review	6	CO4
UNIT-V	**Rate Monotonic Timing Analysis of Feasibility and Safety Margin (Part 1)**	**Hrs.**	**CO**
	• Scan and Question Original paper on Rate Monotonic theory (Liu & Layland)	6	CO5
UNIT-VI	**Rate Monotonic Timing Analysis of Feasibility and safety Margin (Part 2)**	**Hrs.**	**CO**
	• Optional reading on Linux NPTL and SCHED_DEADLINE	6	CO6

Text Books:

[T1] Sloss Andrew N, Symes Dominic, Wright Chris, ―ARM System Developer's Guide: Designing and Optimizing‖, Morgan Kaufman Publication,2004.

[T2] Embedded Systems: Real-Time Interfacing to ARM Cortex-M Microcontrollers, 2014, Jonathan W Valvano Create space publications ISBN: 978-1463590154.

[T3] Embedded Systems: Introduction to ARM Cortex - M Microcontrollers, 5th edition Jonathan W Valvano, Create space publications ISBN-13: 978-1477508992

References:

[R1] https://www.coursera.org/learn/real-time-embedded-systems-concepts-practices/resources/JE6X3
[R2] https://dl.acm.org/citation.cfm?id=321743

EE406C: REAL-TIME EMBEDDED SYSTEMS CONCEPTS & PRACTICES

Teaching Scheme	**Examination Scheme**	
Lectures: 02 Hrs./Week	**Continuous Assessment :**	**20 Marks**
Practical : -- Hr/Week	**In-Sem Exam:**	**-- Marks**
	End-Sem Exam:	**30 Marks**
Credits: 2	**Total:**	**50 Marks**

Prerequisite Course:

1. Knowledge of basic C programming.

Course Objectives

1. Understand the basic concepts, and building blocks of embedded System.
2. To learn the internal architecture and programming concept of 8051.
3. To introduce the advanced concepts on embedded system.
4. To learn the introduction on RTOS, and aspects required in developing a new embedded processor80386, 80486.
5. To introduce the microprocessor interfacing and related concepts.

Course Outcomes (COs):

After successful completion of the course, student will be able to

1. An ability to introduce the basic terminology in embedded system to meet desired needs within realistic constraints
2. Describe the 8051 internal architecture and programming.
3. An ability to design the embedded system.
4. Ability to understand the advanced processor architecture and concept of RTOS.
5. Describe the microprocessor interfacing and various protocols.

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	An ability to introduce the basic terminology in embedded system to meet desired needs within realistic constraints	2	Understanding
CO2	Describe the 8051 internal architecture and programming.	2	Understanding
CO3	An ability to design the embedded system.	3	Applying
CO4	Ability to understand the advanced processor architecture and concept of RTOS.	2	Understanding
CO5	Describe the microprocessor interfacing and various protocols.	2	Understanding

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	--	--	--	--	--	--	--	--	--	--	3	2
CO2	2	3	2	3	--	--	2	--	1	--	1	--	3	2
CO3	2	3	3	3	--	--	2	--	2	--	--	--	3	3
CO4	2	3	3	2	--	--	1	--	1	--	1	--	3	3
CO5	1	3	1	--	--	--	--	--	1	--	1	--	3	2

Course Contents			
UNIT-I	**Introduction**	**Hrs.**	**COs**
	• Course Introduction • Home Lab Set Up • Code Walkthroughs and Demonstrations • Scan and Question RTES Terminology	6	1,2
UNIT-II	**Real-Time Utility Curves & Practice Creating SRT & HRT Threads**	**Hrs.**	**CO**
	• Code Demonstration: SMP compared to AMP • Code Walkthrough: Starter code for AMP using thread affinity	6	3
UNIT-III	**Measuring and Tracking Relative and Absolute Time on RT Embedded Systems**	**Hrs.**	**CO**
	• Code Walkthrough: RT Clock • Review of absolute time and date standards and resources • Peer-graded Assignment: CPU Core Affinity and RT Clock Code Review	6	4
UNIT-IV	**Rate Monotonic Timing Analysis of Feasibility and Safety Margin**	**Hrs.**	**CO**
	• Scan and Question Original paper on Rate Monotonic theory (Liu & Layland) • Optional reading on Linux NPTL and SCHED_DEADLINE	6	5

Text Books:

[T1] Sloss Andrew N, Symes Dominic, Wright Chris, ―ARM System Developer's Guide: Designing and Optimizing‖, Morgan Kaufman Publication,2004.

[T2] Embedded Systems: Real-Time Interfacing to ARM Cortex-M Microcontrollers, 2014, Jonathan W Valvano Create space publications ISBN: 978-1463590154.

[T3] Embedded Systems: Introduction to ARM Cortex - M Microcontrollers, 5th edition Jonathan W Valvano, Create space publications ISBN-13: 978-1477508992

References:

[R1] https://www.coursera.org/learn/real-time-embedded-systems-concepts-practices/resources/JE6X3
[R2] https://dl.acm.org/citation.cfm?id=321743

EE407: SWITCHGEAR AND PROTECTION LABORATORY

Teaching Scheme	Examination Scheme	
Lectures: -- Hrs./Week	**Oral:**	**-- Marks**
Tutorial: -- Hrs./Week	**Practical:**	**50 Marks**
Practical: 02 Hrs./Week	**Term Work:**	**-- Marks**
Credits: 1	**Total:**	**50 Marks**

Prerequisite Course:

1. Different type of faults in power system.
2. Various switchgears and their use in substation.
3. Principle and working of rotating machines and transformer with vector groups

Course Objectives

1. Acquaint about construction and working principle of different types of HVCBs.
2. Elaborate the Need of protective Relaying and operating principles of different types of relays.
3. Explain different type of faults in transformer, alternator and 3 phase Induction motor and various protective schemes related to them.
4. Impart knowledge about transmission line protection schemes and characteristics of different types of distance relays.

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		Bloom's Taxonomy	
		Level	**Descriptor**
CO1	Understand the different types of relay configuration.	2	Understanding
CO2	Derive expression for restriking voltage and RRRV in circuit breaker	4	Analysing
CO3	Explain construction and working of different high voltage circuit breakers such as ABCB, SF6 CB, and VCB.	2	Understanding
CO4	Classify and describe different type of relays such as over current relay, Reverse power relay, directional over current relay, Differential relay, Distance relay, Static relay and numerical relay.	2	Understanding
CO5	Describe various protection schemes used for transformer, alternator and busbar.	2	Understanding
CO6	Describe transmission line protection schemes.	2	Understanding

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	2	1	-	-	-	1	-	-	1	-	1	2
CO2	1	2	2	1	-	-	-	1	-	-	1	-	1	2
CO3	1	1	2	1	-	-	-	1	-	-	1	-	1	2
CO4	1	1	2	1	-	-	-	1	-	-	1	-	1	2
CO5	1	1	2	1	-	-	-	1	-	-	1	-	1	2
CO6	1	1	2	1	-	-	-	1	-	-	1	-	1	2

Course Contents			
Ex. No	**Name of Experiment**	**Hrs.**	**COs**
1	Study of switchgear testing kit.	2	1
2	Study of bus-bar protection schemes.	**2**	**1**
3	Study and testing of Fuse, MCB and MCCB	2	2
4	Study and testing of contactors	**2**	**2**
5	Study and testing of ACB.	2	3
6	Study and testing of thermal overload relay for Induction Motor protection.	**2**	**4**
7	Study and plot Characteristics of IDMT type Induction over current relay	2	4
8	Study and plot Characteristics of digital over current relay	**2**	**4**
9	Percentage differential protection of transformer.	2	5
10	Protection of alternator.	**2**	**5**
11	Protection of Transmission line using Impedance relay.	2	6
12	Study of various LT switchgears like RCCB, timers.	2	6

Text Books:

[T1] S. Rao, "Switchgear Protection and Power Systems", Khanna Publications
[T2] Y. G. Paithankar, S. R. Bhide, "Fundamentals of Power System Protection", Prentice Hall of India
[T3] Bhavesh Bhalja,R.P. Maheshwari, N.G. Chothani," Protection and Switchgear", Oxford University Press, 2011 Edition.
[T4] J.B.Gupta " Switchgear and Protection", S.K. Kataria and Sons.

References:

[R1] Badri Ram, D. N. Vishwakarma, "Power System Protection and Switchgear", Tata McGraw Hill Publishing Co. Ltd.
[R2] J Lewis Blackburn , "Protective Relaying- Principles and Applications", Dekker Publications.
[R3] A.G. Phadke, J.S. Thorp ,Computer relaying for Power System , Research Studies Press LTD, England.(John Willy and Sons Inc New York)
[R4] Mason C.R., "Art and Science of Protective Relaying", Wiley Eastern Limited.
[R5] Arun Ingole, "Switchgear and Protection", Pearson.

E-References

[1] Prof. Dr S.A. Soman, IIT Mumbai, A Web course on "Digital Protection of power System" http://www.cdeep.iitb.ac.in/nptel/Electrical%20Engineering/Power%20System%20Protection/Course_home_L27.html

EE408: CONTROL SYSTEM DESIGN LABORATORY

Teaching Scheme	**Examination Scheme**	
Lectures: -- Hrs./Week	**Oral:**	**50 Marks**
Tutorial: -- Hrs./Week	**Practical:**	**-- Marks**
Practical: 02 Hrs./Week	**Term Work:**	**-- Marks**
Credits: 1	**Total:**	**50 Marks**

Prerequisite Course:

1. Control System Engineering
2. MATLAB Programming

Course Objectives

1. Make students identify various characteristics of nonlinear systems.
2. Develop skills for analysing nonlinear systems.
3. Make students study features and configurations of digital control systems.
4. Understand the practical controllers and compensators

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Analyse peculiar non-linearities using describing function	4	Analyse
CO2	Apply various compensation technique using hardware and software	3	Apply
CO3	Improve system performance by designing P,I and D Controller	6	Design
CO4	Apply concepts of state space approach for system design	4	Apply
CO5	Test controllability and observability properties of the system	5	Evaluate

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	3	-	-	-	-	-	-	1	1	1
CO2	3	2	2	2	3	-	-	-	-	-	-	1	1	1
CO3	3	2	2	2	3	-	-	-	-	-	-	1	1	1
CO4	3	2	2	2	3	-	-	-	-	-	-	1	1	1
CO5	3	2	2	2	3	-	-	-	-	-	-	1	1	1

Course Contents

Ex. No	**Name of Experiment**	**Hrs.**	**COs**
1	To study peculiar nonlinearities analysis using MATLAB.	02	CO1
2	Software programming for determination of state space representation for given transfer function and vice-versa	02	CO4
3	Calculation of state transition matrix, state X (t), Eigen values using MATLAB.	02	CO4

4	Convert a continuous time system into digital control system and check response using software.	02	CO3
5	Effect of sampling and verification of sampling theorem	02	CO3
6	Test observability of the system	02	CO5
7	Test controllability of the system	02	CO5
8	Experimentally evaluate the closed loop performance of the control setup for different P and PI controller settings and compare with simulation results.	02	CO2
9	To design and study the effect of different Compensation for given system using MATLAB	02	CO2
10	To design and study the effect of different Compensation for given system using experimental kit	02	CO2

Text Books:

[T1] Norman S. Nise, Control System Engineering, Sixth Edition, John Wily and Sons, Inc. 2011.

[T2] Richard C. Dorf, Robert H. Bishop, Modern Control Systems, Twelfth Edition, Pearson Education.

[T3] Benjamin C. Kuo, Digital Control System, Second Edition, Oxford University Press, 2003.

[T4] I. J. Nagarath, M. Gopal, Control System Engineering, Fourth Edition, New Age International (P) Limited, Publishers

[T5] A. Nagoor Kani, Advanced Control Theory, Third Edition, CBS Publishers and Distributes, 2020.

References:

[R1] M. Gopal, “Control Systems: Principles and Design”, McGraw Hill Education, 1997.

[R2] B. C. Kuo, “Automatic Control System”, Prentice Hall, 1995

E-Resources:

[E1] https://nptel.ac.in/courses/108102043

[E2] https://nptel.ac.in/courses/108102113

EE409: PROJECT STAGE I

Teaching Scheme	**Examination Scheme**	
Practical: 04 Hrs./Week	**Oral:**	**50 Marks**
Credits: 2	**Total:**	**50 Marks**

Prerequisite Course: Mini Project, Seminar

Course Objectives

1. To offer an opportunity to demonstrate their competence in laboratory work.
2. To integrate the knowledge gained in courses studied.
3. To allow the exercise maturity, initiative and creative ability.
4. To apply communication skills, both oral and written, to communicate results, concepts and ideas.
5. To solve problems of a non-routine nature.

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		Bloom's Taxonomy	
		Level	**Descriptor**
CO1	Ability to plan and implement an investigative or developmental project given general objectives and guidelines.	2	Understanding
CO2	In-depth skill to use some laboratory, modern tools and techniques.	3	Applying
CO3	Ability to analyze data to produce useful information and to draw conclusions by systematic deduction.	4	Analyzing
CO4	Facilitate significant individualized interactions between faculty members and students through a multi-term research experience.	5	Evaluate
CO5	Ability to communicate results, concepts, analyses and ideas in written and oral form.	5	Evaluate
CO6	Conduct an extended independent investigation that results in the production of a research thesis.	6	Create

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	1	1	1	1	1	1	1	1	1	1
CO2	2	1	1	1	1	1	1	1	1	2	1	1	1	1
CO3	2	2	1	2	2	1	1	1	1	2	1	1	1	1
CO4	2	2	1	2	2	1	1	1	1	2	1	1	1	1
CO5	2	1	1	1	1	1	1	1	1	1	1	1	1	1
CO6	2	1	1	1	1	1	1	1	1	1	1	1	1	1

Course Contents

A. Guidelines for Students:

1. To identify the problems in industry and society.
2. Perform Literature survey on the specific chosen topic through research papers, Journals, books etc. and market survey if required.
3. To narrow down the area taking into consideration his/her strength and interest. The nature of project can be analytical, simulation, experimentation, design and validation.
4. Define problem, objectives, scope and its outcomes.
5. Design scheme of implementation of project.
6. Data collection, simulation, design, hardware if any, needs to be completed.
7. Presentation based on partially completed work.
8. Submission of report based on the work carried out.

9. Student should maintain Project Work Book.
B. Domains for Seminar / Mini Project may be from the following, but not limited to: · Power Systems · Power/Smart Grid · Electric automobile · Computer/Communication Networking · IOT · AI in Electrical Engineering · Microcontroller based/Embedded systems · Power electronics and drives · High Voltage Engineering · Agriculture Engineering · Battery Technology's · Robotics/Mechatronics/Process Automation · Energy efficiency technique · Green / Clean energy
The student shall take up a project in the field closely related to Electrical Engineering. Preferably, group of 3/4 students should be formed for project work. The project work should be based on the knowledge acquired by the student during the graduation and preferably it should meet and contribute towards the needs of the society. The project aims to provide an opportunity of designing and building complete system or subsystems based on area where the student likes to acquire specialized skills. Project work in this semester is an integral part of the complete project. In this, the student shall complete the partial work of the project which will consists of problem statement, literature review, project overview and scheme of implementation. As a part of the progress report of project work, the candidate shall deliver a presentation on the advancement in Technology pertaining to the selected project topic.

MC410A: CIRCUIT SIMULATION AND PCB DESIGN

Teaching Scheme	**Examination Scheme**	
Lectures: 1 Hrs./Week	**End Sem:**	**PASS/FAIL**
Credits: Non-Credit	**Total:**	**NA**

Prerequisite Course:
A Computer or Laptop with any operating system and the Software that will be used to create the PCB.

Course Objectives

1. Predict and verify the behaviour and performance of the circuit before implementing it.
2. Allows us to evaluate, compare and optimize alternative designs, plans.

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Simulate and perform various analyses for the given Electronic Circuit.	3	Applying
CO2	Design a PCB Layout for the given circuit	4	Analysing
CO3	Fabricate the PCB and assemble the components	2	Understand
CO4	Existing circuit designs can be customised as per the requirement	3	Applying

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	3	-	3	-	-	-	2	-	-	2	3	3
CO2	1	2	3	-	3	-	-	-	2	-	-	2	3	3
CO3	1	2	3	-	3	-	-	-	2	-	-	2	3	3
CO4	1	2	3	-	3	-	-	-	2	-	-	2	3	3

Course Contents

Simulation of electronic circuit uses mathematical models to get the actual behavior of the printed circuit board or electronic devices. Simulation software allows for modelling of electronic circuit operation. Simulation allows designers to stay within a budget. Any part of the printed circuit board can be analysed. Simulation models can be used both for Analog devices and for digital electronic components testing. PCB simulation software applies mathematical models to predict board operation.

The free and/or open source electronic circuit simulation software on this page allows you to design, analyse and test a circuit virtually in a browser or on a computer. They simulate the behaviour of an electronic device/circuit, and are often used because it is cheaper, quicker and often more practical to simulate a circuit than to physically build one. The programs below may provide either Analog or digital simulation capabilities Proteus, Easy EDA electronic circuit design, circuit simulation and PCB design Do Circuits are some of the simulation software's.

Ex. No	Introduction and List of Experiments	Hrs.	Cos
1	Introduction to the software	2	CO1
2	Design and simulation of Voltage regulator(78XX)	1	CO2
3	Design and simulation of Half wave rectifier using 1N4001 and its implementation on PCB.	1	CO3,CO4
4	Design and simulation of Full wave Bridge rectifier using 1N4001.	1	CO2
5	Design and simulation of Single Stage CE Amplifier.	1	CO2
6	Design and simulation of Op-Amp as Inverting and Non-Inverting Amplifier.	1	CO2
7	Design and simulation of Half Adder circuit.	1	CO2
8	Design and simulation of 1N4001.	1	CO2

Text Books:

[T1] Sergio Franco, 'Design with Op-Amps and Analog Integrated Circuits', TMH.
[T2] Allen Mottershed, 'Electronic Devices & Circuits', PHI.

https://docs.easyeda.com/en/Simulation/Chapter4-Introduction-to-using-a-simulator/index.html
https://www.pcbway.com/blog/PCB_Design_Tutorial/How_to_Design_PCB_in_Proteus_1.html

SEMESTER VIII

EE411: POWER QUALITY AND FACTS

Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs./Week	**Continuous Assessment:**	**20 Marks**
Tutorial: --- Hrs./Week	**In-Sem Exam:**	**30 Marks**
	End-Sem Exam:	**50 Marks**
Credits: 03	**Total:**	**100 Marks**

Prerequisite Course:

1. Power Electronics, Power System Transients

Course Objectives

1. To describe the types of power quality problem.
2. To analyze the concepts and mitigation of voltages sags/swells.
3. To study the sources and effect of harmonics in power system.
4. To impart knowledge on various methods of power quality monitoring.
5. To understand the concept of flexible AC transmission and the associated problems
6. To understand the needs of custom power devices.

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Characterize the various power quality events and international standards	02	Understand
CO2	Recognize the voltage sag and swell problems and its mitigation techniques.	02	Understand
CO3	Identify the harmonic sources and the effects of harmonic distortion.	02	Understand
CO4	Apply modern data acquisition systems and processing methods for condition monitoring	03	Apply
CO5	Explain the impact of FACTS devices on modern power systems	02	Understand
CO6	Apply the suitable custom devices for PQ improvement	03	Apply

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	2	-	-	-	-	-	1	3	2
CO2	3	3	2	2	2	2	-	-	-	-	-	1	3	2
CO3	3	3	2	2	2	2	-	-	-	-	-	1	3	2
CO4	2	3	3	2	2	-	-	-	-	-	-	1	3	2
CO5	3	2	1	1	1	2	-	-	-	-	-	1	3	2
CO6	3	3	3	2	2	2	-	-	-	-	-	1	3	2

Course Contents			
UNIT-I	**INTRODUCTION TO POWER QUALITY**	**Hrs.**	**COs**
	Terms and definitions & Sources – Overloading, under voltage, over voltage - Concepts of transients - Short duration variations such as interruption - Long duration variation such as sustained interruption - Sags and swells - Voltage sag - Voltage swell - Voltage imbalance – Voltage fluctuations - Power frequency variations - International standards of power quality – Computer Business Equipment Manufacturers Associations (CBEMA) curve	08	1
UNIT-II	**VOLTAGE SAGS AND SWELL**	**Hrs.**	**CO**
	Estimating voltage sag performance - Analysis and calculation of various faulted condition - Estimation of the sag severity - Mitigation of voltage sag, Static transfer switches and fast transfer switches. - Capacitor switching – Lightning - Ferro resonance - Mitigation of voltage swell.	08	2
UNIT-III	**HARMONICS**	**Hrs.**	**CO**
	Harmonic sources from commercial and industrial loads - Locating harmonic sources – Power system response characteristics - Harmonics Vs transients. Effect of harmonics – Harmonic distortion - Voltage and current distortions - Harmonic indices - Inter harmonics – Resonance Harmonic distortion evaluation, IEEE and IEC standards	08	3
UNIT-IV	**POWER QUALITY MONITORING**	**Hrs.**	**CO**
	Monitoring considerations – Power quality measurement equipment - Harmonic / spectrum analyzer - Flicker meters - Disturbance analyzer - Smart power quality monitors - Applications of expert systems for power quality monitoring.	08	4
UNIT-V	**INTRODUCTION TO FLEXIBLE AC TRANSMISSION SYSTEMS**	**Hrs.**	**CO**
	The concept of flexible AC transmission - reactive power control in electrical power transmission lines -uncompensated transmission line – series and shunt compensation. Overview of FACTS devices - Static VAR Compensator (SVC) – Thyristor Switched Series capacitor (TCSC) – Unified Power Flow controller (UPFC) - Integrated Power Flow controller	07	5
UNIT- VI	**CUSTOM POWER DEVICES FOR PQ IMPROVEMENT**	**Hrs.**	**CO**
	Static Synchronous Compensator (STATCOM) – operating principle – VI characteristics. DVR Structure – Rectifier supported DVR – DC Capacitor supported DVR. Unified Power Flow Controller (UPFC) – Principle of operation - modes of operation – applications.	06	6

Text Books:

[T1] Roger. C. Dugan, Mark. F. Mc Granagham, Surya Santoso, H.WayneBeaty, 'Electrical Power Systems Quality' McGraw Hill,2003.(For Chapters1,2,3, 4 and 5).

[T2] J. Arrillaga, N.R. Watson, S. Chen, "Power System Quality Assessment",(New York : Wiley),2000.

[T3] Bhim Singh, Ambrish Chandra, Kamal Al-Haddad," Power Quality Problems & Mitigation Techniques" Wiley, 2015.

[T4] Arindam Ghosh, Gerard Ledwich, "Power Quality Enhancement Using Custom Power Devices", Springer US, 2002.

References:

[R1] G.T. Heydt, 'Electric Power Quality', 2nd Edition. (West Lafayette, IN, Stars in a Circle Publications, 1994).

[R2] M.H.J Bollen, 'Understanding Power Quality Problems: Voltage Sags and Interruptions', (New York: IEEE Press, 1999).

[R3] G.J.Wakileh, "Power Systems Harmonics – Fundamentals, Analysis and Filter Design," Springer 2007.

E-resources:

[E1] https://nptel.ac.in/courses/108106025/(Power Quality in Power Distribution Systems)

EE412: HIGH VOLTAGE ENGINEERING

Teaching Scheme	Examination Scheme	
Lectures: 03 Hrs./Week	**Continuous Assessment:**	**20 Marks**
Tutorial: --- Hrs./Week	**In-Sem Exam:**	**30 Marks**
	End-Sem Exam:	**50 Marks**
Credits: 03	**Total:**	**100 Marks**

Prerequisite Course: Atomic and molecular structure of gaseous and solid materials, basic properties of conductors insulators, knowledge of Electrical Engineering Materials.

Course Objectives

1. To enable students to know and compare the various processes of breakdown in solid, liquid and gaseous dielectric materials ·
2. To enable students understand and apply various methods of generation and measurement of DC, AC, impulse voltage and current.
3. To enable students to know the charge formation and separation phenomenon in clouds, causes of overvoltage and lightening phenomenon ·
4. To develop ability among learners to execute testing on various high voltage equipments as per standards ·
5. To introduce students to the design, layout, safety precautions, earthing, and shielding of HV laboratory.

Course Outcomes (COs):

After successful completion of the course, student will be able to

1. Identify, describe and analyze the breakdown theories of solid materials.
2. Identify, describe and analyze the breakdown theories of liquid materials.
3. Identify, describe and analyze the breakdown theories of gaseous materials.
4. Describe as well as use different methods of generation of high AC, DC, impulse voltage and current.
5. Identify the occurrence of overvoltage and to provide remedial solutions.
6. Demonstrate an ability to carry out different tests on high voltage equipment and devices as well as ability to design the high voltage laboratory with all safety measures

Course Outcome (s)		Bloom's Taxonomy	
		Level	**Descriptor**
CO1	Identify, describe and analyze the breakdown theories of solid materials.	4	Analyzing
CO2	Identify, describe and analyze the breakdown theories of liquid materials.	4	Analyzing
CO3	Identify, describe and analyze the breakdown theories of gaseous materials.	4	Analyzing
CO4	Describe as well as use different methods of generation of high AC, DC, impulse voltage and current.	3	Applying
CO5	Identify the occurrence of overvoltage and to provide remedial solutions.	3	Applying
CO6	Demonstrate an ability to carry out different tests on high voltage equipment and devices as well as ability to design the high voltage laboratory with all safety measures.	4	Analyzing

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	1	3	1	4	2	2	1	3	1	4
CO2	2	1	3	5	5	3	2	3	3	3	5	3	2	3
CO3	1	3	1	6	3	2	1	3	5	5	3	2	1	3
CO4	2	3	2	4	5	1	3	1	6	3	5	1	3	1
CO5	3	2	3	3	3	2	3	2	4	5	3	2	3	2
CO6	3	1	4	2	2	2	1	3	5	5	2	2	1	3

Course Contents			
UNIT-I	**BREAKDOWN IN GASES DIELECTRICS**		**COs**
	Ionization process in gas, Townsend's Theory, current growth equation in presence of primary and secondary ionization processes, Townsend's breakdown criterion, primary and secondary ionization coefficients, limitations of Townsend's theory, Streamer mechanism of breakdown, Paschen's Law and its limitations, Corona discharges for point plane electrode combination with positive and negative pulse application, time lag and factors on which time lag depends. (Numerical on Townsend's theory and Paschen's law).	06	01
UNIT-II	**BREAKDOWN IN LIQUID DIELECTRICS**	**Hrs.**	**CO**
	Pure and commercial liquids, Different breakdown theories: Breakdown in Pure liquid and breakdown in commercial liquids: Suspended Particle theory, Cavitations and bubble theory, Thermal mechanism of breakdown and Stressed Oil volume theory. (Numerical on theories of liquid dielectric materials)	06	02
UNIT-III	**BREAKDOWN IN SOLID DIELECTRICS**	**Hrs.**	**CO**
	Intrinsic breakdown: electronic breakdown, avalanche or streamer breakdown, electro-mechanical breakdown, thermal breakdown, treeing and tracking phenomenon, Chemical and electrochemical breakdown, Partial discharge (Internal discharge), Composite dielectric material, Properties of composite dielectrics, breakdown in composite dielectrics. (Numerical on theories of solid dielectric materials)	06	03
UNIT-IV	**GENERATION OF HIGH CURRENT AND VOLTAGES**	**Hrs.**	**CO**
	Generation of high ac voltages-Cascading of transformers, series and parallel resonance system, Tesla coil. Generation of impulse voltages and current-Impulse voltage definition, wave front and wave tail time, Multistage impulse generator, Modified Marx circuit, Tripping and control of impulse generators, Generation of high impulse current	06	04
UNIT-V	**LIGHTNING AND SWITCHING OVER VOLTAGES**	**Hrs.**	**CO**
	Causes of over voltages, lightning phenomenon, Different types of lightening strokes and mechanisms of lightening strokes, Charge separation theories, Wilson theory, Simpson theory, Reynolds and Mason theory, Over voltage due to switching surges and methods to minimize switching surges. Statistical approach of insulation coordination.	**06**	**05**
UNIT-VI	**HIGH VOLTAGE TESTING OF ELECTRICAL APPARATUS AND HIGH VOLTAGE LABORATORIES**	**Hrs.**	**CO**
	Testing of insulators and bushings, Power capacitors and cables testing, testing of surge arresters. Design, planning and layout of High Voltage laboratory:-Classification and layouts, earthing and shielding of H.V. laboratories.	**06**	**06**

Text Books:

[T1] M. S. Naidu, V. Kamaraju, "High Voltage Engineering", Tata McGraw Hill Publication Co. Ltd. New Delhi.

[T2] C. L. Wadhwa, "High Voltage Engineering", New Age International Publishers Ltd.

References:

[R1] E. Kuffel, W. S. Zaengl, J. Kuffel, "High Voltage Engineering Fundamentals", Newnes Publication.

[R2] Prof. D. V. Razevig Translated from Russian by Dr. M. P. Chourasia, "High Voltage Engineering", Khanna Publishers, New Delhi.

[R3] Ravindra Arora, Wolf Gang Mosch, "High Voltage Insulation Engineering", New Age International.

[R4] High Voltage Engineering Theory and Practice by M. Khalifa Marcel Dekker Inc. New York.

[R5] Subir Ray, "An Introduction to High voltage Engineering" PHI Pvt. Ltd. New Delhi

[R6] IS 731-1971:Porcelain insulator for overhead power lines with nominal voltage > 1000 Volt

[R7] Bushings :IS2099-1986,specification for bushings for A.C. Voltages > 1000 Volts.

[R8] Pollution test :IEC 60507-1991 on external and internal insulator.

[R9] High voltage test techniques, general definitions and test requirements: IS 2071(part 1) 1993,IEC Pub 60-1(1989)

E-resources:

[E1] NPTEL https://archive.nptel.ac.in/courses/108/104/108104048/

EE413: EHV AND UHV AC TRANSMISSION

Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs./Week	**Continuous Assessment:**	**20 Marks**
Tutorial: --- Hr./Week	**In-Sem Exam:**	**30 Marks**
	End-Sem Exam:	**50 Marks**
Credits: 03	**Total:**	**100 Marks**

Prerequisite Course:

1. Knowledge of semiconductor material, basic power electronics switches.
2. Electromagnetic field theory.

Objectives: The course aims:-

To impart the knowledge of the student in:

1. To understand the need of EHV and UHV systems.
2. To associate the knowledge of electro static field theory
3. To study the voltage distribution in insulator strings and cables.
4. To know methods of governance on the line conductor design, lin height and phase.
5. To study the expressions for the computation of transmission line parameters.
6. To select voltage control methods for extra high voltage AC transmission system.

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Interpret the basic concepts of EHV and UHV Systems.	2	Understand
CO2	Explain the knowledge of electro static field theory in transmission lines	2	Understand
CO3	Understand the voltage distribution of EHV lines in insulator strings and cables	2	Understand
CO4	Apply the mathematical approach to discuss the effect of corona while designing the EHV lines along with consideration of environmental pollution.	3	Apply
CO5	Illustrate the equivalent circuits for the transmission lines	2	Understand
CO6	Summarize the operation of the different distribution schemes.	2	Understand

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	1	2	2	2	-	-	-	2	1	-	-	2	-
CO2	3	3	3	3	2	-	-	-	1	1	-	-	2	-
CO3	2	3	3	2	2	-	-	-	-	1	-	-	2	-
CO4	2	1	3	2	3	-	-	-	1	1	-	1	3	-
CO5	2	3	3	3	3	-	-	-	1	1	-	1	3	-
CO6	2	2	3	2	3	-	-	-	-	1	-	1	3	-

Level 3 – Substantial; Level 2 – Moderate; Level 1 – Low.

Course Contents			
UNIT-I	**TRANSMISSION LINE TRENDS AND PRELIMINARIES**	**Hrs.**	**COs**
	Structure of electric power system: generation, transmission and distribution; Types of AC and DC distributors – distributed and concentrated loads – interconnection – EHVAC and HVDC transmission - Introduction to FACTS	06	CO1
UNIT-II	**ELECTRO STATIC FIELD**	**Hrs.**	**CO**
	Electrostatic field: calculation of electrostatic field of EHV/AC lines – Effect on humans, animals and plants – Electrostatic induction in un-energized circuit of double circuit line - Electromagnetic interference.	03	CO4
UNIT-III	**EHV INSULATORS AND CABLES**	**Hrs.**	**CO**
	Insulators - Types, voltage distribution in insulator string, improvement of string efficiency, testing of insulators. Underground cables - Types of cables, Capacitance of Single-core cable, Grading of cables, Power factor and heating of cables, Capacitance of 3- core belted cable.	09	CO2
UNIT-IV	**MECHANICAL DESIGN OF LINES AND GROUNDING**	**Hrs.**	**CO**
	Mechanical design of transmission line – Sag and tension calculations for different weather conditions, Tower spotting, Types of towers, Substation Layout (AIS, GIS), Methods of grounding.	09	CO3
UNIT-V	**TRANSMISSION LINE PARAMETERS**	**Hrs.**	**CO**
	Introduction to transmission line parameters - Resistance of a Transmission Line - Inductance of a transmission Line - Inductance of a 3-Phase Overhead Line - Symmetrical and unsymmetrical spacing and transposition - Capacitance of single and double transmission lines - Application of self and mutual GMD - Skin and proximity effects - corona - Factors Affecting Corona.	09	CO5
UNIT-VI	**MODELLING OF TRANSMISSION LINES**	**Hrs.**	**CO**
	Classification of lines - Short line, medium line and long line - equivalent circuits, phasor diagram, transmission efficiency and voltage regulation, real and reactive power flow in transmission lines, methods of voltage control.	09	CO6

Text Books:

1. Rakesh Das Begamudre, "Extra High Voltage AC Transmission Engineering", Fourth Edition, New Age International publishers, 2014.
2. Allen J Wood & Bruce Wollenberg, "Power Generation Operation & Control, Third Edition, 2016.
3. B.R.Gupta, “Power System Analysis and Design”, Fourth Edition, Chand, 2003

References:

1. Turan Gonen, "Electric Power Transmission System Engineering Analysis and Design", CRC Press, Third Edition, 2014
2. Md. Abdus Salam, Quazi M. Rahman "Power Systems Grounding" Springer publishers, 2016
3. A Chakraborti, D.P. Kothari and A.K. Mukhopadyay: Performance, Operation and Control of EHV Power Transmission Systems, T.M.H. (Pub) 1992.

EE414A: INTELLIGENT SYSTEMS WITH AI AND ML

Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs./Week	**Continuous Assessment:**	**20 Marks**
Tutorial: --- Hr./Week	**In-Sem Exam:**	**30 Marks**
	End-Sem Exam:	**50 Marks**
Credits: 03	**Total:**	**100 Marks**

Prerequisite Course:

1. : Discrete Mathematics, Any Programming Knowledge (MATLAB)

Course Objectives

1. To understand the concept of Artificial Intelligence (AI) in the form of various Intellectual tasks.
2. To understand multi-agent environment in competitive environment.
3. To introduce the theoretical foundations, algorithms, methodologies, and application of neural networks and deep learning.
4. To provide the knowledge for analyzing real world applications.

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	**Understand** the concepts of Artificial Intelligence	2	**Understand**
CO2	**Identify** and **apply** suitable Intelligent agents for various AI applications	2,3	**Identify, Apply**
CO3	Learn the fundamentals concepts of the Artificial Neural Network and **classify** them.	2	**classify**
CO4	**Apply** the suitable algorithms to solve AI problems	3	**Apply**
CO5	**Analyze** the concept of Memory for testing.	4	**Analyze**
CO6	**Evaluate** the performance of deep learning algorithms and to provide solution for various real-world applications.	5	**Evaluate**

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	1	-	-	-	-	2	-	1	1	-
CO2	3	2	2	1	1	-	-	-	-	2	-	1	1	-
CO3	3	2	2	1	1	-	-	-	-	2	-	1	1	-
CO4	3	2	2	1	1	-	-	-	-	2	-	1	1	-
CO5	3	2	2	1	1	-	-	-	-	2	-	1	1	-
CO6	3	2	2	1	1	-	-	-	-	2	-	1	1	-

Course Contents			
UNIT-I	**ARTIFICIAL INTELLIGENCE**	**Hrs.**	**COs**
	Introduction to Artificial Intelligence, Rational thinking, AI definition, Foundations of Artificial Intelligence, History of Artificial Intelligence, State of the Art, Risks and Benefits of AI, Applications of AI, Case study of Alexa.	06	CO1
UNIT-II	**INTELLIGENT AGENTS**	**Hrs.**	**CO**
	Agents and Environments, Good Behavior: Concept of Rationality, The Nature of Environments, Structure of Agents, types of agents, pseudo code.	06	CO2
UNIT-III	**MACHINE LEARNING**	**Hrs.**	**CO**
	Introduction to machine learning, Fundamentals of ANN, Evolution of NN, Basic Models of ANN, and Terminologies of ANN: weights, Bias, Threshold, Learning Rate, and Momentum factor, Vigilance parameter, Notations, Architecture of McCulloch-Pitts Neuron, Hebb Network: Introduction, Flow chart of training algorithm.	06	CO3
UNIT-IV	**SUPERVISED AND UNSUPERVISED LEARNING NETWORK**	**Hrs.**	**CO**
	Introduction to supervised and unsupervised learning , Perceptron Network: Architecture, Flow chart for training process, Perceptron training algorithm for single and multiple output class, Adaptive Linear Neuron: Architecture, Training and testing Algorithm, Multiple Adaptive Linear Neuron: Architecture, Backpropagation Architecture.	06	CO4
UNIT-V	**ASSOCIATIVE MEMORY NETWORK**		**CO**
	Introduction, Associative memory network: Architecture, Flow chart for training and testing process, Heteroassociative Memory: Architecture, Testing Algorithm, Architecture of Bidirectional Associative Memory (BAM).		CO5
UNIT-VI	**DEEP LEARNING**	**Hrs.**	**CO**
	What is Deep Learning?, Multilayer Perceptron ,Feed forward neural, Back propagation, Gradient descent, Activation Functions: RELU, Introduction to CNN, Convolution Operation, Parameter Sharing, Equivariant Representation, Pooling, Recurrent Neural Networks: Introduction, Types of Recurrent Neural Networks, Applications.	06	CO6

Text Books:

[T1] Dr. S N Sivanandam (Author), Dr. S.N Deepa (Author), Principles of Soft Computing , Wiley 2008
[T2] Stuart Russell (Author), Peter Norvig (Author), Artificial Intelligence A Modern Approach, Pearson Prentice Hall.

References:

[R1] Simon Haykin (Author) Neural Networks: A Comprehensive Foundation 2nd Edition, Pearson Education.

E-resources:

[E1] https://nptel.ac.in/courses/106106202
[E2] https://nptel.ac.in/courses/106106213
[E3] https://www.coursera.org/learn/introduction-to-ai

EE414B: IOT APPLICATIONS

Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs./Week	**Continuous Assessment:**	**20 Marks**
Tutorial: --- Hr./Week	**In-Sem Exam:**	**30 Marks**
	End-Sem Exam:	**50 Marks**
Credits: 03	**Total:**	**100 Marks**

Prerequisite Course:

1. **Basic programming knowledge**

Course Objectives

Course Objectives:

1. Introduction to IoT, Overview of IoT Building Blocks.
2. Build small applications in IoT for Engineering Applications using Sensors, Actuators.
3. Learn commonly used IoT Simulation Hardware platforms.
4. Understand different Communication Technologies used in IoT.
5. Development of application-level protocol and Security of IoT Ecosystem.
6. Understand IoT applications in different domains.

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Identify different basic blocks of IoT systems.	2	**Understand**
CO2	Use hardware and IoT components.	2,3	**Identify, Apply**
CO3	Select commonly used IoT Simulation Hardware platforms	2	**classify**
CO4	Application of Interfacing and Communication Technologies for IoT.	3	**Apply**
CO5	Illustrate IoT Application Development and Security of IoT Ecosystem.	4	**Analyze**
CO6	Evaluate Present and Future Domain specific Applications of IoT Ecosystem.	5	**Evaluate**

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	1	3	-	-	-	2-	1	-	-	1	-
CO2	3	2	2	1	2	-	-	-	-	1	-	-	1	-
CO3	3	2	3	3	2	-	-	-	-	1	-	-	1	-
CO4	3	3	3	3	2	-	-	-	1	1	-	1	2	-
CO5	3	3	3	3	2	-	-	-	1	1	-	1	1	-
CO6	3	3	3	3	2	-	-	-	-	1	-	1	1	-

Course Contents			
UNIT-I	**Introduction to Internet of Things (IoT)**	**Hrs.**	**COs**
	Introduction to IoT, IoT characteristics,Logical design of IoT: IoT Fundamental blocks, IoT Communication Model, IoT Communication API's IoT Enabling Technologies: Wireless Sensor Networks, Cloud Computing, Embedded Systems,IoT Levels and Deployment templates	06	CO1
UNIT-II	**Working with Sensors and Hardware Platforms**	**Hrs.**	**CO**
	Sensors and its different parameters sensed by sensor: Temperature, Light, Ultrasonic, Humidity, Water detector, PIR sensor, Pressure Sensor, IR sensor, Touch Sensor, Color Sensor, Humidity Sensor, Tilt Sensor, Flow and Level Sensor, Smoke, Gas and Alcohol Sensor,Input and out pins of sensors, magnet relays and switches Middleware: M2M: RFID, WSN, SCADA.	06	CO2
UNIT-III	**IoT Simulation Environment Hardware platforms and Endpoint Interfacing**	**Hrs.**	**CO**
	IoT supported Hardware platforms: Introduction to IoT Simulation Environment and,Devices (Raspberry Pi, Arduino), Architecture, Setup, IDE, Installation,Interfaces,Programming with focus on interfacing for reading input from pins,connecting external gadgets/sensors/actuators, Controlling and Displaying Output, Libraries, Introduction to Python programming, Introduction to Raspberry Pi, Implementation of IoT with Arduino	06	CO3
UNIT-IV	**Interfacing and Communication for Building IoT Applications**	**Hrs.**	**CO**
	Overview and Working of Controlled Systems, Connectivity models - TCP/IP Vs OSI model, IoT Communication Models, IoT Communication APIs, Serial Vs Parallel Communication, Wires Vs Wireless Communication, their Technologies and Hardware **Physical Servers and Cloud Platforms:** Web server, Posting sensor(s) data to web server, Introduction to Cloud Storage models and Communication APIs Webserver, API Virtualization concepts and Cloud Architecture, Advantages and limitations of Cloud computing, IoT Cloudplatforms, Cloud services.	06	CO4
UNIT-V	**IoT Application Development and Security of IoT Ecosystem**		**CO**
	Application Protocols: MQTT, REST/HTTP, SQL Back-end Application Designing, Non SQL Back-end Application Designing **Security:** Need of security in IoT, Security & Privacy during development, Privacy for IoT enabled devices, IoT security for consumer devices, Security levels, protecting IoT devices,Security, Privacy and Trust in IoT-Data-Platforms	06	CO5
UNIT-VI	**Present and Future Domain specific Applications of IoT Ecosystem**	**Hrs.**	**CO**
	IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications. Study of existing IoT platforms/middleware,Business,Manufacturing, Smart Homes/Home automation,Surveillance applications, Connected Vehicles, Agriculture, Healthcare,Activity Monitoring, Retail, Logistics, Security, Health and Lifestyle,Smart Grid, Smart Cities - Security.	06	CO6
Text Books:			

[T1] Bahga, A. and Madisetti, V., (2015), "Internet of Things - A Hands-on Approach," Universities Press, ISBN: 9788173719547
[T2] Raj, P. and Raman, A. C., (2017), "The Internet of Things: Enabling Technologies, Platforms, and Use Cases," Auerbach Publications/CRC Press, ISBN: 9781498761284
[T3] Adrian McEwen, A. and Cassimally, H., (2013), "Designing the Internet of Things," John Wiley and Sons, ISBN:
[T4] Veneri, G., Capasso, A., (2018), "Hands-On Industrial Internet of Things: Create a powerful Industrial IoT infrastructure using Industry 4.0," Packt Publishing, ISBN: 9781789537222
[T5] Hersent, O, Boswarthick, D., Elloumi, O., (2012), "The Internet of Things: Key Applications and Protocols", Wiley, ISBN: 9781119994350

References:

[R1] Uckelmann, D., Harrison, M., Michahelles, F., (2011), "Architecting the Internet of Things," Springer, ISBN: 9781119994350

E-resources:

[E1] https://nptel.ac.in/courses/106105166

EE414C: VLSI CIRCUITS

Teaching Scheme	Examination Scheme	
Lectures: 03 Hrs./Week	**Continuous Assessment:**	**20 Marks**
Tutorial: --- Hr/Week	**In-Sem Exam:**	**30 Marks**
	End-Sem Exam:	**50 Marks**
Credits: 03	**Total:**	**100 Marks**

Prerequisite Course:

1. Study of basic PLDs.
2. Knowledge of VHDL

Course Objectives

1. To understand CMOS and its application in VLSI Circuits.
2. To design digital circuits using VHDL.
3. To implement digital circuits using CPLD/FPGA.
4. To detect faults in the design.

Course Outcomes (COs):

After successful completion of the course, student will be able to

1. Understand VLSI Design Flow.
2. Design any digital circuit using VHDL.
3. Understand the importance of testability in chip design.

Course Outcome (s)		Bloom's Taxonomy	
		Level	Descriptor
CO1	Understand VLSI Design Flow.	2	Understanding
CO2	Design any digital circuit using VHDL	3	Applying
CO3	Understand the importance of testability in chip design.	2	Understanding

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	2	1	--	--	--	--	--	--	--	--	1	--
CO2	1	2	2	1	3	--	--	--	--	--	--	--	--	--
CO3	1	2	2	1	3	1	--	--	--	--	--	--	1	--

Course Contents

UNIT-I	Introduction to VLSI Circuits	Hrs.	COs
	Introduction to MOSFETs: MOS Transistor Theory –Device Structure and Physical Operation, Current Voltage Characteristics, Fabrication, MOS Capacitor, Body Effect, Temperature Effects, Channel Length Modulation, Latch-up. MOS Inverter: MOS Transistors, MOS Transistor Switches, CMOS Logic, Circuit and System Representations, Design Equations, Transistor Sizing, Voltage Transfer Characteristics, Power Dissipation, Noise Margin, Power Delay Product, Energy dissipation. MOS Layers Stick/Layout Diagrams; Layout Design Rules, Issues of Scaling, Scaling factor for device parameters. Combinational MOS	12	1

	Logic Circuits: Pass Transistors/Transmission Gates; Designing with transmission gates: Primitive Logic Gates.		
UNIT-II	**Digital Circuit Design using VHDL**	**Hrs.**	**CO**
	Design of sequential circuits, asynchronous and synchronous design issues, state machine modeling (Moore and mealy machines), packages, sub programs, attributes, test benches.	06	2
UNIT-III	**Programmable Logic Devices**	**Hrs.**	**CO**
	Complex Programmable Logic Devices – Architecture of CPLD, Organization of FPGAs, FPGA Programming Technologies, Programmable Logic Block Architectures, Programmable Interconnects, Programmable I/O blocks in FPGAs, Dedicated Specialized Components of FPGAs, and Applications of FPGAs.	07	3
UNIT-IV	**CMOS Subsystem Design**	**Hrs.**	**CO**
	Semiconductor memories, memory chip organization, Random Access Memories (RAM), Static RAM (SRAM), standard architecture, 6T cell, sense amplifier, address decoders, timings. Dynamic RAM (DRAM), different DRAM cells, refresh circuits, timings.	06	3
UNIT-V	**Floor Planning and Placement**	**Hrs.**	**CO**
	Floor planning concepts, shape functions and floor plan sizing, Types of local routing problems Area routing, channel routing, global routing, algorithms for global routing.	06	**3**
UNIT-VI	**Fault Tolerance and Testability**	**Hrs.**	**CO**
	Types of fault, stuck open, short, stuck at 1, 0 faults, Fault coverage, Need of Design for Testability (DFT), Controllability, predictability, testability, built in Self Test (BIST), Partial and full scan check, Need of boundary scan check, JTAG, Test Access Port (TAP) controller.	06	**3**

Text Books:

[T1] Neil H. Weste and Kamran, Principles of CMOS VLSI Design, Pearson Publication.

[T2] John F. Wakerly, Digital Design, Principles and Practices, Prentice Hall Publication.

References:

[R1] Douglas Perry, VHDL, McGraw Hill Publication.

[R2] Charles Roth, Digital System Design using VHDL, McGraw Hill Publication.

[R3] Data Sheets of PLDs.

[R4] Sung-Mo (Steve) Kang, Yusuf Leblebici, CMOS Digital Integrated Circuits, Tata McGraw Hill Publication.

E-resources:

[E1] https://nptel.ac.in/courses/117106092

[E2] https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=92

EE415: POWER QUALITY AND FACTS LABORATORY

Teaching Scheme	**Examination Scheme**
Practical: 02 Hrs./Week	**Oral: 50 Marks**
Credits: 1	**Total: 50 Marks**

Prerequisite Course:

1. Power Electronics, Power System Transients

Course Objectives

1. Develop ability to identify various power quality issues, its sources and effects on various equipment.
2. Monitor and analyse the voltage sag and swell
3. Describe and selection of cost effective power quality mitigation solutions.
4. Study of various FACTS Devices for power quality improvement

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Explain the importance of various power quality issues.	02	Understand
CO2	Analyse the voltage sag and swell caused by various instruments	02	Understand
CO3	Analyse the voltage flicker problem and mitigate the cause	02	Understand
CO4	Construct the system for mitigating the harmonics with respect to IEEE 519-2014 standard.	03	Apply
CO5	Construct the various FACTS devices for PQ Enhancement	03	Apply

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	1	3	-	-	-	-	-	-	1	3	2
CO2	3	2	3	2	3	-	-	-	-	-	-	1	3	2
CO3	3	2	3	2	3	-	-	-	-	-	-	1	3	2
CO4	3	2	3	2	3	-	-	-	-	-	-	1	3	2
CO5	3	2	3	2	3	-	-	-	-	-	-	1	3	2

Course Contents

Ex. No	**Name of Experiment**	**Hrs.**	**COs**
1	Study of various power quality events	2	1
2	Simulation study of Voltage Sag Caused by Transformer Energizing	2	1
3	Simulation study of Voltage Sag Caused by Induction Motor Starting	2	1,2
4	Simulation study of Voltage Sag and Voltage Swell Caused by Line Fault	2	2

5	Mitigation of Voltage Flicker by FACTS Devices	2	3
6	Simulation Study of Single Phase Dynamic Voltage Restorer	2	4
7	Simulink studies of Harmonic generating load	2	4
8	Design of Passive filter for Power System Harmonic Mitigation	2	4
9	Design and study of Shunt Active Filter using Matlab	2	5
10	Design and study of DSTATCOM for power quality improvement in distribution system using Matlab	2	5

Text Books:

[T1] Roger. C. Dugan, Mark. F. Mc Granagham, Surya Santoso, H.WayneBeaty, 'Electrical Power Systems Quality' McGraw Hill,2003.(For Chapters1,2,3, 4 and 5).

[T2] J. Arrillaga, N.R. Watson, S. Chen, "Power System Quality Assessment",(New York : Wiley),2000.

[T3] Bhim Singh, Ambrish Chandra, Kamal Al-Haddad," Power Quality Problems & Mitigation Techniques" Wiley, 2015.

[T4] Arindam Ghosh, Gerard Ledwich, "Power Quality Enhancement Using Custom Power Devices", Springer US, 2002.

References:

[R1] G.T. Heydt, 'Electric Power Quality', 2nd Edition. (West Lafayette, IN, Stars in a Circle Publications, 1994).

[R2] M.H.J Bollen, 'Understanding Power Quality Problems: Voltage Sags and Interruptions', (New York: IEEE Press, 1999).

[R3] G.J.Wakileh, "Power Systems Harmonics – Fundamentals, Analysis and Filter Design," Springer 2007.

E-resources:

[E1] https://nptel.ac.in/courses/108106025/(Power Quality in Power Distribution Systems)

EE416: HIGH VOLTAGE ENGINEERING LABORATORY

Teaching Scheme	**Examination Scheme**
Practical: 02 Hrs./Week	**Practical: 50 Marks**
Credits: 01	**Total: 50 Marks**

Prerequisite Course: Atomic and molecular structure of gaseous and solid materials, basic properties conductors and insulators, knowledge of Electrical Engineering Materials.

Course Objectives

1. To enable students to know and compare the various processes of breakdown in solid, liquid and gaseous dielectric materials ·
2. To enable students understand and apply various methods of generation and measurement of DC, AC, impulse voltage and current.
3. To enable students to know the charge formation and separation phenomenon in clouds, causes of overvoltage and lightening phenomenon ·
4. To develop ability among learners to execute testing on various high voltage equipments as per standards ·
5. To introduce students to the design, layout, safety precautions, earthing, and shielding of HV laboratory.

Course Outcomes (COs):

After successful completion of the course, student will be able to

	Course Outcome (s)	**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Identify, describe and analyze the breakdown theories of solid materials.	4	Analyzing
CO2	Identify, describe and analyze the breakdown theories of liquid materials.	4	Analyzing
CO3	Identify, describe and analyze the breakdown theories of gaseous materials.	4	Analyzing
CO4	Describe as well as use different methods of generation of high AC, DC, impulse voltage and current.	3	Applying
CO5	Identify the occurrence of overvoltage and to provide remedial solutions.	3	Applying
CO6	Demonstrate an ability to carry out different tests on high voltage equipment and devices as well as ability to design the high voltage laboratory with all safety measures.	4	Analyzing

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	1	3	1	4	2	2	1	3	1	4
CO2	2	1	3	5	5	3	2	3	3	3	5	3	2	3
CO3	1	3	1	6	3	2	1	3	5	5	3	2	1	3
CO4	2	3	2	4	5	1	3	1	6	3	5	1	3	1
CO5	3	2	3	3	3	2	3	2	4	5	3	2	3	2
CO6	3	1	4	2	2	2	1	3	5	5	2	2	1	3

Course Contents			
Ex. No	**Name of Experiment**	**Hrs.**	**COs**
1	To find the constants of breakdown equation of transformer oil.(Analytical and graphical method)	02	01
2	Measurement of unknown high a.c. voltage using sphere gap	02	01
3	To obtain breakdown strength of composite insulation system, and observe the effect of parameter like no. of layers, thickness of layer, effect of interfacing.	02	02
4	To find out the breakdown of air in uniform and non uniform field and compare it.	02	**02**
5	To study surface flashover on corrugated porcelain/polymeric insulation system.	02	03
6	To understand basic principle of corona and obtain audible and visible corona inception and extinction voltage under non uniform field.	02	**03**
7	To perform experiment on horn gap arrestor and understand arc quenching phenomenon.	02	04
8	To observe development of tracks and trees on polymeric insulation system.	02	**04**
9	Parametric analysis of Impulse current generator using virtual Laboratory.	02	04
10	10. To perform experiment on rod gap arrestor.	02	**05**
11	To Study effect of barrier on breakdown voltage of air/ transformer oil.	02	05
12.	Simulation of lightening and switching impulse voltage generator using any simulation software.	02	05
13.	To perform various HV insulation tests on cables as per IS.	02	06
14.	Study of layout /earthing/safety of HV installation /lab in any industry by visit /virtual lab	02	06
15.	Study of any IS for any power apparatus (Power Transformer/Induction Motor/ Alternator etc)	02	06

Text Books:

[T1] M. S. Naidu, V. Kamaraju, “High Voltage Engineering”, Tata McGraw Hill Publication Co. Ltd. New Delhi.

[T2] C. L. Wadhwa, “High Voltage Engineering”, New Age International Publishers Ltd.

References:

[R1] E. Kuffel, W. S. Zaengl, J. Kuffel, “High Voltage Engineering Fundamentals”, Newnes Publication.

[R2] Prof. D. V. Razevig Translated from Russian by Dr. M. P. Chourasia, “High Voltage Engineering”, Khanna Publishers, New Delhi.

[R3] Ravindra Arora, Wolf Gang Mosch, “High Voltage Insulation Engineering”, New Age International.

[R4] High Voltage Engineering Theory and Practice by M. Khalifa Marcel Dekker Inc. New York.

[R5] Subir Ray, "An Introduction to High voltage Engineering" PHI Pvt. Ltd. New Delhi

[R6] IS 731-1971:Porcelain insulator for overhead power lines with nominal voltage > 1000 Volt

[R7] Bushings :IS2099-1986,specification for bushings for A.C. Voltages > 1000 Volts.

[R8] Pollution test :IEC 60507-1991 on external and internal insulator.

[R9] High voltage test techniques, general definitions and test requirements: IS 2071(part 1) 1993,IEC Pub 60-1(1989)

E-resources:

[E1] NPTEL https://archive.nptel.ac.in/courses/108/104/108104048/

EE417: PROJECT STAGE II

Teaching Scheme	**Examination Scheme**	
Practical: 08 Hrs./Week	**Oral:**	**50 Marks**
	Term Work:	**100 Marks**
Credits: 04 Credits	**Total:**	**150 Marks**

Prerequisite Course:

1. Mini Project, Seminar

Course Objectives

1. To develop skills for carrying literature survey and organize the material in proper manner.
2. To provide opportunity of designing and building complete system/subsystem based on their knowledge acquired during graduation.
3. To understand the needs of society and based on it to contribute towards its betterment and to learn to work in a team.
4. To explore and to acquire specified skill in areas related to Electrical Engineering.
5. To ensure the completion of given project such as fabrication, conducting experimentation, analysis, validation with optimized cost.
6. Collect the data in report form and represent and communicate findings of the completed work in written and verbal form.

Course Outcomes (COs):

After successful completion of the course, student will be able to

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Work in team and ensure satisfactory completion of project in all respect.	**2**	Understand
CO2	Handle different tools to complete the given task and to acquire specified knowledge in area of interest.	**2**	Understand
CO3	Provide solution to the current issues faced by the society.	**4**	Evaluate
CO4	Practice moral and ethical value while completing the given task.	**5**	Analyse
CO5	Communicate effectively findings in verbal and written forms.	**6**	Create

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	3			1	1	2						1	
CO2	1	3			1	1	2						1	
CO3	1	3	1		1	1	2				1		1	
CO4	1	3		1	1	1	2			1			1	
CO5	1	3			1	1	2	2				1	1	

Project Stage-II Guidelines: Project Work will be evaluated for an individual student based on the presentation of the work done in a year [Project Stage-I (Sem-I) + Project Stage-II (Sem-II)] and submission of the report. The project work shall consist of any one of the following demanding area in Electrical Engineering related subjects.
1. Experimental investigation in the particular domain of engineering field.
2. Software development and usage of software's for solving complex engineering problems.
3. Benefits cost economic analysis / optimized solutions
4. Working model design and fabrication / product development
5. Industrial applications / Environmental issues / Awareness / sustainable solutions
6. Case study with development of methodology using soft computing tools.
7. Society problem / Agricultural problems / new material evaluation
8. Live industry problems / Industry sponsored projects. It is recommended to promote the students to present a paper based on project work in appropriate conference / journal.

II. Evaluation of Project work: Evaluation of Project work in final exam will be done by the pair of experienced internal guide and external Examiner.

Additional weightage will be given if projects / research related to
Option A: Industry Sponsored Project
Option B: Project as an Entrepreneur
Option C: Internal Product development
Option D: Interdisciplinary projects
Option E: Paper presented / Published on project work in appropriate conference / journal.

III. Format of project report: The report shall contain finalization of topic, literature survey, objectives based on the gaps identified, methodology to be used, planning schedule / flow chart for completion of project. The report must be printed and submitted in black color hard bound with front page embossed. The report must be submitted as 2 Copies (1 College + 1 Guide) + each individual copy of student.

IV. Sequence of pages: i)Front Cover Page ii) Certificate iii) Program Outcomes iv) Acknowledgement v) Synopsis / Abstract vi) Contents / Index vii) Notations viii) List of Tables ix) List of Figures x) List of Graphs.

Chapter 1 Introduction (This chapter should consists of: 1.1 Introduction of the Project Work; 1.2 Problem Statement, 1.3 Objectives, 1.4 Scope of the Project Works, 1.5 Need of the investigation, 1.5 Limitations of study, 1.6 Expected outcome)

Chapter 2 Literature Review / Survey from minimum 15 articles published in International Journals and 10 articles published in national journals, books, I.S.Codes, etc. (It shall include details regarding work done by various researchers in the area, methods established / used, any new approach. It should preferably highlight the development in the field of research chronologically as reflected from books, journals etc.).

Chapter 3 Methodology used / scientific approach used Planning Schedule/ Flow chart for completion of project

Chapter 4 Results and Discussion

Chapter 5 Conclusions

References and Bibliography :The references should include name of author/code/manual/book, Title of paper, name of the journal, month & year of publication, volume number / ISBN number, page number.

(References shall be mentioned at the end as per standards of international journals of professional body).

V. Report printing details: Report shall be typed on A4 size Executive Bond paper with 1.5 spacing preferably on both the sides of paper.
Margins: Left Margin: 37.5 mm, Right Margin: 25 mm, Top Margin: 25 mm, Bottom Margin: 25 mm. Give page number at bottom margin at center.

Font size & Type:
a. Chapter Number and Name - 14 Font size, Times New Roman in Capital Bold Letters.
b. Main Titles (1.1, 2.5 etc) - 12 Font size, Times New Roman in Bold Capital Letters.
c. Sub Titles (1.1.5, 4.5.1 etc) - 12 Font size, Times New Roman in Bold Title case.
d. All other matter / content -12 Font size, Times New Roman sentence case.
e. Figure name - 12 Font size, Bold Times New Roman sentence case below the figure.
f. Table title - 12 font size, Bold Times New Roman sentence case above the above the table.
g. No blank sheet / page should be left in the report.

Layout of typed content:

a. Chapter Number and Name – Center of Page.
b. Main Titles and Sub Titles - Justified
c. All other matter / content - Justified
d. Figure & Figure name – Figure should be at Centre of page and Figure name should be at Centre of page below the figure.
e. Table & Table title - Table should be at Centre of page and Table title should be at centre of page Above the Table.

MC418A: INDUSTRIAL TECHNOLOGY AND MANAGEMENT

Teaching Scheme	**Examination Scheme**
Lectures: 01 Hrs./Week	**End-Sem Exam: PASS / FAIL**
Credits: Non Credit	**Total: NA**

Prerequisite Course:

Course Objectives:

1. Possess knowledge of types of business organizations; explore the fundamentals of economics and Management.
2. Understand the basic concepts of Technology management and Quality management.
3. Analyse and differentiate between marketing management and financial management.
4. Recognize the importance of Motivation, Group dynamics, Team work, leadership skill and entrepreneurship.
5. Explain the fundamentals of Human Resource management.
6. Identify the importance of Intellectual property rights and understand the concept of patents, copy rights and trademarks.

Course Outcomes (COs):

After successful completion of the course, student will be able to

	Course Outcome (s)	**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Differentiate between different types of business organization and discuss the fundamentals of economics and management	2	Understanding
CO2	Explain the importance of technology and quality management	2	Understanding
CO3	Describe the characteristics of marketing and its types	2	Understanding
CO4	Discuss the fundamentals of Human Resource management and qualities of a good leader	2	Understanding

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	1	1	2	2	2	2	2	-	-
CO2	-	-	-	-	-	1	1	2	2	2	2	2	-	-
CO3	-	-	-	-	-	1	1	2	2	2	2	2	-	-
CO4	-	-	-	-	-	1	1	2	2	2	2	2	-	-

Course Contents

UNIT I	**INTRODUCTION TO MANAGERIAL AND ECONOMICAL DEMAND**	**Hrs.**	**COs**
	Introduction of economics, Demand and Supply concept Law of demand and supply, Elasticity of demand and supply, Demand forecasting: Meaning and methods Meaning, scope, function, and importance of management. Difference between administration and management. Types of business ownership Business Organizations Joint Stock Company	3	CO1

UNIT II	TECHNOLOGY AND INDUSTRIAL MANAGEMENT	Hrs.	COs
	Introduction to industrial management: Concept, development application and its scope Definition of technology Definition of management and its relation with society, classification of technology Management of technology at various levels- its importance on National Economy, Ethics in technology management	3	CO2
UNIT III	**QUALITY MANAGEMENT**	**Hrs.**	**Cos**
	Definition of quality, continuous improvement, types of quality Quality of design, Assistance Tools: Ishikawa diagram – Pareto Analysis Pokka Yoke (Mistake Proofing) quality circles, Kaizen. TQM, 5S 5S - Case study of Toyota Six-Sigma, Quality Management Standards: ISO 9001:2000 Quality Management System Standard- The ISO 14001:2004 Environmental Management System Standard	3	CO2
UNIT IV	**MARKETING AND FINANCIAL MANAGEMENT**	**Hrs.**	**Cos**
	Market, meaning, characteristics types: Perfect Competition, Monopoly, Monopolistic completion and Oligopoly Marketing and selling, marketing planning Market survey and market research, online Marketing Definition of financial management Types of costs, and methods of costing, price, capital Books of accounts and final accounts	2	CO3
UNIT V	**HUMAN RESOURCE MANAGEMENT**	**Hrs.**	**Cos**
	Motivation: Introduction to Motivation, theories of work motivation: Maslow Hierarchy of need's theory Theory X, Theory Y and F. Herzberg's two factor theory Group dynamics: Types and interactions of groups Leadership- Laissez-faire, importance, qualities of good leadership Human Resource Management- Introduction, importance, scope. HR planning. Recruitment, selection, training and development, Performance management.	2	CO4

Text Books:

[T1] Industrial Engineering and Management, O.P. Khanna, Dhanpat Rai and Sons, New Delhi, ISBN 10138
[T2] Basic Managerial Skill for All, E. H. McGrah, 52101
[T3] Management of Technology , Tarek Khalil, Tata Mc Graw Hill Publication Pvt. Ltd., 54543
[T4] Prabuddha Ganguli Intellectual Property Rights, Prabuddha Ganguli , TATA McGraw-Hill Publishing Company,
[T5] Management Accounting and Financial management, "M. Y. Khan and P. K. jain, Mcgraw Hill

References:

[R1] Personnel Management, C. B. Mamoria and V.S.P.Rao,,Himalaya Publishing House, 60852
[R2] Marketing Management,Philip Kotler, Pearson Edition 2008 , 15265
[R3] Financial Management by "I M Pandey", I M Pandey, Vikas Publishing House Pvt. Ltd., Delhi Philip Kotler- Marketing Management 45416
[R4] Total Quality Management, Kelly John M, InfoTech Standard, Delhi.
[R5] The Law of Intellectual Property Rights Shiv Sahai Singh