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 III of Curriculum Pattern 2021 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 29/9/2022

SANJIVANI COLLEGE OF ENGINEERING, KOPARGAON Approved

Director

COURSE STRUCTURE- 2021 PATTERN
SECOND YEAR B. TECH. ELECTRICAL ENGINEERING

SEMESTER-III

Course			Teaching Scheme Hours/week				Evaluation Scheme-Marks					
							Theory					
Cat.	Code	Title	L	T	P	Credits	ESE	CIA	OR	PR	TW	Total
PCC	EE201	Electrical Engineering Materials	3	-	-	3	60	40	-	-	-	100
BSC	BS202	Engineering Mathematics III	3	1	-	4	60	40	-	-	-	100
PCC	EE203	Electrical Measurements and Instrumentation	4	-	-	4	60	40	-	-	-	100
PCC	EE204	Analog and Digital Electronics	3	-	-	3	60	40	-	-	-	100
HSMC	HS205	Universal Human Values & Professional Ethics	3	-	-	3	60	40	-	-	-	100
HSMC	EE206	General Proficiency	-	-	2	1	-	-	-	-	50	50
LC	EE207	Electrical Engineering Materials Laboratory	-	-	2	1	-	-	50	-	-	50
LC	EE208	Electronics and Electrical Instrumentation Laboratory	-	-	2	1	-	-	-	50	-	50
LC	EE209	Electrical Design and Modelling-I Laboratory	-	-	2	1	-	-	-	50	-	50
MLC	MC210	Mandatory Learning Course-III	2	-	-	No Credit	-	-	-	-	-	-
Total			18	1	8	21	300	200	50	100	50	700

MC210	Mandatory Learning Course-III	MC210A Constitution of India – Basic features and fundamental principles

29/9/2022

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 IV of Curriculum Pattern 2021 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

05/04/2022

Dean Academics

SANJIVANI COLLEGE OF ENGINEERING KOPARGAON Approved

Director

COURSE STRUCTURE- 2021 PATTERN
SECOND YEAR B. TECH. ELECTRICAL ENGINEERING

SEMESTER-IV

Course			Teaching Scheme Hours/week				Evaluation Scheme-Marks					
							Theory					
Cat.	Code	Title	L	T	P	Credits	ESE	CIA	OR	PR	TW	Total
PCC	EE211	Numerical Computations with Signals and Systems	3	1	-	4	60	40	-	-	-	100
PCC	EE212	Network Analysis	3	1	-	4	60	40	-	-	-	100
PCC	EE213	Electrical Machines I	4	-	-	4	60	40	-	-	-	100
PCC	EE214	Power System I	3	-	-	3	60	40	-	-	-	100
PROJ	EE215	Project Based Learning	-	-	2	1	-	-	-	-	50	50
HSMC	HS216	Corporate Readiness-I	-	-	2	1	-	-	-	-	50	50
PROJ	EE217	Professional Development	-	-	2	1	-	-	-	-	25	25
LC	EE218	Network Analysis Laboratory	-	-	2	1	-	-	25	-	-	25
LC	EE219	Electrical Machines I Laboratory	-	-	2	1	-	-	-	50	-	50
LC	EE220	Power System I Laboratory	-	-	2	1	-	-	25	-	-	25
LC	EE221	Electrical Design and Modelling-II Laboratory	-	-	2	1	-	-	-	50	-	50
LC	EE222	Software Programming Laboratory	-	-	2	1	-	-	25	-	-	25
MLC	MC222	Mandatory Course-IV A. Innovation - Project based – Sci., Tech, Social, Design & Innovation	2	-	-	Non Credit	-	-	-	-	-	Pass/Fail
		Total	15	2	16	23	240	160	75	100	125	700

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 V of Curriculum Pattern 2021 w.e.f. A.Y 2023-2024 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

COURSE STRUCTURE- 2021 PATTERN
THIRD YEAR B. TECH. ELECTRICAL ENGINEERING

SEMESTER- V

Course			Teaching Scheme Hours/week				Evaluation Scheme-Marks					
Cat.	Code	Title	L	T	P	Credits	Theory ESE	Theory CIA	OR	PR	TW	Total
PCC	EE301	Microcontrollers And Applications	3	-	-	3	60	40	-	-	-	100
PCC	EE302	Electrical Machines II	3	-	-	3	60	40	-	-	-	100
PCC	EE303	Power System II	3	-	-	3	60	40	-	-	-	100
PCC	EE304	Power Electronics	3	-	-	3	60	40	-	-	-	100
PEC	EE305	Professional Elective-I A. Renewable Energy Sources B. Smart Grid C. Industry 4.0	3	-	-	3	60	40	-	-	-	100
LC	EE306	Microcontrollers And Applications Laboratory	-	-	2	1	-	-	25	-	-	25
LC	EE307	Electrical Machines II Laboratory	-	-	2	1	-	-	-	25	-	25
LC	EE308	Power System II Laboratory	-	-	2	1	-	-	25	-	-	25
LC	EE309	Power Electronics Laboratory	-	-	2	1	-	-	-	25	-	25
PROJ	EE310	Corporate Readiness-II	-	-	2	1	-	-	-	-	50	50
PROJ	EE311	Seminar & Technical Communication Skills	-	-	4	2	-	-	-	-	50	50
MLC	MC312	Mandatory Learning Course-V A. Electrical Energy Conservation and Auditing	1	-	-	Non Credit	-	-	-	-	-	Pass Fail
		Total	16	-	14	22	300	200	50	50	100	700

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 VI of Curriculum Pattern 2021 w.e.f. A.Y. 2023-2024 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

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

Approved by

Dean Academics

SANJIVANI COLLEGE OF ENGINEERING KOPARGAON Approved

Director

COURSE STRUCTURE- 2021 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	CIA	OR	PR	TW	Total
PCC	EE313	Power System Operation and Control	3	-	-	3	60	40	-	-	-	100
PCC	EE314	Feedback Control Systems	4	-	-	4	60	40	-	-	-	100
PCC	EE315	Computer Aided Electrical Machine Design	3	-	-	3	60	40	-	-	-	100
PROJ	PR316	IPR & EDP	2	-	-	2	30	20	-	-	-	50
PEC	EE317	Professional Elective-II A. Electrical Drives B. Utilization of Electrical Energy C. PLC and SCADA D. Building automation and Control	3	-	-	3	60	40	-	-	-	100
LC	EE318	Power System Operation and Control Laboratory	-	-	2	1	-	-	25	-	-	25
LC	EE319	Feedback Control Systems Laboratory	-	-	2	1	-	-	-	50	-	50
LC	EE320	Computer Aided Electrical Machine Design	-	-	2	1	-	-	25	-	-	25
PROJ	PR321	Mini Project	-	-	2	1	-	-	-	-	25	25
HSMC	EE322	Creational Activity	-	-	2	1	-	-	-	-	25	25
MLC	MC323	Mandatory Learning Course-VI A.Professional Leadership Skills	-	-	2	Non Credit	-	-	-	-	-	Pass/Fail
		Total	14	1	10	20	270	180	50	50	50	600

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

Dean Academics
Sanjivani College of Engineering
Kopargaon-423603

Director
Sanjivani College of Engineering
Kopargaon

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 VII of Curriculum Pattern 2021 w.e.f. A.Y 2024-2025 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.

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

Submitted by

02/8/2024

BoS Chairman

Approved by

Dean Academics

Director

Sanjivani College of Engineering, Kopargaon

(An Autonomous Institute affiliated to SPPU, Pune)

Teaching and Evaluation Scheme for Academic Year 2024-2025

Electrical Engineering

COURSE STRUCTURE- 2021 PATTERN

SEMESTER-VII

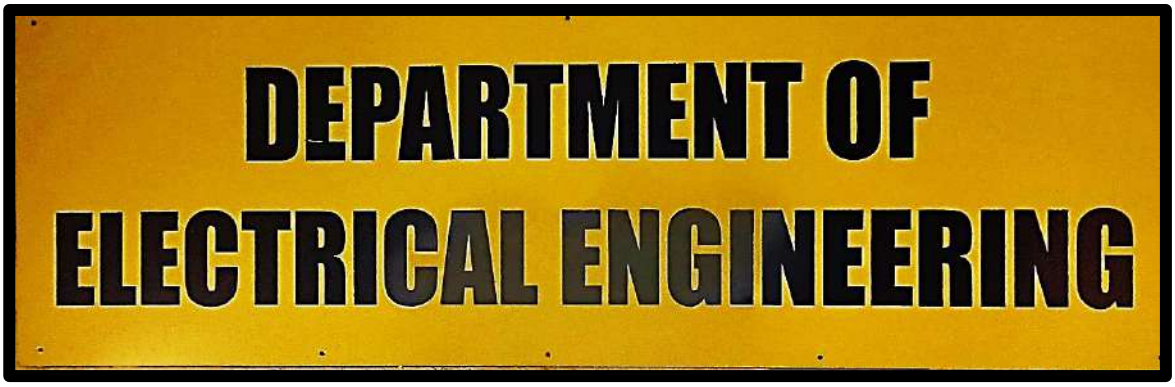
Course			Teaching Scheme Hours/week				Evaluation Scheme-Marks					
							Theory		OR	PR	TW	Total
Cat.	Code	Title	L	T	P	Credits	ESE	CIA				
PCC	EE401	Switch Gear and Protection	3	-	-	3	60	40	-	-	-	100
PCC	EE402	Control System Design	3	-	-	3	60	40	-	-	-	100
PCC	EE403	High Voltage Engineering	3	-	-	3	60	40	-	-	-	100
PEC	EE404	Professional Elective-III **A.** Electric and Hybrid Vehicle **B.** HVDC Transmission Systems **C.** Digital Signal Processing	3	-	-	3	60	40	-	-	-	100
PEC	EE405	Professional Elective-IV **A.** Power Quality **B.** Transmission and Distribution **C.** Intelligent Systems with AI and ML	3	-	-	3	60	40	-	-	-	100
LC	EE406	Switch Gear and Protection Laboratory	-	-	2	1	-	-	50	-	-	50
LC	EE407	Control System Design Laboratory	-	-	2	1	-	-	50	-	-	50
LC	EE408	High Voltage Engineering Laboratory	-	-	2	1	-	-	-	50	-	50
PROJ	EE409	Project Stage I	-	-	4	2	-	-	50	-	50	100
MLC	MC410	Mandatory Learning Course-VII **A.** Financially Smart	1	-	-	Non Credit	-	-	-	-	-	Pass/Fail
		Total	**16**	**-**	**10**	**20**	**300**	**200**	**150**	**50**	**100**	**750**

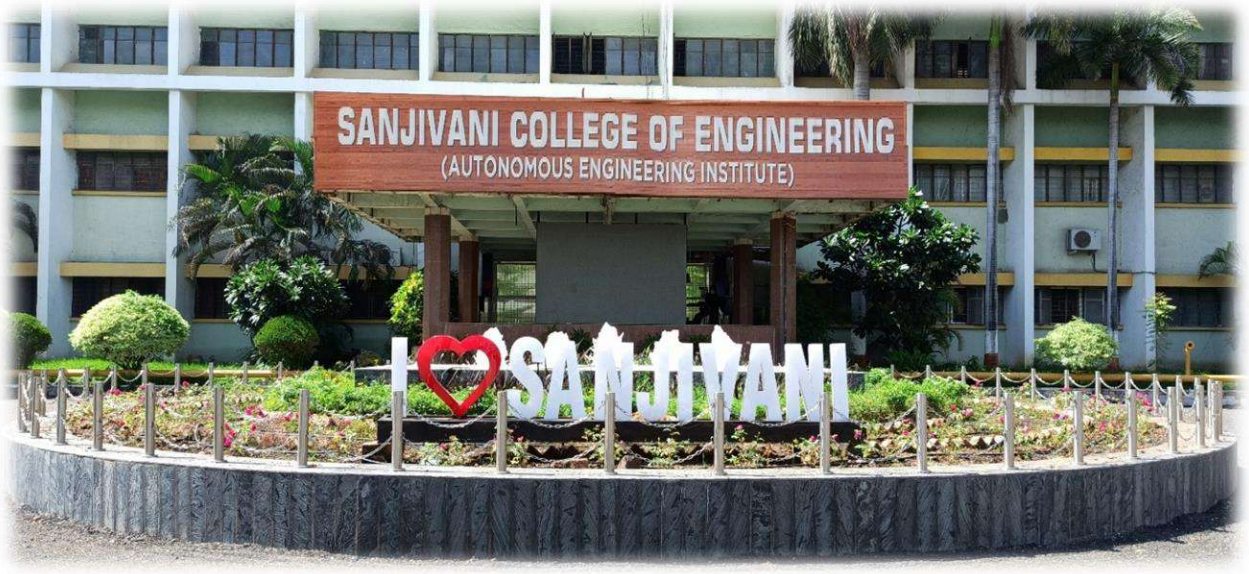
Sanjivani College of Engineering, Kopargaon
Dept. of Electrical Engineering

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 - 2021 PATTERN

SECOND 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

Our vision is to create an environment of academic excellence in the subject areas of Electrical Engineering & allied discipline through classroom teaching, practical demonstration & research activities. We are looking towards expansion of problem-solving horizons in the emerging areas of Switchgear & Protection, Power Systems, Electrical Machines & Drives, Control Systems etc.

Mission of Department

Our mission is to make use of the Technology of Electrical Engineering as a principal instrument for deriving optimal solutions in multidisciplinary Engineering problems having social relevance.
We are committed to the development of Technical human resources exhibiting professional and ethical attitudes and interdisciplinary approach.

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:

1. **PEO 1:** Graduates will have the mathematical & scientific knowledge to analyze & solve emerging real-world problems related to power systems, electrical machines, control systems, electrical measurements, switchgear & protection.

2. **PEO 2:** Graduates will be able to pursue higher education in Electrical Engineering or other fields of their interest in reputed organizations.

3. **PEO 3:** Graduates will be employable in the diversified sectors of industry, government organizations, public sector, and multinational corporations.

4. **PEO 4:** Graduates will be able to communicate effectively, adopt lifelong learning, act with integrity, and have interpersonal skills with commitment to their ethical and social responsibilities.

Program Specific Objectives (PSOs)

1. **PSO 1:** Apply the knowledge of mathematics, science & Electrical Engineering fundamentals to complex problems in Electrical Machines, Control Systems, Power Systems, Power Electronics, switchgear & Protection.

2. **PSO 2:** Ability to critically understand the generation, transmission and distribution concepts in Electrical Power Systems, Control systems and renewable energy sector.

3. **PSO 3:** Capability to understand various computational methods for design & analysis of Electrical Systems.

4. **PSO 4:** An understanding of professional, ethical, legal, security issues, social responsibilities and indulge in lifelong learning.

COURSE STRUCTURE- 2021 PATTERN
SECOND YEAR B. TECH. ELECTRICAL ENGINEERING

SEMESTER-III

Course			Teaching Scheme Hours/week				Evaluation Scheme-Marks					
							Theory					
Cat.	Code	Title	L	T	P	Credits	ESE	CIA	OR	PR	TW	Total
PCC	EE201	Electrical Engineering Materials	3	-	-	3	60	40	-	-	-	100
BSC	BS202	Engineering Mathematics III	3	1	-	4	60	40	-	-	-	100
PCC	EE203	Electrical Measurements and Instrumentation	4	-	-	4	60	40	-	-	-	100
PCC	EE204	Analog and Digital Electronics	3	-	-	3	60	40	-	-	-	100
HSMC	HS205	Universal Human Values & Professional Ethics	3	-	-	3	60	40	-	-	-	100
HSMC	EE206	General Proficiency	-	-	2	1	-	-	-	-	50	50
LC	EE207	Electrical Engineering Materials Laboratory	-	-	2	1	-	-	50	-	-	50
LC	EE208	Electronics and Electrical Instrumentation Laboratory	-	-	2	1	-	-	-	50	-	50
LC	EE209	Electrical Design and Modelling-I Laboratory	-	-	2	1	-	-	-	50	-	50
MLC	MC210	Mandatory Course-III A. Constitution of India – Basic features and fundamental principles	2	-	-	Non Credit	-	-	-	-	-	Pass/Fail
Total			**18**	**1**	**8**	**21**	**300**	**200**	**50**	**100**	**50**	**700**

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

COURSE STRUCTURE- 2021 PATTERN
SECOND YEAR B. TECH. ELECTRICAL ENGINEERING

SEMESTER-IV

Course			Teaching Scheme Hours/week				Evaluation Scheme-Marks					
							Theory					
Cat.	Code	Title	L	T	P	Credits	ESE	CIA	OR	PR	TW	Total
PCC	EE211	Numerical Computations with Signals and Systems	3	1	-	4	60	40	-	-	-	100
PCC	EE212	Network Analysis	3	1	-	4	60	40	-	-	-	100
PCC	EE213	Electrical Machines I	4	-	-	4	60	40	-	-	-	100
PCC	EE214	Power System I	3	-	-	3	60	40	-	-	-	100
PROJ	EE215	Project Based Learning	-	-	2	1	-	-	-	-	50	50
HSMC	HS216	Corporate Readiness-I	-	-	2	1	-	-	-	-	50	50
PROJ	EE217	Professional Development	-	-	2	1	-	-	-	-	25	25
LC	EE218	Network Analysis Laboratory	-	-	2	1	-	-	25	-	-	25
LC	EE219	Electrical Machines I Laboratory	-	-	2	1	-	-	-	50	-	50
LC	EE220	Power System I Laboratory	-	-	2	1	-	-	25	-	-	25
LC	EE221	Electrical Design and Modelling-II Laboratory	-	-	2	1	-	-	-	50	-	50
LC	EE222	Software Programming Laboratory	-	-	2	1	-	-	25	-	-	25
MLC	MC222	Mandatory Course-IV **A.** Innovation - Project based – Sci., Tech, Social, Design & Innovation	2	-	-	Non Credit	-	-	-	-	-	Pass/Fail
		Total	**15**	**2**	**16**	**23**	**240**	**160**	**75**	**100**	**125**	**700**

List of Abbreviations			
Abbreviation	**Full Form**	**Abbreviation**	**Full Form**
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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

SEMESTER III

EE201: ELECTRICAL ENGINEERING MATERIALS

Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs./Week	**Continuous Assessment:**	**40 Marks**
	End-Sem Exam:	**60 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	PO10	PO11	PO12	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**	**Hrs.**	**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**	**Hrs.**	**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**	**Hrs.**	**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**	**Hrs.**	**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**	**Hrs.**	**CO**
	Introduction, Concepts of Energy bands & various Conducting Mechanism in Nano-structures, Carbon Nano-structures, Carbon Molecules, Carbon Clusters, Carbon Nano-tubes and applications.	06	CO5

	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).		
UNIT-VI	**TESTING OF MATERIALS**	**Hrs.**	**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, "Understanding Batteries", 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. Chalara & 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.

BS202: ENGINEERING MATHEMATICS III

Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs./Week	**Continuous Assessment:**	**40 Marks**
Tutorial: 01 Hrs./Week	**End-Sem Exam:**	**60 Marks**
Credits: 4	**Total:**	**100 Marks**

Prerequisite Course:

1. Linear Algebra and Partial Differentiation (LA101)
2. Multivariate Calculus (MC109)

Course Objectives

1 To make students familiarize with concepts and techniques of vector calculus, probability, and differential calculus.

2 The intent is to furnish them with the techniques to understand engineering mathematics and its applications that would develop logical thinking power, useful in their disciplines.

Course Outcomes (COs):

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

	Course Outcome (s)	**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	**Describe** and **recall** the basics of vector algebra, **apply** it to **calculate** directional derivative, divergence, and curl of vector function	**1,2,3**	**Remember/ Understand/ Apply**
CO2	**Understand** the concept vector integration, **analyze,** and **apply** it solve engineering problems **using** Green's theorem, Stoke's theorem, Gauss's theorem	**2,3,4**	**Understand/ Apply/ Analyze**
CO3	**Solve** ordinary differential equations **using** iterative, interpolation methods	**1,2**	**Remember/ Understand**
CO4	**Apply** integral transform technique to **solve** equations involved in engineering applications**.**	**1,3**	**Apply**
CO5	**Analyze** data, **find** mean, correlation, regression of a statistical data, **calculate** probability using different distributions.	**1,4**	**Analyze**
CO6	**Analyze** and **apply** partial differential equation and **solve** practical problems in engineering	**3,4**	**Apply/ Analyze**

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	-	-	-	-
CO2	3	2	-	-	-	-	-	1	1	1	-	-	-	-
CO3	2	3	-	-	1	-	-	1	1	1	-	-	-	-
CO4	3	2	-	-	-	-	-	1	1	1	-	-	-	-
CO5	2	2	-	-	1	-	-	1	1	1	-	-	-	-
CO6	3	3	-	-	-	-	-	1	1	1	-	-	-	-

Course Contents			
UNIT-I	**VECTOR DIFFERENTIATION**	**Hrs.**	**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.	06	1
UNIT-II	**VECTOR INTEGRATION**	**Hrs.**	**COs**
	Line integral, Green's theorem, Work done, Conservative field, surface integral, Stokes theorem, volume integral, Gauss Divergence theorem, Equation of Stream line.	06	2
UNIT-III	**NUMERICAL METHODS**	**Hrs.**	**COs**
	Interpolation with unequal intervals: Lagrange's formulae, Interpolation using Newton's forward and backward difference formulae. Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 rules. Numerical Differentiation: Euler and modified Euler's methods, Runge-Kutta method of fourth order for solving first order equations.	06	3
UNIT-IV	**FOURIER TRANSFORM**	**Hrs.**	**Cos**
	Dirichlet's Condition, Definition of Fourier transform, Properties of Fourier transform, Fourier Cosine transform, Fourier sine transform, Inverse Fourier transform.	06	4
UNIT-V	**BASIC STATISTICS AND PROBABILITY**	**Hrs.**	**Cos**
	Measures of Central tendency, Moments, Skewness and Kurtosis, Correlation and regression, Definitions of probability, Bay's theorem, Distribution function, Binomial, Poisson, and normal distributions	06	5
UNIT-VI	**APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS**	**Hrs.**	**COs**
	Separation of variables; solutions of one-dimensional diffusion equation; first and second order one-dimensional wave equation and two-dimensional Laplace equations.	06	6

Text Books:

[T1] B. S. Grewal, Higher Engineering Mathematics, 42/e, Khanna Publishers, 2012, ISBN-13: 978-8174091154.
[T2] Scott Miller, Donald Childers, Probability and Random Processes, 2 Ed, Elsevier, 2012.
[T3] R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, Narosa Publishing House, 2014. ISBN-13: 978-1842653418.

References:

[R1] K.A. Stroud & D. S. Booth, Advanced Engineering Mathematics, Industrial Press, 5/e, 2011, ISBN-9780831134495
[R2] P. C. Matthews, Vector Calculus, Springer, 2/e, 2012, ISBN-9783540761808
[R3] T. Veerarajan, Probability Statistics and random processes, Tata McGraw Hill, 3/e 2008. ISBN 13: 9780070669253
[R4] Erwin Kreyszig, Advanced Engineering Mathematics, Wiley, 9/e, 2013, ISBN-13: 978-0471488859.

EE203: ELECTRICAL MEASUREMENTS AND INSTRUMENTATION

Teaching Scheme	**Examination Scheme**	
Lectures: 04 Hrs./Week	**Continuous Assessment:**	**40 Marks**
	End-Sem Exam:	**60 Marks**
Credits: 4	**Total:**	**100 Marks**

Prerequisite Course: Basic Electrical and Electronics Engineering

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	PO10	PO11	PO12	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 analyser, Multi meter.	8	**CO3**
UNITIV:	**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] John turner and Martyn Hill, "Instrumentation for Engineers & Scientist", Oxford publication

EE204: ANALOG AND DIGITAL ELECTRONICS

Teaching Scheme	**Examination Scheme**	
Lectures: 03Hrs./Week	**Continuous Assessment:**	**40 Marks**
	End-Sem Exam:	**60 Marks**
Credits: 3	**Total:**	**100 Marks**

Prerequisite Course:

1. Knowledge of Basic Electrical and Electronics Engineering

Course Objectives

1. 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. It is aimed to enable students for implementing combinational logic circuits for various applications.
4. To impart knowledge for implementing sequential circuits using flip-flops.

Course Outcomes (COs):

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

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	**Understand** and explain different types of analog and digital circuits.	2	Understand
CO2	**Apply** the knowledge and implement analog and digital circuits to meet stated applications	3	Apply
CO3	**Analyze** the performance of electronic circuits	4	Analyze
CO4	**Apply** the knowledge and implement basic analog filters, combinational and sequential circuits	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	2	1	1	2	-	-	-	2	1	-	2	2	2
CO2	3	2	1	1	2	-	-	-	2	1	-	2	2	2
CO3	3	2	1	1	2	-	-	-	1	1	-	2	2	2
CO4	3	2	1	1	2	-	-	-	2	1	-	2	2	2

Course Contents

UNIT-I	**Foundations of Op-Amps**	**Hrs.**	**COs**
	Op-Amp: Block diagram of 741, ideal and practical parameters, open loop and close loop configuration of Op-Amp, Differential Amplifier (1st stage of OP-AMP), Ideal Operational Amplifiers Characteristics, feedback in op-amp circuits, inverting, non-inverting amplifiers, adder, subtractor, voltage comparator, Schmitt trigger, difference amplifier.	6	CO1

UNIT-II	Applications of Op-amps and Voltage Regulators	Hrs.	CO
	Generation of different waveforms using op-amp, integrator, Differentiator, Active filters-Low pass, high pass, Multi-vibrators, IC 555, Current to voltage convertor, voltage to current convertor, precision rectifier, peak detector, sample & hold circuit, Voltage regulators (Block Diagram), fixed voltage regulators (± 5 V, ± 12 V).	8	CO2
UNIT-III	**Review of Transistors and Power Amplifiers**	**Hrs.**	**CO**
	Introduction, types, common base, common emitter and common collector configurations, operating point, stability and biasing circuits, class A and B amplifier, Complementary Symmetry amplifiers.	8	CO3
UNIT-IV	**Combinational Circuits and Sequential Circuits**	**Hrs.**	**CO**
	Review of k-map minimization technique, multiplexer, de-multiplexer, half & full adders. Latches – S-R latch, D latch, flip-flops- D F/F, J-K F/F, T F/F, master slave J-K F/F (Logic diagram, Truth Table and its verification)	8	CO4
UNIT-V	**Applications of Sequential circuits**	**Hrs.**	**CO**
	Synchronous and Asynchronous counters, Ripple counters, drawbacks of ripple counters, Ring counters, Twisted Ring Counters, Shift registers, types of shift registers, design using D/J-K/ T- F/Fs.	8	CO4
UNIT-VI	**Digital to Analog and Analog to Digital Converters**	**Hrs.**	**CO**
	Binary weighted DAC, R-2R ladder DAC, Ramp ADC, dual slope ADC, successive approximation technique, flash ADC, voltage, current and phase angle measurement (block level treatment only)	8	CO2,3

Text Books:

[T1] R.P. Jain "Digital Electronics "Tata McGraw Hill, New Delhi
[T2] Sergio Franco, 'Design with Op-Amps and analog Integrated Circuits', TMH.
[T3] Allen Mottershed, 'Electronic Devices & Circuits', PHI.
[T4] A Anand Kumar, 'Fundamentals of Digital Circuits, PHI.

References:

[R1] R.A. Gayakwad, 'Op-Amps & Linear Integrated Circuits', PHI, Fourth Edition,
[R2] Boylestad R. L. and Nashelsky Louis, 'Electronic Devices & Circuit Theory', Pearson, Tenth Edition,
[R3] M. Moris Mano and Michael Ciletti, 'Digital Design', Pearson Publications.

E-References

[1] https://www.youtube.com/watch?v=clTA0pONnMs
[2] https://www.youtube.com/watch?v=xki9taCqsWY
[3] https://www.youtube.com/watch?v=XCiLHOZsQl8
[4] https://www.youtube.com/watch?v=ibQBb5yEDlQ
[5] https://www.youtube.com/watch?v=6qeGq0jD7wA

HS205: UNIVERSAL HUMAN VALUES AND PROFESSIONAL ETHICS

Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs./Week	**Continuous Assessment:**	**40 Marks**
	End-Sem Exam:	**60 Marks**
Credits: 3	**Total:**	**100 Marks**

Prerequisite Course:

Course Objectives

1. To help the students appreciate the essential complementarity between values and skills to ensure mutual happiness and prosperity.
2. To elaborate on 'Self exploration' as the process for Value Education
3. To facilitate the understanding of harmony at various levels starting from self and going towards family and society.
4. To elaborate on the salient aspects of harmony in nature and the entire existence
5. To explain how the Right understanding forms the basis of Universal human values and definitiveness of Ethical human conduct.
6. To provide the vision for a holistic way of living and facilitate transition from chaotic life to an orderly life

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.	1	Remember
CO2	Interpret the human being as the coexistence of self and body.	2	Understand
CO3	Explain relationship between one Self and the other Self as the essential part of relationship and harmony in the family	2	Understand
CO4	Explain the goal of human being living in the society, the system required to achieve the human goal and the scope of this system.	2	Understand
CO5	Interpret the interconnectedness, harmony, and mutual fulfilment inherent in the nature and the entire existence.	2	Understand
CO6	Draw ethical conclusions in the light of Right understanding facilitating the development of holistic technologies, production systems and management models.	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	-	3	2	1	-	3	-	-
CO2	-	-	-	-	-	2	-	3	2	1	-	3	-	-
CO3	-	-	-	-	-	3	2	3	3	1	-	3	-	-
CO4	-	-	-	-	-	3	2	3	3	1	-	3	-	-

CO5	-	-	-	-	-	3	2	3	3	1	-	3	-	-
CO6	-	-	-	-	-	2	2	3	3	1	-	3	-	-

Course Contents			
UNIT-I	**INTRODUCTION TO VALUE EDUCATION**	**Hrs.**	**COs**
	Value education and Skill education; Priority of values over skills; Implications of Value education; Self-exploration as the process for Value education; Basic human aspirations and their fulfillment; Understanding Happiness and Prosperity-Their continuity and Programme for fulfilment.	06	CO1
UNIT-II	**HARMONY IN THE HUMAN BEING**	**Hrs.**	**COs**
	Understanding 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**	**Hrs.**	**COs**
	Family as the basic unit of human interaction; Understanding relationship; Feelings in relationship; Right feeling; Role of physical facility in fulfilment of relationship; Response and reaction in behaviour; Understanding Justice	06	CO3
UNIT-IV	**HARMONY IN THE SOCIETY**	**Hrs.**	**COs**
	Understanding Human Goal; Human Order; Dimensions of Human Order; Professions in a human society; World Family Order; Harmony from Family Order to World Family Order	06	CO4
UNIT-V	**HARMONY IN THE NATURE AND EXISTENCE**	**Hrs.**	**COs**
	Nature as a collection of units; Classification of units into four orders; Interconnectedness and mutual fulfilment among the four orders; Significance of Education – Sanskar for human order; Existence as units in space; Understanding submergence; Material and consciousness units; Expression of coexistence at different levels; Role of human being in existence.	06	CO5
UNIT-VI	**RIGHT UNDERSTANDING IN LIFE AND PROFESSION**	**Hrs.**	**COs**
	Universal Human Values and Ethical Human Conduct; Professional Ethics in the light of right understanding; Holistic development towards Universal Human Order; Vision for Holistic technologies, Production systems and Management models; Journey towards Universal Human Order	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:

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

Weblink: 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.

EE206: GENERAL PROFICIENCY

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

Prerequisite Course:

Course Objectives

1. Development of students Soft Skills
2. Expose the students' to right attitudinal and behavioral aspects
3. Enhancement of Students' personality
4. Enhancement of Students' interpersonal skills
5. Enhancement of English Communication

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 behavioural traits	3	Applying
CO2	Communicate effectively	4	Analysing
CO3	Present themselves confidently in curricular and extra-curricular activities	5	Evaluating
CO4	Function effectively in multidisciplinary and hetero generous teams	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	-	2	2	1	-	2	-	-
CO2	-	-	-	-	-	2	-	2	2	1	-	2	-	-
CO3	-	-	-	-	-	2	-	2	2	1	-	2	-	-
CO4	-	-	-	-	-	2	-	2	2	1	-	2	-	-

Course Contents

GUIDELINES FOR GENERAL PROFICIENCY

The course aims to cause a basic awareness about the significance of soft skills in professional and inter-personal communications and facilitate an all-round development of personality. Hard or technical skills help securing a basic position in one's life and career. But only soft skills can ensure a person retain it, climb further, reach a pinnacle, achieve excellence, and derive fulfilment and supreme joy. Soft skills comprise

pleasant and appealing personality traits as self-confidence, positive attitude, emotional intelligence, social grace, flexibility, friendliness, and effective communication skills.

Recommended online NPTEL/SWAYAM courses for students are as following

1. **Course Name:** Developing Soft Skills and Personality, By Prof. T. Ravichandran | IIT Kanpur
2. **Course Name:** Body language: Key to professional Success, By Prof. Rashmi Gaur | IIT Roorkee
3. **Course Name:** German – I, By Prof. Milind Brahme | IIT Madras
4. **Course Name:** Fundamental Concepts in Sociolinguistics, By Prof. Om Prakash | IIT Madras
5. **Course Name:** Soft skills, By Prof. Binod Mishra | IIT Roorkee
6. **Course Name:** Science, Technology and Society, By Prof. Sambit Mallick | IIT Guwahati
7. **Course Name:** Business English Communication, By Prof Aysha Iqbal Viswamohan | IIT Madras

And other relevant courses

NOTE: The students should take approval before registering the course from the department.

- ✓ Students are suggested to follow the deadlines of the courses, and submit all the assignments due.
- ✓ Continuous Assessment is based on your Assignment Scores, Final Presentation and Report Submission.
- ✓ Students are motivated to appear for exam and earn Course Completion Certificate.

EE207: ELECTRICAL ENGINEERING MATERIALS LABORATORY

Teaching Scheme	**Examination Scheme**	
Lectures: -- Hrs./Week	**Oral:**	**50 Marks**
Practical: 02 Hrs./Week	**Term Work:**	**-- Marks**
Credits: 1	**Total:**	**50 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	PO10	PO11	PO12	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**	**Hrs.**	**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, "A Course in Electrical Engineering Materials", Dhanpat Rai and Sons publication.
[T6] RonaldM.DellandDavidA. J. Rand, "Understanding Batteries", Royal Society of Chemistry, 2001Publication.
[T7] James F. 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. 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] Traugott Fischer, "Materials Science for Engineering Students", Elsevier publications.

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

EE208: ELECTRONICS AND ELECTRICAL INSTRUMENTATION LABORATORY

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

Prerequisite Course:
Knowledge of Basic Electrical and Electronics Engineering

Course Objectives

1. 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 impart knowledge for implementing sequential circuits using flip-flops.
4. To provide knowledge of systems of units, classification and essentials of measuring instruments.
5. To apply the knowledge to identify the measuring instruments and make use of its foe qualifying 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	Execute and interpret different analog and digital circuits.	2	Understanding
CO2	Implement different linear integrated circuits using electronic components like Op-amps, transistors, etc.	3	Applying
CO3	Implement applications of different analog and digital circuits.	2	Understanding
CO4	Understand various characteristics of measuring instruments, their classification and range extension technique.	2	Understanding
CO5	Explain construction, working principle and use of dynamometer type wattmeter for measurement of power under balance and unbalance condition.	3	Applying
CO6	Use of CRO for measurement of various electrical parameters, importance of transducers, their classification, selection criterion and various applications.	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	3	-	-	-	1	1	1	1	-	-	2	1	2
CO2	3	2	2	-	-	1	2	1	1	-	-	1	1	2
CO3	3	3		-	-	1	1	1	1	-	-	1	1	2
CO4	3	2	2	-	-	1	1	1	1	1	-	2	1	2
CO5	3	3		-	-	1	2	1	1	1	-	2	1	2
CO6	3	2	2	-	-	1	2	1	1	1	-	2	1	2

Course Contents			
Ex. No	**Name of Experiment**	**Hrs.**	**COs**
1	Design and implementation of half and full wave rectifier.	2	**CO1**
2	Implementation and verification of D and JK flip flop	2	**CO1**
3	Design and implementation of op-amp as an inverting & non-inverting amplifier	2	**CO2**
4	Study of active filter low pass and high pass	2	**CO3**
5	Verification of decade counters.	2	**CO3**
6	Implementation and verification of shift register operation IC7495	2	**CO3**
7	Demonstration of working parts of various types of meters by opening the instrument & explanation of symbols & notations used on instruments.	2	**CO4**
8	Extension of instrument range: ammeter, voltmeter, watt meter using CT & PT.	2	**CO4**
9	Measurement of active & reactive power in three phase circuit using two wattmeter methods (balanced & unbalanced loads).	2	**CO5**
10	Measurement of active & reactive power in three phase	2	**CO5**

	balanced circuit using one wattmeter method with two-way switch.		
11	Calibration of single-phase static energy meter at different power factors.	2	**CO6**
12	Measurement of voltage, current, time period, frequency & phase angle using CRO.	2	**CO6**

Text Books:

[T1] R.P. Jain "Digital Electronics "Tata McGraw Hill, New Delhi
[T2] Sergio Franco, 'Design with Op-Amps and analog Integrated Circuits', TMH.
[T3] Allen Mottershed, 'Electronic Devices & Circuits', PHI.
[T4] A Anand Kumar, 'Fundamentals of Digital Circuits, PHI.
[T5] A. K. Sawhney, "A Course in Electrical and Electronic Measurements & Instrumentation" Dhanpat Rai & Co.
[T6] J. B. Gupta, "A Course in Electronics and Electrical Measurements and Instrumentation" S. K. Kataria & Sons,
[T7] R. K. Jain, "Mechanical and Industrial Measurements" Khanna Publishers.
[T8] B. C. Nakra & K. K. Chaudhari, "Instrumentation Measurement and Analysis" Tata McGrawHill.

Reference Books:

[R1] R.A. Gayakwad, 'Op-Amps & Linear Integrated Circuits', PHI, Fourth Edition,
[R2] Boylestad R. L. and Nashelsky Louis, 'Electronic Devices & Circuit Theory' Pearson, Tenth Edition,
[R3] M. Moris Mano and Michael Ciletti, 'Digital Design', Pearson Publications.
[R4] E. W. Golding & F. C. Widdies, "Electrical Measurements & Measuring Instruments", Reem Publications.
[R5] Dr. Rajendra Prasad, "Electronic Measurements & Instrumentation", Khanna Publishers
[R6] Arun K. Ghosh, "Introduction to Measurements and Instrumentation", PHI Publication

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[1] https://www.youtube.com/watch?v=clTA0pONnMs
[2] https://www.youtube.com/watch?v=xki9taCqsWY
[3] https://www.youtube.com/watch?v=XCiLHOZsQl8
[4] https://www.youtube.com/watch?v=ibQBb5yEDlQ
[5] https://www.youtube.com/watch?v=6qeGq0jD7wA

EE209: ELECTRICAL DESIGN AND MODELLING - I LABORATORY

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

Prerequisite Course:

1. Basic Electrical and Electronics Engineering.
2. Computer programming knowledge.

Course Objectives

1. This course provides enhancement of the knowledge of some Electrical Engineering based soft-wares like MATLAB, PSPICE, SCILAB and Python.
2. Its aim is to analyze the outputs of the circuitry problems of Electrical Engineering with the help of the above-mentioned software's.
3. To design some basic circuit elements and machines by using software.
4. To design some electronics circuits by using software.

Course Outcomes (COs):

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

Course Outcome (s)		Bloom's Taxonomy	
		Level	**Descriptor**
CO1	Gain knowledge of different Electrical Engineering elements and tools used in MATLAB Simulink including input of specifications	**1, 2**	Remembering and Understanding
CO2	Evaluate branch currents and voltages across different circuit elements, and analyze the voltage profiles across them	**5, 4**	Evaluating and Analyzing
CO3	Simulate some circuit theorems using PSPICE soft-ware	**4**	Analyzing
CO4	Design electrical elements and calculate parameters using SCILAB Coding	**6**	Creating
CO5	Calculate ripple factor of rectifiers and generate three-phase waveform for star and delta configuration using Python commands	**3**	Applying
CO6	Model and analyze any electrical and electronics circuit using Python coding	**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	1	1	3	-	-	1	2	2	-	1	1	1
CO2	3	3	2	3	3	-	-	2	2	2	-	1	3	1
CO3	3	3	1	3	3	-	-	1	2	1	-	-	1	-
CO4	3	2	3	3	3	-	-	-	2	2	-	2	3	-
CO5	3	3	2	1	3	-	-	1	2	2	-	2	3	2
CO6	3	3	3	2	3	-	2	1	2	2	-	2	3	-

Course Contents			
Ex. No	**Name of Experiment**	**Hrs.**	**COs**
1	Study of different Electrical Engineering elements and tools used in MATLAB Simulink including input of specifications	2	**CO1, CO2**
2	Evaluation of branch currents and branch voltages of an electrical circuit (both a.c. and d.c.) using MATLAB Simulink	**2**	**CO1, CO2, CO5**
3	Evaluation of current, voltage across R and L of an a.c. R-L circuit, and voltage across R and C of an a.c. R-C circuit, and to observe their wave-forms across each elements using MATLAB Simulink	**2**	**CO5**
4	Evaluation of current, voltage across R, L & C of an a.c. R-L-C series and parallel circuit, and to observe the wave-forms across each elements using MATLAB Simulink	2	**CO5**
5	Study and observation of the output waveform of half-wave and full wave rectifier using MATLAB Simulink	**2**	**CO2, CO4**
6	Study and observation of the output waveform of a full-wave rectifier along with filter circuit using MATLAB Simulink	2	**CO2, CO4**
7	Calculation of Resonance Frequency of R-L-C series and parallel circuits using MATLAB programming	**2**	**CO3, CO5**
8	PSPICE Simulation of Nodal Analysis for D.C. Circuits	**2**	**CO4**
9	PSPICE Simulation of D.C. Circuit for determining Thevenin's equivalent circuit	2	**CO4**
10	PSPICE Simulation of Superposition Theorems for d.c. circuits	**2**	**CO4**
11	PSPICE Simulation of Maximum Power Transfer Theorem for d.c. circuits	**2**	**CO4**
12	Design of an iron cored choke coil using SCILAB Coding	**2**	**CO6**
13	Design of Electromagnet using SCILAB Programming	**2**	**CO6**
14	Core-loss calculations in magnetic materials using SCILAB Programming	**2**	**CO6**
15	Design of a small single-phase transformer using SCILAB Coding	**2**	**CO6**
16	Apply Mesh analysis for a given electrical circuit using Python	**2**	**CO3**
17	Obtain the characteristics for the given circuit using Maximum power transfer theorem using Python	**2**	**CO5**
18	Calculation of ripple factor for a given rectifier: Half-wave/Full-wave/Bridge circuit using Python program	**2**	**CO4**
19	Generation of three phase voltage wave-forms for Star and Delta configurations using Python commands	**2**	**CO6**
20	Modeling of an electrical circuit using Python program.	**2**	**CO6**

Text Books:

[T1]. M.S. Naidu and S. Kamakshiah – Basic Electrical Engineering – TMH.
[T2]. T.K. Nagasarkar and M.S. Sukhija – Basic Electrical Engineering – Oxford University Press.
[T3]. Rudra Pratap – Getting Started with MATLAB – Oxford University Press.
[T4]. Agam Kumar Tyagi – MATLAB & Simulink for Engineers - Oxford University Press.
[T5]. Bansal, Goel, Sharma – MATLAB & its Application in Engineering – Pearson.
[T6]. Y. Daniel Liang – Introduction to Programming using Python – 1st Edition, Pearson Publications, 2017
[T7]. Sheetal Taneja – Python Programming A Modular Approach – 1st Edition, Pearson Publications, 2017.

References:

[R1]. Rao V. Dukkipati – MATLAB-An Introduction with Applications – New Age International Publishers.
[R2]. Shailendra Jain – Modeling & Simulation using MATLAB Simulink – Wiley (2nd Edition).
[R3]. Stephen J Chapman – MATLAB Programming for Engineers – Cangage India.
[R4]. Laboratory Manual – Electrical Circuits Simulation Lab – EEE DCepartment, ASTRA.
[R5]. Prof. Kaustubh Vyas – Scilab Manual for Elements of Electrical Design – EE Deptt. of Vishwakarma Govt. Engg. College.
[R6]. G. Sivagami – Lab Manual of Scilab – SRM University, Tamil Nadu.
[R7]. Brett Slatkin (C) – Effective Python: 59 Specific Ways to Write Better Python, I/C – 1st Edition, Pearson Publications, 2015.
[R8]. Ashok Namdev, Kamathane and Amit Ashok Kamathane – Programming and Problem Solving with Python – 1st Edition, McGraw Hill Education (India) Pvt, Ltd., 2017.

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[E1]. www.mathworks.com
[E2]. https://pyspice.fabrice-salvaire.fr/releases/v1.6
[E3]. https://tbc-python.fossee.in/convert notebook/Electrical_Circuit_Theory_And_Technology
[E4]. https://wiki.python.org/moin/PythonBooks

MC210: CONSTITUTION OF INDIA – BASIC FEATURES AND FUNDAMENTAL PRINCIPLES

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

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	PO10	PO11	PO12	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. Cultural and educational rights; 6. Right to property; 7. Right to constitutional remedies	5	2
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	5	3

	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		
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 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	5	6
Text Books:			
1. Indian Polity for Civil Service Examination, M Laxmikanth, Mc GrawHill Education, Fifth Ed. **2.** Introduction to the Constitution of India, Durga Das Basu, LexisNexis, 22nd Edition			

SEMESTER IV

EE211: NUMERICAL COMPUTATIONS WITH SIGNALS AND SYSTEMS

Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs./Week	**Continuous Assessment:**	**40 Marks**
Tutorial: 01 Hr./Week	**End-Sem Exam:**	**60 Marks**
Credits: 04	**Total:**	**100 Marks**

Prerequisite Course:

1. Engineering Mathematics

Course Objectives

1. Development of the strong foundation of signals and systems
2. Understand sampling theorem and its implications.
3. Development of strong foundation analytical mathematics
4. Study of various methods of numerical analysis of linear and non-linear problems
5. Use of method for solving the problems in engineering
6. 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	Demonstrate arithmetic operations on floating point representation, and types of errors in computation and their causes of occurrence and apply appropriate numerical method to solve different nonlinear equations	3	Applying
CO2	Apply different numerical methods for interpolation	3	Applying
CO3	Apply and compare various numerical methods to solve first and second order ODE, PDE and least square approximations	3	Applying
CO4	Understand the classification of signal and systems and Apply Shannon's Sampling Theorem	2 3	Understanding Apply
CO5	Apply the signal transformations Fourier transform on signals and systems	3	Applying
CO6	Apply the signal	3	Applying

	transformations Laplace transform and Z- transform on signals and systems		

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	1	1	1	-	1	1	1	-
CO2	2	2	1	2	2	1	1	1	1	-	1	1	1	-
CO3	2	2	1	2	1	1	1	1	1	-	1	1	1	-
CO4	3	2	1	2	3	1	1	1	1	-	1	2	2	-
CO5	2	2	1	2	1	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 AND SOLUTION OF NON-LINEAR EQUATIONS**	**Hrs.**	**COs**
	Floating Point representation, Arithmetic operations with normalized floating-point numbers, errors in numbers, Truncation error, round off error, inherent error, absolute and relative error. Bisection method, and Newton-Raphson method, rate of convergence.	6	CO1
UNIT-II	**INTERPOLATION AND NUMERICAL DIFFERENTIATION**	**Hrs.**	**CO**
	Finite difference, Difference table, Lagrange's interpolation, Newton's Interpolation, Stirling's, and Bessel's central difference formulae, approximation to derivatives.	6	CO2
UNIT-III	**NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATION AND LEAST SQUARE APPROXIMATION OF FUNCTIONS**	**Hrs.**	**CO**
	Laplace equation, Iterative methods for the solution of	6	CO3

	equations. Linear regression, Polynomial regression, fitting exponential and trigonometric functions.		
UNIT-IV	**BASICS OF SIGNALS AND SYSTEMS**	**Hrs.**	**CO**
	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, Sampling Theorem and Aliasing Effect	6	CO4
UNIT-V	**SIGNAL TRANSFORMATION I**	**Hrs.**	**CO**
	Fourier Transformation: Fourier transformation of continuous and discrete time signals and their properties. Parseval's theorem; Convolution in time (both discrete and continuous) and frequency domains with magnitude and phase response of LTI systems.	6	CO5
UNIT-VI	**SIGNAL TRANSFORMATION II**	**Hrs.**	**CO**
	Laplace Transform: Laplace transformation-analysis with examples and properties. Recapitulation, Analysis, and characterization of LTI systems using Laplace transform: Computation of impulse response and transfer function using Laplace transform. **Z-Transforms:** Basic	6	CO6

	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.		

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", John Wiley & Sons, Incorporated, 2011
[T4] B.P. Lathi, "Signal Processing & Linear Systems", Oxford, Third Edition.
[T5] P. Ramesh Babu & R. Anandanatarajan, "Signals and Systems", SciTech, fourth edition
[T6] S Ghosh, "Signals and Systems", Pearson.
[T7] S. Haykin&B.V. Veen, "Signals and Systems", John Wiley.

References:

[R1] A. Quarteroni, F. Saleri, and P. Gervasio, Scientific computing with MATLAB and Octave, Third edition, (Springer, 2010).
[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.
[R5] A.V. Oppenheim, A.S. Willsky and S.H. Nawab, "Signals & Systems", Pearson.
[R6] A. NagoorKani, "Signals and Systems", McGraw Hill.
[R7] H.P. Hsu, "Schaum's outline of Signals and systems", McGraw Hill Publication.

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[2] https://nptel.ac.in/courses/115/103/115103114/
[3] https://nptel.ac.in/courses/108/104/108104100/
[4] https://nptel.ac.in/courses/117/101/117101055/
[5] https://nptel.ac.in/courses/108/106/108106163/

EE212: NETWORK ANALYSIS

Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs./Week	**Continuous Assessment:**	**40 Marks**
Tutorial: 01 Hr./Week	**End-Sem Exam:**	**60 Marks**
Credits: 04	**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	Analyze the behavior of the network by transient response	4	Analyzing
CO4	Demonstrate of Standard test inputs and transformed network.	3	Applying
CO5	Understand the behavior of the network by analyzing two ports analysis	2	Understanding
CO6	Apply network for designing and synthesis of Filters	4	Analyzing

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

Examination Scheme	
Continuous Assessment:	**40 Marks**
End-Sem Exam:	**60 Marks**
Total:	**100 Marks**

		Bloom's Taxonomy	
			Descriptor
CO1	Understand basic laws, concepts of magnetic circuits and its applications.	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	Apply Characteristics of D.C. Shunt and Series Motors to choose proper motor for proper applications	3	Applying
CO 6	Understand Induction motors & its operation on the basis of Speed, Slip, Torque, Power, and efficiency.	2	Understanding

	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	--	1	--	--	2	2	3	2
CO3	3	2	1	1	1	1	--	1	--	--	1	2	3	2
CO4	3	2	1	1	1	1	--	1	--	--	1	2	3	2
CO5	3	2	1	1	1	1	--	1	--	--	1	2	3	2
CO6	3	2	1	2	2	1	--	1	--	--	2	2	3	2

Course Contents			
UNIT-I	**MAGNETIC FIELDS, CIRCUITS AND BASIC CONSIDERATIONS**	**Hrs.**	**COs**
	a) Basic principles, conservation of energy, physical phenomenon involved in conversion, energy balance, energy stored in magnetic field. b) Magnetic circuits, analogy between electric and magnetic-circuits, series and parallel magnetic circuits, practical magnetic circuits, permanent magnet, and their applications c) Types of faults in electrical equipments {Electrical equipments such as transformer, CT/PT and rotating electrical machines}, maintenance strategies, breakdown maintenance, planned, preventative and condition-based maintenance.	08	CO1
UNIT-II	**TRANSFORMERS**	**Hrs.**	**CO**
	Single phase Transformer: Review, Concept of ideal transformer. 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. **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**	**Hrs.**	**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. Modern trends in transformers, type, and routine tests.	08	CO3
UNIT-IV	**D.C. MACHINES –I**	**Hrs.**	**CO**
	Review of 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 –II**	**Hrs.**	**CO**
	a) Characteristics and Selection of DC Motors for various applications (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**	**Hrs.**	**CO**
	Review, Construction of Stator, Squirrel cage & wound rotors, Production of rotating mmf by 3-phase balanced voltage fed to a symmetrical 3-phase winding. Principle of working, simplified theory with constant air gap flux;	08	CO6

	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.		

Text Books:

[T1] Edward Hughes "Electrical Technology", ELBS, Pearson Education.
[T2] Ashfaq Husain, "Electrical Machines", Dhanpat Rai& 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.

EE214: POWER SYSTEM-I

Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs./Week	**Continuous Assessment:**	**40 Marks**
	End-Sem Exam:	**60 Marks**
Credits: 3	**Total:**	**100 Marks**

Prerequisite Course: Students should have knowledge of Basics Electrical Engineering, Power Generation, various insulating materials, and properties and knowledge of fundamental of electrical circuit components.

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	Working of various equipment & transmission line parameters used in power system.	2	Understanding
CO5	Evaluate transmission line performance and economic operation of power system	5	Evaluating
CO6	Classify types of feeders, cables, voltage and P.F. control Methods	4	Analyzing

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

COURSE CONTENTS			
UNIT-I	**BASIC STRUCTURE OF POWER SYSTEM**	**Hrs.**	**COs**
	A) Structure of Electrical Power Systems: 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 use factor, Load curve, load duration curve, concept of base load and peak load stations.	06	CO1
UNIT-II	**MAJOR ELECTRICAL EQUIPMENT'S IN POWER STATIONS**	**Hrs.**	**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	06	CO2
UNIT-III	**MECHANICAL DESIGN OF OVERHEAD LINES**	**Hrs.**	**CO**
	A) Mechanical Design of Overhead Lines: 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. **B) Underground Cables:** Classification, Construction of cable, XLPE cables, insulation resistance, dielectric stress in single core cable, capacitance of single core and three core cables. Grading of cables, inter sheath grading, capacitance grading.	06	CO3
UNIT-IV	**TRANSMISSION LINE PARAMETERS**	**Hrs.**	**CO**
	A. Resistance: Resistance, skin effect and proximity effect B. Inductance: Definition of inductance, inductance of single phase two wire line, conductor types, and bundled conductors. Inductance of composite conductor, single circuit three phase line, double circuit three phase line.	06	CO4
UNIT-V	**PERFORMANCE OF TRANSMISSION LINES**	**Hrs.**	**CO**
	Classification of lines based on length and voltage levels such as short, medium and long lines, 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.	06	CO5
UNIT-VI	**VOLTAGE AND POWER FACTOR CONTROL**	**Hrs.**	**CO**
	Methods of voltage control, AVRs, tap changing transformers, causes of low power factor, effects of low power factor, Shunt capacitors, Correction, Ferranti effect Surge impedance loading, power flow through transmission lines.	06	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

E-References:

1. https://onlinecourses.nptel.ac.in/noc22_ee17/preview
2. https://onlinecourses.nptel.ac.in/noc22_ee18/preview
3. https://onlinecourses.nptel.ac.in/noc22_ee41/preview

Industrial visit: Minimum one visit to HV substations is recommended

EE215: PROJECT BASED LEARNING

Teaching Scheme	**Examination Scheme**
Practical: 02 Hrs./Week	**In-Sem Exam: -- Marks**
Tutorial: --- Hr./Week	**Term Work: 50 Marks**
Credits: 01	**Total: 50 Marks**

Preamble

- For better learning experience, along with traditional classroom teaching and laboratory learning, project-based learning has been introduced to motivate students to learn by working in a group cooperatively to solve a problem. Project-Based Learning (PBL) is a student-centered and experimental approach to education promoting 'deeper learning' through active exploration of real-world problems and challenges.
- A central goal of PBL is to facilitate the deeper learning process and support students' acquisition of complex cognitive competencies,e.g., rigorous content knowledge and critical thinking skills. The PBL engages students in the problem definition, design process, contextual understanding, and systems thinking approaches. In the PBL approach, learning based on memorization is de-emphasized and more emphasis is given on understanding and application of engineering design principles. Because of frequent assessments throughout the course, plagiarism can be more easily controlled.

Objectives: The course aims:-

To impart the knowledge of the student in:

1. Impart technical knowledge and skills, and develop deeper understanding to integrate knowledge and skills from various areas.
2. Build critical thinking, problem-solving, communication, collaboration and creativity, and innovation amongst students
3. Make students aware of their own academic, personal, and social developments.
4. Develop habits of self-evaluation and self-criticism, against self-competency and trying to see beyond own ideas and knowledge

Course Outcomes (COs):

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

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Identify, formulate, and analyze the simple project problem.	2	Understand
CO2	Apply knowledge of mathematics, basic sciences, and electrical engineering fundamentals to develop solutions for the project.	3	Apply
CO3	Learn to work in teams, and to plan and carry out different tasks that are required during a project.	2	Understand
CO4	Understand their own and their team-mate's strengths and skills.	2	Understand
CO5	Draw information from a variety of sources and be able to filter and summarize the relevant points.	2	Understand
CO6	Communicate to different audiences in oral, visual, and written forms.	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	PSO 1	PSO 2
CO 1	3	3	1	1	-	-	1	2	3	1	-	-	-	-
CO 2	2	2	2	3	-	3	1	-	3	3	-	2	-	2
CO 3	1	1	3	3	3	-	-	2	3	2	1	2	3	-
CO 4	1	1	1	-	-	-	3	2	3	1	-	1	-	-
CO 5	2	2	1	-	-	-	-	-	3	3	-	1	-	1
CO 6	1	1	2	-	-	-	-	-	3	3	1	1	-	-

Level 3 – Substantial; Level 2 – Moderate; Level 1 – Low.

Course Contents

PROCEDURE:

- A group of 4-5 students will be assigned to a faculty member called a mentor. Based on the engineering knowledge of a group and societal and industry problems, the mentor has to guide a group to identify project problems and plan the work schedule. Here, the expected outcomes of the project must be noted.
- The complete work-plan should be divided in the form of the individual tasks to be accomplished with targets. Weekly review of the completed task should be taken and further guidelines are to be given to a group. The final activity will be presenting the work completed and submitting the report.
- A group should be promoted to participate in a competition or write a paper. A problem needs to refer back to a particularly practical, scientific, social, and/or technical domain. The problem should stand as one specific example or manifestation of more general learning outcomes related to knowledge and/or modes of inquiry. There are no commonly shared criteria for what constitutes an acceptable project.
- Projects vary greatly in the depth of the questions explored, the clarity of the learning goals, the content, and the structure of the activity.
- It may have
  - ✓ A few hands-on activities that may or may not be multidisciplinary.
  - ✓ Use of technology in meaningful ways to help them investigate, collaborate, analyze, synthesize, and present their learning.
  - ✓ Activities on solving real-life problems, investigation /study, and writing reports of in-depth study, fieldwork.

ASSESSMENT

- The department/mentor is committed to assess and evaluate both students' performance and course effectiveness. The progress of PBL is monitored regularly every week.
- During the process of monitoring, continuous assessment and evaluation the individual and team performances are to be measured by supervisor/mentor and authorities.
- Students must maintain an institutional culture of authentic collaboration, self-motivation, peer learning, and personal responsibility. The institution/department should support students in this

regard through guidance/orientation programs and the provision of appropriate resources and services. Supervisor/mentor and students must actively participate in the assessment and evaluation processes. Groups may demonstrate their knowledge and skills by developing a solution to the problem, public product, and/or report and/or presentation.

✓ Individual assessment for each student (Understanding individual capacity, role, and involvement in the project)

✓ Group assessment (roles defined, distribution of work, intra-team communication and togetherness)

✓ Documentation and presentation

EVALUATION AND CONTINUOUS ASSESSMENT:

- It is recommended that all activities are to be recorded in a PBL workbook regularly, regular assessment of work to be done and proper documents are to be maintained at the department level by both students as well as a mentor. Continuous Assessment Sheet (CAS) is to be maintained by all mentors/department. Recommended parameters for assessment, evaluation, and weightage are as follows.

  ✓ Idea Inception (**5%**)

  ✓ Outcomes of PBL/ Problem Solving Skills/ Solution provided/ Final product (**50%**) (Individual assessment and team assessment)

  ✓ Documentation (Gathering requirements, design and modeling, implementation/execution, use of technology and final report, other documents) (**25%**)

  ✓ Demonstration (Presentation, User Interface, Usability, etc.) (**10%**)

  ✓ Contest Participation/ publication (**5%**)

  ✓ Awareness /Consideration of -Environment/ Social /Ethics/ Safety measures/Legal aspects (**5%**)
- PBL workbook will serve the purpose and facilitate the job of students, mentors, and project coordinator. This workbook will reflect accountability, punctuality, technical writing ability and work flow of the work undertaken

HS216: CORPORATE READINESS

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

Prerequisite Course:
Verbal and Non-verbal communication, Writing & Reading Skills

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 improve interpersonal and communication skills.
3. To develop reading and writing skills.
4. To demonstrate the importance of team work & leadership quality.
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	Understanding the concepts of grammar through various topics	**BTL 2**	**Understand**
CO2	Understanding reading skills which can improve the phonetics	**BTL 2**	**Understand**
CO3	Apply the knowledge of Verbal Ability to apply it in written form	**BTL 3**	**Apply**
CO4	Analyse and apply the critical thinking ability as required to showcase leadership skills.	**BTL 4**	**Analyse**
CO5	Examining based on communication skills	**BTL 4**	**Examine**
CO6	Judging an ideal personality that fits Industry requirement.	**BTL 5**	**Judge**

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	--	3
CO2	--	--	--	--	--	--	--	--	--	3	--	1	--	3
CO3	--	--	--	--	--	--	--	--	--	2	--	2	--	1
CO4	--	1	--	--	--	1	--	1	3	2	--	2	1	--
CO5	--	2	--	--	--	--	--	1	2	2	--	1	--	--
CO6	--	--	--	--	--	--	--	--	--	--	--	2	--	--

Course Contents			
UNIT-I	**VERBAL ENGLISH**	**Hrs.**	**CO**

	Para Jumbles, Idioms and phrases, Parts of speech, Brief overview of Tense	06	CO1
UNIT-II	**READING SKILLS**	**Hrs.**	**CO**
	Reading Skills-why and how, Reading Newspaper, Reading Comprehension, Passage Reading	04	CO2
UNIT-III	**WRITING SKILLS**	**Hrs.**	**CO**
	Story Writing, Email Writing, Content Writing, Article and Passage Writing	04	CO3
UNIT-IV	**LEADERSHIP AND TEAMING UP**	**Hrs.**	**CO**
	Team work, Good team member qualities, Leadership qualities, Team work activities	06	CO4
UNIT-V	**COMMUNICATION SKILLS**	**Hrs.**	**CO**
	Spoken English, Phonetics, Accent and Intonation, Interpersonal Activities	06	C05
UNIT-VI	**BODY LANGUAGE**	**Hrs.**	**CO**
	Reveals your Inner Self and Personality, Grooming, Personal Interviews	04	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- Books:

[1].https://themech.in/quantitative-aptitude-and-logical-reasoning-books/
[2].https://www.thelocalhub.in/2021/01/reasoning-competitive-exams-pdf.html

E-learning Resources/MOOCs/ NPTEL Course Links:

[1]. https://www.practiceaptitudetests.com/non-verbal-reasoning-tests/
[2]. https://www.educationquizzes.com/11-plus/non-verbal-reasoning/
[3]. https://www.livecareer.com/resume/examples/web-development/e-learning-developer
[4]. https://novoresume.com/career-blog/how-to-write-a-resume-guide

EE217: PROFESSIONAL DEVELOPMENT

Teaching Scheme	**Examination Scheme**	
Practical: 02 Hrs./Week	**Term Work:**	**25 Marks**
Credits: 1	**Total:**	**25 Marks**

Prerequisite Course:

1. Knowledge of English grammar and set up a google account.

Course Objectives

1. Tracking and documenting the individual skills.
2. Give knowledge and experience to enhance an individual's current work
3. Allow them to practise various skills and get best achievements in future career.

Course Outcomes (COs):

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

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Understand and learn to write an informal letter	2	Understanding
CO2	Develop the ability to format a targeted resume for specific positions and organisations.	5	Develop
CO3	Build applications like PowerPoint presentations right in your web browser	3	Application
CO4	Create Quizzes, games in Google Forms	5	Develop
CO5	Demonstrate skills, Employment Opportunities and Get Job Alerts	3	Demonstrate

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	-	3	2	3	-	3	2	2
CO2	-	-	-	-	2	2	-	3	2	3	-	3	2	2
CO3	-	-	-	-	3	2	-	3	2	3	-	3	2	2
CO4	-	-	-	-	3	2	-	3	2	3	–	3	2	2
CO5	-	-	-	-	3	2	-	3	2	3	-	3	2	2

Course Contents

Minimum eight experiments should be conducted

Ex. No	**Name of Experiment**	**Hrs.**	**COs**
1	Formal letter writing.	02	CO1
2	Resume Writing	02	**CO2**

3	Google Docs for Professional Development	02	CO3
4	Google sheet for Professional Development.	02	**CO4**
5	To study and learn how to use Google slide.	02	CO3
6	Google forms for professional development	02	**CO4**
7	Google drive for professional Development.	02	CO3
8	LinkedIn for professionals	02	**CO5**
9	Working with spread sheets in google drive	02	CO3

1. https://onlinecourses.nptel.ac.in/noc20_hs16/preview
2. https://onlinecourses.nptel.ac.in/noc22_hs05/preview

EE218: NETWORK ANALYSIS LABORATORY

Teaching Scheme	**Examination Scheme**
Practical: 02 Hrs./Week	**Oral: 25 Marks**
Credits: 01	**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	Analyze 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

	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

Expt. No.	**Name of the Experiment**	**Hrs.**	**COs**
1	Study of mesh, nodal analysis	2	CO1

2	Study of Graph network Theory	2	CO1
3	Verification of Superposition theorem in D.C &A.C. circuits.	2	CO2
4	Verification of Thevenin's theorem in DC &A.C. circuits.	2	CO2
5	Verification of Reciprocity theorem in DC&A.C. circuits	2	CO2
6	Verification of Millman's' theorem.	2	CO2
7	Verification of Maximum Power Transfer theorem.	2	CO2
8	Study of time response of R-L, R-C circuit to a step D.C. voltage input.	2	CO3
9	Study of R-L, R-C circuit to a step D.C. voltage input using Laplace domain	2	CO4
10	Study determination of parameter of Two Port Network.	2	CO5
11	Study the Frequency response of constant K- low pass filters	2	CO6
12	Study the Frequency response of constant K- high pass filters.	2	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. Abhijit Chakrabarti, "Circuit Theory", DhanpatRai and Company, 7thedition

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", McGrawHill Publication.

EE219: ELECTRICAL MACHINES I LABORATORY

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

Prerequisite Course:

1. Basic Electrical Engineering.
2. Basic circuital Laws.

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 a motor to test the various machine for performance calculation.	**4**	Analyze
CO5	Understand the Characteristics and applications of D.C. Shunt and Series Motors and the process of commutation.	**2**	Understanding
CO6	Understand Induction motors & their operation based on Speed, Slip, Torque, Power, and efficiency.	**2**	Understanding

	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	--	--	2	2	3	2
CO3	3	2	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** (Any 8 Experiments)	**Hrs.**	**COs**
1	O.C. and S.C. test on single phase Transformer.	2	CO1, CO6, CO3
2	Polarity test on single-phase and three-phase transformer	2	CO6, CO3

3	Parallel operation of two single-phase transformers and study of their load sharing under various conditions of voltage ratios and leakage impedances.	2	CO6, CO3
4	Speed control of D.C. Shunt motor and study of starters.	2	CO1, CO4
5	Brake test on D.C. Shunt motor	2	CO3, CO4
6	Load characteristics of D.C. series motor	2	CO2, CO3
7	Load test on a 3-phase induction motor.	2	CO1, CO3
8	No-load & blocked-rotor test on 3-phase induction motor: a) Determination of parameters of equivalent circuit. b) Plotting of circle diagram.	2	CO1, CO4, CO2
9	Calculation of motor performance from (a) Determination of parameters of equivalent circuit & (b) Plotting of circle diagram above.	2	CO3
10	Determination of sequence impedance of the transformer.	2	CO3, CO4

Text Books:

[T1] Edward Hughes "Electrical Technology", ELBS, Pearson Education.
[T2] Ashfaq Husain, "Electrical Machines", Dhanpat Rai & 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.

EE220: POWER SYSTEM I LABORATORY

Teaching Scheme	**Examination Scheme**
Practical: 02 Hrs./Week	**Oral: 25 Marks**
Credits: 01	**Total: 25 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	Working of various equipment & transmission line parameters Used in power system.	2	Understanding
CO5	Evaluate transmission line performance and economic operation Of power system	5	Evaluating
CO6	Classify types of feeders, cables, voltage and P.F. control Methods	4	Analyzing

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

Course Contents

Ex. No	**Name of experiment**	**Hrs.**	**COs**

1	Visit Local Substation	2	CO2
2	Study of cables & find charging current	2	CO6
3	Study of different types of insulators	2	CO3
4	Study of Tariffs		
5	To study the Ferranti Effect of a Transmission line.	2	CO5
6	To find out the string efficiency across the string of insulators	2	CO3, CO5
7	To study the effects on transmission line simulator for Shunt Reactor Compensation for Unloaded Line	2	CO3, CO5
8	Determine A, B, C, D parameters of short and medium transmission line.	2	CO4, CO5
9	Introduction to simulation of power system using various tools	2	CO6
10	Efficiency, Regulation & ABCD parameters of Transmission line	2	CO4, CO5
11	To study various effects on Loading of transmission line	2	CO3, CO5

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

EE221: ELECTRICAL DESIGN AND MODELLING-II LABORATORY

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

Prerequisite Course:

1. Electrical Design and Modelling I

Course Objectives

1. To relate mathematics and Electrical Engineering problems
2. To introduce software solution
3. To develop complex problem-solving skills

Course Outcomes (COs):

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

Course Outcome (s)		Bloom's Taxonomy	
		Level	**Descriptor**
CO1	Apply fundamentals of mathematics in solving Electrical Engineering Problems	3	Apply
CO2	Analyse complex Electrical Engineering problems using software solution	4	Analyze
CO3	Implement program and software simulation for problems in Electrical Engineering	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	2	2	2	-	-	-	-	-	-	1	1	-
CO2	2	2	2	2	2	-	-	-	-	-	-	1	1	-
CO3	2	2	2	2	2	-	-	-	-	-	-	1	1	-

Course Contents

Ex. No	Name of Experiment	Hrs.	COs
1	Revision of basic concepts of mathematics and software programming	2	CO1 CO2 CO3
2	Develop logarithm draw flow chart and write a program to implement Bisection / Regular-Falsi / Newton Raphson method for single variable in the applications of a. finding critical angle in power system stability b. relation between voltage current in solar PV	2	CO1 CO2 CO3
3	Develop algorithm, draw flowchart and write a program to apply Newton's forward/backward interpolation method in the applications of	2	CO1 CO2 CO3

	a. Voltage across capacitor during charging b. Relation of speed and armature voltage		
4	Develop algorithm, draw flowchart and write a program to apply Newton's Divided Difference / Lagrange's interpolation method in the applications of a. Power transfer equation to find power at particular angle b. Growth of electricity consumption in India (year vs per capita electrical consumption)	2	CO1 CO2 CO3
5	Develop algorithm, draw flowchart and write a program to implement Gauss elimination/Jordon in the applications of a. Electrical networks using KVL b. Electrical network using KCL	2	CO1 CO2 CO3
6	Perform mathematical addition, subtraction, multiplication and division of electrical signals	2	CO1 CO2 CO3
7	Solve ODE in Electrical circuits/DC motors	2	CO1 CO2 CO3
8	Solve ODE in Electrical circuits using Laplace Transform	2	CO1 CO2 CO3
9	Solve difference equations using Z-transform	2	CO1 CO2 CO3
10	Calculate transfer function and poles and zeros in complex electrical network	2	CO1 CO2 CO3

Perform any **eight** experiments from the list using any professional software.

Text Books:

[T1] V. Rajaraman Computer Oriented Numerical Methods VI 2019 PHI Learning
[T2] Sastry S.S. Introductory Methods Of Numerical Analysis V 2012 PHI Learning
[T3] C. Woodford, C. Phillips Numerical Methods with Worked Examples: MATLAB Edition II 2011 John Wiley & Sons
[T4] B.P. Lathi Signal Processing & Linear Systems I 1998 Oxford

References:

[R1 A. Quarteroni, F. Saleri, and P. Gervasio Scientific computing with MATLAB and Octave III 2010 Springer.
[R2] A. NagoorKani, "Signals and Systems", McGraw Hill

EE222: SOFTWARE PROGRAMMING LABORATORY

Teaching Scheme	**Examination Scheme**
Practical: 02 Hrs./Week	**Oral: 25 Marks**
Credits: 1	**Total: 25 Marks**

Prerequisite Course:

1. Basic knowledge of C programming

Course Objectives

4. To make the student learn a programming language.
5. To learn problem solving techniques.
6. To teach the student to write programs in C and to solve the problems.

Course Outcomes (COs):

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

Course Outcome (s)		Bloom's Taxonomy	
		Level	**Descriptor**
CO1	Apply the logic for a given problem.	3	Apply
CO2	Solve and write the algorithm of a given problem	4	Analyse
CO3	Create a flow chart of a given problem	6	Create
CO4	Apply and Analyse different data-structures like arrays, pointers, structures, and files	3	Apply
CO5	Understand proper use of user defined functions	2	Understand
CO6	Learn the methods of iteration or looping and branching.	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	2	-	1	1	1	1	1	1	1	1	--	--
CO2	3	3	2	-	2	1	1	1	1	2	2	1	--	--
CO3	3	2	3	2	2	1	1	1	1	3	2	1	--	--
CO4	3	3	2	-	2	1	1	1	1	1	2	1	--	--
CO5	3	3	2	-	2	1	1	1	1	2	2	1	--	--
CO6	3	2	3	2	2	1	1	1	1	3	2	1	--	--

Course Contents

Ex. No	Name of Experiment	Hrs.	COs
1	To be familiar with different data types, Operators and Expressions in C.	2	4
2	To understand the programming knowledge using Decision Statements (if, if-else, if-else-if ladder, switch and GOTO)	2	2,3,6

3	To apply the knowledge of Loop & nested loop Statements (for, while, do-while)	2	2,3,6
4	To understand programming using different dimensions of Array.	2	2,3,6
5	To create function programming, its types and function-call.	2	2,3,6
6	To create programming with Pointer, String and Function call by reference.	2	2,3,6
7	To understand programming with Structure	2	2,3,6
8	To understand data files and file handling in C.	2	2,6

Text Books:

[T1] Greg Perry and Dean Miller, *"C Programming Absolute Beginner's Guide"*
[T2] Brain W. Kernighan, *"C Programming Language"*

References:

[R1] Kernighan Brian W, 'C Programming Language'

E-References

[E1] https://www3.ntu.edu.sg/home/ehchua/programming/cpp/c1_Basics.html
[E2] https://www.javatpoint.com/c-programming-language-tutorial

MC222A: INNOVATION - Project based – Science and Technology, Social, Design & Innovation

Teaching Scheme	Examination Scheme	
Lectures: 02 Hrs./Week	**End-Sem Exam:**	**N/A**
Credits: Non-Credit	**Total:**	**PASS / FAIL**

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 dimensions of innovation
4. Understand the effective management of technological innovation requires the integration of people, 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	--	--

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)

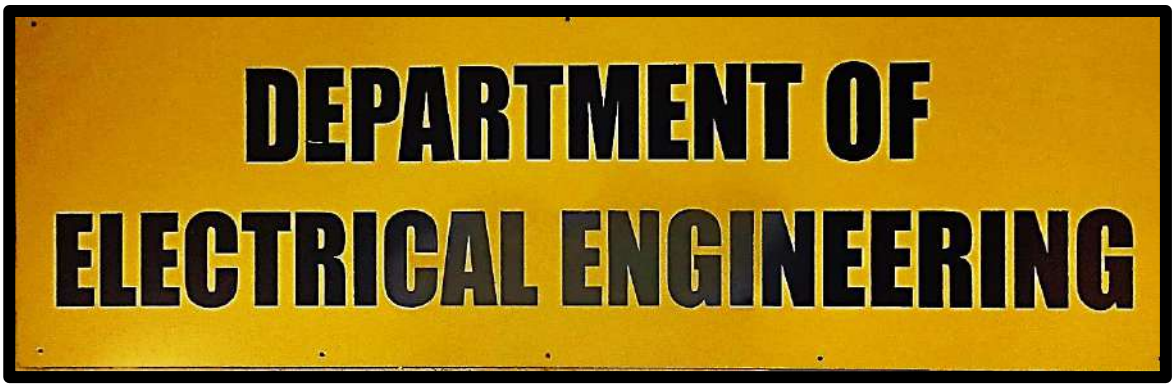
(b) Design & Innovation (to address above problems)

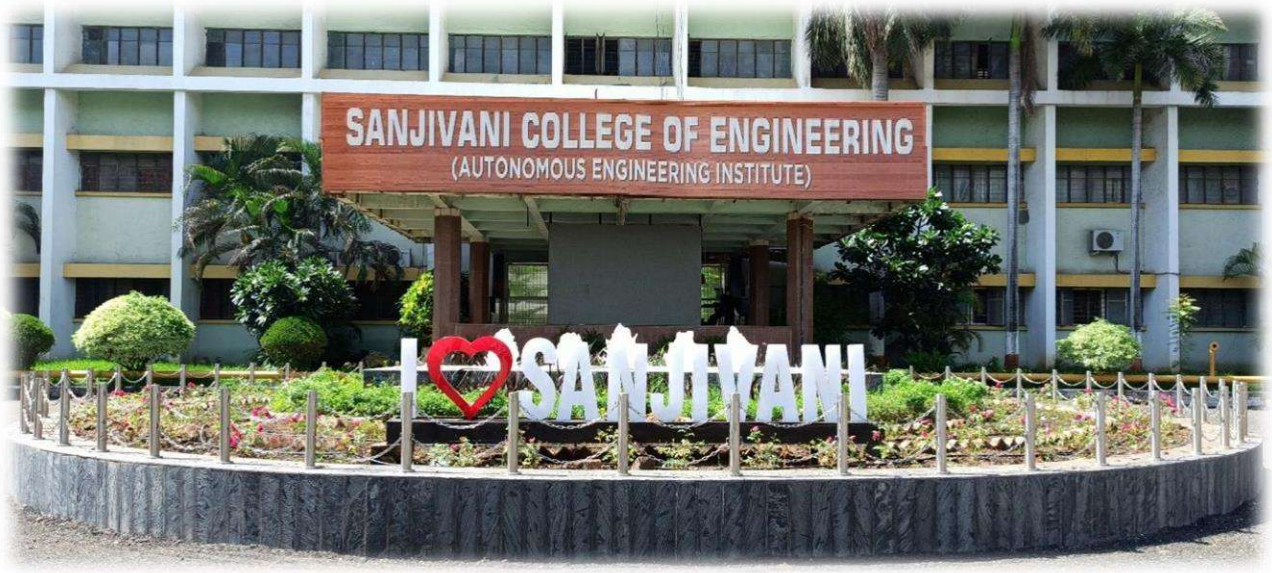
After this student, be encouraged to undertake technology projects of social relevance

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 - 2021 PATTERN

THIRD YEAR B. TECH

Academic Year 2023-24

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:

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

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

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

Program Specific Objectives (PSOs)

1. **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.

2. **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- 2021 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	ESE	CIA	OR	PR	TW	Total
PCC	EE301	Microcontrollers And Applications	3	-	-	3	60	40	-	-	-	100
PCC	EE302	Electrical Machines II	3	-	-	3	60	40	-	-	-	100
PCC	EE303	Power System II	3	-	-	3	60	40	-	-	-	100
PCC	EE304	Power Electronics	3	-	-	3	60	40	-	-	-	100
PEC	EE305	Professional Elective-I **A.** Renewable Energy Sources **B.** Smart Grid **C.** Industry 4.0	3	-	-	3	60	40	-	-	-	100
LC	EE306	Microcontrollers And Applications Laboratory	-	-	2	1	-	-	25	-	-	25
LC	EE307	Electrical Machines II Laboratory	-	-	2	1	-	-	-	25	-	25
LC	EE308	Power System II Laboratory	-	-	2	1	-	-	25	-	-	25
LC	EE309	Power Electronics Laboratory	-	-	2	1	-	-	-	25	-	25
PROJ	EE310	Corporate Readiness-II	-	-	2	1	-	-	-	-	50	50
PROJ	EE311	Seminar & Technical Communication Skills	-	-	4	2	-	-	-	-	50	50
MLC	MC312	Mandatory Learning Course-V **A.** Electrical Energy Conservation and Auditing	1	-	-	Non Credit	-	-	-	-	-	Pass/Fail
		Total	**16**	**-**	**14**	**22**	**300**	**200**	**50**	**50**	**100**	**700**

SEMESTER V

EE301: MICROCONTROLLERS AND APPLICATIONS			
Teaching Scheme		**Examination Scheme**	
Lectures:	**03 Hrs./Week**	**Continuous Assessment:**	**40 Marks**
Tutorial:	**--- Hr./Week**	**End-Sem Exam:**	**60 Marks**
Credits:	**03**	**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	Construct assembly language programs based on the instruction set of 8051.	3	Applying
CO3	Apply concept of PIC 18 for real life applications	2	Understanding
CO4	Understand Arduino Board and Interfacing	2	Understanding
CO5	Build programs and interface different component with Arduino board for various applications	3	Applying
CO6	Interface I/O for real life applications using Advance controllers	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	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**	**Hrs.**	**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. Addressing modes of 8051	7	CO1, CO2
UNIT-II	**Programming and Interfacing**	**Hrs.**	**CO**
	Instruction set of 8051, Stack and Stack Related instruction, Counters and timers in 8051, timer modes, Parallel Data transfer scheme, Serial data input, output, Serial data modes and serial interface with pc. Interfacing of 8051 with 8 bit ADC (0809) and DAC (0808) Introduction to embedded C programming. Applications: Interfacing of 8051 with single key, LED, Relay, speed control of dc motors, Stepper motor control.	6	CO2
UNIT-III	**PIC microcontroller**	**Hrs.**	**CO**
	History of PIC microcontroller, Comparison of 8051 and PIC 18 family, Comparison of CISC and RISC, RAM and Program memory organization, Program counters, Stack pointer, Bank Select Register, Status register, Data transfer instructions, Arithmetic and logical instructions. Assembly language programs. Addressing	6	CO3

	Modes for PIC 18 microcontroller, Branch instruction, CALL, RETURN, Bit addressable instruction. Assembly language programs I/O ports, SFR related to PORTs, I/O port programming. Applications		
UNIT-IV	**Introduction to Arduino Board**	**Hrs.**	**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**	**Hrs.**	**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**	**Hrs.**	**CO**
	Introduction, survey of different microcontrollers, Specifications, features, applications of different microcontrollers like PIC, NodeMCU, ARM processor, Raspberry pi development board, Concept of SOC.	8	CO6

Text Books:

[T1]. Muhammad Ali Mazidi, Janice G. Mazidi and Rolin D. McKinlay, "The Microcontroller and Embedded Systems", Second Edition, Pearson, 2012.

[T2]. Ayala K. J., "8051 Microcontroller: Architecture, Programming and applications "Second Edition, Penram international.

[T3]. Subrata Ghoshal, "8051 microcontroller", Pearsons Publishers.

[T4]. Started with Arduino by Massimo Banzi and Michael Shiloh Published by Maker Media, Inc.

[T5]. Arduino microcontroller processing for everyone-Steven F Barret, Morgan and Claypool Publisher.

[T6]. PIC Microcontroller and Embedded Systems Using Assembly and C for PIC18 by Muhammad Ali Mazidi, Rolind D. McKinley, Danny Causey, Pearson Education.

[T7]. **Beginning Robotics with Raspberry Pi and Arduino:Using Python and OpenCV by Jeff Cicolani**

[T8]. **ARM system on chip by Stephen B. Furber published by Pearson publication.**

References:

[R1]. V Udayashankara and M S MallikarjunaSwamy, "8051 Microcontroller, Hardware, software and applications", TATA McGraw Hill.

[R2]. Scott Mackenzie, "8051 Microcontroller", Pearson Education.

[R3]. Ajay Deshmukh, "Microcontroller 8051" –TATA McGraw Hill.

[R4]. Getting Started With Arduino: A Beginner's Guide by by Brad Kendall (Author), Justin Pot (Editor), Angela Alcorn (Editor)

[R5]. Arduino Cookbook, 2nd Edition by Michael Margolis published by O'Reilly Media

[R6]. Programming And Customizing the PIC Microcontroller by MykePredko, TATA McGraw-Hill.

[R7]. ARM assembly language programming and architecture by Muhammad Mazidi, Naimi and Chen.

EE302: ELECTRICAL MACHINES II

Teaching Scheme		**Examination Scheme**	
Lectures:	**03 Hrs./Week**	**Continuous Assessment:**	**40 Marks**
Tutorial:	**--- Hr./Week**	**End-Sem Exam:**	**60 Marks**
Credits:	**03**	**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	Select machine for specific applications by utilizing acquired knowledge about the starting & speed control of induction motors.	3	Applying
CO2	Demonstrate knowledge about the basic principles and working of induction machines and Special purpose motors.	2	Understanding
CO3	Analyse the operation of series motor on AC/ DC supply & examine applications of Universal motor.	4	Analyzing
CO4	Analyse the performance of alternators.	4	Analyzing
CO5	Estimate operation of synchronous motor at constant load and variable excitation (v curves & ^curves) & constant excitation and variable load.	4	Analyzing
CO6	Determine the voltage regulations of 3ph synchronous generator and analyse the parallel operation of 3ph alternator	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	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. Performance curves. Necessity of starter, Various starters for slip-ring and squirrel cage rotor induction motors with their relevant torque and current relations. Comparison of various starters, Speed control of three phase induction motor by various methods, Action of 3-phase induction motor as induction generator, Applications of induction generator. Testing of three phase induction motor as per IS 12615.	8	CO1
UNIT-II	**INDUCTION MACHINES AND SPECIAL PURPOSE MOTORS**	**Hrs.**	**CO**
	Introduction to Energy Efficient three phase Induction Motor and Super Conducting Generator **Single Phase Induction motor:** Construction, 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. **Special Purpose Motors**: (Descriptive Treatment Only)	8	CO2

	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.		
UNIT-III	**A.C. SERIES MOTOR**	**Hrs.**	**CO**
	Operation of D.C. series motor on A.C. supply, nature of torque developed, problems associated with AC. operation and remedies. **Compensated series motor:** Compensating winding, conductively and inductively compensated motor. Use of compoles for improving commutation. Ratings and applications of Compensated Series motors. **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**
	Three phase Synchronous machines: Construction, rotating-field type and rotating-armature type, salient-pole type and non-salient-pole type and their comparison. Excitation Methods. **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. **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.	8	CO4
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**
	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. **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, ISBN Number: 9780070583771
[T2] S. K. Bhattacharya, Electrical Machines, Tata McGraw Hill, ISBN Number 978-9332902855
[T3] A.S. Langsdorf, Theory of Alternating Current Machinery, Tata McGraw Hill ISBN Number: 978-0070994232
[T4] P. S. Bimbhra, Electric Machinery, Khanna Publications ISBN Number: 978-8174091734
[T5] B.R. Gupta and Vandana Singhal -Fundamentals of Electric Machines, New Age International (P) ISBN Number: 9788122416145
[T6] E. Openshaw Taylor, Performance and design of A.C. commutator motors, Wheeler Publishing ISBN Number: 9788185614816, 8185614814
[T7] V. K. Mehta and Rohit Mehta, Principles of Electrical Machines, S Chand Publications, ISBN Number: 9788121921916
[T8] Krishna Reddy –Electrical Machines Vol.II and III, SCITECH publications, ISBN Number:

9788183711296
[T9] Ashfaq Husain, Electrical Machines, Dhanpat Rai and Company, ISBN Number: 978-8177001662
[T10] M V Deshpande, Electrical Machines, Prentice Hall of India, ISBN Number: 978-8120340268

References:

[R1] M.G. Say, Performance and Design of A.C. Machines (3rd Ed.), ELBS, ISBN Number: 978-8123910277
[R2] J B Gupta - Theory and performance of Electrical Machines, S K Kataria Publications, ISBN Number:
[R3] Samarjit Ghosh, Electrical Machines, Pearson Publication, ISBN Number: 978-93-5014-277-6
[R4] Bhag S Guru and Huseyin R Hiziroglu, Electrical Machinary and Transformer, 3rd Edition, Oxford University Press, ISBN Number: *9780195138900*
[R5] E G Janardanan, Special Electrical Machines, Prentice Hall of India, ISBN Number: 978-8120340268

Unit	Text Books	Reference Books
1	T4,T7,T9	R5
2	T2,T3,T7,T9	R2,R3
3	T4,T6,T3	R1,R2
4	T1,T2,T7,T9	R3
5	T1,T4,T7	R2,R4
6	T4,T7,T9	R2

GATE Syllabus for reference of Electrical Machine

- **Single phase transformer:** equivalent circuit, phasor diagram, open circuit and short circuit tests, regulation and efficiency;
- **Three-phase transformers**: connections, vector groups, parallel operation; Auto-transformer, Electromechanical energy conversion principles;
- **DC machines:** separately excited, series and shunt, motoring and generating mode of operation and their characteristics, speed control of dc motors;
- **Three-phase induction machines:** principle of operation, types, performance, torque-speed characteristics, no-load and blocked-rotor tests, equivalent circuit, starting and speed control;
- Operating principle of single-phase induction motors;
- **Synchronous machines:** cylindrical and salient pole machines, performance and characteristics, regulation and parallel operation of generators, starting of synchronous motors;
- Types of losses and efficiency calculations of electric machines.

NPTEL Resources:

[E1] Electromagnetic Fields, IIT Madras by Prof. Harishankar Ramachandran
https://nptel.ac.in/courses/108/106/108106073/
[E2] Electromagnetic Theory, IIT Bombay by Prof. D.K. Ghosh
https://nptel.ac.in/courses/115/101/115101005/
[E3] Modelling and Analysis of Electric Machines, IIT Madras by Dr. Krishna Vasudevan
https://nptel.ac.in/courses/108/106/108106023/

EE303: POWER SYSTEM II			
Teaching Scheme		**Examination Scheme**	
Lectures:	**03 Hrs./Week**	**Continuous Assessment:**	**40 Marks**
Tutorial:	**--- Hr./Week**	**End-Sem Exam:**	**60 Marks**
Credits:	**03**	**Total:**	**100 Marks**

Prerequisite Course:
1. Power System I
2. Electrical Machine
3. Network Analysis

Course Objectives

1. This course provides the knowledge of Power System Analysis.
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	Apply the transmission line parameters and estimate performance of long transmission lines and complex power flow along with generalized constants.	3	Applying
CO2	Apply per unit system and load flow analysis methods in a power system network.	3	Applying
CO3	Apply different types of Symmetrical Fault Analysis methods under different conditions on a power system network.	3	Applying
CO4	Apply different types of Unsymmetrical Fault Analysis methods under different conditions on a power system network.	3	Applying
CO5	Demonstrate knowledge of Power Generation Pool, its Economics, Planning, Electricity Markets, Bilateral Markets and Price Formation in power system.	2	Understanding
CO6	Understand the definition and technical terminologies, potential, and performances of Distributed Generation.	2	Understanding

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

Course Contents			
UNIT-I	**Transmission Line Performance**	**Hrs.**	**COs**
	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-II	**Per Unit System and Load Flow Analysis**	**Hrs.**	**CO**
	Per unit system: Single line diagram, Impedance and reactance diagrams and their uses, per unit quantities, relationships, selection of base, change of base, reduction to common base, advantages and application 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,	06	CO2

	classification of buses, Newton- Raphson method (polar method) Decoupled and Fast decoupled load flow (descriptive treatment only).		
UNIT-III	**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, Numerical problem based on symmetrical fault analysis.	08	CO3
UNIT-IV	**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-V	**Power Generation Pool and 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. 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.	06	CO5
UNIT-VI	**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, ISBN-13: 978-0-07-049489-3, ISBN-10: 0-07-049489-3
[T2]. B R Gupta, Power System Analysis and Design, S. Chand, ISBN: 978-81-219-2238-8
[T3]. Ashfaq Hussain, "Electrical Power Systems", CBS Publication 5th Edition, ISBN-13: 9788123914480
[T4]. J.B.Gupta. "A course in power systems" S. K. Kataria Publications, ISBN: 978-93-5014-373-5
[T5]. P.S.R. Murthy, "Power System Analysis", B. S. Publications, ISBN: 9789386819932
[T6]. Anthony J. Pansini "Electrical Distribution Engineering", CRC Press, ISBN (print): 978-08-4938-249-9, ISBN (online): 978-87-7022-337-9
[T7]. A. J. Wood and B. F. Wallenberg, "Power generation, operation and control", Wiley Interscience, 2nd Edition, 1996, ISBN: 0-471-58699-4
[T8]. H Lee Willis, "Distributed Power Generation Planning and Evaluation", CRC Press, ISBN: 9781498771832

References:

[R1]. H. Hadi Sadat: Power System Analysis, Tata McGraw-Hill New Delhi, ISBN-13: 978-0075616344, ISBN-10: 0075616343
[R2]. G. W. Stagg and El- Abiad – Computer Methods in Power System Analysis – Tata McGraw Hill, New Delhi, ISBN-13: 978-9388716154, ISBN-10: 9388716159
[R3]. M. E. El-Hawary, Electric Power Systems: Design and Analysis, IEEE Press, New York, ISBN-13: 978-0780311404, ISBN-10: 078031140X
[R4]. Rakash Das Begamudre, "Extra High voltage A.C. Transmission Engineering ", New age publication, ISBN-13: 978-1906574741, ISBN-10: 190657474X
[R5]. M. A. Pai, Computer Techniques in Power System Analysis, Tata McGraw Hill Publication, ISBN-13: 9780070965515, ISBN-10: 007096551X
[R6]. Stevenson W.D. Elements of Power System Analysis (4th Ed.) Tata McGraw Hill, New Delhi, ISBN-13: 978-0070665842, ISBN-10: 0070665842
[R7]. K. R. Padiyar: HVDC Transmission Systems, New Age International Publishers Ltd, New Delhi, ISBN-13: 978-8122437850, ISBN-10: 9788122437850
[R8]. Olle I. Elgard – Electric Energy Systems Theory – Tata McGraw Hill, New Delhi, ISBN-13: 978-0070992863, 007099286X
[R9]. V. K. Chandra, Power Systems, Cyber tech Publications, ISBN-13: 978-8178840703, 8178840707

E references:

[E1]. NPTEL Course: Power System Analysis
https://archive.nptel.ac.in/courses/108/105/108105067/

[E2]. NPTEL Course: Energy Economics and Policy: https://onlinecourses.nptel.ac.in/noc20_hs68/preview [E3]. NPTEL Course: Electrical Distribution System Analysis: https://onlinecourses.nptel.ac.in/noc19_ee61/preview
GATE Syllaus:
Basic concepts of electrical power generation, ac and dc transmission concepts, Models and performance of transmission lines and cables, Series and shunt compensation, Electric field distribution and insulators, Distribution systems, Per-unit quantities, Bus admittance matrix, Gauss- Seidel and Newton-Raphson load flow methods, Voltage and Frequency control, Power factor correction, Symmetrical components, Symmetrical and unsymmetrical fault analysis, Principles of over-current, differential, directional and distance protection; Circuit breakers, System stability concepts, Equal area criterion, Economic Load Dispatch (with and without considering transmission losses).

EE304: POWER ELECTRONICS			
Teaching Scheme		**Examination Scheme**	
Lectures:	**03 Hrs./Week**	**Continuous Assessment:**	**40 Marks**
Tutorial:	**--- Hr./Week**	**End-Sem Exam:**	**60 Marks**
Credits:	**03**	**Total:**	**100 Marks**

Prerequisite Course:

1. Knowledge of semiconductor material, basic electronics switches and its characteristics.
2. Basic concepts of circuits, Analog electronics

Objectives: The course aims: -

To impart the knowledge of the student in:

1. Fundamental of power electronics switching devices and their characteristics
2. Concepts and characteristics of Single phase and three-phase-controlled rectifiers
3. Functions of different modes of inverter and modulation techniques
4. Operation, switching regulators and basic topologies of DC - DC converters
5. Operation of AC voltage controller and its types of configurations

Course Outcomes (COs):

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

Course Outcome (s)		Bloom's Taxonomy	
		Level	Descriptor
CO1	**Describe** the characteristics of power semiconductor devices, SCR protection and commutation techniques.	2	Understand
CO2	**Construct** half and full controlled converters for different loads	3	Apply
CO3	**Demonstrate** the operation of three phase-controlled rectifiers	2	Understand
CO4	**Apply** different modulation techniques to inverters and identify the harmonic reduction methods.	3	Apply
CO5	**Relate** suitable DC chopper for various quadrant operations	2	Understand
CO6	**Explain** the operation of Cyclo-converter and matrix converter	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	3	2	2	1	1	-	-	-	2	1	-	-	1	-
CO2	3	2	2	1	1	-	-	-	-	1	-	-	1	-
CO3	3	2	2	1	1	-	-	-	-	1	-	-	1	-
CO4	3	3	2	2	2	-	-	-	1	1	-	1	2	-
CO5	3	2	1	1	1	-	-	-	1	1	-	1	1	-
CO6	3	3	3	1	1	-	-	-	-	1	-	1	1	-

Level 3 – Substantial; Level 2 – Moderate; Level 1 – Low.

Course Contents			
UNIT-I	**POWER SEMICONDUCTOR DEVICES**	**Hrs.**	**COs**
	Introduction - VI and switching characteristics of power semiconductor devices: Power Diode, Thyristor, BJT, MOSFET, IGBT - SCR two transistor analogies - SCR Protection circuits - SCR firing circuits - SCR Commutation techniques – Introduction to TRIAC & GTO	09	CO1
UNIT-II	**SINGLE PHASE AC to DC CONVERTERS**	**Hrs.**	**CO**
	Principle of phase-controlled converter - Single phase half and fully controlled converter with R, RL, RLE load - Derivation of average output current and voltage - Derivation of RMS output current and voltage - Freewheeling diode - Effect of source Inductance - Simple problems in single phase converters	06	CO2
UNIT-III	**THREE PHASE AC to DC CONVERTERS**	**Hrs.**	**CO**
	Three phase half and fully controlled converter with R, RL load - Derivation of average output current and voltage – Derivation of RMS output current and voltage	03	CO3
UNIT-IV	**DC to AC CONVERTERS**	**Hrs.**	**CO**
	Principle of operation Single phase voltage source inverters - Three phase voltage source inverters - 120^0 and 180^0 mode operation - Voltage control of inverter using PWM, Single PWM, Multiple PWM, Sinusoidal PWM and Modified SPWM - Harmonic reduction techniques - Single phase current source inverter	09	CO4
UNIT-V	**DC to DC CONVERTERS**	**Hrs.**	**CO**
	Principle of chopper operations - control strategy - Buck converter, Boost converter, Buck	09	CO5

	- Boost converter – Problems Applications: Boost Converters for Photovoltaic Power generation - Boost Converters for wind Power generation - Introduction to voltage, current and load commutated chopper		
UNIT-VI	**AC to AC CONVERTERS**	**Hrs.**	**CO**
	Single phase AC voltage controller with R and RL load – Principle of operation of single phase to single phase cycloconverter - Principle of operation of single phase to three phase cycloconverter - Operation of single-phase Matrix converter – Basic resonant circuit concept	09	CO6

Text Books:

[T1]. M. H. Rashid - Power Electronics 2nd Edition, Pearson publication
[T2]. Ned Mohan, T.M. Undel and, W.P. Robbins - Power Electronics, 3rd Edition, John Wiley and Sons
[T3]. B.W. Williams: Power Electronics 2nd edition, John Wiley and sons
[T4]. Ashfaq Ahmed- Power Electronics for Technology, LPE Pearson Edition.
[T5]. 5. Dr. P.S. Bimbhra, Power Electronics, Third Edition, Khanna Publication.

References:

[R1]. Vedam Subramanyam - Power Electronics, New Age International, New Delhi
[R2]. M. D. Singh and K. B. Khand Chandani, Power Electronics, Tata McGraw Hill
[R3]. L. Umanand, Power Electronics – Essentials and Applications Wiley Publication.
[R4]. 4. V.R. Moorthi, Power Electronics Devices, circuits, and Industrial applications, Oxford University Press.

E-Resources:

[E1]. NPTEL Web course and video course on Power Electronics by Prof. D.Prasad, IIT, Kharagpur
   a. (https://nptel.ac.in/courses/108105066)
[E2]. https://www.youtube.com/watch?v=_1uPJhqo18Q (Boost Converter design and simulation in MATLAB/Simulink)
[E3]. https://www.youtube.com/watch?v=Ku50FzwomvA (How to design boost converter for photovoltaic system Pspiece)
[E4]. Buck Boost Converters in Electric Vehicle | (MATLAB / SIMULINK Based Design & Simulation)
   a. (https://www.youtube.com/watch?v=Z2NE3i9Bzc0)
https://ijret.org/volumes/2013v02/i11/IJRET20130211056.pdf (A review on power electronics application on wind turbines)

GATE Syllabus:

Static V-I characteristics and firing/gating circuits for Thyristor, MOSFET, IGBT; DC to DC conversion: Buck, Boost and Buck-Boost Converters; Single and three-phase configuration of uncontrolled rectifiers; Voltage and Current commutated Thyristor based converters; Bidirectional ac to dc voltage source converters; Magnitude and Phase of line current harmonics for uncontrolled and thyristor based converters; Power factor and Distortion Factor of ac to dc converters; Single-phase and three-phase voltage and current source inverters, sinusoidal pulse width modulation

EE305A: RENEWABLE ENERGY SOURCES			
Teaching Scheme		**Examination Scheme**	
Lectures:	**03 Hrs./Week**	**Continuous Assessment:**	**40 Marks**
Tutorial:	**--- Hr/Week**	**End-Sem Exam:**	**60 Marks**
Credits:	**03**	**Total:**	**100 Marks**

Prerequisite Course:

1. Basic Electrical and Electronics Engineering
2. Electrical Technology

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.
4. To participate in reducing the use of energy wherever possible for each individuals in the society.
5. To enhance the use of renewable energy by understanding its role towards environment.
6. To develop the solar PV array model or a wind mill for any one commercial application through MATLAB.

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 and critically analyse individual role towards energy utilization for environment conservation.	2	Understanding
CO2	Relate solar power generation and its utilization.	3	Applying
CO3	Analyse wind power generation and its utilization.	4	Analyzing
CO4	Explain biomass power generation and its utilization.	2	Understanding
CO5	Analyse trending renewable energy sources and energy storage systems.	4	Analyzing
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	3	3	3	3	2	3	-	-	-	2	3	1	1
CO2	3	3	3	3	3	3	3	-	-	-	3	3	3	3
CO3	3	3	3	3	3	3	3	-	-	-	3	3	3	3
CO4	3	3	3	3	3	3	3	-	-	-	3	3	3	3
CO5	3	3	3	3	3	2	3	-	-	-	3	3	3	3
CO6	3	3	3	2	3	2	3	-	-	-	3	3	3	3

Course Contents			
UNIT-I	**INTRODUCTION TO RENEWABLE ENERGY SYSTEMS**	**Hrs.**	**CO**
	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. Critical analysis of individual role towards energy utilization towards environment conservation.	8	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, characteristics curves of PV cell, solar thermal power generation, solar thermal conversion: basics of solar concentrator and tracking system, flat plate collectors-liquid and air type, theory of flat plate collectors, selective coatings, advanced collectors: ETC, Solar Pond. Modelling of solar PV array for a commercial application.	8	CO2
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. Modelling of a wind mill for commercial application integrated with grid.	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,ISBN 10 0199261784
[T2] G. S. Sawhney, "Non-Conventional Resources of Energy", PHI Publication 2012.ISBN: 8120346092, 9788120346093
[T3] G.D. Rai, Non conventional energy sources, Khanna publication ISBN. 8174090738, 9788174090737.

References:

[R1] Gary-L. Johnson Wind Energy Systems Tata Mc-Graw-Hill Book Company.ISBN-10. 0139577548
[R2] S. P. Sukhatme, J. K. Nayak Solar Energy- Principles of Thermal Collection and Storage (3rd ed.), Tata McGraw-Hill Publication.ISBN: 9352607120, 978935260712
[R3]Gilbert M.Masters-Renewable & Efficient Electrical Power System-Wiley 2013 ISBN NO-1118633504, 9781118633502

E-References

[E1] Non Conventional Energy Sources https://nptel.ac.in/courses/121/106/121106014/
[E2]Renewable Energy engineering Solar,Wind and Biomass Energy System https://nptel.ac.in/courses/103/103/103103206/

EE305B: SMART GRID

Teaching Scheme		Examination Scheme	
Lectures:	**03 Hrs./Week**	**Continuous Assessment:**	**40 Marks**
Tutorials:	**--**	**End-Sem Exam:**	**60 Marks**
Credits:	**03**	**Total:**	**100 Marks**

Prerequisite Course:

1. Basic knowledge of power systems and power electronics.
2. Basic knowledge of computer and communications networks

Course Objectives

1. To learn the fundamentals, objectives and architecture of the smart grid
2. To describe the aspects of measurement equipment and automation technologies used in smart grid.
3. To get familiar with wide area networks used in smart grid.
4. To describe the power electronic converters and energy storage technologies used in smart grid
5. To impart the knowledge about the communication technology of Smart grid.
6. To explain the concept of micro grid.

Course Outcomes (COs):

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

Course Outcome (s)		Bloom's Taxonomy	
		Level	Descriptor
CO1	Describe the concept of smart grid and its present developments	2	Understand
CO2	Formulate solutions in the areas of smart substations, distributed generation and wide area measurements.	2	Understand
CO3	Discuss the need of wide area measurement systems in smart grid.	2	Understand
CO4	Use the suitable converters and energy storage technologies for smart grid applications	2	Understand
CO5	Select the suitable communication networks for smart grid applications	2	Understand
CO6	Describe the structure and control of micro grid.	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	2	1	1	-	1	-	-	-	-	-	-	1	1	2
CO2	2	2	2	1	1	2	-	-	-	-	-	1	1	2
CO3	2	1	1	1	1	2	-	-	-	-	-	1	1	2
CO4	2	2	1	1	1	2	-	-	-	-	-	1	1	2
CO5	2	1	1	2	1	2	-	-	-	-	-	1	1	2
CO6	2	1	1	-	1	-	-	-	-	-	-	1	1	2

Course Contents

UNIT-I	Introduction to Smart Grid	Hrs.	COs
	Background and history of smart Grid evolution, Definition and characteristics of smart grid, Benefits of smart grid, Smart Grid vision and its realization, Motives behind developing the Smart Grid concept, Examples of Smart Grid projects/initiatives, Smart Grid versus conventional electrical networks, Smart Grid basic infrastructure, Functions of smart grid components.	08	CO1
UNIT-II	**Smart Grid Measurement and Automation Technologies**	**Hrs.**	**CO**
	Smart metering, Communications infrastructure and protocols for smart metering, Demand Side Integration, Distribution Automation Equipment - Current transformers, Voltage Transformers, Intelligent Electronic Devices, Fault in the distribution system, Distribution Management System – SCADA, Modelling and Analysis tool, Applications, Transmission System Operation- IEDs, Phasor Measurement unit , Energy Management, wide area applications	10	CO2
UNIT-III	**Smart grid and wide-area networks**	**Hrs.**	**CO**

	Networking technologies for wide-area measurement applications- Components of a wide area measurement system, communication networks for WAMS, WAMS application, WAMS modelling and network simulations; Smart grid application requirements, network topologies, deployment factors, performance metrics and trade-offs.	08	CO3
UNIT-IV	**Power Electronics and Energy Storage in Smart Grid**	**Hrs.**	**CO**
	Power electronics in the Smart Grid - Renewable energy generation, Fault current limiting, Shunt compensation, Series compensation, FACTS, HVDC. Energy storage technologies - Batteries, Flow Battery , Fuel and hydrogen electrolyzer, fuel cells, DLC, SMES, Case study.	07	CO4
UNIT-V	**Communication Technology for Smart Grid**	**Hrs.**	**CO**
	Communication Technology- IEEE 802 series, Mobile communications Multi-protocol label switching, Power line communication, Standard for information exchange - Standards for smart metering, Modbus, DNP3, IEC 61850, Introduction to cyber security standards.	06	CO5
UNIT-VI	**Microgrids**	**Hrs.**	**CO**
	Microgrid Concept and Structure, Building Blocks of a Microgrid, Operation Modes, Control Mechanism of the Connected Distributed Generators in a Microgrid, Speed Control of Classical Distributed Generators, Control of Inverter-based Distributed Generators, Hierarchical Microgrid Control, DC Microgrid Control	07	CO6

Text Books:

[T1]. Salman K.Salman, "Introduction to Smart Grid: Concepts, technologies and Evolution", IET Engineering Series 94, UK, 2017

[T2]. Janaka Ekanayake et al, "Smart Grid Technology and Applications", John Wiley & Sons, USA, 2012.

[T3]. Hassan Bevrani etal, "Microgrid Dynamics and Control", JohnWiley & Sons, USA, 2017.

References:

[R1]. James Momoh, "SMART GRID Fundamentals of Design and Analysis", IEEE Press, Published by John Wiley & Sons, 2012

[R2]. P.Parjof et al "Smart Grid and Microgrids: Concepts and Applications", John Wiley & Sons, 2022

E-References

[E1] Introduction to Smart Grid (https://onlinecourses.nptel.ac.in/noc19_ee64/preview)

EE305C: INDUSTRY 4.0			
Teaching Scheme		**Examination Scheme**	
Lectures:	**03 Hrs./Week**	**Continuous Assessment:**	**40 Marks**
Tutorials:	**--**	**End-Sem Exam:**	**60 Marks**
Credits:	**03**	**Total:**	**100 Marks**

Prerequisite Course:

1. Internet of Things, Hardware and Simulation of IoT platforms.

Course Objectives

1. Introduction of Industry 4.0 and its concept.
2. Understand framework of Industry 4.0 and discuss its various components.
3. Develop applications related industry 4.0.
4. Implement industry 4.0 in industrial robotic developments.
5. Introduction of Augmented Reality and its hardware and software developments.
6. Analyze obstacles in Industry 4.0 and identify the solutions.

Course Outcomes (COs):

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

Course Outcome (s)		Bloom's Taxonomy	
		Level	**Descriptor**
CO1	Describe Industry 4.0 and its its significance	2	Understand
CO2	Explain framework and components of Industry 4.0	2	Understand
CO3	Illustrate various technologies under industry 4.0 roadmap.	4	Analyze
CO4	Apply knowledge of industry 4.0 in robotic engineering field.	3	Apply
CO5	Illustrate Augmented Reality, its Hardware and Software domains.	4	Analyze
CO6	Analyze Obstacles in Industry 4.0 and identify the solutions.	4	Analyze

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 and Background of Industry 4.0**	**Hrs.**	**CO**
	Industry 4.0: Introduction, core idea of Industry 4.0, origin concept of industry 4.0, Industry 4.0 production system, current state of industry 4.0, Technologies, India's preparation for Industry 4.0.	07	**CO1**
UNIT-II	**Industry 4.0 Conceptual Framework**	**Hrs.**	**CO**
	Framework: Introduction, Main Concepts and Components of Industry 4.0, State of Art, Supportive Technologies, Proposed Framework for Industry 4.0.	07	**CO2**
UNIT-III	**Technological Roadmap to Industry 4.0**	**Hrs.**	**CO**
	Introduction, Proposed Framework for Technology Roadmap, Internet of Things (IoT), Industrial Internet of Things (IIoT) & Internet of Services. - Smart Manufacturing - Smart Devices and Products - Smart Logistics - Smart Cities - Predictive Analytics	08	**CO3**
UNIT-IV	**Advances in Robotics in the Era of Industry 4.0**	**Hrs.**	**CO**
	Introduction, Recent Technological Components of robots Advanced Sensor Technologies, Internet of Robotic Things, Cloud Robotics, and Cognitive Architecture for Cyber-physical Robotics, Industrial Robotic Applications- Manufacturing, Maintenance and Assembly	08	**CO4**
UNIT-V	**The Role of Augmented Reality in the Age of Industry 4.0**	**Hrs.**	**CO**
	Introduction, AR Hardware and Software Technology, Industrial Applications of AR.	07	**CO5**
UNIT-VI	**Obstacles and Framework Conditions for Industry 4.0**	**Hrs.**	**CO**

	Lack of A Digital Strategy alongside Resource Scarcity, Lack of standards and poor data security, Financing conditions, availability of skilled workers, comprehensive broadband infrastructure, state support, legal framework, protection of corporate data, liability, handling personal data, Industry 5.0	08	**CO6**

Text Books:

[T1] Alp Ustundag, Emre Cevikcan, "Industry 4.0: Managing The Digital Transformation" Springer, ISBN 978-3-319-57869-9, 2018.

[T2] Diego Galar Pascual, Pasquale Daponte, Uday Kumar, "Handbook of Industry 4.0 and SMART Systems" Taylor and Francis,2020. ISBN 9780429455759

References:

[R1] Jean-Claude André, "Industry 4.0", Wiley- ISTE, July 2019, ISBN: 781786304827,2019.

[R2] Miller M, ―The internet of things: How smart TVs, smart cars, smart homes, and smart cities are changing the world‖, Pearson Education, 2015, ISBN: 9780134021300.

E-resources:

[E1] NPTEL course: course name: Introduction to Industry 4.0 and Industrial Internet of Things, Course Link: https://onlinecourses.nptel.ac.in/noc20_cs69/preview

EE306: MICROCONTROLLERS AND APPLICATIONS LABORATORY

Teaching Scheme		**Examination Scheme**	
Practical:	**02 Hr/Week**	**Oral:**	**25 Marks**
Credits:	**01**	**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 & outputoperations.
3. To define the protocol for serial communication and understand the microcontrollerdevelopment systems.
4. To build and test a microcontroller-based system; interface the system to switch, keypad, anddisplay.
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	PO10	PO11	PO12	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**	**Hrs**	**CO**
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:

[T1] Muhammad Ali Mazidi, Janice G. Mazidi and Rolin D. McKinlay, "The Microcontroller and Embedded Systems", Second Edition, Pearson, 2012.
[T2] Ayala K. J., "8051 Microcontroller: Architecture, Programming and applications" Second Edition, Penram international.
[T3] SubrataGhoshal, "8051 microcontroller", Pearsons Publishers.
[T4] Started with Arduino by Massimo Banzi and Michael Shiloh Published by Maker Media, Inc.
[T5] Arduino microcontroller processing for everyone-Steven F Barret, Morgan and ClaypoolPublisher.

References:

[R1] V Udayashankara and M S MallikarjunaSwamy, "8051 Microcontroller, Hardware, software and applications", TATA McGraw Hill.
[R2] Scott Mackenzie, "8051 Microcontroller", Pearson Education.
[R3] Ajay Deshmukh, "Microcontroller 8051" –TATA McGraw Hill.
[R4] Getting Started With Arduino: A Beginner's Guide by by Brad Kendall (Author), Justin Pot (Editor), Angela Alcorn (Editor)
[R5] Arduino Cookbook, 2nd Edition by Michael Margolis published by O'Reilly Media

EE307: ELECTRICAL MACHINES II LABORATORY

Teaching Scheme		**Examination Scheme**	
Practical:	**02 Hr/Week**	**Practical:**	**25 Marks**
Credits:	**01**	**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	Analyzing
CO2	Calculate various parameters of electrical machines	5	Evaluate
CO3	Examine the process and determine voltage regulation of electrical machines	4	Analyzing
CO4	Analyze the response of synchronous motors and alternator	4	Analyzing
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	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	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**	**Hrs**	**CO**
	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.

EE308: POWER SYSTEM II LABORATORY

Teaching Scheme		**Examination Scheme**	
Practical:	**02 Hr/Week**	**Practical:**	**25 Marks**
Credits:	**01**	**Total:**	**25 Marks**

Prerequisite Course:

1. Power System - I
2. MATLAB programming and Simulink

Course Objectives

1. This course provides the knowledge of Power System Analysis.
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	Measure Transmission Line parameters of a Transmission Line	3	Applying
CO2	Form the Y-bus matrix of a given power system network using software.	3	Applying
CO3	Measure the various reactance of a synchronous machine	3	Applying
CO4	Apply various methods to observe the performance of Transmission Line.	3	Applying
CO5	Apply various load flow analysis methods using Software.	3	Applying
CO6	Simulate various Faults in a power system by using software.	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	3	2	3	2	-	-	1	3	3	1	3	2	1
CO2	2	3	2	2	2	-	-	1	-	3	1	3	2	2
CO3	2	3	2	3	2	-	-	1	3	3	1	3	2	1
CO4	2	3	2	3	2	-	-	1	3	3	1	3	1	1
CO5	3	3	2	2	2	-	-	1	-	3	1	3	2	2
CO6	2	3	2	2	2	-	-	1	-	3	1	3	2	1

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	Formulation and calculation of Y- bus matrix of a given system using software.	2	CO2
4	Measurement of sequence reactance of a synchronous machine (Negative and zero).	2	CO3
5	Static measurement of the sub-transient reactance of a salient-pole alternator.	2	CO3
6	Performance study of the effect of VAR compensation using capacitor bank on the transmission line.	2	CO4
7	Plotting of receiving end circle diagrams to evaluate the performance of medium transmission lines.	2	CO4
8	Solution of a load flow problem using Gauss-Seidel method using software.	2	CO5
9	Solution of a load flow problem using Newton-Raphson method using software.	2	CO5
10	Simulation of Symmetrical fault of single machine connected to infinite bus by using Software	2	CO6
11	Simulation of Unsymmetrical fault of single machine connected to infinite bus.	2	CO6

Text Books:

[T1]. J. Nagrath and D.P. Kothari – Modern Power System Analysis – Tata McGraw Hill, New Delhi, ISBN-13: 978-0-07-049489-3, ISBN-10: 0-07-049489-3
[T2]. B R Gupta, "Power System Analysis and Design", S. Chand, ISBN: 978-81-219-2238-8
[T3]. Ashfaq Hussain, "Electrical Power Systems", CBS Publication 5th Edition, ISBN-13: 9788123914480
[T4]. J.B.Gupta. "A course in power systems" S. K. Kataria Publications, ISBN: 978-93-5014-373-5

[T5]. P.S.R. Murthy, “Power System Analysis”, B. S. Publications, ISBN: 9789386819932

References:

[R1]. H. Hadi Sadat: Power System Analysis, Tata McGraw-Hill New Delhi, ISBN-13: 978-0075616344, ISBN-10: 0075616343
[R2]. G. W. Stagg and El- Abiad – Computer Methods in Power System Analysis – Tata McGraw Hill, New Delhi, ISBN-13: 978-9388716154, ISBN-10: 9388716159
[R3]. M. E.El-Hawary, Electric Power Systems: Design and Analysis, IEEE Press, New York, ISBN-13: 978-0780311404, ISBN-10: 078031140X
[R4]. Rakash Das Begamudre, “Extra High voltage A.C. Transmission Engineering ", New age publication, ISBN-13: 978-1906574741, ISBN-10: 190657474X
[R5]. M. A. Pai, Computer Techniques in Power System Analysis, Tata McGraw Hill Publication, ISBN-13: 9780070965515, ISBN-10: 007096551X

E-References

[1] NPTEL Course: Power System Analysis: https://nptel.ac.in/courses/108105067

EE309: POWER ELECTRONICS LABORATORY

Teaching Scheme		**Examination Scheme**	
Practical:	**02 Hr/Week**	**Practical:**	**25 Marks**
Credits:	**01**	**Total:**	**25 Marks**

Prerequisite Course:

1. Knowledge of semiconductor material, basic electronics switches and its characteristics.
2. Basic concepts of circuits, analog and digital electronics

Course Objectives: The course aims:-

To impart the knowledge of the student in:

1. Apply the concepts of power electronic converters for efficient conversion/control of power from source to load.
2. Design the power converter with suitable switches meeting a specific load requirement

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 operational behaviour of semiconductor devices SCR and MOSFET	2	Understand
CO2	Describe the suitable circuit topologies associated with converter application.	2	Understand
CO3	Control the AC and DC motors using appropriate method.	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	3	2	2	1	1	-	-	-	2	1	-	-	1	1
CO2	3	2	2	1	1	-	-	-	-	1	-	-	1	1
CO3	3	2	2	1	1	-	-	-	-	1	-	-	1	1

Course Contents

Ex. No	**Name of Experiment**	**Hrs.**	**COs**
1	Static VI characteristic of SCR / GTO	2	CO1
2	Static VI characteristic of MOSFET / IGBT	2	CO1
3	Single phase half and fully controlled converters.	2	CO2
4	Simulations of single phase half and fully controlled converter	2	CO2
5	Three phase half and fully controlled converters.	2	CO2
6	Simulations of three phase half and fully controlled converter	2	CO2
7	IGBT based Single phase PWM inverters.	2	CO3
8	Simulation of single phase Full bridge inverter	2	CO3
9	MOSFET based step up chopper	2	CO3
10	Single phase cyclo-converter	2	CO3

Text Books:

1. M. H. Rashid - Power Electronics 2nd Edition, Pearson publication
2. Ned Mohan, T.M. Undel and, 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, Khanna Publication.

References:

1. Vedam Subramanyam - Power Electronics, New Age International, New Delhi
2. M. D. Singh and K. B. Khand Chandani, Power Electronics, Tata McGraw Hill
3. L. Umanand, Power Electronics – Essentials and Applications Wiley Publication.
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 Prof. D.Prasad, IIT, Kharagpur (https://nptel.ac.in/courses/108105066)
6.https://www.youtube.com/watch?v=_1uPJhqo18Q (Boost Converter design and simulation in MATLAB/Simulink)
7.https://www.youtube.com/watch?v=Ku50FzwomvA (How to design boost converter for photovoltaic system Pspiece)
8.Buck Boost Converters in Electric Vehicle | (MATLAB / SIMULINK Based Design & Simulation) (https://www.youtube.com/watch?v=Z2NE3i9Bzc0)
9.https://ijret.org/volumes/2013v02/i11/IJRET20130211056.pdf (A review on power electronics application on wind turbines)

EE310: CORPORATE READINESS			
Teaching Scheme		**Examination Scheme**	
Practical:	**2 Hrs./Week**	**TW:**	**25 Marks**
Credits:	**01**	**Total:**	**25 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. Discussion over Different Competition organised by companies & other platforms, Revision and Assessment of Verbal reasoning.	05 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.	03 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.	04 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, Blood relation and dices, Clocks and Calendar, Direction sense and cubes, Logical connectives.	06 Hrs.	CO5
UNIT-VI	Preparation for Job Interviews	**Hrs.**	**CO**
	Prepare for Different Types of Job Interviews, Most Common Interview Questions, Prepare for Best Practices before & after the Job Interview, Expected Technical Questions, Strategic	03 Hrs.	CO6

	Questions at the end of the Job Interview.		

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- Books :

[1].https://themech.in/quantitative-aptitude-and-logical-reasoning-books/
[2].https://www.thelocalhub.in/2021/01/reasoning-competitive-exams-pdf.html

E-learning Resources/MOOCs/ NPTEL Course Links:

[1]. https://www.practiceaptitudetests.com/non-verbal-reasoning-tests/
[2]. https://www.educationquizzes.com/11-plus/non-verbal-reasoning/
[3]. https://www.livecareer.com/resume/examples/web-development/e-learning-developer
[4]. https://novoresume.com/career-blog/how-to-write-a-resume-guide

EE311: SEMINAR AND TECHNICAL COMMUNICATION SKILLS			
Teaching Scheme		**Examination Scheme**	
Practical:	**04 Hrs./Week**	**Term Work:**	**50 Marks**
Credits:	**02**	**Total:**	**50 Marks**

Prerequisite Course:

1. Soft Skills
2. Professional Development
3. Corporate Readiness

Course Objectives

1. Introduce students to the importance of technical writing.
2. Learning modern tools for technical report writing.
3. Discussion and critical thinking about current technical topics.
4. Develop the verbal and written English communication skills among the students.
5. Develop skills required to deliver an effective seminar in front of a diverse audience.

Course Outcomes (COs):

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

Course Outcome (s)		Bloom's Taxonomy	
		Level	**Descriptor**
CO1	Express the nature and objective of technical writing relevant for the workplace as Engineers.	2	Understand
CO2	Utilize the technical writing for the purposes of Technical report writing and its exposure in various dimensions.	3	Apply
CO3	Use modern tools for writing and analyzing technical writing	4	Anlyzing
CO4	To apply the basic elements of technical language in formal correspondence	3	Apply
CO5	Evaluate their efficacy as fluent & efficient communicators by learning the voice-dynamics.	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	2	-	-	-	-	1	-	-	1	1	1	3	-	1
CO2	2	-	-	-	-	1	-	-	1	1	1	3	-	1
CO3	1	-	-	-	3	1	-	-	2	1	1	3	-	1
CO4	2	-	-	-	-	2	-	2	3	3	1	3	-	2
CO5	2	-	-	-	1	3	-	2	3	3	-	3	-	2
CO6	2	-	-	-	1	2	-	2	3	3	-	3	-	2

Course Contents

Any 8 topics from Part A and any 8 from part B.

PART A

Sr. No	Topics to be covered	Hrs.	COs
1	Importance of report writing in academics and research. Various kinds of academic and research activities. Necessity of report writing for achievement of academic and research goals.	2	1
2	Various kinds of reports / presentations. Characteristics of academic and research reports / presentations. Conclusions.	2	1
3	Types of research papers, Structure of research papers, Research paper formats, Abstract writing,	2	1
4	Methodology, Results and discussions, Different formats for referencing, Ways of communicating a research paper.	2	2
5	Structure of a thesis, Scope of the work, Literature review, Experimental / computational details	2	2
6	Preliminary studies, Results and Discussions, Figures and Tables preparation, Conclusions and future works, Bibliography, Appendices.	2	2
7	Various word processors, e.g, MS Word, Libra-office, Latex etc. Making effective presentations using PowerPoint and Beamer.	2	3
8	Use of plagiarism detection tools.	2	3
9	**Activity -** Writing a research paper with plagiarism below 10%.	4	3

PART B

Sr. No	Topics to be covered	Hrs.	COs

1	Technical Communication- Features, Distinction between General and Technical Communication, Language as a tool of Communication	2	4
2	C.V./Resume writing	2	4
3	Presentation: Forms, interpersonal Communication, Classroom presentation	2	4
4	Individual conferencing: essentials, Public Speaking	2	5
5	Techniques: Clarity of substance, emotion, Humour, Modes of Presentation Overcoming Stage Fear, Audience Analysis & retention of audience interest.	2	5
6	Methods of Presentation: Interpersonal, Impersonal, Audience Participation, Quizzes & Interjections.	2	5
7	Seminar Conferences Presentation skills- Focus, Content Style, Flow in Speaking, Speaking with a purpose, Speech & personality, Professional Personality Attributes, Empathy, Considerateness, Leadership	2	6
8	Interview skills, Group Discussion	2	6
9	**Activity** - Deliver an effective Seminar on any technical topic with proper communication skills	4	6

Text Books:

[T1] Technical Communication – Principles and Practices by Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2007, New Delhi.
[T2] Personality Development and Soft Skills by Barun K. Mitra, OUP, 2012, New Delhi.
[T3] Spoken English- A Manual of Speech and Phonetics by R.K.Bansal & J.B.Harrison, Orient Blackswan, 2013, New Delhi
[T4] A Step-by-Step Guide to Writing Academic Papers, by Anne Whitaker September 2009
[T5] On Writing a Thesis by C P Ravikumar, IETE Journal of Education, 2000
[T6] Microsoft Office 2016, by Joan Lambert and Curtis Frye, Microsoft Press, Washington 98052-6399

References:

[R1] Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.
[R2] Practical Communication: Process and Practice by L.U.B. Pandey; A.I.T.B.S. Publications India Ltd.; Krishan Nagar, 2014, Delhi.
[R3] Modern Technical Writing by Sherman, Theodore A (et.al); Apprentice Hall; New Jersey; U.S.
[R4] LATEX for Beginners, Edition 5, March 2014 Document Reference: 3722-2014
[R5] Essential LATEX ++, Jon Warbrick with additions by David Carlisle, Michel Goossens, Sebastian Rahtz, Adrian Clark January 1994

E-References

[E1] Coursera course- https://www.coursera.org/learn/academic-writing-capstone
[E2] NPTEL course- https://onlinecourses.swayam2.ac.in/ntr20_ed30/preview

MC312A: ELECTRICAL ENERGY CONSERVATION AND AUDITING			
Teaching Scheme		**Examination Scheme**	
Lectures:	**01 Hrs./Week**		**NA**
Credits:	**Non-Credit**	**Total:**	**PASS/FAIL**

Prerequisite Course:
1. Power Systems
2. 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	PO10	PO11	PO12	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

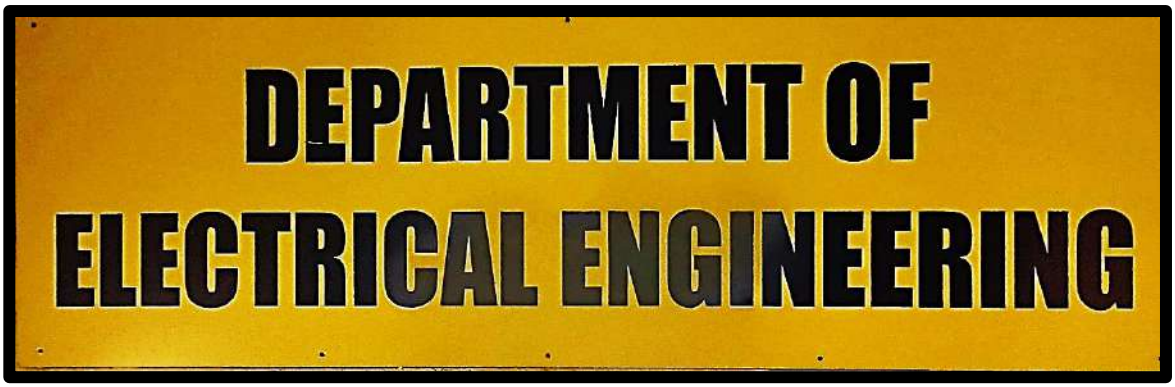
UNIT-I	ENERGY SCENARIO	Hrs.	CO
	Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy security, energy conservation and its importance, Energy Conservation Act-2001 and its features.	3	CO1
UNIT-II	**BASICS OF ENERGY AND ITS VARIOUS FORMS**	**Hrs.**	**CO**
	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.	3	CO2
UNIT-III	**ENERGY MANAGEMENT & AUDIT**	**Hrs.**	**CO**
	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.	3	CO3
UNIT-IV	**ENERGY EFFICIENCY IN INDUSTRIAL SYSTEMS**	**Hrs.**	**CO**
	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.	3	CO4

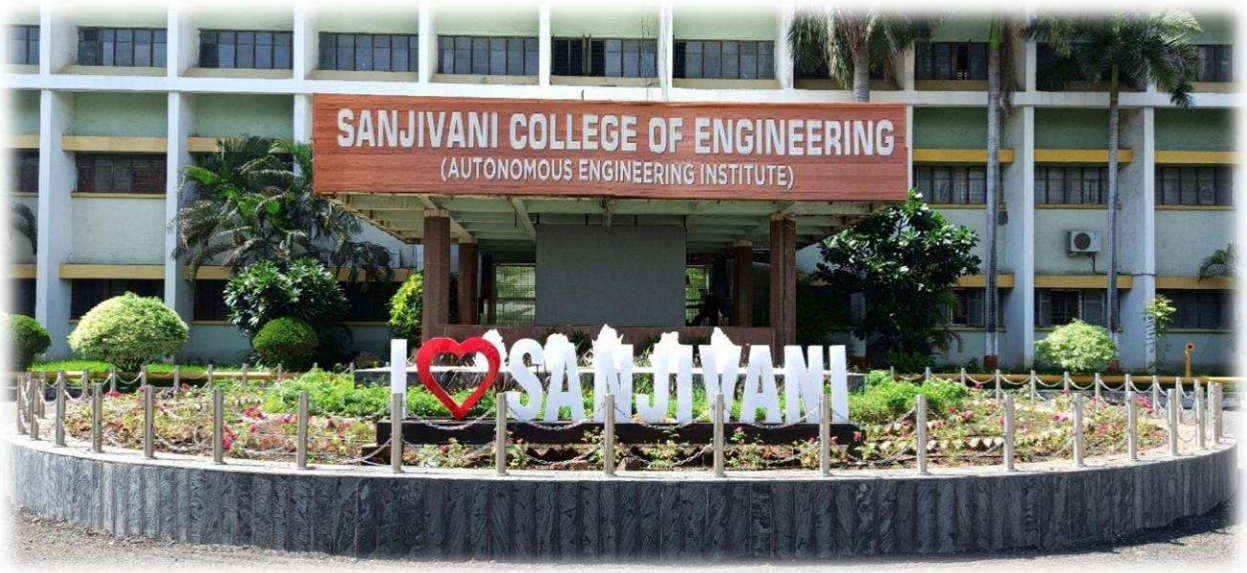
Text Books:
[T1] Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects (available online) [T2] Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-3, Electrical Utilities (available online) [T3] S. C. Tripathy, "Utilization of Electrical Energy and Conservation", McGraw Hill, 1991. [T4] Success stories of Energy Conservation by BEE, New Delhi (www.bee-india.org)
Reference Books:
[R1] W C Turner and Steve Doty: Energy Management Handbook, Seventh Edition,(Fairmont Press Inc., 2007) [R2] Sumper Andreas and Baggini Angelo: Electrical Energy Efficiency: Technologies and applications (John Wiley 2012) [R3] Frank Kreith: Handbook on Energy Efficiency and Renewable Energy (CRC Press, 2007) [R4] George Polimeros: Energy Cogeneration Handbook (Industrial Press, Inc., New York, 1981)
E-references:
[E1] National Productivity Council(http://www.npcindia.gov.in) [E2] Bureau of Energy Efficiency (https://www.beeindia.gov.in) [E3] Petroleum Conservation Research Association (https://www.pcra.org)

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 - 2021 PATTERN

THIRD YEAR B. TECH

Academic Year 2023-24

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- 2021 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	ESE	CIA	OR	PR	TW	Total
PCC	EE301	Microcontrollers And Applications	3	-	-	3	60	40	-	-	-	100
PCC	EE302	Electrical Machines II	3	-	-	3	60	40	-	-	-	100
PCC	EE303	Power System II	3	-	-	3	60	40	-	-	-	100
PCC	EE304	Power Electronics	3	-	-	3	60	40	-	-	-	100
PEC	EE305	Professional Elective-I **A.** Renewable Energy Sources **B.** Smart Grid **C.** Industry 4.0	3	-	-	3	60	40	-	-	-	100
LC	EE306	Microcontrollers And Applications Laboratory	-	-	2	1	-	-	25	-	-	25
LC	EE307	Electrical Machines II Laboratory	-	-	2	1	-	-	-	50	-	50
LC	EE308	Power System II Laboratory	-	-	2	1	-	-	25	-	-	25
LC	EE309	Power Electronics Laboratory	-	-	2	1	-	-	-	25	-	25
HSMC	HS310	Corporate Readiness-II	-	-	2	1	-	-	-	-	25	25
HSMC	HS311	Seminar & Communication Skills	-	-	4	2	-	-	-	-	50	50
MLC	MC312	Mandatory Learning Course-V **A.** Electrical Energy Conservation and Auditing	1	-	-	Non Credit	-	-	-	-	-	Pass/ Fail
		Total	**16**	**-**	**14**	**22**	**300**	**200**	**50**	**75**	**75**	**700**

COURSE STRUCTURE- 2021 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	CIA	OR	PR	TW	Total
PCC	EE313	Power System Operation and Control	3	-	-	3	60	40	-	-	-	100
PCC	EE314	Feedback Control Systems	4	-	-	4	60	40	-	-	-	100
PCC	EE315	Computer Aided Electrical Machine Design	3	-	-	3	60	40	-	-	-	100
PROJ	PR316	IPR & EDP	2	-	-	2	30	20	-	-	-	50
PEC	EE317	Professional Elective-II A. Electrical Drives B. Utilization of Electrical Energy C. PLC and SCADA D. Building automation and Control	3	-	-	3	60	40	-	-	-	100
LC	EE318	Power System Operation and Control Laboratory	-	-	2	1	-	-	25	-	-	25
LC	EE319	Feedback Control Systems Laboratory	-	-	2	1	-	-	-	50	-	50
LC	EE320	Computer Aided Electrical Machine Design	-	-	2	1	-	-	25	-	-	25
PROJ	PR321	Mini Project	-	-	2	1	-	-	-	-	25	25
HSMC	EE322	Creational Activity	-	-	2	1	-	-	-	-	25	25
MLC	MC323	Mandatory Learning Course-VI A.Professional Leadership Skills	-	-	2	Non Credit	-	-	-	-	-	Pass/Fail
		Total	**14**	**1**	**10**	**20**	**270**	**180**	**50**	**50**	**50**	**600**

SEMESTER VI

EE313: POWER SYSTEM OPERATION AND CONTROL

Teaching Scheme		**Examination Scheme**	
Lectures:	**3 Hrs./Week**	**Continuous Internal Assessment:**	**40 Marks**
Tutorial:	**---**	**End-Sem Exam:**	**60 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	Analyze
CO2	Suggest the appropriate method of reactive power generation and control	3	Apply
CO3	Select the appropriate device of FACTS Technology in power System	3	Apply
CO4	Analyze the generation-load balance in real time operation and its effect on frequency and develop automatic control strategies with mathematical relations.	5	Evaluate
CO5	Formulate objective functions for optimization tasks such as unit commitment and economic load dispatch and get solution using computational techniques.	5	Evaluate
CO6	Gain knowledge on the need of real time system functions.	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	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-point of swing equation, Multi-machine 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 hydro-power plant, plant scheduling method, equal incremental cost method, method of Lagrange multiplier (neglecting transmission losses), B_{mn} 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, ISBN-13: 978-8120340152

[T2] J. Nagrath, D. P. Kothari, "Modern Power System Analysis", 4th Edition, Tata McGraw Hill Publishing Co. Ltd., ISBN-13: 978-0071077750

[T3] P. S. R. Murthy, "Operation & Control in Power System", 2nd Edition, B. S. Publications, ISBN: 978-81-7800-200-2

[T4] Allen J. Wood, Bruce F. Wollenberg "Power Generation, Operation, and Control", Wiley India Edition, ISBN-13: 978-0471586999

[T5] P. Kundur, “Power System Stability and Control”, Tata McGraw Hill Publishing Co. Ltd., ISBN-13: 978-0070635159

References:

[R1] N.V.Ramana, Power system operation and control, Pearson Editions, ISBN-13: 978-8131755914
[R2] S. Sreenivasan, G. Sivanagaraju, Power System Operation and Control , Pearson Editions, ISBN-13: 978-8131726624
[R3] Narain G. Hingorani, Laszlo Gyugyi, “Understanding FACTs” IEEE Press, ISBN-13: 978-0780334557

E-references:-

[E1] https://nptel.ac.in/courses/108101040
[E2] https://nptel.ac.in/courses/108104052
[E3] https://nptel.ac.in/courses/108105104
[E4] https://freevideolectures.com/course/2354/power-systems-operation-and-control
[E5] https://onlinecourses.nptel.ac.in/noc23_ee128/preview

EE314: FEEDBACK CONTROL SYSTEMS

Teaching Scheme	**Examination Scheme**	
Lectures: 04 Hrs./Week	**Continuous Assessment:**	**40 Marks**
Tutorial: --- Hr./Week	**End Sem Exam:**	**60 Marks**
Credits: 4	**Total:**	**100 Marks**

Prerequisite Course:

1. Knowledge of circuits, analog electronics and Power electronics.
2. Basic of engineering mathematics, complex variables and laplace transform.

Objectives: The course aims: -

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	Characterize any system in Laplace domain to illustrate different specification of the system using transfer function concept.	2	Understand
CO2	Identify a set of algebraic equations to represent a complicated system into a more simplified form.	3	Apply
CO3	Interpret the time domain response analysis for various types of inputs	2	Understand
CO4	Construct the root loci to obtain Frequency Response.	3	Apply
CO5	Explain different types of analysis in frequency domain and the nature of stability of the system	2	Understand
CO6	Describe the system response and stability of systems in state space form	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	3	2	2	1	1	-	-	-	2	1	-	-	1	-
CO2	3	2	2	1	1	-	-	-	-	1	-	-	1	-
CO3	3	2	2	1	1	-	-	-	-	1	-	-	1	-
CO4	3	3	2	2	2	-	-	-	1	1	-	1	2	-
CO5	3	2	1	1	1	-	-	-	1	1	-	1	1	-
CO6	3	3	3	1	1	-	-	-	-	1	-	1	1	-

Course Contents			
UNIT-I	**MODELLING OF PHYSICAL SYSTEMS**	**No. of Hours**	**COs**
	Laplace transform review - open loop and closed loop systems - differential equations - transfer function - electric network transfer function - modelling of translational mechanical and rotational mechanical system - electro-mechanical system transfer function - electrical circuit analogy.	06	CO1
UNIT-II	**CONVENTIONAL REDUCTION TECHNIQUES**	**No. of Hours**	**CO**
	Block diagrams algebra - block diagram of a closed loop system - multiple input mutiple output systems - block diagram reduction - feedforward compensation - signal flow graphs - mason's gain formula - time domain to s-domain representation	06	CO2
UNIT-III	**TIME RESPONSE AND STABILITY ANALYSIS**	**No. of Hours**	**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 - Relative stability analysis.	06	CO3
UNIT-IV	**ROOT LOCUS TECHNIQUES**	**No. of Hours**	**CO**
	Introduction - root locus concepts - root locus technique - root locus plots - rules for constructing root-loci - root locus analysis for control systems - root loci for systems with transport lag	06	CO4
UNIT-V	**FREQUENCY RESPONSE TECHNIQUES**	**No. of Hours**	**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.	06	CO5
UNIT-VI	**INTRODUCTION TO STATE SPACE ANALYSIS**	**No. of Hours**	**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	06	CO6

Text Books:

1. J. Nagrath, M. Gopal, "Control System Engineering", New Age International Publishers, 5th edition, 2015, ISBN-13 : 978-8122420081 **(Library Slot No: 621.381.1 NIS-TB-45989)**
2. Norman S Nise, "Control Systems Engineering", Wiley, 2019, ISBN: 978-1-119-47422-7

References:

1. Katsuhiko Ogata, "Modern control system engineering", Prentice Hall Pearson, 5th edition, 2010 (ISBN 10: 0-13-615673-8)
2. Benjamin C. Kuo, "Automatic Control System", 9th edition, Wiley, 2014 (ISBN: 9788126513710, 9788126513710)
3. M Gopal, "Control Systems: Principles and Design", McGraw Hill Education, 2012. (ISBN: 9780071333269, 0071333266)
4. Control Systems Engineering by A. Nagoor Kani, 2nd edition RBA Publications. (ISBN: 9789389239003, 9789389239003)

E-References:

1. https://nptel.ac.in/courses/107106081 (NPTEL Video Lecture Notes on "Control Engineering" by Professor C.S.Shankar Ram, IIT Madras)
2. https://lpsa.swarthmore.edu/ (Matlab)

EE315: COMPUTER AIDED ELECTRICAL MACHINE DESIGN

Teaching Scheme	**Examination Scheme**
Lectures: 03 Hrs./Week	**Continuous Assessment: 40 Marks**
Tutorial: --- Hrs./Week	**End-Sem Exam: 60 Marks**
Credits: 03	**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 select proper commercial materials for Electrical Machine design and acknowledge with fundamentals of ANSYS.
2. To design a transformer.
3. To determine parameters of the transformer.
4. To design Induction motor.
5. To determine parameters of an Induction motor.
6. To apply computer aided optimization techniques for 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 to design of single phase and three phase transformer.	3	Applying
CO3	Calculate the design parameters of transformer.	3	Applying
CO4	Calculate main dimensions to design of three phase Induction motor.	3	Applying
CO5	Calculate the design parameters of three phase Induction motor.	3	Applying
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	2	2	2	2	1	1	1	1	-	1	1	2	2
CO2	3	2	2	2	2	1	1	1	1	-	1	1	2	2
CO3	3	2	2	2	2	1	1	1	1	-	1	1	2	2
CO4	3	2	2	2	2	1	1	1	1	-	1	1	2	2
CO5	3	2	2	2	2	1	1	1	1	-	1	1	2	2
CO6	3	2	2	2	3	1	1	1	1	-	2	1	3	3

Course Contents			
UNIT I:	**FUNDAMENTALS OF ANSYS AND CHALLENGES TO ELECTRICAL MACHINE DESIGN**	**Hrs.**	**CO**
	A] **FUNDAMENTALS OF ANSYS:** Introduction to ANSYS, structural and thermal overview, ANSYS solution and post-processing, Finite Element Equations, uses of commands in ANSYS and graphical user interface (GUI) [3 Hrs] B] **CHALLENGES TO ELECTRICAL MACHINE DESIGN:** Transformers and three phase induction motors - specifications, types, constructional features, conducting, magnetic and insulating materials, heating and cooling in electrical machines. [3 Hrs]	6	CO1
UNIT II:	**TRANSFORMER DESIGN (PART I)**	**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.	6	CO2
UNIT III:	**TRANSFORMER DESIGN (PART II)**	**Hrs.**	**CO**
	Estimation of no-load current, losses, efficiency and regulation of transformer, 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.	6	CO3
UNIT IV:	**INDUCTION MOTOR DESIGN (PART I)**	**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, squirrel cage and wound rotor design.	6	CO4
UNIT V:	**INDUCTION MOTOR DESIGN (PART II)**	**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, performance calculations - losses, efficiency, temperature rise, maximum torque from circle diagram.	6	CO5
UNIT VI:	**COMPUTER AIDED DESIGN (CAD) OF ELECTRICAL MACHINES**	**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.	6	CO6

Text Books:

[T1] Erdogan Madenci and Ibrahim Guven-The Finite Element Method and Applications in Engineering Using ANSYS, Springer (ISBN:9788184897463 and SCOEK Library Accession No. 70461)
[T2] A.K.Sawhney – A Course in Electrical Machine Design, 10th Edition, - Dhanpat Rai and sons New Delhi. (ISBN: 978-81-7700-101-3 and SCOEK Library Accession No. 65058, 65059)
[T3] R. K. Agarwal – Principles of Electrical Machine Design, S. K.Katariya and Sons. (ISBN: 978-93-80027-12-8 and SCOEK Library Accession No. 64134, 64135)
[T4] M.G. Say – The Performance and Design of A.C. Machines, 3rd Edition, CBS Publishers & Distributors Pvt. Ltd. (ISBN: 81-239-1027-4 and SCOEK Library Accession No. 64080)
[T5] Prof. Sham Tickoo – AutoCAD 2021 for Engineers and Designers (ISBN: 978-93-8998-97-2) and SCOEK Library Accession No. 64570 , 64571)

References:

[R1] CADD Centre India-ANSYS Reference Guide (SCOEK Library Accession No. 0024404)
[R2] K. G. Upadhyay- Design of Electrical Machines, New age International (P) Limited, Publishers London (ISBN:978-81-224-2282-5, and SCOEK Library Accession No. 64876)
[R3] Indrajit Dasgupta – Design of Transformers, Mc Graw Hill Education (ISBN-13:978-0-07-043640-4 and SCOEK Library Accession No. 64309)

[R4] T. A. Lipo, "Introduction to AC Machine Design", IEEE Press – Wiley Publications, 2017.
[R5] J. R. Hendershot and T. J. E. Miller, "Design of Brushless Permanent – Magnet Motors", Motor Design Books LLC, 2nd edition, 2010.
[R6] J. Pyrhonen, T. Jokinen, and V. Hrabovcova, "Design of Rotating Electrical Machines", John Wiley and Sons Inc., 2nd edition, 2013.
[R7] R. Krishnan, "Switched Reluctance Motor Drives", CRC Press LLC, USA, 2001.
[R8] SHANMUGASUNDARAM A ELECTRICAL MACHINE DESIGN DATA BOOK / ASHANMUGASUNDARAM ; 2nd ed. ; Vol. ; : NEW AGE, 2015 (SCOEK Library Accession No. 64876, 64877, 64878 and 64879)

E-References

[1] https://onlinecourses.nptel.ac.in/noc23_ee140
[2] https://onlinecourses.nptel.ac.in/noc24_ee50

PR316: INTELLECTUAL PROPERTY RIGHTS AND ENTREPRENEURSHIP DEVELOPMENT	
Teaching Scheme	**Examination Scheme**
Lectures: 02 Hrs./Week	**Continuous Assessment: 20 Marks**
	End-Sem Exam: 30 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 • Registration procedure of Copyrights • Infringement (piracy) of Copyrights and Remedies • Copyrights over software and hardware	04	CO4

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 6.4 **Case Studies of Successful Entrepreneurs**	04	CO6

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.

EE317A: ELECTRICAL DRIVES

Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs./Week	**Continuous Assessment:**	**40 Marks**
Tutorial: --- Hr./Week	**End-Sem Exam:**	**60 Marks**
Credits: 03	**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.
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	Analyze
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	Analyze

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.**	**CO1**
	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**	**CO1**
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**	**CO2**
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**	**CO3**
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**	**CO4**
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**	**CO5**
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**	**CO6**

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 HillAustin Huges, “Electrical motor and drives: Fundamental, types and applications”, Heinemann Newnes, London
[R4] Tyagi MATLAB for engineers oxford (Indian Edition)

EE317B: UTILIZATION OF ELECTRICAL ENERGY

Teaching Scheme	**Examination Scheme**
Lectures: 03 Hrs./Week	**Continuous Assessment: 40 Marks**
Tutorial: --- Hr/Week	**End-Sem Exam: 60 Marks**
Credits: 03	**Total: 100 Marks**

Prerequisite Course:

1. Basic Electrical and Electronics Engineering
2. Electrical Technology
3. Effects of electric current
4. Chemical reactions in electrolyte
5. Control circuit design basics, awareness about artificial lighting, refrigeration, air conditioning
6. Characteristics and application of different electric motors, awareness about traction

Course Objectives

1. Ensure that the knowledge acquired can be applied in various fields such as electric heating, illumination, chemical processes, and electric traction.
2. Make the students aware about the importance of maximizing the energy efficiency by optimum utilization of electrical energy.
3. Develop ability amongst the students to design -heating element for resistance furnaces and design- illumination schemes. To develop ability amongst the students to analyze the performance of arc furnaces, electric traction, different sources of light, illumination schemes.
4. Know how about Refrigeration, Air Conditioning.
5. Know about electrochemical processes and applications of these in practical world, modern welding techniques.

Course Outcomes (COs):

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

	Course Outcome (s)	**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Get knowledge of principle of electric heating, welding and its applications.	2	Understanding
CO2	Understand electrochemical process, electrical circuits used in refrigeration, air conditioning	2	Understanding
CO3	Design different illumination schemes to save energy	3	Applying
CO4	Understand various equipment's and accessories of traction system	2	Understanding
CO5	Calculate tractive effort, power, acceleration and velocity of traction	3	Applying
CO6	Analyse electric braking methods, control of traction motors, train lighting system	4	Analysis

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	2	3	2	2	1	-	1	3	2	1
CO2	3	2	2	2	2	2	1	1	1	-	1	3	3	1

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
CO3	3	2	3	2	2	2	3	2	1	-	2	3	3	1
CO4	3	2	2	2	2	2	1	-	1	-	1	3	3	3
CO5	3	2	2	2	2	2	1	2	1	-	1	3	3	2
CO6	3	3	3	2	2	2	2	2	2	1	2	3	2	2

Course Contents			
UNIT-I	**ELECTRIC HEATING**	**Hrs**	**COs**
	Modes of heat transfer, mathematical expressions Electric heating: Introduction to electric heating, Advantages of electrical heating Heating methods: - Resistance heating – Direct resistance heating, indirect resistance heating, electric ovens, different types of heating element materials, temperature control of resistance furnaces, and design of heating element (Numerical) Applications of resistance heating Induction heating : Principle, core type and coreless induction furnaces, Ajax Wyatt furnace, Numerical on melting furnaces Applications of induction heating Electric arc heating – Direct and indirect arc heating, types of arc furnaces, equivalent circuit of arc furnace, condition for maximum output, power factor at maximum output (Numerical), Heat control in arc furnace, Applications of arc heating Dielectric heating –Principle, choice of voltage and frequency for dielectric heating (Numerical), Applications of dielectric heating Electric Welding -Welding methods –Electric arc welding and resistance welding, Equivalent circuit of arc furnace (Numerical) Modern welding techniques like ultrasonic welding and laser welding	8	CO1
UNIT-II	**ELECTROCHEMICAL PROCESS**	**Hrs.**	**CO**
	Need of electro-deposition. Applications of Faraday's laws in electro-deposition. Factors governing electro-deposition. Objectives of electroplating. Equipment's and accessories for electroplating plant, Electroplating on non-conducting materials, Principle of anodizing and its applications Electrical Circuits Used in Refrigeration, Air Conditioning Brief description of vapour compression refrigeration cycle. Description of electrical circuits used in Refrigerator, Air Conditioner	6	CO2
UNIT-III	**ILLUMINATION**	**Hrs.**	**CO**
	Definitions of luminous flux, solid angle, luminous intensity, illumination, luminous efficacy, depreciation factor, coefficient of utilization, space to height ratio, reflection factor; Laws of illumination. Design of illumination schemes-Factors to be considered for design of illumination scheme, Calculation of illumination at different points, considerations involved in simple design problems for indoor installation, illumination schemes, standard illumination level. Natural day light illumination (brief information)	6	CO3

	Different sources of light: Incandescent lamp, fluorescent lamp, comparison between them. Incandescent and discharge lamps – their construction and characteristics; mercury vapour lamp, sodium lamp, halogen lamp, compact fluorescent lamp, metal halide lamp, neon lamps, LEDs, LASERs; comparison of all above luminaries.		
UNIT-IV	**ELECTRIC TRACTION**	**Hrs.**	**CO**
	Traction systems - Steam engine drive, electric drive, diesel electric drive, types of diesel locomotives, Advantages of electric traction Systems of track electrification: D.C. system, single phase low frequency A.C. system, 3 phase low frequency A.C. systems, composite systems – kando systems, single phase A.C. to D.C. system Different accessories for track electrification -overhead wires, conductor rail system, current collector Electric locomotive- Block diagram with description of various equipment and accessories. Details of major equipment in traction substation-transformer, circuit breaker, interrupter	6	CO4
UNIT-V	**TRACTION MECHANICS**	**Hrs.**	**CO**
	Types of services- Urban, Sub-urban, Main line Speed time curves, trapezoidal and quadrilateral speed-time curves, average and schedule speed (Numerical), Tractive effort. Specific energy consumption. Factors affecting specific energy consumption (Numerical), Mechanics of train movement, coefficient of adhesion (Numerical).	6	CO5
UNIT-VI	**CONTROL OF TRACTION MOTORS AND TRAIN LIGHTING**	**Hrs.**	**CO**
	Desirable characteristic of traction motors. Suitability of D.C. series motor, A.C. series motor, 3 phase induction motor and linear induction motor for traction. Control of traction motors -Series-parallel control, Shunt and bridge transition (Numerical), Electrical breaking, Regenerative breaking in traction, Suitability of different motors for braking. Train lighting system.	6	CO6

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[T1] J.B. Gupta, 'Utilization of Electric Power and Electric Traction', S.K. Kataria and sons, Delhi
[T2] E. O. Taylor 'Utilization of Electrical Energy' – Revised in S.I. Units by V.V.L. Rao, Orient Longman
[T3]C. L. Wadhwa, 'Generation, Distribution and Utilization of Electrical Energy', Eastern Wiley Ltd.

References:

[R1] 'Modern Electric Traction' by H. Partab, Dhanpat Rai and Co. (P) Ltd –Delhi
[R2] 'Electrical Powers' S. L. Uppal, Khanna Publication
[R3] 'Generation and Utilization of Electrical Energy' S. Sivanagaraju, M. Balsubba Reddy, D. Srilatha (Pearson)

E-References

[1] https://nptel.ac.in/courses/108105060
[2] https://archive.nptel.ac.in/courses/108/105/108105060/
[3] https://nptel.ac.in/courses/108104140

EE317C: PLC & SCADA

Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs./Week	**Continuous Assessment:**	**40 Marks**
Tutorial: --- Hr./Week	**End-Sem Exam:**	**60 Marks**
Credits: 3	**Total:**	**100 Marks**

Prerequisite Course:

1. Basic knowledge of Electronics and Computer
2. Basic knowledge of sensors and power supply
3. Basic concept of control system.

Course Objectives

1. Understand Automation & System Overview
2. Understand Different functionalities of PLC
3. Understanding of the Features of SCADA
4. Communicate between PLC and SCADA.

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 fundamentals of Industrial Automation	2	Understanding
CO2	Develop Ladder Program using basic & advanced PLC instructions	3	Applying
CO3	Illustrate and analyze complex control systems efficiently using PLC	4	Analyze
CO4	Apply troubleshooting techniques for efficient PLC operation.	3	Applying
CO5	Interface PLC to Hydraulic and Pneumatic Devices	3	Applying
CO6	Infer the fundamentals of SCADA system & its Applications	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	2	3	3	3	2	-	-	2	3	3	3	3
CO2	3	3	3	3	3	2	-	-	-	3	2	1	3	3
CO3	3	3	3	3	3	2	-	-	-	3	2	2	3	3
CO4	3	3	2	3	3	2	-	-	-	2	1	1	3	3
CO5	2	2	2	1	2	2	-	-	-	2	1	-	3	3
CO6	3	3	3	3	3	2	-	-	-	2	2	3	3	3

Course Contents			
UNIT-I	**Introduction to Automation and PLC**	**Hrs.**	**CO 1**
	Need & Role of Automation, Types of Industrial Automation System,Definition & History of PLC, Basic structure & Components of PLC, Principle of Operation, Selection of PLC, PLC I/O Modules, Memory, PLC advantages & Disadvantages, What is Logic? Overview of Logic functions, Number systems & Codes, Hardwired Logic vs Programmed logic.	**06**	**CO 1**
UNIT-II	**PLC Programming-I**	**Hrs.**	**CO**
	PLC Programming languages,Processor memory organization,, Ladder diagrams, Relays, contactors, switches, sensors, output control devices, latching relays,Ladder diagram elements. PLC input/output instructions, adder diagram fundamentals, proper construction of ladder diagram, basic components and their symbols in ladder diagram,Development of Relay ladder logic, Ladder programming for logic gates & Boolean algebra,Ladder diagram for Process Control, Develop a PLC ladder logic diagram,Programming equipment, Various techniques,Necessity of Analog input, output interface to PLC.	**08**	**CO 2**
UNIT-III	**PLC Programming -II**	**Hrs.**	**CO**
	PLC Timer & Counter functions, Timer & Counter Industrial applications,Arithmetic functions,Comparison functions, Jump functions, Data handling functions, Digital Bit functions, PLC matrix Functions, Advanced PLC Functions: Analog PLC operation, Comparison & Math operations,Shift Register & Sequencer instructions. Applications using Advanced PLC Programming instructions. Interfacing of Input and Output devices with PLC. Sourcing & sinking, Classification of input & output modules,Programming ON/OFF Inputs to produce ON/OFF outputs. Analog PLC operation, PID controller	**08**	**CO 3**
UNIT-IV	**PLC Installation,Communication & Troubleshooting**	**Hrs.**	**CO**
	Consideration of operating environment, Receiving test, check & assembly, Electrical Noise, Leaky inputs & outputs, Grounding, voltage variations & surges, Circuit protections & wiring, Program Editing & Commissioning. Troubleshooting: Processor module, Input & Output malfunctions, Ladder logic program. PLC Maintenance,Overview, of Siemens PLC, Allen Bradley PLC, Schneider Electric PLC, Omron PLC, Mitsubishi PLC & GE FANUC.Types of communication interface, Types of networking channels, Data Communications, Serial communication, Industrial network : CAN (Controller area network), DeviceNet, ControlNet, EtherNet/IP, Modbus, Fieldbus, Profibus-PA/DP.	**08**	**CO 4**
UNIT-V	**Interfacing PLC to HMI, Hydraulic, Pneumatic (07)**	**Hrs.**	**CO**
	Describe fundamentals of process control,Need of HMI, Advantages of using HMI, PLC Interfacing to Hydraulic & Pneumatic circuits. Interfacing of VFD to PLC,Interfacing of I/O devices to PLC	**06**	**CO 5**

UNIT-VI	Supervisory Control & Data Acquisition (SCADA)	Hrs.	CO
	General definition & SCADA Components. Need of SCADA system, application & benefits, Communications in SCADA- types & methods used,Future trends,SCADA display system, Comparison of different SCADA packages. Trending, Historical data storage & Reporting, Alarm management. Programming techniques for: Creation of pages, Sequencing of pages, Creating graphics & Animation & Development of application using SCADA System.	**06**	**CO 6**

Text Books:

[T1] Programmable Logic Controllers, Frank D. Petruzella, McGraw-Hill Education, Sixth Edition. ISBN 13: 9781264163342
[T2] Gary Dunning, "Introduction to Programmable Logic Controllers", Thomson, 2nd Edition ,1998,ISBN 0827378661
[T3] John W. Webb, Ronald A. Reis, "Programmable Logic Controllers: Principles and Application", 3rd Edition 1995 ISBN 002424980
[T4] Ronald L. Krutz, "Securing SCADA System", Wiley Publishing 2015,ISBN no 978-0764597879

References:

[R1]Programmable logic controllers & Industrial Automation- Madhuchandra Mitra, Samarjeet Sen Gupta Penram International Pvt. Ltd., Fourth reprint, 2012,ISBN NO 978-8187972631
[R2] Programmable Logic Controllers, W. Bolton, Elsevier, Fourth Edition,2015 ISBN-13 : 978-0750681124

E-References

[E1] https://onlinecourses.nptel.ac.in/noc24_ee56/course

EE317D: Building Automation & Control

Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs./Week	**Continuous Assessment:**	**40 Marks**
Tutorial: --- Hr./Week	**End-Sem Exam:**	**60 Marks**
Credits: 1	**Total:**	**100 Marks**

Prerequisite Course:

1. Basics of Electronics and Instrumentation.
2. Basics of Heating Ventilation and Air conditioning.
3. Basic concept Energy Audit and Management basics of Internet of Things.

Course Objectives

Students will be

1. Able to understand basic concept of building automation.
2. Learn to create safe, secure, comfortable, healthy, and sustainable environment in buildings
3. Learn to bring energy efficiency in building systems.
4. Learn the concept of Smart homes and basics of Internet of Things.

Course Outcomes (COs):

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

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Infer the basic operation and components of Heating, ventilation and Air Conditioning (HVAC) system.	2	Understanding
CO2	Design different types of boilers, chillers.	3	Applying
CO3	Construct Smart infrastructure using Internet of Things.	3	Applying
CO4	Develop the safety system for Residential, commercial & Industrial Buildings.	3	Applying
CO5	Prepare an Energy Audit report of any system.	3	Applying
CO6	Calculate the performance Energy efficiencies of any system.	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	-	-	-	-	-	-	2	-	-
C02	3	1	2	-	1	-	-	-	-	-	-	1	1	1
CO3	3	2	2	2	2	-	-	-	-	-	-	3	1	1
CO4	3	2	2	2	2	-	-	-	-	-	-	3	2	1
CO5	3	2	3	2	2	-	-	-	-	-	-	3	2	2
CO6	3	2	2	2	2	-	-	-	-	-	-	3	2	2

Course Contents			
UNIT-I	**Building Automation Systems**	**Hrs.**	**CO 1**
	Intelligent buildings, its's architecture and structure, Evolution of intelligent buildings. Facilities management vs. intelligent buildings, Lifecycle of building, BAS System Hierarchy – Field level components, Direct Digital Control (DDC), Supervisory, Controller, Server, Operator Workstation (OWS) Different systems in BAS which includes HVAC, security, fire, lighting systems. Importance of each system in BAS, Process of BAS design, Role of different stakeholders (Architect, contractor, consultant, application engineer and engineer) in BAS system design, BAS communication protocols and addressing concepts – BACnet and LON	**06**	**CO 1**
UNIT-II	**Heating Ventilation and Air Conditioning**	**Hrs.**	**CO**
	Refrigeration cycle: Working, mechanical configuration of different types of components used in refrigeration cycle - evaporator, condenser, compressor, expansion valve. **Chilled water system:** Design, different types of chilled water systems - single chiller system, series chiller system, parallel chiller system. Working of different components of chilled water system - decoupler line, bypass line, primary circuit, secondary circuit, and condenser pumps. **Hot Water Systems:** Working and design of different types of boilers- fire tube, water tube, packaged boiler. **Air Handling Units:** Concept of Air handling unit. Design, working of different components in AHU - damper, filter, cooling coil, heating coil, fan, heat recovery wheel, humidifier. Concept of Air handling unit. Design, working of different components in AHU - damper, filter, cooling coil, heating coil, fan, heat recovery wheel, humidifier. **Variable Air Volume (VAV) system:** Design, working, use of different types of VAV- CAV, cooling only, with reheat.	**06**	**CO 2**
UNIT-III	**Internet of Things**	**Hrs.**	**CO**
	What is IoT – History, Overview, Definition, Architecture and Application, Technical Building blocks of IoT, Device, Communication Technologies, Data, Physical design of IoT, IoT Issues and Challenges- Planning, Costs and Quality, Security and Privacy, Risks, Case Studies Smart Home: Characteristics of Smart Home - Smart Home Energy Management, Smart Appliances, Communication Technologies for Smart Homes, maintenance, security, challenges. operation, PID control of continuous processes, simple closed loop systems, problems with simple closed loop systems, closed loop system using Proportional, Integral & Derivative (PID), PLC interface, and Industrial process example.	**06**	**CO 3**

UNIT-IV	**Fire Alarm System, Fire Detection and Access Control**	**Hrs.**	**CO**
	What is Fire? Fire alarm System-The History, FAS architecture & operation, Classification of Fire Alarm System, Conventional and Addressable Fire Alarm System, Important Codes-NFPA72, IS 2189, BS 5839,FAS Loops-Classification of Loops and Example, Network terminology for Fire Systems, Classification of Cables, Class of Cables, Types, and distance Supported specific to fire alarm system ,Working Principles of Fire Alarm devices and its working Application in building safety, Basic Concept of Access Control System it's benefits & architecture ,Secure and Non-Secure Concept, Basic of CCTV system, System Architecture of CCTV System.	**06**	**CO 4**
UNIT-V	**Energy Management and Audit**	**Hrs.**	**CO**
	Definition and Objectives of Energy Management, Definition and need for Energy Audit., Types of Energy Audits and Approach: Preliminary, Targeted, Detailed Audits, Energy Audit Report, Understanding energy Costs. Energy Performance: Plant Energy Performance, Production Factor Maximizing System Efficiencies., Optimizing Input Energy Requirement, Instruments and Metering for Energy Audit.	**06**	**CO 5**
UNIT-VI	**Energy Efficiency in HVAC and Refrigeration systems**	**Hrs.**	**CO**
	Selection of a Suitable Refrigeration system , Performance Assessment of Refrigeration Plants, Factors Affecting Performance & Energy Efficiency of Refrigeration Plants ,Performance Assessment of window Split and package air conditioning units, Energy Efficiency Ratio, Energy Saving Opportunities: Cold Insulation, Building Envelope, Building Heat Loads Minimization, Process Heat Loads Minimization and At the Refrigeration A/C Plant Area, Building Energy Management System , Star Rating of Buildings: Energy Performance Index, Energy Efficiency Measures in Buildings: For Air-Conditioning System and Lighting System.	**06**	**CO 6**

Text Books:

[T1] Robert Gagnon, Design of Special Hazards and Fire Alarm Systems, Second edition, Thomson Delmar Larning, ISBN NO 1418039500.
[T2] Montgomery R, Fundamentals of HVAC Control Systems, first edition, Elsevier Publications ISBN: 0080915132.
[T3] Roger W.Haines "HVAC Systems Design Handbook", Fifth Edition, McGraw Hill, ISBN NO 978-0071622974.
[T4] Arshdeep Bahga "Internet of Things: A Hands-On Approach" First Edition, Orient Black Swan Private Limited - New Delhi ISBN NO 8173719543.

References:

[R1] Herbert W Stanford, Chillers Basics, Indian Society of Heating, Refrigerating & Air Conditioning Engineers, First edition, Kindle publication, ISBN NO 1439862028.
[R2] Amlan Chakrabarti Energy engineering and management, second edition Kindle publication, ASIN B07WLDQQY2.

EE318: POWER SYSTEM OPERATION AND CONTROL LABORATORY

Teaching Scheme		**Examination Scheme**	
Lectures:	**-- Hrs./Week**	**Oral:**	**25 Marks**
Practical:	**02 Hrs./Week**	**Term Work:**	**-- Marks**
Credits:	**01**	**Total:**	**25 Marks**

Prerequisite Course:

1. Basics of Power System.
2. MATLAB Programming & Simulink.

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	Solve the Swing equation for analyzing the power system stability	3	Applying
CO2	Study and apply equal area criteria for stability analysis	3	Applying
CO3	Study reactive power compensation using simulation of TCR or TCSC and plot exact dynamic response of two area load frequency control without integral action	3	Applying
CO4	Model two area network for evaluating transient stability and IEEE excitation system, turbine and governor system	3	Applying
CO5	Apply the optimum loading of generators considering transmission losses (penalty factor) along with Economic Dispatch using Lambda iteration method	3	Applying
CO6	Observe the effect of midpoint reactive power compensation on voltage through some compensating devices	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	3	1	3	3	-	-	-	3	2	1	3	3	3
CO2	3	3	1	3	3	-	-	-	3	2	1	3	3	3
CO3	3	3	1	3	3	-	-	-	3	2	1	3	3	3
CO4	3	3	1	3	3	-	-	-	3	2	1	3	3	3
CO5	3	3	1	3	3	-	-	-	3	2	1	3	3	3
CO6	1	2	1	1	-	-	-	-	3	1	1	3	1	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	**CO2**
3	To apply equal area criteria for analysis stability under a sudden rise in mechanical power input.	2	CO2
4	To study reactive power compensation using simulation of TCR or TCSC.	2	**CO3**
5	To plot exact dynamic response of two area load frequency control without integral action.	2	CO3
6	Simulink model for two area load frequency control with integral action.	2	**CO4**
7	Simulink model for evaluating transient stability of single machine connected to infinite bus	2	CO4
8	Modelling of IEEE excitation system, turbine and Governor system	2	**CO4**
9	Economic Dispatch using Lambda iteration method	2	CO5
10	To study the optimum loading of generators considering transmission losses (penalty factor)	2	**CO5**
11	To observe the effect of midpoint reactive power compensation on voltage through static var compensator (SVC) and static synchronous compensation (STATCOM)	2	**CO6**
12	MATLAB Program to Solve Swing Equation using Point-by-Point Method	2	CO1
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, ISBN 9781498797214. [T2] Abhijit Chakrabarti, Sunita Halder, "Power System Analysis Operation and Control", Prentice Hall of India, ISBN-13: 978-8120340152. [T3] J. Nagrath, D. P. Kothari, "Modern Power System Analysis", 4th Edition, Tata McGraw Hill Publishing Co. Ltd., ISBN-13: 978-0071077750. [T4] P. S. R. Murthy, "Operation & Control in Power System", 2nd Edition, B. S. Publication, ISBN: 978-81-7800-200-2.			
References:			
[R1]. S. Sreenivasan, G. Sivanagaraju, Power System Operation and Control , Pearson Editions, ISBN-13: 978-8131726624. [R2]. Narain G. Hingorani, Laszlo Gyugyi, "Understanding FACTs" IEEE Press, ISBN-13: 978-0780334557. [R3]. Allen J. Wood, Bruce F. Wollenberg "Power Generation, Operation, and Control", Wiley India Ed., ISBN-13: 978-0471586999.			
E-references:			
http://vp-dei.vlabs.ac.in/ (Virtual Power Lab)			

EE319: FEEDBACK CONTROL SYSTEMS LABORATORY

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

Prerequisite Course:

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

Course Objectives: The course aims:-

To impart the knowledge of the student in:

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.	2	Understand
CO2	Analyze time domain stability and frequency response of linear system	2	Understand
CO3	Determine frequency response of Lead-Lag Compensator	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	3	2	2	1	2	-	-	-	2	1	-	-	1	1
CO2	3	2	2	1	2	-	-	-	-	1	-	-	1	1
CO3	3	2	2	1	2	-	-	-	-	1	-	-	1	1

Course Contents			
A. Minimum Four experiments should be conducted			
Ex. No	**Name of Experiment**	**No.of Hours**	**COs**
1.	Determination of transfer function of Armature-controlled DC Shunt motor	2	CO1
2.	Determination of transfer function of field controlled DC Shunt motor	2	CO1
3.	Study of characteristics of synchros transmitter and receiver	2	CO1
4.	Digital position control system using DC Servomotor	2	CO1
5.	Time response of First & Second order system	2	CO2
6.	DC position control system convert continuous response system to digital control system	2	CO2
7.	Study of PID simulator	2	CO2
B. Minimum Four experiments should be conducted (perform using software)			
8.	Digital simulation of step response of unity feedback first order system (type 0 & type 1)	2	CO2
9.	Digital simulation of step response of unity feedback second order systems (type 0 & type 1)	2	CO2
10.	Digital simulation of root locus plot for the desired time response of a higher order system	2	CO2
11.	Digital simulation of Nyquist plot & bode plot for stability analysis	2	CO2
12.	Digital simulation of PID controller design for a given system	2	CO2
13.	Digital simulation of lag & lead Compensator design	2	CO3
14.	Digital simulation of state space analysis	2	CO3

Text Books:

1. J. Nagrath, M. Gopal, "Control System Engineering", New Age International Publishers, 5th edition, 2015, ISBN-13 : 978-8122420081 **(Library Slot No: 621.381.1 NIS-TB-45989)**
2. Norman S Nise, "Control Systems Engineering", Wiley, 2019, ISBN: 978-1-119-47422-7

References:

3. Katsuhiko Ogata, "Modern control system engineering", Prentice Hall Pearson, 5th edition, 2010 (ISBN 10: 0-13-615673-8)
4. Benjamin C. Kuo, "Automatic Control System", 9th edition, Wiley, 2014 (ISBN: 9788126513710, 9788126513710)
5. M Gopal, "Control Systems: Principles and Design", McGraw Hill Education, 2012. (ISBN: 9780071333269, 0071333266)
6. Control Systems Engineering by A. Nagoor Kani, 2nd edition RBA Publications. (ISBN: 9789389239003, 9789389239003)
7. https://nptel.ac.in/courses/107106081 (NPTEL Video Lecture Notes on "Control Engineering" by Professor C.S.Shankar Ram, IIT Madras)
8. https://lpsa.swarthmore.edu/ (Matlab)
9. https://newhorizoncollegeofengineering.in/control-systems-lab/ (Matlab)
10. https://kcgcollege.ac.in/Virtual-Lab/Electrical-and-Electronics-Engineering/theory.html

EE320: COMPUTER AIDED ELECTRICAL MACHINE DESIGN LAB

Teaching Scheme	**Examination Scheme**	
Lectures: -- Hrs./Week	**Oral:**	**25 Marks**
Practical: 02 Hrs./Week	**Term Work:**	**-- Marks**
Credits: 1	**Total:**	**25 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 calculate design parameters of a transformer and design the transformer.
2. To calculate design parameters of a three phase induction motor and design the three phase induction motor.
3. To draw layout of AC winding with its details using E-CAD
4. To analyse and prepare a report based on the Industrial visit to a manufacturing unit. (Transformer or Induction motor)
5. To design of a Transformer using E-CAD and analyse its design using ANSYS/MATLAB
6. To design of a three phase Induction Motor using E-CAD and analyse its design using ANSYS/MATLAB

Course Outcomes (COs):

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

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Calculate design parameters of a transformer and design the transformer.	3	Applying
CO2	Calculate design parameters of a three phase induction motor and design the three phase induction motor.	3	Applying
CO3	Draw layout of AC winding with its details using E-CAD	3	Applying
CO4	Analyse and prepare a report based on the Industrial visit to a manufacturing unit. (Transformer or Induction motor)	4	Analysing
CO5	Design of a Transformer using E-CAD and analyse its design using ANSYS/MATLAB	6	Creating
CO6	Design of a three phase Induction Motor using E-CAD and analyse its design using ANSYS/MATLAB	6	Creating

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	1	1	1	1	-	1	1	2	2
CO2	3	2	2	2	2	1	1	1	1	-	1	1	2	2
CO3	3	2	2	2	3	1	1	1	1	-	1	1	3	3
CO4	3	2	2	2	2	1	1	1	1	-	1	1	2	2
CO5	3	2	3	3	3	1	1	1	1	-	2	1	3	3
CO6	3	2	3	3	3	1	1	1	1	-	2	1	3	3

Course Contents			
Ex. No	**Name of Experiment**	**Hrs.**	**COs**
1	Design a transformer for laboratory and commercial applications on a drawing sheet and using E-CAD showing different parts of transformer.	2	1
2	Design an induction motor for laboratory and commercial applications on a drawing sheet and using E-CAD showing different parts of three phase induction motor.	2	2
3	Draw layout of AC winding with its details using E-CAD.	2	3
4	Analyse and prepare a report based on the Industrial visit to a manufacturing unit. (Transformer or Induction motor)	2	4
5	Design of 500kVA Transformer using E-CAD and analyse its design using ANSYS/MATLAB	2	5
6	Design of 3HP Induction Motor using E-CAD and analyse its design using ANSYS/MATLAB	2	6

Text Books:

[T1] Erdogan Madenci and Ibrahim Guven-The Finite Element Method and Applications in Engineering Using ANSYS, Springer (ISBN:9788184897463 and SCOEK Library Accession No. 70461)
[T2] A.K.Sawhney – A Course in Electrical Machine Design, 10th Edition, - Dhanpat Rai and sons New Delhi. (ISBN: 978-81-7700-101-3 and SCOEK Library Accession No. 65058, 65059)
[T3] R. K. Agarwal – Principles of Electrical Machine Design, S. K.Katariya and Sons. (ISBN: 978-93-80027-12-8 and SCOEK Library Accession No. 64134, 64135)
[T4] M.G. Say – The Performance and Design of A.C. Machines, 3rd Edition, CBS Publishers & Distributors Pvt. Ltd. (ISBN: 81-239-1027-4 and SCOEK Library Accession No. 64080)
[T5] Prof. Sham Tickoo – AutoCAD 2021 for Engineers and Designers (ISBN: 978-93-8998-97-2) and SCOEK Library Accession No. 64570 , 64571)

References:

[R1] CADD Centre India-ANSYS Reference Guide (SCOEK Library Accession No. 0024404)
[R2] K. G. Upadhyay- Design of Electrical Machines, New age International (P) Limited, Publishers London (ISBN:978-81-224-2282-5, and SCOEK Library Accession No. 64876)
[R3] Indrajit Dasgupta – Design of Transformers, Mc Graw Hill Education (ISBN-13:978-0-07-043640-4 and SCOEK Library Accession No. 64309)
[R4] T. A. Lipo, “Introduction to AC Machine Design”, IEEE Press – Wiley Publications, 2017.
[R5] J. R. Hendershot and T. J. E. Miller, “Design of Brushless Permanent – Magnet Motors”, Motor Design Books LLC, 2nd edition, 2010.
[R6] J. Pyrhonen, T. Jokinen, and V. Hrabovcova, “Design of Rotating Electrical Machines”, John Wiley and Sons Inc., 2nd edition, 2013.
[R7] R. Krishnan, “Switched Reluctance Motor Drives”, CRC Press LLC, USA, 2001.
[R8] SHANMUGASUNDARAM A ELECTRICAL MACHINE DESIGN DATA BOOK / ASHANMUGASUNDARAM ; 2nd ed. ; Vol. ; : NEW AGE, 2015 (SCOEK Library Accession No. 64876, 64877, 64878 and 64879)

E-References

[1] https://onlinecourses.nptel.ac.in/noc23_ee140
[2] https://onlinecourses.nptel.ac.in/noc24_ee50

PR321: MINI PROJECT	
Teaching Scheme	**Examination Scheme**
Practical: 02 Hrs./Week	**Term Work: 25 Marks**
Tutorial: --- Hr./Week	**Total: 25 Marks**
Credits: 01	

Preamble

- For better learning experience, along with traditional classroom teaching and laboratory learning, project-based learning has been introduced to motivate students to learn by working in a group cooperatively to solve a problem.
- A central goal of miniproject is to facilitate the deeper learning process and support students' acquisition of complex cognitive competencies,e.g., rigorous content knowledge and critical thinking skills. The miniproject engages students in the problem definition, design process, contextual understanding, and systemsthinking approaches. In this approach, learning based on memorization is de-emphasized and more emphasis is given on understanding and application of engineering design principles. Because of frequentassessments throughout the course, plagiarism can be more easily controlled.

Objectives: The course aims:-

To impart the knowledge of the student in:

1. Impart technical knowledge and skills, and develop deeper understanding to integrate knowledge andskills from various areas.
2. Build critical thinking, problem-solving, communication, collaboration and creativity, and innovationamongst students
3. Make students aware of their own academic, personal, and social developments.
4. Develop habits of self-evaluation and self-criticism, against self-competency and trying to see beyondown ideas and knowledge

Course Outcomes (COs):

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

Course Outcome (s)		Bloom's Taxonomy	
		Level	Descriptor
CO1	Identify, formulate, and analyze the simple project problem.	2	Understand
CO2	Apply knowledge of mathematics, basic sciences, and electrical engineering fundamentals to develop solutions for the project.	3	Apply
CO3	Learn to work in teams, and to plan and carry out different tasks that are required during a project.	2	Understand
CO4	Understand their own and their team-mate's strengths and skills.	2	Understand
CO5	Draw information from a variety of sources and be able to filter and summarize the relevant points.	2	Understand
CO6	Communicate to different audiences in oral, visual, and written forms.	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	3	3	1	1	-	-	1	2	3	1	-	-	-	-
CO2	2	2	2	3	-	3	1	-	3	3	-	2	-	2
CO3	1	1	3	3	3	-	-	2	3	2	1	2	3	-
CO4	1	1	1	-	-	-	3	2	3	1	-	1	-	-
CO5	2	2	1	-	-	-	-	-	3	3	-	1	-	1
CO6	1	1	2	-	-	-	-	-	3	3	1	1	-	-

Course Contents

PROCEDURE:

- A group of 4-5 students will be assigned to a faculty member called a mentor. Based on the engineering knowledge of a group and societal and industry problems, the mentor has to guide a group to identify project problems and plan the work schedule. Here, the expected outcomes of the project must be noted.
- The complete work-plan should be divided in the form of the individual tasks to be accomplished with targets. Weekly review of the completed task should be taken and further guidelines are to be given to a group. The final activity will be presenting the work completed and submitting the report.
- A group should be promoted to participate in a competition or write a paper. A problem needs to refer back to a particularly practical, scientific, social, and/or technical domain. The problem shouldstand as one specific example or manifestation of more general learning outcomes related to knowledge and/or modes of inquiry. There are no commonly shared criteria for what constitutes anacceptable project.
- Projects vary greatly in the depth of the questions explored, the clarity of the learning goals, the content, and the structure of the activity.
- It may have
  - ✓ A few hands-on activities that may or may not be multidisciplinary.
  - ✓ Use of technology in meaningful ways to help them investigate, collaborate, analyze, synthesize,and present their learning.
  - ✓ Activities on solving real-life problems, investigation /study, and writing reports of in-depth study,fieldwork.

ASSESSMENT

- The department/mentor is committed to assess and evaluate both students' performance and courseeffectiveness. The progress of miniproject is monitored regularly every week.
- During the process of monitoring, continuous assessment and evaluation the individual and team performances are to be measured by supervisor/mentor and authorities.
- Students must maintain an institutional culture of authentic collaboration, self-motivation, peer learning, and personal responsibility. The institution/department should support students in this regard through guidance/orientation programs and the provision of appropriate resources and services. Supervisor/mentor and students must actively participate in the assessment and evaluationprocesses. Groups may demonstrate their knowledge and skills by developing a solution to the problem, public product, and/or report and/or presentation.
  - ✓ Individual assessment for each student (Understanding individual capacity, role, and involvementin the project)
  - ✓ Group assessment (roles defined, distribution of work, intra-team communication and togetherness)
  - ✓ Documentation and presentation

EVALUATION AND CONTINUOUS ASSESSMENT:

- It is recommended that all activities are to be recorded in a workbook regularly, regular assessment of work to be done and proper documents are to be maintained at the department level by both students as well as a mentor. Continuous Assessment Sheet (CAS) is to be maintained by allmentors/department. Recommended parameters for assessment, evaluation, and weightage are as follows.
  - ✓ Idea Inception (**5%**)
  - ✓ Outcomes of miniproject/ Problem Solving Skills/ Solution provided/ Final product (**50%**) (Individualassessment and team assessment)
  - ✓ Documentation (Gathering requirements, design and modeling, implementation/execution, use oftechnology and final report, other documents) (**25%**)
  - ✓ Demonstration (Presentation, User Interface, Usability, etc.) (**10%**)

- ✓ Contest Participation/ publication (**5%**)
- ✓ Awareness /Consideration of -Environment/ Social /Ethics/ Safety measures/Legal aspects (**5%**)

Miniproject workbook will serve the purpose and facilitate the job of students, mentors, and project coordinator. This workbook will reflect accountability, punctuality, technical writing ability and work flow of the work undertaken

EE322: CREATIONAL ACTIVITY

Teaching Scheme	**Examination Scheme**	
Practical: 02 Hrs./Week	**Term Work:**	**25 Marks**
Credits: 01	**Total:**	**25 Marks**

Prerequisite Course:
Human Values, Communication Skills, Sports Enthusiasm

Course Objectives

1. Overall development of a Student's Technically, Mentally, and emotionally.

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 ability to identify real-world problems and propose innovative solutions, integrating creativity and critical thinking into their project work.	6	Create
CO 2	Develop effective presentation and demonstration skills, conveying complex technical concepts to both technical and non-technical audiences.	6	Create
CO 3	Develop a competitive spirit, learning to handle both success and failure gracefully, and using competition experiences as learning opportunities.	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	2	2	2	2	1	1	1	3	3	2	3	2	1
CO2	2	1	1	1	3	1	1	1	3	3	1	3	2	1
CO3	2	1	1	-	-	-	1	1	3	3	-	3	2	1

Course Guidelines

Students will be awarded with grades based upon his or her participation in events or/and contribution in various activities mentioned below

1. Participation in International Level Hackathon competition
2. Participation in National Level Hackathon competition
3. Participation in National Level Project expo competition
4. Participation in International/ National level Conference
5. Patent / Copyright Filling of your own idea /project
6. Participation in National Level Technical Symposia
7. Participation in various technical events competition in other institute / universities
8. Zonal / Regional / State level Sports Competition
9. Skill based Activities –Certified course
10. Applying for foreign internship

Maximum of 3 students to form as group to complete the above activities (Group activity is not applicable for S.No.7 to 10).
The Rubrics for the grades and marks will be different depending on the activities enlisted

MC322: Professional Leadership Skills

Teaching Scheme	**Examination Scheme**
Practical: 02 Hrs./Week	**In-Sem Exam: -- Marks**
Tutorial: --- Hr./Week	**Term Work:**
Credits: Non Credit	**Total: Pass/ Fail**

Prerequisite

- Basic Grammar of English Language
- Seminar Skills

Course Outcomes (COs):

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

Course Outcome (s)		Bloom's Taxonomy	
		Level	**Descriptor**
CO1	Explain traits of a leadership through real life examples	2	Understand
CO2	Exhibit the ability to work effectively in team	3	Apply
CO3	Express their ideas relevant to a given topic.	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	-	-
CO2	-	-	-	-	-	3	-	3	3	2	-	3	-	-
CO3	-	-	-	-	-	3	-	3	3	3	-	3	-	-

Course Contents

Minimum 12 sessions will be conducted from the following list:

Experiment Number	Description	Hrs
1	**SMART Goal Setting, SWOT/C Analysis and Action Plan:** Discussion on Dos and Don'ts, Advantages, and Generation of the Document by Students and its Assessment	2
2	**Assertiveness and Positive Thinking:** Types of Behaviour, Benefits of Being Assertive and Positive Thinking, Developing Positive Attitude, Case Studies and Presentations	2
3	**Self Management:** Need of Self Management, Developing Self Acceptance, Steps of Self Management, Individual Classroom Activity and its Assessment	2
4	**Leadership Styles and Change Management:** Introduction to Different Types of Leaderships, Effective Organizational Change Management, Individual Classroom Activity and its Assessment	2
5	**Team Formation and Leading a Team-I:** Why Teams? Roles and Responsibilities in Teams, Strategies for Team Development, Barriers to	2

	Teams, Steps of Team Development	
6	**Team Formation and Leading a Team — II:** Case Studies of Teams and Student Presentations	2
7	**Business Meetings and Decision Making — I:** Preparing for the Meeting, Role of Chairperson and Participants in Meetings	2
8	**Business Meetings and Decision Making — II:** Mock Meetings, Decision Making Case Studies and Feedback	2
9	**Conflict Management:** Types of Personalities, Possible Reasons of Conflicts at WorkPlace, Conflict Resolution Strategies, Conflict Management Case Studies and Feedback	2
10	Time Management: Time Management Techniques, Introduction to Time Management Tools, Benefits of Time Management, Case Studies and Presentations	2
11	**Presentation Skills — I:** Preparation, Types of Presentations - Informative, Instructional, Arousing, Persuasive, Decision-making, Presentation Tools	2
12	**Presentation Skills — II:** Body Language, Managing Questions and Student Presentations Student Presentations and Feedback, Student Presentations and Feedback	2
13	**Creative and Critical Thinking:** Approaches to Creative Thinking, Strategies for Creative Thinking, Characteristics and Strategies of Critical Thinking	2
14	**Motivating People:** Types of Motivation, Components of Motivation, Steps in Keeping Motivation Level High	2

EVALUATION AND CONTINUOUS ASSESSMENT:

In Every Session Students will be assessed. Each Assessment will be of 10 Marks. Best 10 performances will be considered for final marks calculation

Minimum Passing Marks - 40%

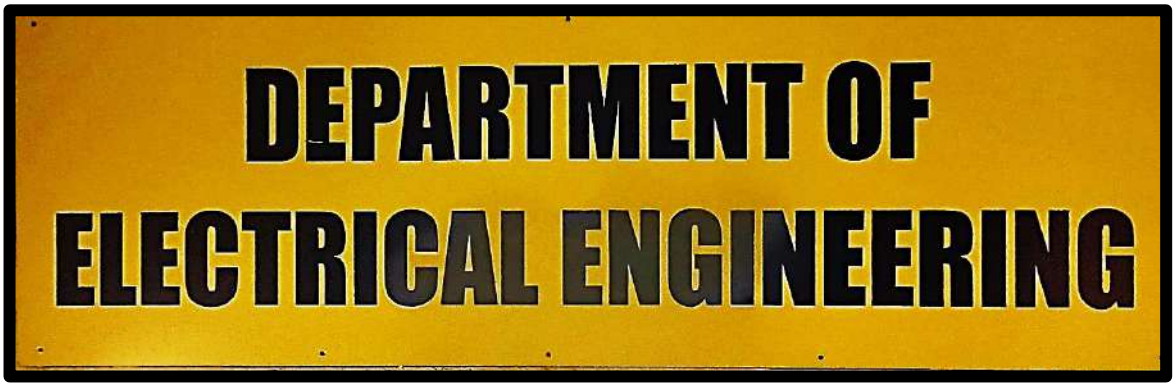
References:

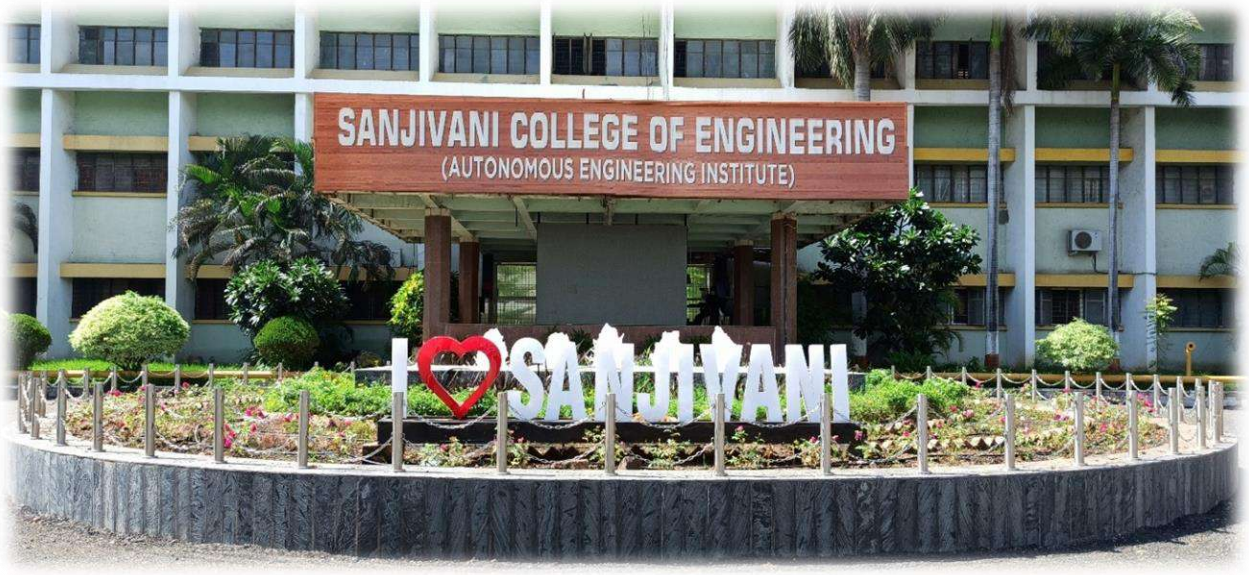
1. Krishna Mohan and Meera Banerji; Developing Communication Skills, Macmillan India Ltd., New Delhi.
2. Masters, L. Ann et al. Personal Development for Life and Work, New Delhi: Cengage Learning.
3. Jeff Butterfield, Soft Skills for Everyone, Cengage Learning India Private Limited.
4. John Seely, Oxford Guide to Effective Writing and Speaking; Oxford University Press.
5. UNLEASH the power within... Soft Skills — Infosys Training Manual Module l to 5 (Infosys Campus Connect Programme)

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 - 2021 PATTERN

FINAL YEAR B. TECH

Academic Year 2023-24

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:

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

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

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

Program Specific Objectives (PSOs)

1. **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.

2. **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- 2021 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	CA	OR	PR	TW	Total
PCC	**EE401**	Switch Gear and Protection	3	-	-	3	30	50	20	-	-	-	100
PCC	**EE402**	Control System Design	3	-	-	3	30	50	20	-	-	-	100
PCC	**EE403**	High Voltage Engineering	3	-	-	3	30	50	20	-	-	-	100
PEC	**EE404**	Professional Elective- III **A.** Electric and Hybrid Vehicle **B.** HVDC Transmission Systems **C.** Digital Signal Processing	4	-	-	4	30	50	20	-	-	-	100
PEC	**EE405**	Professional Elective-IV **A.** Power Quality **B.** Transmission and Distribution **C.** Intelligent Systems with AI and ML	3	-	-	3	30	50	20	-	-	-	100
LC	**EE406**	Switch Gear and Protection Laboratory	-	-	2	1	-	-	-	50	-	-	50
LC	**EE407**	Control System Design Laboratory	-	-	2	1	-	-	-	50	-	-	50
LC	**EE408**	High Voltage Engineering Laboratory	-	-	2	1	-	-	-	-	50	-	50
PROJ	**EE409**	Project Stage I	-	-	6	3	-	-	-	50	-	100	150
MLC	**MC410**	Mandatory Learning Course-VII **A.** Financially Smart	1	-	-	Non Credit	-	-	-	-	-	-	Pass/Fail
		Total	**17**	**-**	**12**	**22**	**150**	**250**	**100**	**150**	**50**	**100**	**800**

SEMESTER VII

EE401: 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:	**03**	**Total:**	**100 Marks**

Prerequisite Course:

1. Power system

Course Objectives

1. To educate the causes of abnormal operating conditions (faults, lightning and switching surges) of the apparatus and system.
2. To introduce the characteristics and functions of relays and protection schemes.
3. To impart knowledge on apparatus protection
4. To introduce static and numerical relays
5. To impart knowledge on arc formation.
6. To impart knowledge on functioning of circuit breakers

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 various types of faults in Power system and discuss the needs of protective devices.	3	Apply
CO2	Illustrate the operations and applications of various types of protective relays with its characteristics in power system.	2	Understand
CO3	Describe the various schemes employed for apparatus protection in power system	2	Understand
CO4	Elucidate the importance of numerical and static relays in power system	2	Understand
CO5	Demonstrate the arc interruption and analyze the RRRV in circuit breakers	2	Understand
CO6	Illustrate the different types of circuit breakers in power system.	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	2	1	2	1	1	2	-	-	-	-	-	1	3	1
CO2	2	2	3	1	1	2	-	-	-	-	-	1	3	1
CO3	2	2	3	2	1	2	-	-	-	-	-	1	3	1
CO4	2	2	3	2	1	2	-	-	-	-	-	1	3	1
CO5	2	2	3	2	1	2	-	-	-	-	-	1	3	1
CO6	2	2	2	1	1	2	-	-	-	-	-	1	3	1

Course Contents

UNIT-I	**PROTECTIVE RELAYING**	**Hrs.**	**COs**
	Principles and need for protective schemes – nature and causes of faults – types of faults – fault current calculation using symmetrical components – Methods of Neutral grounding – Zones of protection and essential qualities of protection – Protection schemes.	8	1
UNIT-II	**ELECTROMAGNETIC RELAYS**	**Hrs.**	**CO**
	Operating principles of relays - the Universal relay – Torque equation – R-X diagram – Electromagnetic Relays – Overcurrent, Directional, Distance, Differential, Negative sequence and Under frequency relays.	10	2
UNIT-III	**APPARATUS PROTECTION**	**Hrs.**	**CO**
	Current transformers and Potential transformers and their applications in protection schemes - Protection of transformer, generator, motor, busbars and transmission line.	8	3
UNIT-IV	**STATIC RELAYS AND NUMERICAL PROTECTION**	**Hrs.**	**CO**
	Static relays – Phase, Amplitude Comparators – Synthesis of various relays using Static comparators – Block diagram of Numerical relays – Overcurrent protection,	8	4

	transformer differential protection, distant protection of transmission lines		
UNIT-V	**FUNDAMENTALS OF ARC INTERRUPTIONS**	**Hrs.**	**CO**
	Ionization of gases, deionization, ARC Formation - DC and AC circuit breaking – Current interruption in AC circuit breakers- Transient recovery voltage (TRV) – derivation of rate of rise of TRV - resistance switching - current chopping - interruption of capacitive current.	8	5
UNIT-VI	**CIRCUIT BREAKERS**	**Hrs.**	**CO**
	Types of circuit breakers – Air blast, Air break, Oil, SF6 and vacuum circuit breakers – Comparison of different circuit breakers – Rating and selection of Circuit breakers.	7	6

Text Books:

[T1]. Sunil S.Rao, "Switchgear and Protection", Khanna Publishers, New Delhi, 14th Edition, 2021, ISBN: 978-9387394728

[T2]. M.L.Soni, P.V.Gupta, U.S.Bhatnagar, A.Chakrabarti, "A Text Book on Power System Engineering", Dhanpat Rai & Co.,Jan 2016, ISBN : 9788177000207

[T3]. Stanley H. Horowitz, Arun G. Phadke , Power System Relaying, John Wiley, 2014, ISBN: 978-0-470-75878-6

References:

[R1] Badri Ram, D. N. Vishwakarma, "Power System Protection and Switchgear" Tata McGraw Hill Publishing Co. Ltd., 3rd edition, 2022, ISBN: 978-9355322852

[R2] H Lee Blackburn , "Protective Relaying- Principles and Applications", Dekker Publications, 3rd edition, 2007, ISBN: 978-0-9568678-0-3

[R3] Mason C.R., "Art and Science of Protective Relaying", Wiley Eastern Limited, 1996, ISBN: 978-0471575528

E-References

[1] Power System Protection and Switchgear (IIT Roorkee)
https://archive.nptel.ac.in/courses/108/107/108107167/

EE402: 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:	**03**	**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	Identify the various nonlinearities and their behaviour observed in real world	2	Understanding
CO2	Analyse the system using state space approach	4	Analysing
CO3	Apply controllability and observability tests on the system	3	Applying
CO4	Use Sampling theorem and other concepts of Digital control systems	3	Applying
CO5	Analyse system with P, I and D controller	4	Analysing
CO6	Apply the compensator concepts to enhance the system performance	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	3	2	2	2	-	-	-	-	-	-	1	2	2
CO2	2	3	2	2	1	-	-	-	-	-	-	1	2	2
CO3	2	3	2	2	1	-	-	-	-	-	-	1	2	2
CO4	2	3	3	3	2	-	-	-	-	-	-	1	2	2
CO5	2	3	2	2	2	-	-	-	-	-	-	1	2	2
CO6	2	3	2	1	1	-	-	-	-	-	-	1	2	2

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	06	CO4

	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.		
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, 8th Edition, John Wily and Sons, Inc. 2018 ISBN 8126571837.
[T2]. Richard C. Dorf, Robert H. Bishop, Modern Control Systems, 13th Edition, Pearson Ed, ISBN 9780134407623.
[T3]. Benjamin C. Kuo, Digital Control System, Second Edition, Oxford University Press, 2007, ISBN 0195686209
[T4]. I. J. Nagarath, M. Gopal, Control System Engineering, 7th Edition, New Age International (P) Limited, Publishers, 2021, ISBN 8195175589
[T5]. A. Nagoor Kani, Advanced Control Theory, Third Edition, CBS Publishers and Distributes,2020, ISBN 9389396298

References:

[R1] M. Gopal, “Control Systems: Principles and Design”, 4th Ed. McGraw Hill Education, 2012, ISBN 9780071333269
[R2] B. C. Kuo, “Automatic Control System”, 9th Ed., Prentice Hall, 2014, ISBN 9788126552337

E-Resources:

[E1] Control Engineering, IIT Delhi by Prof. M. Gopal (https://nptel.ac.in/courses/108102043)
[E2] NOC:Nonlinear and Adaptive Control, IIT Delhi by Prof. Shubhendu Bhasin (https://nptel.ac.in/courses/108102113)

EE403: 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 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 equipment's as per standards ·
5. To introduce students to the design, layout, safety precautions, earthing, and shielding of HV laboratory.

Course Outcomes (COs):

Course Outcome (s)		Bloom's Taxonomy	
		Level	Descriptor
CO1	Identify, describe the breakdown theories of gaseous materials.	2	Understand
CO2	Identify, describe the breakdown theories of liquid materials.	2	Understand
CO3	Identify, describe the breakdown theories of solid materials.	2	Understand
CO4	Describe as well as use different methods of generation of high AC, DC, impulse voltage and current.	2	Understand
CO5	Identify the occurrence of overvoltage and to provide remedial solutions.	2	Understand
CO6	Identify and describe different methods of the measurement of high voltage and cueernt.	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	3	3	1	-	2	2	1	-	-	1	1	1	3	1
CO2	3	3	2	1	2	2	1	-	-	1	1	1	3	1
CO3	3	3	1	1	1	2	1	-	-	1	1	1	3	1
CO4	2	2	1	1	1	-	1	-	-	-	1	1	3	1
CO5	2	2	1	2	1	-	1	-	-	-	1	1	3	1
CO6	2	3	1	-	1	-	1	-	-	-	1	1	3	1

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,	06	03

	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)		
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	**MEASUREMENT OF HIGH VOLTAGE AND HIGH CURRENTS**	**Hrs.**	**CO**
	Sphere gap voltmeter, electrostatic volt meter, generating voltmeter, peak reading voltmeter, resistive, capacitive and mixed potential divider, capacitance voltage transformer, cathode ray oscilloscope for impulse voltage and current measurement, measurement of dielectric constant and loss factor, partial discharge measurements.	06	06

Text Books:

[T1] M. S. Naidu, V. Kamaraju, "High Voltage Engineering", Tata McGraw Hill Publication Co. Ltd. New Delhi, ISBN 0-07-462286-2

[T2] C. L. Wadhwa, "High Voltage Engineering", New Age International Publishers Ltd, ISBN 10: 8122418597 ISBN 13: 9788122418590

References:

[R1] E. Kuffel, W. S. Zaengl, J. Kuffel, "High Voltage Engineering Fundamentals", Newnes Publication, ***ISBN*** 0 7506 3634 3

[R2] Prof. D. V. Razevig Translated from Russian by Dr. M. P. Chourasia, "High Voltage Engineering", Khanna Publishers, New Delhi, ISBN: 978 - 0 - 620 – 3767-7.

[R3] Ravindra Arora, Wolf Gang Mosch, "High Voltage Insulation Engineering", New Age International ISBN 13- 978-8122406191

[R4] High Voltage Engineering Theory and Practice by M. Khalifa Marcel Dekker Inc. New York, ***ISBN*** 10 0824781287

[R5] Subir Ray, "An Introduction to High voltage Engineering" PHI Pvt. Ltd. New Delhi, ***ISBN***, 8120347404

[R6] IS 731-1971:Porcelain insulator for overhead power lines with nominal voltage > 1000 Volt, ***ISBN-13: 978-0824748098***

[R7] Bushings :IS2099-1986,specification for bushings for A.C. Voltages > 1000 Volts, ***ISBN***-13: 978-0824748098

[R8] Pollution test :IEC 60507-1991 on external and internal insulator, ***ISBN***-10: 0824748093

[R9] High voltage test techniques, general definitions and test requirements: IS 2071(part 1) 1993,IEC Pub 60-1(1989), ISBN 60060-1:2010.

E-resources:

[E1] NPTEL https://archive.nptel.ac.in/courses/108/104/108104048/

EE404A Electric and Hybrid Vehicle

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

Prerequisite Course:

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

Course Objectives

1. To make students aware of the need and importance of Electric, Hybrid Electric Vehicles and Fuel cell vehicles.
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	Recognize 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	Understand Indian and Global Scenarios in Electric Vehicles	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	3	-	-	-	-	3	-	-
CO2	2	2	-	-	-	1	3	-	-	-	-	2	-	-
CO3	2	3	-	-	-	-	2	-	-	-	-	3	-	-
CO4	2	1	-	-	-	-	2	-	-	-	-	2	-	-
CO5	2	2	-	-	-	-	1	-	-	-	-	2	-	-
CO6	1	-	-	-	2	2	2	-	-	-	-	3	-	-

Course Contents

UNIT-I	**Introduction**	**Hrs.**	**COs**
	History of Electric Vehicles, Concept of Electrified transportation, Comparison of EVs and IC Engine vehicles, Hybrid Electric Vehicle and Fuel cell Vehicle. Social and environmental importance of Hybrid and Electric vehicles.	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.	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 drivetrain (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	7	CO5

	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, IoT in Electric Vehicles		
UNIT-VI	**Indian & Global Scenarios in Electric Vehicles**	**Hrs.**	**CO**
	Technology Scenario, Recent developments and trends in electric vehicles (BYD, Citroen EV, etc), Market Scenario, Policies & Regulations, Payback & Commercial Model, Policies in India Introduction to Vehicle to Home(V2H), Vehicle to Vehicle (V2V) and Vehicle to Grid (V2G) technologies (Descriptive)	6	CO6
***One Industrial Visit to any EV design and manufacturing company is mandatory.**			
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:	**04 Hrs./Week**	**Continuous Assessment:**	**20 Marks**
Tutorial:	**-- Hrs/Week**	**In-Sem Exam:**	**30 Marks**
		End-Sem Exam:	**50 Marks**
Credits:	**04**	**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	Understand the advantages of HVDC transmission over conventional AC transmission.	2	Understand
CO2	Formulate and solve mathematical problems related to rectifier and inverter control methods.	3	Apply
CO3	Analyze the operation of individual components within an HVDC converter system.	4	Analyze
CO4	Explain the process of harmonics generation in power electronic converters	2	Comprehension
CO5	Understand the nature of faults happening on both the AC and DC sides of the converters.	2	Understand
CO6	Understand and classify various types of Multiterminal DC (MTDC) systems, understanding their configurations, and identifying their applications in modern power systems.	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	3	3	3	3	3	2	-	-	-	-	2	3	3	3
CO2	3	3	3	3	3	2	-	-	-	-	3	3	3	3
CO3	3	3	3	3	3	2	-	-	-	-	3	3	3	3
CO4	3	3	3	3	3	2	-	-	-	-	3	3	3	3
CO5	2	3	3	3	3	2	-	-	-	-	3	3	3	3
CO6	3	3	3	2	3	2	-	-	-	-	3	3	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**
UNIT II	**ANALYSIS OF HVDC 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**	**CO2**
UNIT III	**CONTROL OF HVDC CONVERTERS 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**	**CO3**
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. Use of filter, filter configuration, design of band pass and high pass filter, protection of filters, DC filters, power	**8**	**CO4**

	line communication and RI noise, filters with voltage source converter HDVC schemes.		
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**	**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**	**CO6**

Text Books:

[T1]. EHV-AC ,HVDC Transmission & Distribution Engineering, S. Rao, Khanna Publication,ISBN 81-7409-043-6

[T2]. Power System Stability and Control by PrabhaKundur, McGraw hill,ISBN NO 978-0-07-0635159

[T3]. Power System Analysis: Operation and Control, AbhijitChakrabarti and SunitaHalder, PHI Learning Pvt. Ltd ISBN-10,8120327772

References:

[R1]. High Voltage Direct Current Transmission, J. Arrillaga, Peter Pregrinu ISBN-10.0852969414

[R2]. HVDC Power transmission system, K.R.Padiyar, Wiley Eastern Limited ISBN-13: 978-8122437850

E-References

[E1]. NPTEL :: Electrical Engineering - NOC:DC Power Transmission Systems https://archive.nptel.ac.in/courses/108/106/108106160/

[E2]. NPTEL HIGH VOLTAGE DC TRANSMISSION https://nptel.ac.in/courses/108104013

EE404C: DIGITAL SIGNAL PROCESSING

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

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Identify various signals based of their characteristics and apply sampling theorem	2 3	Understanding Applying
CO2	Apply Z-transform and inverse Z transform on signals	3	Applying
CO3	Demonstrate various properties of Fourier Transform	3	Applying
CO4	Compute DFT and FFT	3	Applying
CO5	Apply various techniques of IIR filter design and its implementation	3	Applying
CO6	Apply various techniques of FIR filter design and its implementation	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	2	3	2	-	-	-	-	-	-	1	2	2
CO2	3	2	1	1	2	-	-	-	-	-	-	1	2	2
CO3	3	2	2	1	2	-	-	-	-	-	-	1	2	2
CO4	3	2	2	2	2	-	-	-	-	-	-	1	2	2
CO5	3	2	1	2	2	-	-	-	-	-	-	1	2	2
CO6	3	2	1	2	2	-	-	-	-	-	-	1	2	2

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	**(06 Hrs)**	CO4

	Convolution, Linear Convolution using DFT, Effective computation of DFT and FFT, DIT FFT, DIF FFT, Inverse DFT using FFT		
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”, 6th Edition Scitech Publication, isbn 818371630X
[T3]. Dr.S. D. Apte,”Digital Signal Processing”,2nd 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

[E1]. 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.
[E2]. Heinen, P., and Neuvo, Y. "FIR-Median Hybrid Filters," *IEEE Trans. on Acoust. Speech, and Signal Proc.*, Vol. ASSP-35, No. 6, June 1987.
[E3]. Oppenheim, A., Schafer, R., and Stockham, T. "Nonlinear Filtering of Multiplied and Convolved Signals," *Proc. IEEE*, Vol. 56, August 1968.
[E4]. Pickerd, John. "Impulse-Response Testing Lets a Single Test Do the Work of Thousands," *EDN*, April 27, 1995

EE405A: POWER QUALITY

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	Classify the various power quality events and international standards	02	Understand
CO2	Predict the voltage sag problems and suggest preventive techniques.	02	Understand
CO3	Discuss the various source of transient over voltages.	02	Understand
CO4	Classify the harmonic sources and the effects of harmonic distortion.	02	Understand
CO5	Describe modern data acquisition systems and processing methods for condition monitoring	02	Understand
CO6	Explain the basics in filter design to improve power quality.	02	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	2	2	2	2	1	2	-	-	-	-	-	3	2	3
CO2	2	3	3	2	2	2	-	-	-	-	-	3	2	3
CO3	2	3	3	2	2	2	-	-	-	-	-	3	2	3
CO4	3	3	3	2	2	2	-	-	-	-	-	3	2	3
CO5	2	3	3	3	3	2	-	-	-	-	-	3	2	3
CO6	3	2	2	2	2	2	-	-	-	-	-	3	2	3

Course Contents

UNIT-I	INTRODUCTION TO POWER QUALITY	Hrs.	COs
	Terms and definitions: 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 fluctuation - power frequency variations. International standards of power quality. Computer Business Equipment Manufacturers Associations (CBEMA) curve.	09	1
UNIT-II	**VOLTAGE SAGS AND INTERRUPTIONS**	**Hrs.**	**CO**
	Sources of sags and interruptions - estimating voltage sag performance-Area of Vulnerability, Equipment sensitivity to voltage sags, Transmission system sag performance evaluation, and Utility distribution system sag performance evaluation. Voltage sag due to induction motor starting - Estimation of the sag severity- Solution at the end user level.	09	2
UNIT-III	**OVERVOLTAGES**	**Hrs.**	**CO**
	Sources of over voltages - Capacitor switching – lightning - ferro resonance. Mitigation of voltage swells - surge arresters - low pass filters - power conditioners. Lightning protection – shielding – line arresters - protection of transformers and cables. An introduction to computer analysis tools for transients, PSCAD and EMTP.	09	3

UNIT-IV	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 –Harmonic distortion evaluation, IEEE and IEC standards.	09	4
UNIT-V	**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.	07	5
UNIT- VI	**PASSIVE AND ACTIVE POWER COMPENSATORS**	**Hrs.**	**CO**
	Passive Compensators: Types of passive filters, single tuned and high pass filters, filter design criteria, double tuned filters, damped filters and their design. Active Compensators: Compensation principle, classification of active filters by objective, system configuration, power circuit and control strategy.	05	6

Text Books:

[T1] Roger. C. Dugan, Mark. F. Mc Granagham, Surya Santoso, H.WayneBeaty, 'Electrical Power Systems Quality' McGraw Hill,2003, ISBN: 007138622X

[T2] J. Arrillaga, N.R. Watson, S. Chen, "Power System Quality Assessment",New York : Wiley,2000, ISBN: 978-8126531745

[T3] Bhim Singh, Ambrish Chandra, Kamal Al-Haddad," Power Quality Problems & Mitigation Techniques" Wiley, 2015, ISBN: 978-1118922057

References:

[R1] G.T. Heydt, 'Electric Power Quality', West Lafayette, IN, Stars in a Circle Publications, 2nd Edition 1994, ISBN: 9789993587149

[R2] M.H.J Bollen, 'Understanding Power Quality Problems: Voltage Sags and Interruptions', New York: IEEE Press, 1999, ISBN: 978-8126530397

[R3] Arindam Ghosh, Gerard Ledwich, "Power Quality Enhancement Using Custom Power Devices", Springer US, 2002, ISBN:978-1402071805

E-resources:

[E1] https://archive.nptel.ac.in/courses/108/102/108102179/ Power Quality

[E2] https://nptel.ac.in/courses/108107157 Power Quality Improvement Technique

EE405B: TRANSMISSION AAND DISTRIBUTION

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	PO10	PO11	PO12	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	-

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	09	CO3

	weather conditions, Tower spotting, Types of towers, Substation Layout (AIS, GIS), Methods of grounding.		
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:

[T1]. Rakesh Das Begamudre, "Extra High Voltage AC Transmission Engineering", Fourth Edition, New Age International publishers, 2014, ISBN 978-81-224-2481-2

[T2]. Allen J Wood & Bruce Wollenberg, "Power Generation Operation & Control, Third Edition, 2016, ISBN 978-0-471-79055-6

[T3]. B.R.Gupta, “Power System Analysis and Design”, Fourth Edition, Chand, 2005, 8121922380

References:

[R1]. Turan Gonen, "Electric Power Transmission System Engineering Analysis and Design", CRC Press, Third Edition, 2014

[R2]. Md. Abdus Salam, Quazi M. Rahman "Power Systems Grounding" Springer publishers, 2018, ISBN 981109165X

[R3]. A Chakraborti, D.P. Kothari and A.K. Mukhopadyay: Performance, Operation and Control of EHV Power Transmission Systems, T.M.H. (Pub) 1999, ISBN 9788185814704

EE405C: 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. Programming languages, Probability.

Course Objectives

1. To locate soft commanding methodologies, such as artificial neural networks, Fuzzy logic and genetic Algorithms.
2. To observe the concepts of feed forward neural networks and about feedback neural networks.
3. To practice the concept of fuzziness involved in various systems and comprehensive knowledge of fuzzy logic control and to design the fuzzy control.
4. To analyze genetic algorithm, genetic operations and genetic mutations.

Course Outcomes (COs):

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

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Express a good understanding of fundamental principles of machine learning.	2	Understand
CO2	Prepare a model using supervised/unsupervised machine learning algorithms for classification/prediction/clustering.	3	Apply
CO3	Discuss foundation principles, mathematical tools and program paradigms of AI.	2	Understand
CO4	Analyze fuzziness involved in various systems and fuzzy set theory.	4	Analyze
CO5	Apply fuzzy logic control for solution of various optimization problems	3	Apply
CO6	Demonstrate application of AI techniques in solving electrical engineering problems.	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	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	**Foundations of AI & ML**	**Hrs.**	**CO**
	Python for AI & ML - Basics, Jupyter Notebook, functions, packages, libraries, data structures, arrays, vectors, and data frames. Applied Statistics - Descriptive statistics, inferential statistics, probability, and hypothesis testing.	07	**CO1**
UNIT-II	**Machine Learning**	**Hrs.**	**CO**
	Supervised Learning - Regression, classification, and support vector machines Unsupervised Learning - Clustering and Dimensionality Reduction Ensemble Techniques - Decision trees, random forests, bagging, and boosting Featurization, Model Selection & Tuning - Feature engineering, model selection and tuning, model performance measures, and ways of regularization.	08	**CO2**
UNIT-III	**Artificial Intelligence**	**Hrs.**	**CO**
	Introduction to Neural Networks and Deep Learning - Gradient Descent, Perceptron, Batch Normalization, Activation and Loss Functions, hyperparameter tuning, Tensor	08	**CO3**

	Flow, and Keras. Computer Vision - Convolutional Neural Networks (CNN), transfer learning, object detection, and segmentation		
UNIT-IV	**Fuzzy Logic**	**Hrs.**	**CO**
	Introduction – Fuzzy versus crisp – Fuzzy sets – Membership function – Basic Fuzzy set operations – Properties of Fuzzy sets – Fuzzy cartesian Product – Operations on Fuzzy relations – Fuzzy logic – Fuzzy Quantifiers – Fuzzy Inference – Fuzzy Rule based system – Defuzzification methods.	07	**CO4**
UNIT-V	**Genetic Algorithms**	**Hrs.**	**CO**
	Introduction-Encoding – Fitness Function-Reproduction operators – Genetic Modeling – Genetic operators – Crossover – Single–site crossover – Two-point crossover – Multi point crossover-Uniform crossover – Matrix crossover – Crossover Rate – Inversion & Deletion – Mutation operator –Mutation – Mutation Rate-Bit-wise operators – Generational cycle-convergence of Genetic Algorithm.	08	**CO5**
UNIT-VI	**Applications of AI Techniques:**	**Hrs.**	**CO**
	Load forecasting – Load flow studies – Economic load dispatch – Load frequency control – Single area system and two area system – Small Signal Stability (Dynamic stability) Reactive power control – speed control of DC and AC Motors.	07	**CO6**

Text Books:

[T1] Stuart J. Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, Prentice Hall 2010. ISBN-13: 978-0-13-604259-4

[T2] Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, Mathematics for Machine Learning, Cambridge University Press 2020. ISBN-13:978-1108455145

[T3] S. Rajasekaran and G.A.V. Pai Neural Networks, Fuzzy Logic and Genetic Algorithms, PHI, New Delhi, 2003. ISBN-9788120321861

References:

[R1] Rober J. Schalkoff, Artificial Neural Networks, Tata McGraw Hill Edition, 2011. ISBN-9780070571181

[R2] Artificial Intelligence and Intelligent Systems, OXFORD University Press, New Delhi, 2005- N. P. Padhy. ISBN-9780195671544

E-resources:

[E1] NPTEL course: course Name: An Introduction to Artificial Intelligence, Course Link: https://nptel.ac.in/courses/106102220

EE406: SWITCHGEAR AND PROTECTION LABORATORY

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

Prerequisite Course:

1. Power system

Course Objectives

1. To introduce the characteristics and functions of relays and protection schemes.
2. To impart knowledge on apparatus protection
3. To introduce static and numerical relays
4. To impart knowledge on functioning of circuit breakers

Course Outcomes (COs):

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

Course Outcome (s)		**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Test the operation of various protective devices used in power system	3	Apply
CO2	Evaluate the operating characteristics of relays and circuit breaker	4	Analyze
CO3	Test the various protection schemes employed for generator protection	4	Analyze

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	-		-	-	-	3	3	1	2	2	2
CO2	2	2	1	2	2	-	-	-	3	3	1	2	2	2
CO3	2	2	1	2	2	-	-	-	3	3	1	2	2	2

Course Contents

Ex. No	**Name of Experiment**	**Hrs.**	**COs**
1	Testing of Fuse, MCB and MCCB	2	1
2	Performance characteristics of IDMT type Induction over current relay	2	2
3	Performance characteristics of gas actuated buchholz relay for oil filled transformer using Virtual Lab	2	2
4	Performance Characteristics of digital over current relay	2	2
5	Performance Characteristics of Air Circuit Breaker	2	2
6	Performance characteristics of over current relay in Generator Protection Simulator	2	3
7	Performance characteristics of Differential Current Relay in Generator Protection Simulator	2	3
8	Performance characteristics of Over Voltage Relay in Generator Protection Simulator	2	3
9	Performance characteristics of Under Voltage Relay Protection Scheme in Generator Protection Simulator	2	3
10	Performance characteristics of Over/Under Frequency Relay in Generator Protection Simulator	2	3
11	Performance characteristics of Reverse Power Relay in Generator Protection Simulator	2	3

Text Books:

[T1]. Sunil S.Rao, "Switchgear and Protection", Khanna Publishers, New Delhi, 14th Edition, 2021, ISBN: 978-9387394728

[T2]. M.L.Soni, P.V.Gupta, U.S.Bhatnagar, A.Chakrabarti, "A Text Book on Power System Engineering", Dhanpat Rai & Co.,Jan 2016, ISBN : 9788177000207

[T3]. Stanley H. Horowitz, Arun G. Phadke , Power System Relaying, John Wiley, 2014, ISBN: 978-0-470-75878-6

References:

[R1] Badri Ram, D. N. Vishwakarma, "Power System Protection and Switchgear" Tata McGraw Hill Publishing Co. Ltd., 3rd edition, 2022, ISBN: 978-9355322852

[R2] H Lee Blackburn , "Protective Relaying- Principles and Applications", Dekker Publications, 3rd edition, 2007, ISBN:

978-0-9568678-0-3
[R3] Mason C.R., “Art and Science of Protective Relaying”, Wiley Eastern Limited, 1996, ISBN: 978-0471575528

E-References

[E1] Power System Protection and Switchgear (IIT Roorkee) https://archive.nptel.ac.in/courses/108/107/108107167/

EE407: CONTROL SYSTEM DESIGN LABORATORY

Teaching Scheme		**Examination Scheme**	
Practical:	**02 Hrs./Week**	**Oral:**	**50 Marks**
Credits:	**01**	**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	Apply sampling theorem and analyse peculiar non-linearities.	3 4	Applying Analysing
CO2	Apply concepts of state space approach for system design.	3	Applying
CO3	Apply PID controller and various compensators using hardware and software.	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	3	3	-	-	-	-	-	-	2	2	2
CO2	3	3	3	3	3	-	-	-	-	-	-	2	2	2
CO3	3	3	3	3	3	-	-	-	-	-	-	2	2	2

Course Contents

Any 8 of the following experiments are to be conducted.

Ex. No	**Name of Experiment**	**Hrs.**	**COs**
1	Demonstration of characteristics of peculiar nonlinearities using software.	02	CO1
2	Demonstration of effect of sampling and verification of sampling theorem.		**CO1**
3	Software programming for determination of state space representation for given transfer function and vice-versa.	02	**CO2**
4	Calculation of state transition matrix, state X (t), Eigen values using MATLAB.	02	**CO2**
5	Test observability and controllability of the system	02	**CO2**
6	Demonstrate digital closed loop position control DC servomotor using optical encoder feedback.	02	**CO3**
7	Transformation of a continuous time system into digital control system and check response using software.	02	**CO3**
8	Evaluate closed loop performance of the control setup for different P, PI, PID controller settings.	02	**CO3**
9	Demonstrate PID simulator on Second order system.	02	**CO3**
10	Demonstrate performance characteristics of different compensators for given system using experimental kit and software.	02	**CO3**

Text Books:

[T1]. Norman S. Nise, Control System Engineering, 8th Edition, John Wily and Sons, Inc. 2018 ISBN 8126571837.
[T2]. Richard C. Dorf, Robert H. Bishop, Modern Control Systems, 13th Edition, Pearson Ed, ISBN 9780134407623.
[T3]. Benjamin C. Kuo, Digital Control System, Second Edition, Oxford University Press, 2007, ISBN 0195686209
[T4]. I. J. Nagarath, M. Gopal, Control System Engineering, 7th Edition, New Age International (P) Limited, Publishers, 2021, ISBN 8195175589
[T5]. A. Nagoor Kani, Advanced Control Theory, Third Edition, CBS Publishers and Distributes,2020, ISBN 9389396298

References:

[R1] M. Gopal, “Control Systems: Principles and Design”, McGraw Hill Education ISBN 9780071333269
[R2] B. C. Kuo, “Automatic Control System”, Prentice Hall, 2014, ISBN 9788126552337

E-Resources:

[E1] Control Engineering, IIT Delhi by Prof. M. Gopal (https://nptel.ac.in/courses/108102043)
[E2] NOC:Nonlinear and Adaptive Control, IIT Delhi by Prof. Shubhendu Bhasin (https://nptel.ac.in/courses/108102113)

EE416: HIGH VOLTAGE ENGINEERING LAB

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 of 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	Test the operation of various protective devices used in insulating materials.	3	Applying
CO2	Evaluate the operating characteristics of relays and circuit breaker	3	Applying
CO3	Test the various protection schemes employed for generator protection	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	-		-	-	-	3	3	1	2	1	2
CO2	2	2	1	2	2	-	-	-	3	3	1	2	1	2
CO3	2	2	1	2	2	-	-	-	3	3	1	2	1	2

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, ISBN 0-07-462286-2

[T2] C. L. Wadhwa, "High Voltage Engineering", New Age International Publishers Ltd,

ISBN 10: 8122418597 ISBN 13: 9788122418590

References:

[R1] E. Kuffel, W. S. Zaengl, J. Kuffel, "High Voltage Engineering Fundamentals", Newnes Publication, ***ISBN*** 0 7506 3634 3

[R2] Prof. D. V. Razevig Translated from Russian by Dr. M. P. Chourasia, "High Voltage Engineering", Khanna Publishers, New Delhi, ISBN: 978 - 0 - 620 – 3767-7.

[R3] Ravindra Arora, Wolf Gang Mosch, "High Voltage Insulation Engineering", New Age International ISBN 13 - 978-8122406191

[R4] High Voltage Engineering Theory and Practice by M. Khalifa Marcel Dekker Inc. New York, ***ISBN*** 10 0824781287

[R5] Subir Ray, "An Introduction to High voltage Engineering" PHI Pvt. Ltd. New Delhi, ***ISBN***, 8120347404

[R6] IS 731-1971:Porcelain insulator for overhead power lines with nominal voltage > 1000 Volt, ***ISBN-13: 978-0824748098***

[R7] Bushings :IS2099-1986,specification for bushings for A.C. Voltages > 1000 Volts, ***ISBN***-13: 978-0824748098

[R8] Pollution test :IEC 60507-1991 on external and internal insulator, ***ISBN***-10: 0824748093

[R9] High voltage test techniques, general definitions and test requirements: IS 2071(part 1) 1993,IEC Pub 60-1(1989), ISBN 60060-1:2010.

EE409: PROJECT STAGE I

Teaching Scheme		Examination Scheme	
Practical:	**06 Hrs./Week**	**Oral:**	**50 Marks**
		Term Work:	**100 Marks**
Credits:	**03**	**Total:**	**150 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	PSO3	PSO4
CO1	2	1	1	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	2	1
CO3	2	2	1	2	2	1	1	1	1	2	1	1	1	1	2	1
CO4	2	2	1	2	2	1	1	1	1	2	1	1	1	1	2	1
CO5	2	1	1	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	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: FINANCIAL SMART

Teaching Scheme		**Examination Scheme**	
Lectures:	**01 Hrs./Week**	**End-Sem Exam:**	**NA**
Credits:	**Non-Credit**	**Total:**	**PASS / FAIL**

Prerequisite Course:

Course Objectives:

1. Personal Financial Literacy Program for Young Adults - Being Financially Smart

Course Outcomes (COs):

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

	Course Outcome (s)	**Bloom's Taxonomy**	
		Level	**Descriptor**
CO1	Adapt psychology of money and financial management in daily life	3	Adapt
CO2	Set financial goals and plan accordingly	2	Set
CO3	Manage the risk involved in personal and business finance and investment	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	-	-	-	-	-	3	-	3	2	-	3	2	-	-
CO2	-	-	-	-	-	3	-	3	2	-	3	2	-	-
CO3	-	-	-	-	-	3	-	3	2	-	3	2	-	-

Course Contents			
UNIT I	**Behavioural Finance**	**Hrs.**	**COs**
	Section 1 – Let's Talk Money 1. Psychology of Money 2. Your Relationship with Money 3. Human Behaviour in Financial Markets Section 2 –Why Financial Literacy? 1. Importance of Financial Literacy 2. Costly Money Mistakes	3	CO1
UNIT II	**Money Management Skills**	**Hrs.**	**COs**
	Section 1 – Important Concepts 1. Saving vs Investing 2. Inflation 3. Power of Compounding Section 2 – Money Management Techniques 1. S.M.A.R.T.E.R way to Wealth 2. Money Jar Method	3	CO1
	Micro-Project 1 - Exercise		
UNIT III	**Steps of Financial Planning**	**Hrs.**	**Cos**
	Section 1 – Let's Start Planning 1. Need & Components of Financial Planning 2. Personal Income Statement– Cashflow Mgt & NetWorth Mgt. 3. S.M.A.R.T Goal Setting Section 2 - Goal Based Investment Planning 1. Contingency/Emergency Fund Planning 2. Lifestyle/ Retirement Planning 3. Estate Planning	3	CO2
UNIT IV	**Risk & Investment Management**	**Hrs.**	**Cos**
	Section 1 - Risk Management 1.Understanding Risk Management 2. Life Insurance	3	CO3

	3. Health Insurance Section 2 - Investment Management 1. Asset Allocation 2. Mutual Funds - Overview 3. Review & Action		
Micro-Project 2 - Case Study			
UNIT V	**Introduction to Business Finance**	**Hrs.**	**Cos**
	1. H ow to Read an Income Statement 2. How to Read a Balance Sheet	3	CO3
Post -session: - 1. Evaluation 2. Feedback 3. Certification			

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