Mahatma Gandhi Institute of Technology (Autonomous)
B.Tech. in Electrical and Electronics Engineering
Scheme of Instruction and Examination
(Choice Based Credit System)
Applicable for the batches admitted from Academic Year 2022-23

V SEMESTER

S.No.	Course Code	Course Title	Instruction Hours per week			Examination Max. Marks		Duration of SEE in Hours	Credits
			L	T	P	CIE	SEE		
1	EE501PC	Power Electronics	3	1	0	40	60	3	4
2	EE502PC	Control Systems	3	1	0	40	60	3	4
3	EE503PC	Electrical Machines - III	3	0	0	40	60	3	3
4		Professional Elective - I	3	0	0	40	60	3	3
5	MS501HS	Business Economics and Financial Analysis	3	0	0	40	60	3	3
6	EE551PC	Electrical Machines Laboratory - II	0	0	2	40	60	3	1
7	EE552PC	Power Electronics Laboratory	0	0	2	40	60	3	1
8	EE553PC	Control Systems Laboratory	0	0	2	40	60	3	1
9	MC502ES	Artificial Intelligence	3	0	0	40	60	3	0
10	MC501HS	Intellectual Property Rights	3	0	0	40	60	3	0
		Total	**21**	**2**	**6**	**400**	**600**		**20**

VI SEMESTER

S.No.	Course Code	Course Title	Instruction Hours per week			Examination Max. Marks		Duration of SEE in Hours	Credits
			L	T	P	CIE	SEE		
1		Open Elective - I	3	0	0	40	60	3	3
2		Professional Elective - II	3	0	0	40	60	3	3
3	EE601PC	Microprocessors and Microcontrollers	3	0	0	40	60	3	3
4	EE602PC	Power System Protection	3	0	0	40	60	3	3
5	EE603PC	Power System Operation and Control	3	0	0	40	60	3	3
6	EE651PC	Power Systems Laboratory	0	0	2	40	60	3	1
7	EE652PC	Microprocessors and Microcontrollers Laboratory	0	0	2	40	60	3	1
8	EN651HS	Advanced English Communication Skills Laboratory	0	0	2	40	60	3	1
9	MC602ES	Cyber Security	3	0	0	40	60	3	0
10	EE653PC	Industry Oriented Mini Project/ Internship	0	0	4	-	100	3	2
		Total	**18**	**0**	**10**	**360**	**640**		**20**
11	MC601BS	*Environmental Science	3	0	0	40	60	3	0

***For Lateral Entry Students only**

Mahatma Gandhi Institute of Technology (Autonomous)
B.Tech. in Electrical and Electronics Engineering
Scheme of Instruction and Examination
(Choice Based Credit System)
Applicable for the batches admitted from Academic Year 2022-23

VII SEMESTER

S.No.	Course Code	Course Title	Instruction			Examination			Credits
			Hours per week			Max. Marks		Duration of SEE in Hours	
			L	T	P	CIE	SEE		
1	EE701PC	Power Electronic Applications to Renewable Energy Systems	3	1	0	40	60	3	4
2		Open Elective - II	3	0	0	40	60	3	3
3		Professional Elective - III	3	0	0	40	60	3	3
4		Professional Elective - IV	3	0	0	40	60	3	3
5	MS702HS	Fundamentals of Management for Engineers	2	0	0	40	60	3	2
6	EE751PC	Simulation of Renewable Energy Systems Laboratory	0	0	4	40	60	3	2
7	EE752PC	Project Stage - I	0	0	6	100	-	-	3
		Total	**14**	**1**	**10**	**340**	**360**		**20**

VIII SEMESTER

S.No.	Course Code	Course Title	Instruction			Examination			Credits
			Hours per week			Max. Marks		Duration of SEE in Hours	
			L	T	P	CIE	SEE		
1		Open Elective - III	3	0	0	40	60	3	3
2		Professional Elective - V	3	0	0	40	60	3	3
3		Professional Elective - VI	3	0	0	40	60	3	3
4	EE851PC	Project Stage - II including Seminar	0	0	22	40	60	-	11
		Total	**9**	**0**	**22**	**160**	**240**		**20**

L: Lecture T: Tutorial D: Drawing P: Practical

CIE: Continuous Internal Evaluation SEE: Semester End Examination

Semester	I	II	III	IV	V	VI	VII	VIII
Credits	20	20	20	20	20	20	20	20

Professional Elective – I

EE511PE	IoT Applications in Electrical Engineering
EE512PE	High Voltage Engineering
EE513PE	Power Systems Analysis

Professional Elective - II

EE611PE	Signals and Systems
EE612PE	Power Semiconductor Drives
EE613PE	Wind and Solar Energy systems

Professional Elective-III

EE711PE	Mobile Application Development
EE712PE	Digital Signal Processing
EE713PE	Electric and Hybrid Vehicles

Professional Elective-IV

EE714PE	HVDC Transmission
EE715PE	Power System Reliability
EE716PE	Advanced Electrical Drives

Professional Elective-V

EE811PE	Utilization of Electrical Energy
EE812PE	Solar Power Batteries
EE813PE	AI Techniques in Electrical Engineering

Professional Elective-VI

EE814PE	Smart Grid Technologies
EE815PE	Electrical Distribution Systems
EE816PE	Power Quality and FACTS

OPEN ELECTIVES OFFERED BY EEE DEPARTMENT

Open Elective-I:

EE621OE	Electrical Engineering Materials
EE622OE	Non - Conventional Power Generation

Open Elective-II:

EE721OE	Energy Conservation and Green Building
EE722OE	Conventional Power Generation

Open Elective-III:

EE821OE	Energy Storage Systems
EE822OE	Electrical Systems and Safety

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)

B.Tech. in Electrical and Electronics Engineering

V Semester Syllabus

EE501PC: POWER ELECTRONICS

L	T	P	C
3	1	0	4

Prerequisite: Electrical Circuits and Basic Electronics

Course Objectives:

1. To introduce students to the basic theory of power semiconductor devices and passive components and their practical applications in Power Electronics.
2. To familiarize students to the principle of operation, design and synthesis of different power conversion circuits and their applications.
3. To provide strong foundation for further study of power electronic circuits and systems.
4. To design / develop suitable power converter for efficient control or conversion of power in drive applications.
5. To design / develop suitable power converter for efficient transmission and utilization of power in power system applications.

Course Outcomes:

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

1. Relate basic semiconductor to properties of power devices.
2. Analyze the AC voltage controllers and Cycloconverters.
3. Analyze controlled rectifier circuits.
4. Analyze the operation of DC-DC choppers.
5. Analyze the operation of voltage source inverters.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To introduce students to the basic theory of power semiconductor devices and passive components and their practical applications in Power Electronics	3	2	2	-	2	-	-	-	-	-	-	2
To familiarize students to the principle of operation, design and synthesis of different power conversion circuits and their applications	3	3	2	-	2	-	-	-	-	-	-	2
To provide strong foundation for further study of power electronic circuits and systems	2	3	2	-	2	-	-	-	-	-	-	2

To design / develop suitable power converter for efficient control or conversion of power in drive applications	3	3	2	-	2	-	-	-	-	-	-	2
To design / develop suitable power converter for efficient transmission and utilization of power in power system applications	3	3	2	-	2	-	-	-	-	-	-	2

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Relate basic semiconductor to properties of power devices	2	2	2	-	2	-	-	-	-	-	-	2
Analyze the AC voltage controllers and Cycloconverters	3	3	2	-	2	-	-	-	-	-	-	2
Analyze controlled rectifier circuits	3	3	2	-	2	-	-	-	-	-	-	2
Analyze the operation of DC-DC choppers	3	3	2	-	2	-	-	-	-	-	-	2
Analyze the operation of voltage source inverters	3	3	2	-	2	-	-	-	-	-	-	2

UNIT - I: POWER SWITCHING DEVICES

Concept of power electronics, scope and applications, types of power converters, Power semiconductor switches and their V-I characteristics, Power Diodes, Power BJT, Power MOSFET, Power IGBT, SCR, Two Transistor Analogy, Turn-on methods of SCR, methods of SCR commutation, Firing circuits of SCR, Thyristor ratings and protection

UNIT - II: AC-AC CONVERTERS

AC Voltage Regulator: Introduction, principle of operation of single-phase voltage controllers for R, R-L loads and its applications, problems. Cyclo-converter, Principle of operation of single phase cyclo-converters, relevant waveforms, circulating current mode of operation, Advantages and disadvantages, Applications

UNIT - III: AC-DC CONVERTERS (PHASE CONTROLLED RECTIFIERS)

Principles of single-phase fully-controlled converter with R, RL, and RLE load, Principles of single-phase half-controlled converter with RL and RLE load, Principles of three-phase fully-controlled converter operation with RLE load, Effect of load and source inductances, Single phase and Three phase dual converters

UNIT - IV: DC-DC CONVERTERS

Introduction, Step down, step up, step up/down choppers, control strategies, chopper classification, Buck, Boost and Buck-Boost converters: Power circuit, analysis and waveforms at steady state, relation between duty ratio and average output voltage, Problems.

UNIT - V: DC-AC CONVERTERS

Introduction, principle of operation, performance parameters, single - phase bridge inverters with R, RL loads, Voltage control of single-phase inverters, single pulse width modulation, multiple pulse width modulation, sinusoidal pulse width modulation, Three - phase bridge inverters with 120^o and 180^o mode of operation.

Suggested Readings:

1. Dr. P. S. Bimbra, "Power Electronics", Khanna Publishers, 7^{th} Edition, Jan'2022.
2. Muhammad H Rashid, Power Electronics Devices, Circuits, and Applications, Pearson, 2017, Fourth edition.

Reference Books:

1. R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science & Business Media, 2007.
2. L. Umanand, "Power Electronics: Essentials and Applications", Wiley India, 2009.
3. N. Mohan and T. M. Undeland, "Power Electronics: Converters, Applications and Design", John Wiley & Sons, 2007.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)

B. Tech. in Electrical and Electronics Engineering

V Semester Syllabus

EE502PC: CONTROL SYSTEMS

L	T	P	C
3	1	0	4

Prerequisite: Ordinary Differential Equations and Vector Calculus, Electrical Circuit Analysis - I

Course Objectives:

1. To understand the system representation using Transfer function and to assess the system dynamic response.
2. To assess the system performance using time domain analysis and methods for improving it.
3. To assess the system performance using frequency domain analysis and techniques for improving the performance.
4. Understand various compensators to improve system performance.
5. To understand the system representation using state space and to assess the system dynamic response.

Course Outcomes:

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

1. Represent a system using Transfer function and assess the system dynamic response.
2. Assess the system performance using time domain analysis and analyze how to improve the performance.
3. Assess the system performance using frequency domain analysis and analyze how to improve the performance.
4. Understand various compensators to improve system performance.
5. Represent the system using state space and assess the system dynamic response.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To understand the system representation using Transfer function and to assess the system dynamic response	3	3	2	2	2	-	-	-	-	-	-	-
To assess the system performance using time domain analysis and methods for improving it	3	3	3	2	3	-	-	-	-	-	-	-
To assess the system performance using frequency domain analysis and techniques for improving the performance	3	3	3	2	3	-	-	-	-	-	-	-
Understand various compensators to improve system performance	3	3	3	3	2	-	-	-	-	-	-	-

To understand the system representation using state space and to assess the system dynamic response	3	3	3	3	3	-	-	-	-	-	-	-

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Students will be able to represent a system using Transfer function and assess the system dynamic response	3	3	2	2	2	-	-	-	-	-	-	-
Students will be able to assess the system performance using time domain analysis and analyze how to improve the performance	3	3	3	2	3	-	-	-	-	-	-	-
Students will be able to assess the system performance using frequency domain analysis and analyze how to improve the performance	3	3	3	2	3	-	-	-	-	-	-	-
Students will be able to understand various compensators to improve system performance	3	3	3	3	2	-	-	-	-	-	-	-
Students will be able to represent the system using state space and assess the system dynamic response	3	3	3	3	3	-	-	-	-	-	-	-

UNIT-I: INTRODUCTION TO CONTROL PROBLEM

Industrial Control examples. Classification of control systems, Open loop systems, closed loop systems, open loop versus closed loop systems. Feedback and its effects : effect of feedback on gain, effect of feedback on stability, effect of feedback on noise and external disturbance, effect of feedback on sensitivity. Mathematical models of physical systems – Translational and rotational systems, electrical systems. Control hardware and their models – DC Servo Motor, AC Servo Motor, Synchro Pair. Transfer function models of linear time-invariant systems. Block diagram algebra. Signal flow graph – Masons Gain formula.

UNIT-II: TIME RESPONSE ANALYSIS OF STANDARD TEST SIGNALS

Test signals - Step, Ramp, Parabolic, Impulse, Gate, Signum signals. Transient response and Steady State response. Time response of first order systems. Time response of second order systems for standard test inputs. Steady state error coefficients. Type and Order of control systems. Concept of Stability. Routh-Hurwitz Criteria. Relative Stability analysis. Root-Locus technique. Construction of Root - loci.

UNIT-III: FREQUENCY-RESPONSE ANALYSIS

Relationship between time and frequency response. Second order systems and Higher order systems. Polar plots and inverse polar plots. Bode plots – Basic factors of $G(j\omega)$ $H(j\omega)$. General rules for constructing bode plots. All Pass and Minimum Phase systems. Computation of Gain Margin and Phase Margin from Bode Plot. Relative stability based on the slope of the Log

Magnitude curve. Determination of transfer function from Bode plot. Principle of Argument. Nyquist stability criterion. Relative stability using Nyquist criterion – Gain and Phase Margin. Closed-loop frequency response.

UNIT-IV: COMPENSATORS & CONTROLLERS

Effect of adding poles and zeros to the transfer function. Effect of adding poles and zeros to G(s)H(s) on the root locus. P, P-I, P-D, P-I-D Controllers. Effects of the controller on the performance of the system. Types of Compensators- Lead Compensator, Lag Compensator, Lag – Lead Compensator. Realization of Basic Compensators. Applications of Proportional, Integral and Derivative Controllers. Applications of Lead, Lag compensating networks.

UNIT-V: STATE VARIABLE ANALYSIS AND CONCEPTS OF STATE VARIABLES

Modern Control Theory versus Conventional Control Theory. Concept of State, State Variable, State Space and State space model. State Space representation by Physical Variables, Phase Variables. Direct Decomposition, Cascade Decomposition, Parallel Decomposition. Diagonalization of State Matrix. Solution of state equations. Computation of the State Transition Matrix. Eigen values and Stability Analysis. Concept of controllability and observability. Testing for Controllability and Observability.

Suggested Readings:

1. I. J. Nagrath and M. Gopal, “Control Systems Engineering”, New Age International, 2009.
2. A. Anand Kumar, “Control Systems”, PHI Learning Pvt. Ltd., 2007.
3. A. Nagoor Kani, “Control Systems”, RBS Publications.

Reference Books:

1. K. Ogata, “Modern Control Engineering”, Prentice Hall, 1991.
2. M.Gopal, “Control Systems: Principles and Design”, Mc Graw Hill Education, 1997.
3. A. K. Jairath, “Problems and Solutions in Control Systems” Khanna Publishers.
4. B. C. Kuo, “Automatic Control System”, Prentice Hall, 1995.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
B. Tech. in Electrical and Electronics Engineering
V Semester Syllabus
EE503PC: ELECTRICAL MACHINES - III

L	T	P	C
3	0	0	3

Prerequisite: Electrical Machines-I and Electrical Machines -II

Course Objectives:

1. To study and understand synchronous machine -it's construction, operation, and applications.
2. To study and understand different methods of determination of voltage regulation of an alternator.
3. To understand the concepts of synchronization of alternators.
4. To study and understand concepts of V and Inverted-V curves and different methods of starting of synchronous motors.
5. To study and understand 1-phase induction motor - it's construction, operation, and applications.

Course Outcomes:

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

1. Identify different parts of a synchronous machine & understand it's operation.
2. Perform the different methods of determining the voltage regulation of an alternator.
3. Understand the synchronization of alternator.
4. Understand the concepts of V and Inverted-V curves and carry out different starting methods of synchronous motors.
5. Analyze single-phase induction motor and it's performance through testing.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To study and understand synchronous machine – it's construction, operation, and applications	2	1	2	-	2	-	-	-	-	-	-	-
To study and understand different methods of determination of voltage regulation of an alternator	3	3	2	2	3	-	-	-	-	-	-	-
To understand the concepts of synchronization of alternators	2	3	3	2	2	-	-	-	-	-	-	-
To study and understand concepts of V and Inverted-V curves and different methods of starting of synchronous motors	3	3	2	2	2	2	-	-	-	-	-	-

Analyze single-phase induction motor and it's performance through testing	3	2	2	3	2	-	-	-	-	-	-	-

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Identify different parts of a synchronous machine and understand it's operation	2	1	2	-	2	-	-	-	-	-	-	-
Perform the different methods of determining the voltage regulation of an alternator	3	3	2	2	3	-	-	-	-	-	-	-
Understand the synchronization of alternator	2	3	3	2	2	-	-	-	-	-	-	-
Understand the concepts of V and Inverted-V curves and carry out different starting methods of synchronous motors	3	3	2	2	2	2	-	-	-	-	-	-
Analyze single-phase induction motor and it's performance through testing	3	2	2	3	2	-	-	-	-	-	-	-

UNIT-I: SYNCHRONOUS MACHINES AND CHARACTERISTICS

Constructional Features of round rotor and salient pole machines – Armature windings – Integral slot and fractional slot windings; Distributed and concentrated windings – distribution, pitch and winding factors – E.M.F Equation. Harmonics in generated EMF – suppression of harmonics – armature reaction - leakage reactance – synchronous reactance and impedance – experimental determination - phasor diagram – load characteristics.

UNIT-II: REGULATION OF SYNCHRONOUS GENERATOR

Regulation by synchronous impedance method, M.M.F. method, Z.P.F. method and A.S.A. methods – salient pole alternators – two reaction analysis – experimental determination of X_d and X_q (Slip test) Phasor diagrams – Regulation of salient pole alternators.

UNIT-III: PARALLEL OPERATION OF SYNCHRONOUS GENERATOR

Synchronization of alternators with infinite bus bars – synchronizing power torque – parallel operation and load sharing - Effect of change of excitation and mechanical power input. Analysis of short circuit current wave form.

UNIT-IV: SYNCHRONOUS MOTORS

Theory of operation – phasor diagram – Variation of current and power factor with excitation – synchronous condenser – Mathematical analysis for power developed, hunting and its suppression, Methods of starting – synchronous motor.

UNIT-V: SINGLE PHASE MOTORS AND SPECIAL MACHINES

Single phase Motors: Single phase induction motor – Constructional features-Double revolving field theory Equivalent circuit – split-phase motors – Capacitor start Capacitor run motors. Principles of AC Series motor-Universal motor, Shaded pole motor, (Qualitative Treatment only).

Suggested Readings:

1. Electrical Machines, P.S. Bimbra, Khanna Publishers.
2. Principles of Electrical Machines, V. K. Mehta, Rohit Mehta, S. Chand Publishing.

Reference Books:

1. Electro mechanics - III (Synchronous and single phase machines), S.Kamakashiah, Right Publishers.
2. Electric Machines, I.J. Nagrath & D.P. Kothari, Tata Mc Graw – Hill Publishers.
3. Performance and Design of AC Machines, MG.Say, BPB Publishers.
4. Theory of Alternating Current Machinery, Langsdorf, Tata McGraw-Hill Companies.
5. Electric machinery, A.E. Fitzgerald, C.Kingsley and S.Umans, McGraw Hill Companies.
6. Electric Machines, Mulukutla S. Sarma, Mukesh K. Pathak, Cengage Learning.
7. Fundamentals of Electric Machines, B. R. Gupta, Vandana Singhal, New Age International Publishers.
8. Electrical Machines, M. V. Deshpande, PHI Learning Private Limited.
9. Electrical Machines, R. K. Srivastava, Cengage Learning.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
B. Tech. in Electrical and Electronics Engineering
V Semester Syllabus
EE511PE: IoT APPLICATIONS IN ELECTRICAL ENGINEERING (PE-I)

L	T	P	C
3	0	0	3

Prerequisite: Programming and Digital Electronics

Course Objectives:

1. To familiarize about various sensors that can be used in IoT applications.
2. To provide the knowledge on motion detectors for IoT applications.
3. To know about Micro Electro Mechanical Systems (MEMS) fundamentals in design process.
4. To understand about applications of IoT in smart grid.
5. To understand the concept of IoE for various applications.

Course Outcomes:

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

1. Understand about usage of various types of sensors.
2. Understand about usage of various types of motion detectors.
3. Design Micro Electro Mechanical Systems (MEMS) based sensors.
4. Understand various applications of IoT in smart grid.
5. Understand future working environment with Energy internet.

Course Objectives	**Program Outcomes**											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To familiarize about various sensors that can be used in IoT applications	2	2	2	-	2	2	1	-	-	-	-	3
To provide the knowledge on motion detectors for IoT applications	2	2	2	-	2	2	1	-	-	-	-	3
To know about Micro Electro Mechanical Systems (MEMS) fundamentals in design process	2	2	2	-	2	2	1	-	-	-	-	3
To understand about applications of IoT in smart grid	2	2	2	-	2	2	1	-	-	-	-	3
To understand the concept of IoE for various applications	2	2	2	-	2	2	1	-	-	-	-	3

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Understand about usage of various types of sensors	2	2	2	-	2	2	1	-	-	-	-	3
Understand about usage of various types of motion detectors	2	2	2	-	2	2	1	-	-	-	-	3
Design Micro Electro Mechanical Systems (MEMS) based sensors	2	2	2	-	2	2	1	-	-	-	-	3
Understand various applications of IoT in smart grid	2	2	2	-	2	2	1	-	-	-	-	3
Understand future working environment with Energy internet	2	2	2	-	2	2	1	-	-	-	-	3

UNIT I: SENSORS

Sensors: Definitions, Terminology, Classification, Temperature sensors, Thermo-resistive, Resistance, temperature detectors, Silicon resistive thermistors, Semiconductor, Piezoelectric, Humidity and moisture sensors. Capacitive, Electrical conductivity, Thermal conductivity, time domain reflectometer, Pressure and Force sensors: Piezo-resistive, Capacitive, force, strain and tactile sensors, Strain gauge, Piezoelectric.

UNIT II: OCCUPANCY AND MOTION DETECTORS

Occupancy and Motion detectors: Capacitive occupancy, Inductive and magnetic, potentiometric - Position, displacement and level sensors, Potentiometric, Capacitive, Inductive, magnetic velocity and acceleration sensors, Capacitive, Piezo-resistive, piezoelectric cables, Flow sensors, Electromagnetic, Acoustic sensors -Resistive microphones, Piezoelectric, Photo resistors.

UNIT III: MEMS

MEMS: Basic concepts of MEMS design, Beam/diaphragm mechanics, electrostatic actuation and fabrication, Process design of MEMS based sensors and actuators, Touch sensor, Pressure sensor, RF MEMS switches, Electric and Magnetic field sensors.

UNIT IV: IoT FOR SMART GRID

IoT for Smart grid: Driving factors, Generation level, Transmission level, Distribution level, Applications, Metering and monitoring applications, Standardization and interoperability, Smart home.

UNIT V: INTERNET OF ENERGY

Internet of Energy: Concept of Internet of Energy, Evaluation of IoE concept, Vision and motivation of IoE, Architecture, Energy routines, information sensing and processing issues, Energy internet as smart grid.

TEXT BOOKS:

1. Jon S. Wilson, "Sensor Technology Hand book", Newnes Publisher, 2004.
2. Tai Ran Hsu, "MEMS and Microsystems: Design and manufacture", 1st Edition, McGraw Hill Education, 2017.
3. Ersan Kabalci and Yasin Kabalci, "From Smart grid to Internet of Energy", 1st Edition, Academic Press, 2019.

REFERENCE BOOKS:

1. Raj Kumar Buyya and Amir Vahid Dastjerdi, "Internet of Things: Principles and Paradigms", Kindle Edition, Morgan Kaufmann Publisher, 2016.
2. Yen Kheng Tan and Mark Wong, "Energy Harvesting Systems for IoT Applications": Generation, Storage and Power Management, 1st Edition, CRC Press, 2019.
3. RMD Sundaram Shriram, K. Vasudevan and Abhishek S. Nagarajan, "Internet of Things", Wiley, 2019.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
B.Tech. in Electrical and Electronics Engineering
V Semester Syllabus
EE512PE: HIGH VOLTAGE ENGINEERING (PE-I)

L	T	P	C
3	0	0	3

Prerequisite: Power Systems – I and Electro Magnetic Fields

Course Objectives:

1. To study and understand breakdown mechanism in gaseous, liquids and solid dielectrics.
2. To study and understand about generation of high voltages and currents.
3. To study and understand about measurement of high voltages and currents.
4. To gain the knowledge of how Overvoltages arise in a power system, and protection against these over-voltages.
5. To study and understand high voltage testing methods.

Course Outcomes:

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

1. Explain Breakdown mechanism in gaseous, liquids and solid dielectrics.
2. Describe various methods to generate high voltages and currents.
3. Describe various methods to measure high voltages and currents.
4. Analyze various Overvoltages.
5. Explain various tests on HV equipment.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To study and understand breakdown mechanism in gaseous, liquids and solid dielectrics	2	1	2	-	2	-	-	-	-	-	-	-
To study and understand about generation of high voltages and currents	3	3	2	2	3	-	-	-	-	-	-	-
To study and understand about measurement of high voltages and currents	2	3	3	2	2	-	-	-	-	-	-	-
To gain the knowledge of how over-voltages arise in a power system, and protection against these over-voltages	3	3	2	2	2	2	-	-	-	-	-	-
To study and understand high voltage testing methods	3	2	2	3	2	-	-	-	-	-	-	-

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Explain Breakdown mechanism in gaseous, liquids and solid dielectrics	2	1	2	-	2	-	-	-	-	-	-	-
Describe various methods to generate High voltages and currents	3	3	2	2	3	-	-	-	-	-	-	-
Describe various methods to measure High voltages and currents	2	3	3	2	2	-	-	-	-	-	-	-
Analyze various Overvoltages	3	3	2	2	2	2	-	-	-	-	-	-
Explain various tests on HV equipment	3	2	2	3	2	-	-	-	-	-	-	-

UNIT-I: CONDUCTION AND BREAKDOWN IN GASEOUS, LIQUIDS AND SOLID DIELECTRICS

Introduction, Breakdown in Gases- Ionization processes, Townsend's theory, Streamer mechanism, Breakdown in pure and commercial liquids, Solid dielectrics and composite dielectrics, Intrinsic breakdown, Electromechanical breakdown and Thermal breakdown, Partial discharge.

UNIT-II: GENERATION OF HIGH VOLTAGES

Generation of high D. C. and A.C. voltages, Generation of impulse voltages, Generation of impulse currents, Tripping and control of impulse generators.

UNIT-III: MEASUREMENTS OF HIGH VOLTAGES AND CURRENTS

Peak voltage, impulse voltage and high direct current measurement method, Cathode ray oscillographs for impulse voltage and current measurement, Measurement of dielectric constant and loss factor, Partial discharge measurements.

UNIT-IV: LIGHTNING AND SWITCHING OVER-VOLTAGES

Charge formation in clouds, Stepped leader, Dart leader, Lightning Surges. Switching over voltages, Protection against over-voltages, Surge diverters, Surge modifiers.

UNIT-V: HIGH VOLTAGE TESTING OF ELECTRICAL APPARATUS AND HIGH VOLTAGE LABORATORIES

Various standards for HV Testing of electrical apparatus, IS, IEC standards, Testing of insulators and bushings, Testing of isolators and circuit breakers, Testing of cables, Power transformers and some high voltage equipment, High voltage laboratory layout, Indoor and outdoor laboratories, Testing facility requirements, Safety precautions in HV Labs.

Suggested Readings:

1. M. S. Naidu and V. Kamaraju, "High Voltage Engineering", McGraw Hill Education, 2013.
2. C. L. Wadhwa, "High Voltage Engineering", New Age International Publishers, 2007.

Reference Books:

1. D. V. Razevig (Translated by Dr. M. P. Chourasia), "High Voltage Engineering Fundamentals", Khanna Publishers, 1993.
2. E. Kuffel, W. S. Zaengl and J. Kuffel, "High Voltage Engineering Fundamentals", Newnes Publication, 2000.
3. R. Arora and W. Mosch "High Voltage and Electrical Insulation Engineering", John Wiley & Sons, 2011.
4. Various IS standards for HV Laboratory Techniques and Testing.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)

B.Tech. in Electrical and Electronics Engineering

V Semester Syllabus

EE513PE: POWER SYSTEMS ANALYSIS (PE-I)

L	T	P	C
3	0	0	3

Prerequisite: Power Systems-I and Power Systems-II

Course Objectives:

1. To understand per unit representation, incidence matrices
2. To study and understand Nodal Admittance matrix
3. To study and understand Power flow studies
4. To study and understand Symmetrical components
5. To understand and analyze faults in power system network

Course Outcomes:

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

1. Understand per unit representation, incidence matrices
2. Study and understand Nodal Admittance matrix
3. Study and understand Power flow studies
4. Study and understand Symmetrical components
5. Understand and analyze faults in power system network

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To understand per unit representation, incidence matrices	2	3	2	3	-	-	-	-	-	-	-	-
To study and understand Nodal Admittance matrix	3	3	2	2	-	-	-	-	-	-	-	-
To study and understand Power flow studies	2	3	3	2	-	-	-	-	-	-	-	-
To study and understand Symmetrical components	3	3	2	2	-	-	-	-	-	-	-	-
To understand and analyze faults in power system network	3	2	2	3	-	-	-	-	-	-	-	-

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Understand per unit representation, incidence matrices	2	3	2	3	-	-	-	-	-	-	-	-
Study and understand Nodal Admittance matrix	3	3	2	2	-	-	-	-	-	-	-	-
Study and understand Power flow studies	2	3	3	2	-	-	-	-	-	-	-	-

Study and understand Symmetrical components	3	3	2	2	-	-	-	-	-	-	-	-
Understand and analyze faults in power system network	3	2	2	3	-	-	-	-	-	-	-	-

UNIT-I: PER UNIT REPRESENTATION IN POWER SYSTEMS AND POWER SYSTEM NETWORK MATRICES

Per Unit Representation in Power Systems: Introduction, Single line diagram, Absolute systems, Comparison of Absolute and Per unit systems, Expressing per unit reactance in terms of base MVA and base kV, Advantages of per unit system.

Power System Network Matrices: Introduction, Graph Theory: Definitions, Incidence matrices: Element-Node incidence matrix and Bus incidence matrix, Primitive element and primitive network, Impedance form representation and admittance form representation, Primitive admittance matrix and primitive impedance matrix.

UNIT-II: NODAL ADMITTANCE MATRIX, Y_{BUS}

Introduction. Classification of buses, Nodal admittance matrix of an interconnected power system network, Properties of nodal admittance matrix, Direct inspection method and Step by step method, Static load flow equations and voltage at i^{th} bus.

UNIT-III: POWER FLOW STUDIES

Introduction, Gauss Seidel method, Newton Raphson method in rectangular form and polar form, Derivation of Jacobian elements, Decoupled load flow method, Fast Decoupled load flow method, Comparison of different load flow methods.

UNIT-IV: SYMMETRICAL COMPONENTS

Introduction, Phase sequence, Significance of positive, negative and zero sequence components, Significance of operator- 'k' or 'a' or 'α', Expressing three phase unbalanced voltages in terms of symmetrical voltage components, Expressing symmetrical voltage components in terms of three phase unbalanced voltages, Sequence generated voltages during fault, Neutral current and voltage to neutral, Neutral to ground connections, Zero sequence networks of three phase Transformer, Sequence networks of Alternator.

UNIT-V: FAULT ANALYSIS

Introduction, Classification of faults, Electrical properties of shunt or short circuit faults and series or open circuit faults, Unsymmetrical shunt fault analysis-single line to ground fault, line to line fault, double line to ground fault, Symmetrical shunt fault analysis-three phase fault or line to line to line fault, Short circuit capacity of a bus.

Suggested Readings:

1. Stagg and El-Abiad, "Computer Methods in Power System Analysis", Mc Graw Hill, 1968.
2. C. L. Wadhwa, "Electrical Power Systems", New Age International Publishers, 6th Edition.
3. J. Nagrath and D. P. Kothari, "Modern Power System Analysis", Tata Mc Graw Hill Publishing Company, 4th Edition, 2011.

Reference Books:

1. Grainger and Stevenson, “Power System Analysis”, Tata Mc Graw Hill, 2003.
2. Hadi Saadat, “Power System Analysis”, Tata Mc Graw Hill, 2002.
3. William D Stevenson, “Elements of Power System Analysis”, Mc Graw Hill,1982.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)

B.Tech. in Electrical and Electronics Engineering

V Semester Syllabus

MS501HS: BUSINESS ECONOMICS AND FINANCIAL ANALYSIS

(Common to CIVIL, EEE, MEC, ECE, MCT, MME & CSE (AI & ML))

L	T	P	C
3	0	0	3

Course Objectives: The Objective of the course are:

1. Students will understand various forms of Business and the impact of economic variables on the business, concepts of Business Economics and its significance.
2. Gain the knowledge on various market dynamics namely Demand, elasticity of demand, and demand forecasting.
3. To disseminate the knowledge on production function, Laws of production, Market structures, while dealing with the concept of cost and breakeven analysis.
4. To acquaint the students regarding Accounting and various books of accounts.
5. To enable the students to analyze a company's financial statements through ratios and come to a reasoned conclusion about the financial situation of the company.

Course Outcomes: After completion of the course the students will be able to:

1. Select a suitable business organization with available resources.
2. Analyze various aspects of Demand, Elasticity of demand and Demand Forecasting.
3. Gain knowledge on different market structures, production theories, cost variables and pricing methods.
4. Prepare Books of accounts and Financial Statements.
5. Analyze financial well-being of the business while using ratios.

UNIT – I: INTRODUCTION TO BUSINESS AND ECONOMICS

Economics: Significance of Economics, Micro and Macro Economic Concepts, National Income - Concepts and Importance, Inflation, Business Cycle - Features and Phases.

Business: Structure of Business Firm, Types of Business Entities – Sole Proprietorship - Partnership – Cooperative Societies - Limited Liability Companies, Sources of Capital - Conventional sources and Non - Conventional Sources of Finance.

Business Economics: Nature and Scope of Business Economics, Role of Business Economist, Multidisciplinary nature of Business Economics.

UNIT – II: DEMAND AND SUPPLY ANALYSIS

Demand Analysis: Demand - Meaning, Determinants of Demand, Law of Demand, Exceptions of Law of Demand, Demand Function, Changes in Demand – Increase and decrease in Demand - Extension and Contraction in Demand.

Elasticity of Demand: Elasticity – Meaning, Types of Elasticity – Price Elasticity – Income Elasticity – Cross Elasticity–Advertising Elasticity of Demand, Factors affecting Elasticity of Demand, Measurement and Significance of Elasticity of Demand, Elasticity of Demand in decision making.

Demand Forecasting: Characteristics of Good Demand Forecasting, Steps in Demand Forecasting, Methods of Demand Forecasting – Survey methods, Statistical methods.

Supply Analysis: Supply – Meaning, Determinants of Supply, Supply Function & Law of Supply.

UNIT III: PRODUCTION, COST, MARKET STRUCTURES & PRICING

Production Analysis: Production – Meaning, Factors of Production, Production Function, Production Function with one variable input, two variable inputs, Returns to Scale, Cobb-Douglas production function.

Cost analysis: Cost–Meaning, Types of Costs, Short run and Long run Cost Functions.

Market Structures: Nature of Competition, Features of Perfect competition, Monopoly, Oligopoly, Monopolistic Competition.

Pricing: Pricing -Meaning, Objectives of pricing, pricing methods – Cost based pricing methods – Demand based pricing methods – Competition based pricing methods – Strategy based pricing methods - Product Life Cycle based Pricing, Break Even Analysis (simple problems), Cost Volume Profit Analysis.

UNIT IV: FINANCIAL ACCOUNTING

Accounting concepts and Conventions, Accounting Equation, Double-Entry system of Accounting, Rules for maintaining Books of Accounts, Journal, Posting to Ledger, Preparation of Trial Balance, Elements of Financial Statements, Preparation of Final Accounts along with adjustments– Trading account – Profit and loss account – Balance sheet (simple problems).

UNIT – V: FINANCIAL ANALYSIS THROUGH RATIOS

Concept of Ratio Analysis, Importance, Liquidity Ratios- Current Ratio – Quick Ratio – Absolute Liquid Ratio, Profitability Ratios – Gross Profit Ratio – Net Profit Ratio – Operating Ratio, Turnover Ratios – Stock Turnover Ratio – Debtors Turnover Ratio – Creditors Turnover Ratio, Leverage Ratios – Debt-to-Assets Ratio - Debt-Equity Ratio - Proprietary Ratios and interpretation (simple problems).

TEXT BOOKS:

1. Geethika Ghosh, Piyali Gosh, Purba Roy Choudhury, “Managerial Economics”, 2e, Tata McGraw Hill Education Pvt. Ltd. 2012.
2. Dhanesh K Khatri, “Financial Accounting”, Tata McGraw Hill, 2011.
3. Ramachandra Aryasri. A, “Business Economics and Financial Analysis”, McGraw Hill Education India Pvt. Ltd. 2020.

REFERENCE BOOKS:

1. P. L. Mehta, Managerial Economics, Analysis, Problems & Cases, 8th Edition, Sultan Chand & Sons, 2001.
2. S.N. Maheshwari, Sunil K Maheshwari, Sharad K Maheshwari, Financial Accounting, 5e, Vikas Publications, 2013.
3. D.D. Chaturvedi, S.L. Gupta, “Business Economics - Theory and Applications”, International Book House Pvt. Ltd. 2013.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)

B.Tech. in Electrical and Electronics Engineering

V Semester Syllabus

EE551PC: ELECTRICAL MACHINES LABORATORY-II

L	T	P	C
0	0	2	1

Prerequisite: Electrical Machines -I and Electrical Machines - II

Course Objectives:

1. To understand the operation of synchronous machines.
2. To understand the equivalent circuit of a single phase transformer and single phase induction motor.
3. To understand the circle diagram of an induction motor by conducting a blocked rotor test.
4. To understand the determination of X_d and X_q of salient pole synchronous machine.
5. To understand the regulation of alternator for different loads.

Course Outcomes:

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

1. Assess the performance of different machines using different testing methods.
2. Develop the equivalent circuit of single phase transformer and single phase induction motor.
3. Construct the circle diagram of a 3-Φ Induction Motor.
4. Determine the X_d and X_q of salient pole synchronous machine.
5. Determine the regulation of alternator for different loads.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To understand the operation of synchronous machines	3	3	3	3	3	3	2	2	1	2	2	1
To understand the equivalent circuit of a single phase transformer and single phase induction motor	3	3	3	1	1	3	1	2	1	2	2	1
To understand the circle diagram of an induction motor by conducting a blocked rotor test	3	3	3	1	1	3	1	2	1	2	2	1
To understand the determination of X_d and X_q of salient pole synchronous machine	3	3	2	1	2	3	2	1	2	1	2	3
To understand the regulation of alternator for different loads	3	2	-	-	2	-	1	-	2	-	2	3

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Assess the performance of different machines using different testing methods	3	3	3	3	3	3	2	2	1	2	2	1

Develop the equivalent circuit of single phase transformer and single phase induction motor	3	3	3	1	1	3	1	2	1	2	2	1
Construct the circle diagram of a 3-Φ Induction Motor	3	3	3	1	1	3	1	2	1	2	2	1
Determine the X_d and X_q of salient pole synchronous machine	3	3	2	1	2	3	2	1	2	1	2	3
Determine the regulation of alternator for different loads	3	2	-	-	2	-	1	-	2	-	2	3

The following experiments are required to be conducted as compulsory experiments:

1. O.C. & S.C. Tests on Single-phase Transformer.
2. Sumpner's test on a pair of single-phase transformers.
3. Brake test on three-phase Induction Motor.
4. No-load and Blocked rotor tests on three - phase Induction motor.
5. Regulation of a three-phase alternator by synchronous impedance and m.m.f. methods.
6. 'V' and 'Inverted V' curves of a three - phase synchronous motor.
7. Equivalent Circuit of a single-phase induction motor.
8. Determination of Xd and Xq of a salient pole synchronous machine.

In addition to the above eight experiments, at least any two of the following experiments are required to be conducted from the following list:

1. Separation of core losses of a single-phase transformer.
2. Scott connection of transformers.
3. Regulation of three - phase alternator by Z.P.F method.
4. Heat run test on three – phase delta connected transformer.

Suggested Readings:

1. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
2. I.J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.

Reference Books:

1. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
2. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
B. Tech. in Electrical and Electronics Engineering
V Semester Syllabus
EE552PC: POWER ELECTRONICS LABORATORY

L	T	P	C
0	0	2	1

Prerequisites: Power Electronics

Course Objectives:

1. To apply the concepts of power electronic converters for efficient conversion/control of power from source to load.
2. To familiarize students to the principle of operation, design and synthesis of different power conversion circuits and their applications.
3. To provide strong foundation for further study of power electronic circuits and systems.
4. To Design/develop suitable power converter for efficient control or conversion of power in drive applications.
5. To design the power converter with suitable switches meeting a specific load requirement.

Course Outcomes:

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

1. Understand the characteristics of SCR, MOSFET, and IGBT.
2. Understand the operating principles of AC to DC, AC to AC converters.
3. Analyze and choose the appropriate converters for various applications.
4. Understand the operating principles of DC to DC and DC to AC converters.
5. Use power electronic simulation packages & hardware to develop the power converters.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To apply the concepts of power electronic converters for efficient conversion / control of power from source to load	3	3	2	2	3	-	-	-	-	-	-	-
To familiarize students to the principle of operation, design and synthesis of different power conversion circuits and their applications	3	3	2	2	3	-	-	-	-	-	-	-
To provide strong foundation for further study of power electronic circuits and systems	3	3	2	2	3	-	-	-	-	-	-	-
To Design/develop suitable power converter for efficient	3	3	2	2	3	-	-	-	-	-	-	-

control or conversion of power in drive applications												
To design the power converter with suitable switches meeting a specific load requirement	3	3	2	2	3	-	-	-	-	-	-	-

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Understand the characteristics of SCR, MOSFET and IGBT	3	2	2	1	2	-	-	-	-	-	-	-
Understand the operating principles of AC to DC, AC to AC converters	3	3	2	2	2	-	-	-	-	-	-	-
Analyze and choose the appropriate converters for various applications	3	3	2	2	3	-	-	-	-	-	-	-
Understand the operating principles of DC to DC and DC to AC converters	3	3	2	2	3	-	-	-	-	-	-	-
Use power electronic simulation packages & hardware to develop the power converters	3	3	2	2	3	-	-	-	-	-	-	2

Any Eight experiments are required to be conducted from the following list of experiments.

1. Study of Characteristics of SCR, MOSFET & IGBT.
2. Gate firing circuits for SCRs.
3. Single Phase AC Voltage Controller with R and RL Loads.
4. Single Phase half controlled bridge converter with R and RL loads.
5. Single Phase fully controlled bridge converter with R and RL loads.
6. Forced Commutation circuits (Class A, Class B, Class C, Class D & Class E).
7. Single Phase Cyclo-converter.
8. Single Phase series inverter.
9. Single Phase parallel inverter.
10. Single Phase Bridge inverter.
11. DC Jones chopper.
12. Single-phase dual converter.

In addition to the above, any two experiments are required to be conducted from the following list of experiments.

1. (a) Simulation of single-phase half wave converter using R and RL loads.
   (b) Simulation of single-phase full converter using R, RL and RLE loads.
   (c) Simulation of single phase semi converter using R, RL and RLE loads.
2. (a) Simulation of Single phase AC voltage controller using R and RL loads.
   (b) Simulation of Single phase cyclo-converter with R and RL-loads.
3. Simulation of Buck chopper.
4. Simulation of single-phase inverter with PWM control.
5. Simulation of three-phase fully controlled converter with R and RL loads, with and without freewheeling diode.

***Note: Perform the simulation of the above list of experiments with PSPICE/any simulation software**

Suggested Readings:

1. M. H. Rashid, Simulation of Electric and Electronic Circuits using PSPICE – by PHI Publications.
2. User's manual of related softwares.

Reference Books:

1. Reference guides of related softwares.
2. Rashid, SPICE for Power Electronics and Electric Power, CRC Press.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)

B.Tech. in Electrical and Electronics Engineering

V Semester Syllabus

EE553PC: CONTROL SYSTEMS LABORATORY

L	T	P	C
0	0	2	1

Prerequisite: Ordinary Differential Equations and Vector Calculus, Electrical Circuit Analysis - I

Course Objectives:

1. To study the time response analysis and error analysis of dynamic systems.
2. To study the performance characteristics of Synchros, DC & AC Servo Motors.
3. To determine the transfer function of the DC Motor and Generator.
4. To study the performance of compensating networks and PID controllers.
5. To learn programming using MATLAB software and PLC Programming.

Course Outcomes:

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

1. Determine the time response, errors and analysis their system performance
2. Analyze the performance characteristics and working of Synchros, DC & AC servo motors
3. Determine the transfer functions of DC Motor and DC generator
4. Analyze the performance of Compensating networks and PID controllers
5. Compute / Operate programmes in MATLAB software and PLC programming which will help them in doing their projects

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To study the time response analysis and error analysis of dynamic systems	3	2	3	3	-	-	-	-	3	-	-	-
To study the performance characteristics of synchros, DC & AC Servo Motors	3	2	1	-	-	-	-	-	3	-	-	-
To determine the transfer function of the DC Motor and Generator	3	2	1	-	-	-	-	-	3	-	-	-
To study the performance of compensating networks and PID controllers	3	2	3	3	-	-	-	-	3	-	-	3
To learn programming using MATLAB software and PLC Programming	2	1	3	3	3	-	-	-	3	-	-	3

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Students will be able to determine the time response, errors and analysis their system performance	3	2	3	3	-	-	-	-	3	-	-	-
Students will be able to analyze the performance characteristics and working of Synchros, DC & AC servo motors	3	2	1	-	-	-	-	-	3	-	-	-
Students will be able to determine the transfer functions of DC Motor and DC generator	3	2	1	-	-	-	-	-	3	-	-	-
Students will be able to analyze the performance of Compensating networks and PID controllers	3	2	3	3	-	-	-	-	3	-	-	3
Students will be able to Computer / Operate programmes in MATLAB software and PLC programming which will help them in doing their projects	2	1	3	3	3	-	-	-	3	-	-	3

The following experiments are required to be conducted compulsory experiments:

1. Time response of Second order system.
2. Characteristics of Synchros.
3. Effect of feedback on DC servo motor.
4. Transfer function of DC motor.
5. Transfer function of DC generator.
6. Temperature controller using PID.
7. Stability analysis (Bode, Root Locus, Nyquist) of Linear Time Invariant system using suitable software.
8. State space model for classical transfer function using suitable software - Verification.

In addition to the above eight experiments, at-least any two of the experiments from the following list are required to be conducted

1. Effect of P, PD, PI, PID Controller on a second order systems.
2. Characteristics of AC servomotor
3. Lag and lead compensation–Magnitude and phase plot.
4. (a) Simulation of P, PI, PID Controller.
   (b) Linear system analysis (Time domain analysis, Error analysis) using suitable software.
5. Design of Lead-Lag compensator for the given system and with specification using suitable software.
6. Programmable logic controller–Study and verification of truth tables of logic gates, simple Boolean expressions, and application of speed control of motor.

Suggested Readings:

1. J. Nagrath and M. Gopal, “Control Systems Engineering”, New Age International, 2009.
2. Anand Kumar, “Control Systems”, PHI Learning Pvt. Ltd., 2007.
3. Nagoor Kani, “Control Systems”, RBS Publications.

Reference Books:

1. K. Ogata, “Modern Control Engineering”, Prentice Hall, 1991.
2. M.Gopal, “Control Systems: Principles and Design”, Mc Graw Hill Education, 1997.
3. K. Jairath, “Problems and Solutions in Control Systems” Khanna Publishers.
4. C. Kuo, “Automatic Control System”, Prentice Hall, 1995.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
B.Tech. in Electrical and Electronics Engineering
V Semester Syllabus
MC502ES: ARTIFICIAL INTELLIGENCE
(Common to all branches except CSE, IT, CSBS, CSE (AI&ML))

L	T	P	C
3	0	0	0

Course Objectives:

1. To train the students to understand different types of AI agents, various AI search algorithms, fundamentals of knowledge representation, building of simple knowledge-based systems and to apply knowledge representation, reasoning.
2. Study of Markov Models enable the student readyto step into applied AI.

UNIT - I:

Introduction: AI problems, Agents and Environments, Structure of Agents, Problem Solving Agents.

Basic Search Strategies: Problem Spaces, Uninformed Search (Breadth-First, Depth-First Search, Depth-first with Iterative Deepening), Heuristic Search (Hill Climbing, Generic Best-First, A*), ConstraintSatisfaction (Backtracking, Local Search).

UNIT – II:

Advanced Search: Constructing Search Trees, Stochastic Search, A* Search Implementation, Minimax Search, Alpha-Beta Pruning.

Basic Knowledge Representation and Reasoning: Propositional Logic, First-Order Logic, Forward Chaining and Backward Chaining, Introduction to Probabilistic Reasoning, Bayes Theorem.

UNIT - III:

Advanced Knowledge Representation and Reasoning: Knowledge Representation Issues, Non-monotonic Reasoning, Other Knowledge Representation Schemes.

Reasoning Under Uncertainty: Basic probability, Acting Under Uncertainty, Bayes' Rule, Representing Knowledge in an Uncertain Domain, Bayesian Networks.

UNIT – IV:

Learning: What Is Learning? Rote Learning, Learning by Taking Advice, Learning in Problem Solving, Learning from Examples, Winston's Learning Program, Decision Trees.

UNIT - V

Expert Systems: Representing and Using Domain Knowledge, Shell, Explanation, Knowledge Acquisition.

TEXT BOOK:

1. Artificial Intelligence, Elaine Rich, Kevin Knight, Shivasankar B. Nair, The McGraw Hill publications, Third Edition, 2009

REFERENCE BOOKS:

1. Russell, S. and Norvig, P, Artificial Intelligence: A Modern Approach, Third Edition, Prentice-Hall, 2010.
2. George F. Luger, Artificial Intelligence: Structures and Strategies for Complex Problem Solving, Pearson Education, 6th ed., 2009.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
B.Tech. in Electrical and Electronics Engineering
V Semester Syllabus

MC501HS: INTELLECTUAL PROPERTY RIGHTS

(Common to EEE, CSE, IT, CSBS, CSE (AI&ML) & CSE (DS))

L	T	P	C
3	0	0	0

Course Objectives: The objectives of the course are:

1. To enable the students to have an overview of Intellectual Property Rights.
2. To provide comprehensive knowledge to the students regarding Trademarks Registration process and law related to it.
3. To disseminate knowledge on Copyrights, its related rights and recent developments.
4. To make the students understand Patent Regime in India and abroad.
5. To understand the framework of Trade secrets.

Course Outcomes: By the end of the course students shall:

1. Gain knowledge on Intellectual property rights and their importance.
2. Understand Indian and International Trademark Law and procedure for registration of Trademarks.
3. Acquire knowledge on Copyright Law, and the privileges awarded to the copyright owners.
4. Familiarized with the process of acquiring the patent and relevant laws.
5. Learn the importance of trade secrets for business sustainability.

UNIT – I: INTRODUCTION TO INTELLECTUAL PROPERTY

Introduction of IPR-Meaning of intellectual property, types of intellectual property-trademarks, copyrights, patents, trade secrets, importance of intellectual property rights, International organizations-WTO-WIPO-USPTO-INTA, International Conventions, agencies and treaties- Paris Convention-Berne Convention- Madrid Protocol-NAFTA-PCT-GATT-TRIPS.

UNIT – II: TRADEMARKS

Trademarks: Purpose and functions of Trademarks-Categories of marks, acquisition of trademark rights - Protectable matter - Selecting and evaluating Trademark- Trademark registration process – Trademark Infringement - Remedies for infringement of Trademarks-New developments in Trademark Law- International Trademarks Law.

UNIT III: COPYRIGHT

Copyrights-Fundamentals of Copyright Law - Requirements of Copyrightability - Originality of material, fixation of material, Authorship works, exclusions from copyright protection- Rights of Copyright Owner-Right of reproduction of copyrighted work, right to do derivative works ,right to distribute copies of the copyrighted work, right to perform the work publicly, right to display the copyrighted work, – Copyright Ownership issues – Joint Works, Works made for Hire, Specially commissioned works, Copyright Registration - Notice of Copyright – Copyright Infringement - Remedies for infringement in Copyrights- New developments in Copyright Law- International Copyright Law.

UNIT IV: PATENTS

Concept of Patent - Classification – Utility Patents – Design Patents and Plant Patents, Patent searching process-Types of Patent Applications-Patent Registration Process, Ownership, Transfer, Assignment and Licensing of Patent-Patent Infringement, Remedies for Infringement of Patents, New developments in Patent Law- International Patent Law.

UNIT – V: TRADE SECRETS & LAW OF UNFAIR COMPETITION

Trade Secrets: Trade secret law, determination of trade secret status, measures for protecting trade secret status-Liability for misappropriation of trade secrets, protection for submissions, trade secret litigation. New developments in Trade secrets Law - International Trade Secret law.

Law of Unfair Competition: Passing off, Misappropriation, Right of publicity, Dilution of trademarks, Product disparagement, False advertising, Internet Piracy.

TEXT BOOKS:

1. Deborah. E.Bouchoux, Intellectual property, Cengage learning India Pvt.Ltd., 4th edition, 2013.
2. Prabuddha Ganguli, Intellectual property right, Tata McGraw Hill Publishing Company, 8th edition, 2016.

REFERENCES:

1. Richard Stim, Intellectual Property, Cengage learning India Pvt. Ltd. 3rd edition, 2017
2. Vinod.V. Sope, Managing Intellectual Property, Asoka K. Ghosh, 2nd edition, 2010.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
B.Tech. in Electrical and Electronics Engineering
VI Semester Syllabus
EE611PE: SIGNALS AND SYSTEMS

L	T	P	C
3	0	0	3

Prerequisites: Linear algebra, Calculus, Ordinary Differential Equation and Laplace Transforms

Course Objectives

1. To understand the behavior of signal in time domain and frequency domain.
2. To understand the behavior of signal in frequency domain.
3. To understand the characteristics of LTI systems.
4. To understand the concepts of signals and their analysis using different transform techniques.
5. To understand the concept of sampling.

Course Outcomes

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

1. Differentiate various signal functions.
2. Represent any arbitrary signal in time and frequency domain.
3. Understand the characteristics of linear time invariant systems.
4. Analyze the signals with different transform technique.
5. Find the Nyquist rate of a given signal.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To understand the behavior of signal in time domain and frequency domain.	2	1	2	-	2	-	-	-	-	-	-	-
To understand the behavior of signal in frequency domain.	3	3	2	2	3	-	-	1	-	2	-	-
To understand the characteristics of LTI systems.	2	3	3	2	2	-	-	3	-	-	-	-
To understand the concepts of signals and their analysis using different transform techniques.	3	3	2	2	2	2	-	-	-	2	-	-
To understand the concept of sampling.	3	2	2	3	2	-	1	3	-	-	-	-

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Differentiate various signal functions.	2	1	2	-	2	-	1	-	-	-	-	-
Represent any arbitrary signal in time and frequency domain.	3	3	2	2	3	-	-	2	-	-	-	-
Understand the characteristics of linear time invariant systems.	2	3	3	2	2	-	3	-	-	2	2	-
Analyze the signals with different transform technique.	3	3	2	2	2	2	-	1	-	-	-	-
Find the Nyquist rate of a given signal.	3	2	2	3	2	-	-	-	-	1	-	-

UNIT – I: SIGNAL ANALYSIS

Analogy between Vectors and Signals, Orthogonal Signal Space, Signal approximation using Orthogonal functions, Mean Square Error, Orthogonality in Complex functions, Classification of Signals and systems, Exponential and Sinusoidal signals, Concepts of Impulse function, Unit Step function, Signum function.

UNIT – II: FOURIER SERIES AND FOURIER TRANSFORMS

Fourier series: Representation of Fourier series-Continuous time periodic signals, Dirichlet's conditions, Trigonometric Fourier Series and Exponential Fourier Series, Complex Fourier spectrum. **Fourier Transforms:** Deriving Fourier Transform from Fourier series, Fourier Transform of arbitrary signal, standard signals, Periodic Signals, Fourier Transforms involving Impulse function and Signum function, Properties of Fourier Transform.

UNIT – III: SIGNAL TRANSMISSION THROUGH LINEAR SYSTEMS

Linear System, Impulse response, Response of a Linear System, Linear Time Invariant(LTI) System, Linear Time Variant (LTV) System, Transfer function of a LTI System, Filter characteristic of Linear System, Distortion less transmission through a system, Signal bandwidth, System Bandwidth, Ideal LPF, HPF, and BPF characteristics, Causality and Paley-Wiener criterion for physical realization, Relationship between Bandwidth and rise time, Convolution of Signals, Concept of convolution in Time domain and Frequency domain, Graphical representation of Convolution. Introduction to Correlation

UNIT – IV: LAPLACE TRANSFORMS AND Z–TRANSFORMS

Laplace Transforms: Laplace Transforms (L.T), Relation between L.T and F.T of a signal Concept of Region of Convergence (ROC) for Laplace Transforms, Properties of L.T., Inverse Laplace Transform, Laplace Transform of certain signals using waveform synthesis. **Z–Transforms:** Concept of Z- Transform of a Discrete Sequence, Distinction between Laplace, Fourier and Z Transforms, Region of Convergence in Z-Transform, Constraints on ROC for various

classes of signals, Inverse Z-transform, Properties of Z-transforms.

UNIT – V: SAMPLING THEOREM

Graphical and analytical proof for Band Limited Signals, Impulse Sampling, Natural and Flat top Sampling, Reconstruction of signal from its samples, Effect of under sampling – Aliasing

Suggested Readings:

1. Signals, Systems & Communications - B.P. Lathi, 2013, BSP.
2. Signals and Systems - A.V. Oppenheim, A.S. Willsky and S.H. Nawabi, 2 Ed.

Reference Books:

1. Signals and Systems – Simon Haykin and Van Veen, Wiley 2 Ed.,
2. Signals and Systems – A. Rama Krishna Rao, 2008, TMH
3. Fundamentals of Signals and Systems - Michel J. Robert, 2008, MGH International Edition.
4. Signals, Systems and Transforms - C. L. Philips, J. M. Parr and Eve A. Riskin, 3 Ed., 2004, PE.
5. Signals and Systems – K. Deergha Rao, Birkhauser, 2018.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)

B. Tech. in Electrical and Electronics Engineering

VI Semester Syllabus

EE612PE: POWER SEMICONDUCTOR DRIVES (PE-II)

L	T	P	C
3	0	0	3

Prerequisites: Power Electronics, Electrical Machines – I and Electrical Machines – II

Course Objectives:

1. To introduce the drive system and operating modes of DC drive and its characteristics.
2. To introduce the chopper controlled DC drive system and four quadrant operation.
3. To understand the fundamentals and control of induction motor from stator side.
4. To understand the control of induction motor from rotor side.
5. To understand the control of synchronous motor.

Course Outcomes:

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

1. Understand the speed control of DC motors and identify the drawbacks of DC Motor drives.
2. Understand the chopper-controlled DC drives, speed-torque characteristics, merits and demerits.
3. Understand AC motor drive speed–torque characteristics using different control strategies on stator side.
4. Understand speed control of induction motor from rotor side and concept of slip power recovery.
5. Understand control of synchronous motor and their characteristics using different control strategies.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To introduce the drive system and operating modes of DC drive and its characteristics	2	1	2	-	2	-	-	-	-	-	-	-
To introduce the chopper controlled DC drive system and four quadrant operation	3	3	2	2	3	-	-	1	-	2	-	-
To understand the fundamentals and control of induction motor from stator side	2	3	3	2	2	-	-	3	-	-	-	-
To understand the control of induction motor from rotor side	3	3	2	2	2	2	-	-	-	2	-	-
To understand the control of synchronous motor	3	2	2	3	2	-	1	3	-	-	-	-

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Understand the speed control of DC motors and identify the drawbacks of DC Motor drives	2	1	2	-	2	-	1	-	-	-	-	-
Understand the chopper-controlled DC drives, speed-torque characteristics, merits and demerits	3	3	2	2	3	-	-	-	2	-	-	-
Understand AC motor drive speed - torque characteristics using different control strategies on stator side	2	3	3	2	2	-	3	-	-	-	2	-
Understand speed control of induction motor from rotor side and concept of slip power recovery	3	3	2	2	2	2	-	1	-	-	-	-
Understand control of synchronous motor and their characteristics using different control strategies	3	2	2	3	2	-	-	-	-	1	-	-

UNIT - I: THYRISTOR CONTROLLED DC MOTORS

Introduction to Thyristor controlled Drives, Single Phase semi and fully controlled converters connectedto DC separately excited and DC series motors – Continuous conduction - output voltage and current waveforms, Speed and Torque expressions, Speed - Torque Characteristics. Three phase semi and fully controlled converters connected to DC separately excited and DC series motors - Continuous conduction - output voltage and current waveforms, Speed and Torque expressions, Speed - Torque characteristics, numerical problems.

UNIT - II: FOUR QUADRANT OPERATION AND CONTROL OF DC MOTORS BY CHOPPERS

Introduction to Four quadrant operation, Motoring operations, Electric Braking: Plugging, Dynamic and Regenerative Braking operations. Four quadrant operation of D.C motor by dual converters, closed loop operation of DC motor (Block Diagram Only).

Control of DC Motors by Choppers: Single quadrant, Two quadrant and four quadrant chopper, Chopper control (Motoring and Braking) of DC separately excited and series motors, Continuous current operation, Output voltage and current wave forms, Speed and torque expressions, speed-torque characteristics, numerical problems, Closed Loop operation (Block Diagram approach Only).

UNIT - III: STATOR SIDE CONTROL OF INDUCTION MOTOR

Variable voltage characteristics, Control of Induction Motor by AC Voltage Controllers, speed - torque characteristics. Variable frequency characteristics, Variable frequency control of induction motor by Voltage source, current source inverter and cyclo converters, PWM control, Comparison

of VSI and CSI control of induction motor, numerical problems - Closed loop operation of induction motor drives (Block Diagram approach Only).

UNIT - IV: ROTOR SIDE CONTROL OF INDUCTION MOTOR

Introduction, Static rotor resistance control, Slip power recovery schemes: Static Scherbius drive, Static Kramer Drive, performance of slip power recovery schemes and speed torque characteristics, advantages, applications and numerical problems.

UNIT - V: CONTROL OF SYNCHRONOUS MOTORS

Separate control and self-control of synchronous motors - Operation of self-controlled synchronous motors employing Load commutated inverter and cyclo converters. Load commutated CSI fed Synchronous Motor drive, Applications, Advantages and Numerical Problems, Closed Loop control operation of synchronous motor drives (Block Diagram Only).

Suggested Readings:

1. G K Dubey, Fundamentals of Electric Drives, CRC Press, 2002.
2. Muhammad H Rashid, Power electronics: Devices, Circuits, and Applications, Pearson, 2017, Fourth edition.

Reference Books:

1. S K Pillai, A First course on Electrical Drives, New Age International (P) Ltd. 2nd Edition. 1989.
2. B. K. Bose, Modern Power Electronics, and AC Drives, Pearson 2015.
3. P. C. Sen, Thyristor DC Drives, Wiley-Blackwell, 1981.
4. R. Krishnan, Electric motor drives - modeling, Analysis and control, Prentice Hall PTR, 2001.
5. Vedam Subramanyam, Thyristor Control of Electric drives, Tata McGraw Hill Publications, 1987.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)

B.Tech. in Electrical and Electronics Engineering

VI Semester Syllabus

EE613PE: WIND AND SOLAR ENERGY SYSTEMS (PE-II)

L	T	P	C
3	0	0	3

Prerequisite: Renewable Energy Systems

Course Objectives:

1. To study the physics of wind energy and understand the principle of operation of wind generators.
2. To know the solar power resources.
3. To analyse the solar photo-voltaic cells.
4. To discuss the solar thermal power generation.
5. To identify the network integration issues.

Course Outcomes:

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

1. Understand the energy scenario and the consequent growths of the power generation by renewable energy sources.
2. Understand the basic physics of wind and solar power generation.
3. Understand the power electronic interfaces for wind and solar generation.
4. Understand the issues related to the grid-integration of solar and wind energy systems
5. Understand the solar collectors and storage mechanisms.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To study the physics of wind energy and understand the principle of operation of wind generators	3	2	3	1	2	-	-	-	-	-	-	-
To know the solar power resources	3	3	2	2	3	-	-	-	-	-	-	-
To analyse the solar photo-voltaic cells	2	3	3	2	2	-	-	-	-	-	-	-
To discuss the solar thermal power generation	3	3	2	2	2		-	-	-	-	-	-
To identify the network integration issues	3	2	2	3	2	-	-	-	-	-	-	-

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Understand the energy scenario and the consequent growths of the power generation by renewable energy sources	3	2	2	2	2	-	-	-	-	-	-	-
Understand the basic physics of wind and solar power generation	3	3	2	2	3	-	-	-	-	-	-	-
Understand the power electronic interfaces for wind and solar generation	2	3	3	2	2	-	-	-	-	-	-	-
Understand the issues related to the grid-integration of solar and wind energy systems	3	3	2	2	2		-	-	-	-	-	-
Understand the energy scenario and the consequent growths of the power generation by renewable energy sources	3	2	2	3	2	-	-	-	-	-	-	-

UNIT - I: PHYSICS OF WIND POWER

History of wind power, Indian and Global statistics, Wind physics, Betz limit ratio, stall and pitch control, Wind speed statistics-probability distributions and Wind power-cumulative distribution functions.

UNIT - II: WIND GENERATOR TOPOLOGIES

Review of modern wind turbine technologies, Fixed and Variable speed wind turbine, Induction Generators, Doubly-Fed Induction Generators and their characteristics, Permanent Magnet Synchronous Generators, Power electronics converters, Generator configurations, Converter Control.

UNIT - III: THE SOLAR RESOURCE AND SOLAR PHOTOVOLTAICS

Introduction, solar radiation spectra, solar radiation geometry, estimation of solar energy availability, Solar Photovoltaic Technologies-Amorphous, mono-crystalline, polycrystalline; V-I characteristics of a PV cell, PV module, array, Power Electronic Converters for Solar Systems, Maximum Power point Tracking (MPPT) algorithms. Converter control.

UNIT - IV: SOLAR THERMAL POWER GENERATION

Technologies, parabolic trough, central receivers, parabolic dish, Fresnel solar pond, elementary analysis.

UNIT - V: NETWORK INTEGRATION ISSUES

Overview of grid code technical requirements, Fault ride-through for wind farms - real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behavior during grid disturbances, power quality issues, power system interconnection experiences in the world, Hybrid and isolated operations of solar PV and wind systems.

Suggested Readings:

1. T. Ackermann, “Wind Power in Power Systems”, John Wiley and Sons Ltd., 2005.
2. G. M. Masters, “Renewable and Efficient Electric Power Systems”, John Wiley and Sons, 2004.

Reference Books:

1. S. P. Sukhatme, “Solar Energy: Principles of Thermal Collection and Storage”, McGraw Hill, 1984.
2. H. Siegfried and R. Waddington, “Grid integration of wind energy conversion systems” John Wiley and Sons Ltd., 2006.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
B.Tech. in Electrical and Electronics Engineering
VI Semester Syllabus
EE601PC: MICROPROCESSORS AND MICROCONTROLLERS

L	T	P	C
3	0	0	3

Prerequisite: Digital Logic and Fundamentals of Computers

Course Objectives:

1. To familiarize the architecture of microprocessors.
2. To familiarize the instruction set and assembly language program.
3. To provide the knowledge about interfacing techniques to microprocessors.
4. To familiarize the architecture and instruction set of microcontrollers.
5. To provide the knowledge about interfacing techniques to microcontrollers.

Course Outcomes:

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

1. Understand the internal architecture, organization of 8086 processors.
2. Design simple programs using assembly language programming of 8086 processors.
3. Understand the interfacing techniques to 8086 based systems.
4. Understand the internal architecture, organization and assembly language programming of 8051 microcontrollers.
5. Understand the interfacing techniques to 8051 based systems.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To familiarize the architecture of microprocessors	2	-	2	-	-	-	-	-	-	-	-	-
To familiarize the instruction set and assembly language program	1	-	2	-	-	-	-	-	-	-	-	-
To provide the knowledge about interfacing techniques to microprocessors	2	-	2	-	-	-	-	-	-	-	-	2
To familiarize the architecture and instruction set of microcontrollers	3	-	2	2	-	-	-	-	-	-	-	-
To provide the knowledge about interfacing techniques to microcontrollers	3	-	2	1	-	-	-	-	-	-	-	2

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Understand the internal architecture, organization of 8086 processors	2	-	2	-	-	-	-	-	-	-	-	-

Design simple programs using assembly language programming of 8086 processors	2	-	2	-	-	-	-	-	-	-	-	-
Understand the interfacing techniques to 8086 based systems	2	-	2	-	-	-	-	-	-	-	-	2
Understand the internal architecture, organization and assembly language programming of 8051 microcontrollers	3	-	2	2	-	-	-	-	-	-	-	-
Understand the interfacing techniques to 8051 based systems	3	-	2	1	-	-	-	-	-	-	-	2

UNIT - I: 8086 ARCHITECTURE

8086 Architecture - Functional diagram, Register Organization, Memory Segmentation, Programming Model, modes of operation, timing diagram, Memory addresses, Physical Memory Organization, Signal descriptions of 8086, interrupts of 8086.

UNIT - II: 8086 INSTRUCTION SET

Instruction Set and Assembly Language Programming of 8086: Instruction formats, Addressing modes, Instruction Set, Assembler Directives, Macros, and Simple Programs involving Logical, Branch and Call Instructions, Sorting, String Manipulations.

UNIT – III: PERIPHERAL AND MEMORY INTERFACING TO 8086

Memory Interfacing to 8086, 8255- various modes of operation, Interfacing 8086 to peripherals using 8255- stepper motor interfacing, ADC, DAC, Serial Communication Standards, USART interfacing, RS232.

UNIT - IV: INTRODUCTION TO 8051 MICROCONTROLLER

Overview of 8051 Microcontroller, Architecture, I/O Ports, Memory Organization, Addressing Modes and Instruction set of 8051, simple programs using stack pointer, Assembly language programming of 8051.

Interrupts, Programming External Hardware Interrupts, Programming the Serial Communication Interrupts, Programming 8051 Timers and Counters.

UNIT – V: INTERFACING AND INDUSTRIAL APPLICATIONS OF 8051

Applications of microcontrollers, Interfacing 8051 to LED, LCD, Keyboard, seven segment display, stepper motor, ADC, DAC

Suggested Readings:

1. Advanced Microprocessors and Peripherals – A. K. Ray and K. M. Bhurchandani, TMH, 2nd Edition 2006.
2. The 8051 Microcontroller, Kenneth. J. Ayala, Cengage Learning, 3rd Ed, 2004.

Reference Books:

1. Microprocessors and Interfacing, D. V. Hall, TMGH, 2nd Edition 2006.
2. The 8051 Microcontrollers, Architecture and Programming and Applications - K. Uma Rao, Andhe Pallavi, Pearson, 2009.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)

B.Tech. in Electrical and Electronics Engineering

VI Semester Syllabus

EE602PC: POWER SYSTEM PROTECTION

L	T	P	C
3	0	0	3

Prerequisite: Power Systems-I, Power Systems-II, Electrical Machines-I, Electrical Machines– II

Course Objectives:

1. To introduce the fundamental concepts of protection and various relays used in the power system for the protection of transmission lines and other equipment.
2. To understand the concept of overcurrent and distance protection in the power system.
3. To describe the wire pilot protection schemes and protective schemes for transformer, generator, and busbar.
4. To understand the concepts and principles of circuit breakers.
5. To understand the types of circuit breakers employed in the power system.

Course Outcomes:

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

1. Compare and contrast the different generations of protective relay schemes and understand the importance of power system protection.
2. Select the relay settings and characteristics for overcurrent in distance protection schemes and analyse their performance.
3. Apply the differential protection scheme to transformer, generators, and bus bars.
4. Understand the introductory concepts of circuit breakers.
5. Analyse the various arc quenching mechanisms used in air, oil, vacuum and SF_6 circuit breakers.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To introduce the fundamental concepts of protection and various relays used in the power system for the protection of transmission lines and other equipment	3	2	3	1	2	-	-	-	-	-	-	-
To understand the concept of overcurrent and distance protection in the power system	3	3	2	2	3	-	-	-	-	-	-	-
To describe the wire pilot protection schemes and protective schemes for transformer, generator, and busbar	2	3	3	2	2	-	-	-	-	-	-	-
To understand the concepts and principles of circuit breakers	3	3	2	2	2		-	-	-	-	-	-
To understand the types of circuit	3	2	2	3	2	-	-	-	-	-	-	-

breakers employed in the power system												

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Compare and contrast the different generations of protective relay schemes and understand the importance of power system protection	3	2	2	2	2	-	-	-	-	-	-	-
Select the relay settings and characteristics for over current in distance protection schemes and analyze their performance	3	3	2	2	3	-	-	-	-	-	-	-
Apply the differential protection scheme to transformer, generators, and bus bars	2	3	3	2	2	-	-	-	-	-	-	-
Understand the introductory concepts of circuit breakers	3	3	2	2	2		-	-	-	-	-	-
Understand the introductory concepts of circuit breakers and analyze the various arc quenching mechanisms used in air, oil, vacuum and SF_6 circuit breakers	3	2	2	3	2	-	-	-	-	-	-	-

UNIT - I: FUNDAMENTALS OF POWER SYSTEM PROTECTION AND RELAYING SCHEMES

Introduction, Need for power system protection, effects of faults, evolution of protective relays, zones of protection, primary and backup protection, essential qualities of protection, classification of protective relays and schemes, current transformers, potential transformers, basic relay terminology. Operating Principles and Relay Construction - Electromagnetic relays, thermal relays, static relays, microprocessor based protective relays.

UNIT - II: OVERCURRENT AND DISTANCE RELAYING SCHEMES

Over-Current Protection: Time-current characteristics, current setting, over current protective schemes, directional relay, protection of parallel feeders, protection of ring mains, Phase fault and earth fault protection, Combined earth fault and phase fault protective scheme, Directional earth fault relay.

Distance Protection: Impedance relay, reactance relay, MHO relay, input quantities for various types of distance relays, Effect of arc resistance, Effect of power swings, selection of distance relays, MHO relay with blinders, auto reclosing.

UNIT - III: EQUIPMENT PROTECTION

Pilot Relaying Schemes - Wire Pilot protection, Protection of Generators, Protection of transformers, Bus zone protection, frame leakage protection.

UNIT - IV: CIRCUIT BREAKERS - I

Introduction, arcing in circuit breakers, arc interruption theories, re-striking and recovery voltage, resistance switching, current chopping.

UNIT - V: CIRCUIT BREAKERS - II

Types of Circuit Breakers: oil circuit breaker, air blast circuit breakers, SF_6 circuit breaker, ratings of circuit breakers.

TEXT BOOKS

1. Badriram, D.N. Vishwakarma, Power System Protection and Switchgear, TMH 2001.
2. Y.G. Paithankar, S.R. Bhide, Power System Protection, Prentice Hall India Learning Private Limited, 2010.

REFERENCE BOOKS

1. C. Russel Mason – "The Art and Science of Protective Relaying, Wiley Eastern, 1995.
2. L. P. Singh "Protective Relaying from Electromechanical to Microprocessors", New Age International.

ONLINE RESOURCES

1. https://nptel.ac.in/courses/108/101/108101039/
2. https://nptel.ac.in/courses/108/105/108105167/
3. https://nptel.ac.in/courses/108/107/108107167/

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
B.Tech. in Electrical and Electronics Engineering
VI Semester Syllabus
EE603PC: POWER SYSTEM OPERATION AND CONTROL

L	T	P	C
3	0	0	3

Prerequisite: Power Systems-I, Power Systems-II and Power Systems Analysis

Course Objectives:

1. To study and understand steady state stability of power system network.
2. To study and understand transient stability of power system network.
3. To study and understand economic operation of generating stations.
4. To analyze an isolated power system network.
5. To study and analyze single area and two area load frequency control.

Course Outcomes:

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

1. Understand steady state stability of power system network.
2. Understand transient stability of power system network.
3. Understand economic operation of generating stations.
4. Analyze an isolated power system network.
5. Analyze single area and two area load frequency control.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To study and understand steady state stability of power system network	2	3	2	3	-	-	-	-	-	-	-	-
To study and understand transient stability of power system network	3	3	2	2	-	-	-	-	-	-	-	-
To study and understand economic operation of generating stations	2	3	3	2	-	-	-	-	-	-	-	-
To analyze an isolated power system network	3	3	2	2	-	-	-	-	-	-	-	-
To study and analyze single area and two area load frequency control	3	2	2	3	-	-	-	-	-	-	-	-

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Understand steady state stability of power system network	2	3	2	3	-	-	-	-	-	-	-	-
Understand transient stability of power system network	3	3	2	2	-	-	-	-	-	-	-	-
Understand economic operation of generating stations	2	3	3	2	-	-	-	-	-	-	-	-

Analyze an isolated power system network	3	3	2	2	-	-	-	-	-	-	-	-
Analyze single area and two area load frequency control	3	2	2	3	-	-	-	-	-	-	-	-

UNIT-I: POWER SYSTEM STABILITY ANALYSIS-I

Introduction, Definition of steady state stability and transient stability, Properties of a stable power system network, Determination of steady state stability by static model, synchronizing power coefficient, ABCD constants and swing equation, Methods to improve steady state stability, Determination of transient stability by dynamic model, Inertia constant, Concept of transfer reactance.

UNIT-II: POWER SYSTEM STABILITY ANALYSIS-II

Coherent and non-coherent swinging of synchronous machines, Equal area criterion method, Applications: Sudden increase in mechanical input to a synchronous generator, Sudden increase in mechanical output of a synchronous motor, Removal of one of the parallel transmission lines using fast acting circuit breakers, Occurrence of fault at the middle of one of the parallel transmission lines, Occurrence of fault on a transmission line near bus bar and Occurrence of fault on bus bar, Critical clearing angle and critical clearing time, Methods to improve transient stability.

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UNIT-III: ECONOMIC OPERATION OF THERMAL GENERATING STATIONS

Introduction, System constraints, Incremental fuel rate, Incremental efficiency, Cost curve, Incremental fuel and production costs, Input-output characteristics, Economic operation of thermal generating stations neglecting losses and considering losses, Penalty factor, Transmission line losses in terms of power loss coefficients or 'B' coefficients.

UNIT-IV: LOAD FREQUENCY CONTROL

Introduction, Mega Watt frequency or P-f control channel, MVAR Voltage or Q-V control channel, Turbine speed governing system and it's components, Modeling of Speed Governor: Block diagram and transfer function, Modeling of Turbine: Reheat and non-reheat type turbines, Block diagram and transfer function, Modeling of Generator-Load model: Block diagram and transfer function, Block diagram of an Isolated Power System.

UNIT-V: SINGLE AREA AND TWO AREA LOAD FREQUENCY CONTROL

Single Area Load Frequency Control: Introduction, Definitions of Coherent group and Control area, Steady state analysis of Load Frequency control of single area system-uncontrolled case and controlled case, Integral Load Frequency control.

Two Area Load Frequency Control: Introduction, Expression of change in tie-line power and frequency, Definition of Area Control Error, Composite block diagram of two area load frequency control.

Suggested Readings:

1. Stagg and El-Abiad, "Computer Methods in Power System Analysis", Mc Graw Hill, 1968.
2. C. L. Wadhwa, "Electrical Power Systems", New Age International Publishers, 6th Edition.

3. I.J. Nagrath and D. P. Kothari, “Modern Power System Analysis”, Tata Mc Graw Hill Publishing Company, 4th Edition, 2011.
4. Allen J. Wood and Bruce F. Wollenberg, “Power Generation Operation and Control”, John Wiley and Sons, Inc.2004.
5. Leon K. Kirchmayer, “Economic Operation of Power Systems”, Wiley India Pvt Ltd. (6 March 2009).

Reference Books:

1. Grainger and Stevenson, “Power System Analysis”, Tata Mc Graw Hill, 2003.
2. Hadi Saadat, “Power System Analysis”, Tata Mc Graw Hill, 2002.
3. William D Stevenson, “Elements of Power System Analysis”, Mc Graw Hill, 1982
4. Dr. K. Uma Rao, “Power System Operation and Control”, Wiley-India, 2016.
5. Prabha Kundur, “Power System Stability and Control”, Tata Mc Graw Hill, 2008.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)

B.Tech. in Electrical and Electronics Engineering

VI Semester Syllabus

EE651PC: POWER SYSTEMS LABORATORY

L	T	P	C
0	0	2	1

Prerequisites: Power Systems-I, Power Systems-II, Power System Protection, Power System Operation and Control, Electrical Machines

Course Objectives:

1. To understand the performance of short transmission line and A,B,C,D constants of a Long Transmission line.
2. To understand the sequence impedances of 3-Φ synchronous machine and 3-Φ Transformer.
3. To understand the characteristics of IDMT Overcurrent Relay and Microprocessor based Over Voltage/Under Voltage relay.
4. To understand the Differential protection of 1-Φ transformer.
5. To understand power system problems using MATLAB.

Course Outcomes:

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

1. Evaluate the performance of transmission lines
2. Deduce the sequence impedances of 3-Φ synchronous machine and 3-Φ Transformer.
3. Plot the characteristics of IDMT Overcurrent Relay and Microprocessor based Over Voltage/Under Voltage relay.
4. Understand the Differential protection of 1-Φ transformer.
5. Perform power systems analysis using MATLAB.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To understand the performance of short transmission line and A,B,C,D constants of a Long Transmission line	3	2	3	2	1	-	-	-	-	-	-	-
To understand the sequence impedances of 3-Φ synchronous machine and 3-Φ Transformer	3	3	2	3	1	-	-	-	-	-	-	-
To understand the characteristics of IDMT Overcurrent Relay and Microprocessor based Over Voltage/Under Voltage relay	3	3	2	2	-	-	-	-	-	-	-	-
To understand the Differential protection of 1-Φ transformer	3	3	2	2	-	-	-	-	-	-	-	-
To understand power system problems using MATLAB	2	2	2	3	3	-	-	-	-	-	-	-

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Evaluate the performance of transmission lines	3	2	3	2	1	-	-	-	-	-	-	-
Deduce the sequence impedances of 3-Φ synchronous machine and 3-Φ Transformer	3	3	2	3	1	-	-	-	-	-	-	-
Plot the characteristics of IDMT Overcurrent Relay and Microprocessor based Over Voltage/Under Voltage relay	3	3	2	2	-	-	-	-	-	-	-	-
Understand the Differential protection of 1-Φ transformer	3	3	2	2	-	-	-	-	-	-	-	-
Perform power systems analysis using MATLAB	2	2	2	3	3	-	-	-	-	-	-	-

LIST OF EXPERIMENTS/DEMONSTRATIONS:

1. Performance of short transmission line.
2. A,B,C,D constants of a Long Transmission line.
3. Finding the sequence impedances of 3-Φ synchronous machine.
4. Finding the sequence impedances of 3-Φ Transformer.
5. Characteristics of IDMT Overcurrent Relay.
6. Differential protection of 1-Φ transformer.
7. Characteristics of Microprocessor based Over Voltage/Under Voltage relay.
8. Testing of CT, PT and Insulator String.
9. Fault analysis of 3-phase Synchronous Machine

In addition to the above, any two experiments are required to be conducted from the following list of experiments using MATLAB/any Simulation software.

10. Formation of Y_{BUS}.
11. Load Flow Analysis using Gauss Seidal (GS) Method.
12. Load Flow Analysis using Fast Decoupled (FD) Method.
13. Determination of maximum power transferred before, during and after fault.
14. Determination of economic operation of generating stations.
15. Load frequency control analysis of two area system.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)

B.Tech in Electrical and Electronics Engineering

VI Semester Syllabus

EE652PC: MICROPROCESSORS AND MICROCONTROLLERS LABORATORY

L	T	P	C
0	0	2	1

Prerequisites: Nil

Course Objectives:

1. To enable students to write simple assembly language programs using 8086/8051 like arithmetic, logical, string operation.
2. To enable students to execute ALP using MPMC kit or an assembler software.
3. To enable students to write programs to perform array operations, looping & branching operations.
4. To enable students to develop applications using timers and interrupts.
5. To interface peripheral devices to Microprocessors or Microcontrollers and do relevant operations.

Course Outcomes:

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

1. Write simple assembly language programs like arithmetic operations, logical operations, string operations on 8086/8051.
2. Demonstrate skill to work with software assembler or hardware kit of MPMC.
3. Develop programs for applications with jump, branching operations.
4. Develop applications using timers or interrupts in 8051.
5. Interface various peripherals to 8086/8051.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To enable students to write simple assembly language programs using 8086/8051 like arithmetic, logical, string operation	1	-	2	3	-	-	-	-	-	-	-	-
To enable students to execute ALP using MPMC kit or an assembler software	1	-	2	3	-	-	-	-	-	-	-	-
To enable students to write programs to perform array operations, looping & branching operations	2	-	2	3	-	-	-	-	-	-	-	-
To enable students to develop applications using timers and interrupts	3	-	2	3	-	-	-	-	-	-	-	2
To interface peripheral devices to Microprocessors or Microcontrollers and do relevant operations	3	-	2	3	-	-	-	-	-	-	-	2

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Write simple assembly language programs like arithmetic operations, logical operations, string operations on 8086/8051	1	-	2	3	-	-	-	-	-	-	-	-
Demonstrate skill to work with software assembler or hardware kit of MPMC	3	-	2	3	-	-	-	-	-	-	-	-
Develop programs for applications with jump, branching operations	3	-	2	3	-	-	-	-	-	-	-	-
Develop applications using timers or interrupts in 8051	3	-	2	3	-	-	-	-	-	-	-	2
Interface various peripherals to 8086/8051	3	-	2	3	-	-	-	-	-	-	-	2

Any Ten from the following programs/ experiments are to be written for assembler and to be executed the same with 8086 and 8051 kits

List of Experiments:

1. Programs for 16-bit arithmetic operations for 8086 (using various addressing modes)
2. Programs for sorting an array for 8086
3. Programs for string manipulation for 8086
4. Program for searching number of characters in a string for 8086
5. Program for digital clock design using 8086
6. Interfacing DAC to 8086
7. Parallel communication between two microprocessor kits using 8255
8. Serial communication between two microprocessor kits using 8251
9. Interfacing stepper motor to 8086
10. Programs using arithmetic, logical and bit manipulation instructions for 8051
11. Program to verify Timer/ Counter in 8051
12. Program to verify interrupt handling in 8051
13. Interfacing LCD to 8051
14. Interfacing Matrix/ Keyboard to 8051
15. Interfacing DAC to 8051
16. Interfacing Stepper motor to 8051

Suggested Readings:

1. Advanced Microprocessors and Peripherals by A K Ray, Tata McGraw-Hill Education, 2006
2. The 8051 Microcontrollers- Kenneth. J.Ayala, Cengage Learning, 3rd Edition

Reference Books:

1. The 8051 Microcontrollers: Architecture, Programming & Applications by Dr. K. Uma Rao, Andhe Pallavi, Pearson, 2009.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
B.Tech in Electrical and Electronics Engineering
VI Semester Syllabus
EN651HS: ADVANCED ENGLISH COMMUNICATION SKILLS LABORATORY
(Common to CE, ECE, EEE, ME, MCT & MME)

L	T	P	C
0	0	2	1

Introduction:

The introduction of the Advanced English Communication Skills Lab is considered essential at the B.Tech 3rd year level. At this stage, the students need to prepare themselves for their career which may require them to listen to, read, speak and write in English both for their professional and interpersonal communication in the globalized context.

The proposed course should be a laboratory course to enable students to use appropriate English and perform the following:

1. Gathering ideas and information to organize ideas relevantly and coherently.
2. Making oral presentations.
3. Writing formal letters.
4. Transferring information from non-verbal to verbal texts and vice-versa.
5. Writing project/research reports/technical reports.
6. Participating in group discussions.
7. Engaging in debates.
8. Facing interviews.
9. Taking part in social and professional communication.

Course Objectives:

This Lab focuses on using multi-media instruction for language development to meet the following targets:

1. Improve the students' fluency in English, with a focus on vocabulary.
2. Enable them to listen to English spoken at normal conversational speed by educated English speakers.
3. Respond appropriately in different socio-cultural and professional contexts.
4. Communicate their ideas relevantly and coherently in writing.
5. Prepare the students for placements.

Course Outcomes:

Students will be able to:

1. Enhance listening proficiency and reading comprehension and cultivate critical thinking ability.
2. Acquire essential vocabulary and develop strategic planning skills for effective technical writing and gain expertise in E-Correspondence and (N) etiquette.
3. Understand the nuances of oral skills (Speaking skills), gain competence in delivering effective presentations, employing suitable language and body language.

4. Communicate confidently in group discussions and enhance the employability skills of students.
5. Apply effective techniques and strategies for successful job interviews.

Syllabus:

The following course content to conduct the activities is prescribed for the Advanced English Communication Skills (AECS) Lab:

1. **Activities on Listening and Reading Comprehension:** Active Listening – Development of Listening Skills Through Audio clips - Benefits of Reading – Methods and Techniques of Reading – Basic Steps to Effective Reading – Common Obstacles – Discourse Markers or Linkers - Sub-skills of reading - Reading for facts, negative facts and Specific Details- Guessing Meanings from Context, Inferring Meaning - Critical Reading — Reading Comprehension – Exercises for Practice.
2. **Activities on Writing Skills**: Vocabulary for Competitive Examinations - Planning for Writing – Improving Writing Skills - Structure and presentation of different types of writing – Free Writing and Structured Writing - Letter Writing –Writing a Letter of Application – Resume vs. Curriculum Vitae – Writing a Résumé **–** Styles of Résumé - e-Correspondence – Emails – Blog Writing - (N)etiquette – Report Writing – Importance of Reports – Types and Formats of Reports– Technical Report Writing– Exercises for Practice.
3. **Activities on Presentation Skills –** Dealing with Glossophobia or stage fear, starting a conversation – responding appropriately and relevantly – using the right language and body language – Role Play in different situations including Seeking Clarification, Making a Request, Asking for and Refusing Permission, Participating in a Small Talk – Oral presentations (individual and group) through JAM sessions- PPTs – Importance of Presentation Skills – Planning, Preparing, Rehearsing and Making a Presentation - Understanding Nuances of Delivery - Presentations through Posters/Projects/Reports – Checklist for Making a Presentation and Rubrics of Evaluation.
4. **Activities on Group Discussion (GD):** Types of GD and GD as a part of a Selection Procedure - Dynamics of Group Discussion - myths and facts (Dos and Don'ts) of GD - Intervention, Summarizing - Modulation of Voice, Body Language, Relevance, Fluency and Organization of Ideas - GD Strategies – Exercises for Practice.
5. **Activities on Interview Skills**: Concept and Process - Interview Preparation Techniques - Types of Interview Questions – Pre-interview Planning, Opening Strategies, Answering Strategies - Interview Through Tele-conference & Video-conference - Mock Interviews.

Suggested Books:

1. Effective Technical Communication by M Ashraf Rizvi. McGraw Hill Education (India) Pvt. Ltd. 2nd Edition.
2. Academic Writing: A Handbook for International Students by Stephen Bailey, Routledge, 5th Edition.

Reference Books:

1. Rizvi, M. Ashraf (2018). *Effective Technical Communication*. (2nded). McGraw Hill Education (India) Pvt. Ltd.
2. Suresh Kumar, E. (2015). *Engineering English.* Orient BlackSwan Pvt. Ltd.

3. Bailey, Stephen. (2018). Academic *Writing: A Handbook for International Students.* (5th Edition). Routledge.
4. Koneru, Aruna. (2016). *Professional Communication*. McGraw Hill Education (India) Pvt. Ltd.
5. Raman, Meenakshi & Sharma, Sangeeta. (2015). *Technical Communication, 3E: Principles and Practice.*Oxford University Press.
6. Anderson, Paul V. (2007). *Technical Communication***.** Cengage Learning Pvt. Ltd. New Delhi.
7. McCarthy, Michael; O'Dell, Felicity & Redman, Stuart. (2017). *English Vocabulary in Use* Series. Cambridge University Press.
8. Sen, Leela. (2009). *Communication Skills.* PHI Learning Pvt Ltd., New Delhi.
9. Elbow, Peter. (1998). *Writing with Power.* Oxford University Press.
10. Goleman, Daniel. (2013). *Emotional Intelligence*: *Why it can matter more than IQ.* Bloomsbury Publishing.
11. Professional Communication by Aruna Koneru, McGraw Hill Education (India) Pvt. Ltd, 2016.
12. Technical Communication by Meenakshi Raman & Sangeeta Sharma, Oxford University Press 2009.
13. How to Write and Speak Better, Reader's Digest, 2003.
14. TOEFL Reading & Writing Workout, The Princeton Review.
15. How to prepare for Group Discussions and Interviews by Harimohan Prasad and Rajneesh Prasad, TataMcgrawHill.
16. Keep Talking, Frederick Klippel, Cambridge University Press, South Asian edition (6 May 2010).
17. Objective English, Edgar Thorpe & Showick Thorpe, Pearson; 5th edition (1 August 2013).
18. Communication Skills for Engineers, Sunitha Mishra, C.Murali Krishna, Pearson; 4th Edition.

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MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
B.Tech. in Electrical and Electronics Engineering
VI Semester Syllabus
MC602ES – CYBER SECURITY
(Common to all branches except CSE, IT, CSBS)

L	T	P	C
3	0	0	0

Course objectives:

1. To familiarize various types of cyber-attacks and cyber-crimes.
2. To give an overview of the cyber laws.
3. To study the defensive techniques against these attacks.

Course Outcomes:

1. The students will be able to understand cyber-attacks, types of cybercrimes, cyber laws and how to protect them self and ultimately the entire Internet community from such attacks.

UNIT - I

Introduction to Cyber Security: Basic Cyber Security Concepts, layers of security, Vulnerability, threat, Harmful acts, Internet Governance – Challenges and Constraints, Computer Criminals, CIA Triad, Assets and Threat, motive of attackers, active attacks, passive attacks, Software attacks, hardware attacks, Spectrum of attacks, Taxonomy of various attacks, IP spoofing, Methods of defence, Security Models, risk management, Cyber Threats-Cyber Warfare, Cyber Crime, Cyber terrorism, Cyber Espionage, etc., Comprehensive Cyber Security Policy.

UNIT - II

Cyberspace and the Law & Cyber Forensics: Introduction, Cyber Security Regulations, Roles of International Law. The INDIAN Cyberspace, National Cyber Security Policy. Introduction, Historical background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber Forensics and Digital evidence, Forensics Analysis of Email, Digital Forensics Lifecycle, Forensics Investigation, Challenges in Computer Forensics, Special Techniques for Forensics Auditing.

UNIT - III

Cybercrime: Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies and Measures in Mobile Computing Era, Laptops.

UNIT- IV

Cyber Security: Organizational Implications: Introduction cost of cybercrimes and IPR issues, web Threats for organizations, security and privacy implications, social media marketing: security risks

and perils for organizations, social computing, and the associated challenges for organizations.
Cybercrime and Cyber terrorism: Introduction, intellectual property in cyberspace, the ethical dimension of cybercrimes the psychology, mindset and skills of hackers and other cyber criminals.

UNIT - V

Privacy Issues: Basic Data Privacy Concepts: Fundamental Concepts, Data Privacy Attacks, Data linking and profiling, privacy policies and their specifications, privacy policy languages, privacy in different domains- medical, financial, etc.
Cybercrime: Examples and Mini-Cases Examples: Official Website of Maharashtra Government Hacked, Indian Banks Lose Millions of Rupees, Parliament Attack, Pune City Police Bust Nigerian Racket, e-mail spoofing instances.
Mini-Cases: The Indian Case of online Gambling, An Indian Case of Intellectual Property Crime, Financial Frauds in Cyber Domain.

TEXT BOOKS:

1. Nina Godbole and Sunit Belpure, Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley.
2. B. B. Gupta, D. P. Agrawal, Haoxiang Wang, Computer and Cyber Security: Principles, Algorithm, Applications, and Perspectives, CRC Press, ISBN 9780815371335, 2018.

REFERENCES:

1. Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press.
2. Introduction to Cyber Security, Chwan-Hwa(john) Wu,J. David Irwin, CRC Press T&F Group.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
B.Tech. in Electrical and Electronics Engineering
VI Semester Syllabus
MC601BS: ENVIRONMENTAL SCIENCE

L	T	P	C
3	0	0	0

Course Objectives:

1. To understand the natural resources and their conservation.
2. To understand the importance of ecosystem, biodiversity and ecological balance for sustainable development.
3. To gain knowledge about environmental pollution, affects and controlling measures.
4. To study about global environmental problems and global issues.
5. To understand the environmental policies, regulations and sustainable development.

Course Outcomes:

After completing the course, the student will be able to:

1. Learn about different types of natural resources and take up the measures to protect the resources.
2. Get the information about ecosystem, biodiversity and their usage and conservation.
3. Get the information about the types of pollution, understand their effects and controlling measures.
4. Gain the knowledge about current global environmental issues and initiations to be taken to protect the environment.
5. Gain the knowledge about environmental acts, EIA, sustainable development and follow the rules and regulations.

UNIT-I: ECOSYSTEMS

Definition, Scope, and Importance of ecosystem. Classification, structure, and function of an ecosystem, Food chains, food webs, and ecological pyramids. Flow of energy, Biogeochemical cycles, Bioaccumulation, Biomagnification, ecosystem value, services and carrying capacity.

UNIT–II: NATURAL RESOURCES

Classification of Resources: Living and Non-Living resources, water resources: use and over utilization of surface and ground water, floods and droughts, Dams: benefits and problems. Mineral resources: use and exploitation, environmental effects of extracting and using mineral resources, Land resources: Forest resources, Energy resources: growing energy needs, renewable and non-renewable energy sources, use of alternate energy source, case studies.

UNIT-III: BIODIVERSITY AND BIOTIC RESOURCES

Introduction, Definition, genetic, species and ecosystem diversity. Value of biodiversity; consumptive use, productive use, social, ethical, aesthetic, and optional values. India as a mega diversity nation, Hot spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; conservation of biodiversity: In-Situ and Ex- situ conservation. National Biodiversity act.

UNIT-IV: ENVIRONMENTAL POLLUTION AND CONTROL TECHNOLOGIES

Environmental Pollution: Classification of pollution, Air Pollution: Primary and secondary pollutants, causes and effects, Ambient air quality standards. Soil Pollution: Sources and types, Impacts of modern agriculture, degradation of soil. Solid waste: Municipal Solid Waste management, composition, and characteristics of e-Waste and its management. Pollution control technologies: Wastewater Treatment methods: Primary, secondary and Tertiary.

Global Environmental Issues and Global Efforts: Climate change and impacts on human environment. Ozone depletion and Ozone depleting substances (ODS).International conventions /Protocols: Earth summit, Kyoto protocol, and Montréal Protocol. NAPCC - Go Initiatives.

UNIT-V: ENVIRONMENTAL POLICY, LEGISLATION& EIA

Environmental Protection act, Legal aspects Air Act-1981, Water Act, biomedical waste management and handling rules, hazardous waste management and handling rules.

Environmental Impact of Assessment (EIA): structure, methods of baseline data acquisition. Concepts of Environmental Management Plan (EMP).

Towards Sustainable Future: Concept of Sustainable Development Goals, Population and its explosion, Environmental Education, Human health, Environmental Ethics, Concept of Green Building, Green chemistry principles, Ecological Foot Print, Life Cycle assessment (LCA), Low carbon life style.

Suggested Readings:

1. Text book of Environmental Studies for Under graduate Courses by Erach Bharucha for University Grants Commission.
2. Environmental Studies by Anubha Kaushik, 4thEdition, Newage international publishers.

Reference Books:

1. Environmental Science: towards a sustainable future by Richard T.Wright.2008 PHL Learning Private Ltd. New Delhi.
2. Environmental Engineering and science by Gilbert M. Masters and Wendell P. Ela. 2008 PHI Learning Pvt. Ltd.
3. Environmental Studies by R. Rajagopalan, Oxford University Press.
4. Environmental Science by Daniel B. Botkin & Edward A. Keller, Wiley INDIA edition.
5. Textbook of Environmental Science and Technology- Dr. M. Anji Reddy, 2007, B S Publications.
6. Introduction to Environmental Science by Y. Anjaneyulu, B S. Publications.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)

B.Tech. in Electrical and Electronics Engineering

VII Semester Syllabus

EE701PC: POWER ELECTRONIC APPLICATIONS TO RENEWABLE ENERGY SYSTEMS

L	T	P	C
3	1	0	4

Prerequisites: Power Electronics and Renewable Energy Sources

Course Objectives:

1. To impart knowledge on different types of renewable energy systems.
2. To learn the operation of power converters used in Solar PV system.
3. To learn about wind energy conversion systems.
4. To analyze the operation of electrical generators used for the wind energy conversion systems.
5. To know the principle and operation of standalone, grid connected and hybrid renewable energy systems.

Course Outcomes:

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

1. Acquire knowledge on solar energy extraction that are used to harness electrical power.
2. Understand power converters used in solar PV system.
3. Acquire knowledge on wind energy conversion system.
4. Design and comprehend the various operating mode of wind electrical generators and turbine used in wind energy conversion system.
5. Demonstrate and analyze the various standalone, grid connected & hybrid renewable energy systems.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To impart knowledge on different types of renewable energy systems	3	2	1	1	2	1	1	-	-	-	-	1
To learn the operation of power converters used in Solar PV system	3	2	2	2	2	1	1	-	-	-	-	1
To learn about wind energy conversion systems	3	2	2	2	2	1	1	-	-	-	-	1
To analyze the operation of electrical generators used for the wind energy conversion systems	3	2	2	2	2	1	1	-	-	-	-	1
To know the principle and operation of standalone, grid connected and hybrid renewable energy systems	3	2	2	2	2	1	1	-	-	-	-	1

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Acquire knowledge on solar energy extraction that are used to harness electrical power.	3	2	1	1	2	1	1	-	-	-	-	1
To understand power converters used in Solar PV system	3	2	2	2	2	1	1	-	-	-	-	1
Acquire knowledge on wind energy conversion system	3	2	2	2	2	1	1	-	-	-	-	1
Design and comprehend the various operating mode of wind electrical generators and turbine used in wind energy conversion system	3	2	2	2	2	1	1	-	-	-	-	1
Demonstrate and analyze the various standalone, grid connected & hybrid renewable energy systems	3	2	2	2	2	1	1	-	-	-	-	1

UNIT I: INTRODUCTION TO RENEWABLE ENERGY SYSTEMS

Solar cell characteristics and their measurement, PV Module, PV array, Partial shading of a solar cell and a module, The diode, Power conditioning unit, maximum power point tracker, Implementation of Perturb and Observe Method, Incremental Conductance Method, Battery Charger / discharge controller.

UNIT II: POWER CONVERTERS AND ANALYSIS OF SOLAR PV SYSTEMS

Power Converters: Line commutated converters (inversion-mode), Boost and buck-boost converters and inverters, battery sizing, array sizing, Block diagram of solar PV systems - Types of Solar PV systems: Stand-alone PV systems, Grid integrated solar PV Systems - Grid Connection Issues.

UNIT III: WIND ENERGY CONVERSION SYSTEMS

Introduction to wind: Characteristics, Wind Turbine, Fixed and Variable-Speed Wind Turbines, Components of WECS, Description of Components, Types of Wind Turbine Generators, Economics of Wind Energy Conversion Systems, Linking Wind Turbines onto the Grid, Power Converter Topologies for Wind Turbine Generators

UNIT IV: ELECTRICAL MACHINES FOR WIND ENERGY CONVERSION SYSTEMS

Introduction, Constructional aspects, classification of induction generator, torque-speed characteristics of induction Generator, Induction generator connected to wind energy systems. Introduction, Construction of Doubly Fed Induction Generator (DFIG), Power flow, slip, principle of operation, Types of Doubly Fed Induction Generators, control via static converter, application to

grid connected wind energy systems.

UNIT V: HYBRID RENEWABLE ENERGY SYSTEMS

Introduction to Hybrid systems, Need for Hybrid Systems, Range and type of Hybrid systems, Hybrid Solar PV/Wind Energy System, Architecture of Solar-Wind Hybrid System, Grid connected issues.

Suggested Readings:

1. S. N. Bhadra, D. Kastha, & S. Banerjee, "Wind Electrical Systems", Oxford University Press, 2005.
2. S. N. Bhadra, D. Kastha, & S. Banerjee, "Wind Electrical Systems", Oxford University Press, 2009.
3. Rashid. M. H, "Power Electronics Hand book", Academic Press, 2001.

Reference Books:

1. Rai. G. D, "Non-conventional energy sources", Khanna Publishers, 1993.
2. Rai. G.D, "Solar energy utilization", Khanna Publishes, 1993.
3. Gray, L. Johnson, "Wind energy system", Prentice Hall of India, 1995.
4. B.H.Khan "Non-conventional Energy sources", Mc Graw-Hill, 2nd Edition, 2009.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
B.Tech. in Electrical and Electronics Engineering
VII Semester Syllabus
EE711PE: MOBILE APPLICATION DEVELOPMENT (PE-III)

L	T	P	C
3	0	0	3

Prerequisite: Acquaintance with JAVA programming and A Course on DBMS

Course Objectives:

1. To understand the fundamentals of Android operating systems.
2. To develop the skills on Android user interfaces.
3. To understand the concepts of intents, broadcasts, and notifications.
4. To get the knowledge on creating files and reading data from files.
5. To inculcate knowledge of SQLite database.

Course Outcomes:

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

1. Understand the working of Android OS Practically.
2. Develop Android user interfaces.
3. Explore the concepts of intents, broadcasts, and notifications.
4. Knowledge on creating files and reading data from files.
5. Apply the SQLite database concepts to mobile applications.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To understand the fundamentals of Android operating systems	2	1	2	-	2	-	1	-	-	-	-	-
To develop the skills on Android user interfaces	3	3	2	2	3	-	-	-	2	-	-	-
To understand the concepts of intents, broadcasts, and notifications	2	3	3	2	2	-	3	-	-	-	2	-
To get the knowledge on creating files and reading data from files	3	3	2	2	2	2	-	1	-	-	-	-
To inculcate knowledge of SQLite database	3	2	2	3	2	-	-	-	-	1	-	-

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Understand the working of Android OS Practically	2	1	2	-	2	-	1	-	-	-	-	-

Develop Android user interfaces	3	3	2	2	3	-	-	-	2	-	-	-
Explore the concepts of intents, broadcasts, and notifications	2	3	3	2	2	-	3	-	-	-	2	-
Knowledge on creating files and reading data from files	3	3	2	2	2	2	-	1	-	-	-	-
Apply the SQLite database concepts to mobile applications	3	2	2	3	2	-	-	-	-	1	-	-

UNIT-I: INTRODUCTION TO ANDROID OPERATING SYSTEM

Introduction to Android Operating System: Android OS design and Features - Android development framework, SDK features, Installing and running applications on Android Studio, Creating AVDs, Types of Android applications, Best practices in Android programming, Android tools Android application components - Android Manifest file, Externalizing resources like values, themes, layouts, Menus etc, Resources for different devices and languages, Runtime Configuration Changes; Android Application Lifecycle -Activities, Activity lifecycle, activity states, monitoring state changes.

UNIT-II: ANDROID USER INTERFACE

Android User Interface: Measurements - Device and pixel density independent measuring units; Layouts – Linear, Relative, Grid and Table Layouts; User Interface (UI) Components -Editable and non-editable Text Views, Buttons, Radio and Toggle Buttons, Checkboxes, Spinners, Dialog and pickers; Event Handling - Handling clicks or changes of various UI components; Fragments - Creating fragments, Lifecycle of fragments, Fragment states, Adding fragments to Activity, adding, removing and replacing fragments with fragment transactions, interfacing between fragments and Activities, Multi-screen Activities.

UNIT-III: INTENTS AND BROADCASTS

Intents and Broadcasts: Intent - Using intents to launch Activities, Explicitly starting new Activity, Implicit Intents, Passing data to Intents, Getting results from Activities, Native Actions, using Intent to dial a number or to send SMS; Broadcast Receivers - Using Intent filters to service implicit Intents, Resolving Intent filters, finding and using Intents received within an Activity; Notifications - Creating and Displaying notifications, Displaying Toasts.

UNIT-IV: PERSISTENT STORAGE

Persistent Storage: Files – Using application specific folders and files, creating files, reading data from files, listing contents of a directory Shared Preferences – Creating shared preferences, saving and retrieving data using Shared Preference.

UNIT-V: DATABASE

Database - Introduction to SQLite database, creating and opening a database, creating tables, inserting retrieving and etindelg data, Registering Content Providers, Using content Providers (insert, delete, retrieve and update)

Suggested Readings:

1. Professional Android 4 Application Development, Reto Meier, Wiley India, (Wrox), 2012.

Reference Books:

1. Android Application Development for Java Programmers, James C Sheusi, Cengage Learning, 2013.
2. Beginning Android 4 Application Development, Wei-Meng Lee, Wiley India (Wrox), 2013.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)

B.Tech. in Electrical and Electronics Engineering

VII Semester Syllabus

EE712PE: DIGITAL SIGNAL PROCESSING (PE-III)

L	T	P	C
3	0	0	3

Prerequisite: Laplace Transforms, Numerical Methods and Complex variables, and Control Systems

Course Objectives:

1. To provide foundational knowledge for the analysis and processing of digital signals.
2. To explore the inter-relationship between continuous-time and discrete-time signals and systems, emphasizing time, frequency, and Z-plane analysis.
3. To design IIR digital filters from analog filters.
4. To understand the characteristics of FIR digital filters and design of it.
5. To understand trade-offs between normal and multi-rate DSP techniques, including finite length word effects.

Course Outcomes:

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

1. Demonstrate proficiency in performing time, frequency, and Z-transform analysis on signals and systems.
2. To explore the inter-relationship between continuous-time and discrete-time signals and systems, emphasizing time, frequency, and Z-plane analysis.
3. Design the IIR digital filters from analog filters.
4. Understand the characteristics of FIR digital filters and design of it.
5. Understand trade-offs between normal and multi-rate DSP techniques, including finite length word effects.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To provide foundational knowledge for the analysis and processing of digital signals	2	1	2	-	2	-	1	-	-	-	-	-
To explore the inter-relationship between continuous-time and discrete-time signals and systems, emphasizing time, frequency, and Z-plane analysis	3	3	2	2	3	-	-	-	2	-	-	-
To design IIR digital filters from analog filters	2	3	3	2	2	-	3	-	-	-	2	-
To understand the characteristics of FIR digital filters and design of it	3	3	2	2	2	2	-	1	-	-	-	-
To understand trade-offs between normal and multi-rate DSP techniques, including finite length	3	2	2	3	2	-	-	-	-	1	-	-

word effects												

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Demonstrate proficiency in performing time, frequency, and Z-transform analysis on signals and systems	2	1	2	-	2	-	1	-	-	-	-	-
To explore the inter-relationship between continuous-time and discrete-time signals and systems, emphasizing time, frequency, and Z-plane analysis	3	3	2	2	3	-	-	-	2	-	-	-
Design the IIR digital filters from analog filters	2	3	3	2	2	-	3	-	-	-	2	-
Understand the characteristics of FIR digital filters and design of it	3	3	2	2	2	2	-	1	-	-	-	-
Understand trade-offs between normal and multi-rate DSP techniques, including finite length word effects	3	2	2	3	2	-	-	-	-	1	-	-

UNIT-I: INTRODUCTION AND REALIZATION OF DIGITAL FILTERS

Introduction: Introduction to Digital Signal Processing: Discrete Time Signals & Sequences, conversion of continuous to discrete signal, Normalized Frequency, Linear Shift Invariant Systems, Stability, and Causality, linear differential equation to difference equation, Linear Constant Coefficient Difference Equations, Frequency Domain Representation of Discrete Time Signals and Systems.

Realization of Digital Filters: Applications of Z-Transforms, Solution of Difference Equations of Digital Filters, System Function, Stability Criterion, Frequency Response of Stable Systems, Realization of Digital Filters – Direct, Canonic, Cascade and Parallel Forms.

UNIT-II: DISCRETE FOURIER TRANSFORMS AND FAST FOURIER TRANSFORMS

Discrete Fourier Transforms: Properties of DFT, Linear Convolution of Sequences using DFT, Computation of DFT: Over-Lap Add Method, Over-Lap Save Method, Relation between DTFT, DFS, DFT and Z-Transform.

Fast Fourier Transforms: Fast Fourier Transforms (FFT) - Radix-2 Decimation-in-Time and Decimation-in-Frequency FFT Algorithms, Inverse FFT, and FFT with General Radix-N.

UNIT-III: IIR DIGITAL FILTERS

IIR Digital Filters: Analog filter approximations – Butterworth and Chebyshev, Design of IIR Digital Filters from Analog Filters, Step and Impulse Invariant Techniques, Bilinear Transformation Method, Spectral Transformations.

UNIT-IV: FIR DIGITAL FILTERS

FIR Digital Filters: Characteristics of FIR Digital Filters, Frequency Response, and Design of FIR Filters: Fourier Method, Digital Filters using Window Techniques, Frequency Sampling Technique, Comparison of IIR & FIR filters.

UNIT-V: MULTI-RATE DIGITAL SIGNAL PROCESSING

Multi-Rate Digital Signal Processing: Introduction, Down Sampling, Decimation, Up sampling, Interpolation, Sampling Rate Conversion, Conversion of Band Pass Signals, Concept of Resampling, Applications of Multi Rate Signal Processing.

Finite Word Length Effects: Limit cycles, Overflow Oscillations, Round-off Noise in IIR Digital Filters, Computational Output Round off Noise, Methods to Prevent Overflow, Tradeoff between Round Off and Overflow Noise, Measurement of Coefficient Quantization Effects through Pole-Zero Movement, Dead Band Effects.

Suggested Readings:

1. Digital Signal Processing, Principles, Algorithms, and Applications: John G. Proakis, Dimitris, G. Manolakis, Pearson Education / PHI, 2007.
2. Discrete Time Signal Processing – A. V. Oppenheim and R.W. Schaffer, PHI, 2009.

Reference Books:

1. Fundamentals of Digital Signal Processing – Loney Ludeman, John Wiley, 2009.
2. Digital Signal Processing – Fundamentals and Applications – Li Tan, Elsevier, 2008.
3. Fundamentals of Digital Signal Processing using MATLAB – Robert J. Schilling, Sandra L.Harris, Thomson, 2007.
4. Digital Signal Processing - A Practical approach, Emmanuel C. Ifeachorand Barrie W. Jervis,2nd Edition, Pearson Education, 2009.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
B.Tech. in Electrical and Electronics Engineering
VII Semester Syllabus

EE713PE: ELECTRIC AND HYBRID VEHICLES (PE-III)

L	T	P	C
3	0	0	3

Prerequisite: Power Semiconductor Drives, Electrical Drives and Control, Utilization of Electric Energy

Course Objectives:

1. To understand the fundamental concepts and principles of hybrid and electric vehicles.
2. To understand the analysis and design of hybrid and electric vehicles.
3. To study the configuration of hybrid and electric drive train.
4. To study different types of electric machines that can be used in hybrid vehicle.
5. To study about energy storage devices used in hybrid and electric vehicles.

Course Outcomes:

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

1. Understand the principles of hybrid vehicles and their performance.
2. Analyze the design aspects of hybrid and electric vehicle.
3. Analyze the different configurations of hybrid and electric drive train.
4. Analyze the different types of electric machines used in hybrid vehicle.
5. Analyze the different strategies related to energy storage systems.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To understand the fundamental concepts and principles of hybrid and electric vehicles	2	1	2	-	-	-	-	-	-	-	-	-
To understand the analysis and design of hybrid and electric vehicles	3	3	2	-	-	-	-	-	-	-	-	-
To study the configuration of hybrid and electric drive train	2	3	3	-	-	-	-	-	-	-	-	-
To study different types of electric machines that can be used in hybrid vehicle	3	3	2	-	-	-	-	-	-	-	-	-
To study about energy storage devices used in hybrid and electric vehicles	3	2	2	-	-	-	-	-	-	-	-	-

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Understand the principles of hybrid vehicles and their performance	2	1	2	-	-	-	-	-	-	-	-	-
Analyze the design aspects hybrid and electric vehicle	3	3	2	-	-	-	-	-	-	-	-	-
Analyze the different configurations of hybrid and electric drive train	2	3	3	-	-	-	-	-	-	-	-	-
Analyze the different types of electric machines used in hybrid vehicle	3	3	2	-	-	-	-	-	-	-	-	-
Analyze the different strategies related to energy storage systems	3	2	2	-	-	-	-	-	-	-	-	-

UNIT-I: INTRODUCTION

Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, and mathematical models to describe vehicle performance.

UNIT-II: HYBRID ELECTRIC VEHICLES AND HYBRID ELECTRIC DRIVE-TRAINS

Hybrid Electric Vehicle: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive - trains on energy supplies.

Hybrid Electric Drive Train: Basic concept of hybrid traction, introduction to various hybrid drive train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

UNIT-III: ELECTRIC TRAIN AND PROPULSION UNIT

Electric Trains: Basic concept of electric traction, introduction to various electric drive train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.

Electric Propulsion Unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

UNIT-IV: ENERGY STORAGE

Energy Storage: 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, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems

UNIT-V: ENERGY MANAGEMENT STRATEGIES AND CASE STUDIES

Energy Management Strategies: Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy

management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.

Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

Suggested Readings:

1. C. Mi, M. A. Masrur and D. W. Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons, 2011.
2. S. Onori, L. Serrao and G. Rizzoni, "Hybrid Electric Vehicles: Energy Management Strategies", Springer, 2015.

Reference Books:

1. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell.
2. Vehicles: Fundamentals, Theory, and Design", CRC Press, 2004.
3. T. Denton, "Electric and Hybrid Vehicles", Rutledge, 2016.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
B.Tech. in Electrical and Electronics Engineering
VII Semester Syllabus
EE714PE: HVDC TRANSMISSION (PE-IV)

L	T	P	C
3	0	0	3

Prerequisite: Power System-I, Power System-II, Power System Protection, Power System Operation and Control, Power Electronics.

Course Objectives:

1. To study the comparison of HVDC and EHV AC transmission, types of HVDC links and major components in a converter station.
2. To analyze the Graetz circuit.
3. To understand the control of converters and HVDC systems.
4. To understand the various protection methods for HVDC systems.
5. To study the harmonics in HVDC systems and design the filters.

Course Outcomes:

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

1. Compare HVDC and EHV AC transmission and to describe various types of DC links.
2. Analyze Graetz circuit for rectifier and inverter mode of operation.
3. Describe various methods for the control of converters and HVDC systems.
4. Describe various protection methods for HVDC systems.
5. Classify harmonics and design different types of filters.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To study the comparison of HVDC and EHV AC transmission, types of HVDC links and major components in a converter station	3	2	3	1	2	-	-	-	-	-	-	-
To analyze the Graetz circuit	3	3	3	3	3	-	-	-	-	-	-	-
To understand the control of converters and HVDC systems	2	3	3	2	1	-	-	-	-	-	-	-
To understand the various protection methods for HVDC systems	2	3	2	1	2	2	1	-	-	-	-	-
To study the harmonics in HVDC systems and design the filters	3	3	3	3	3	-	-	-	-	-	-	-

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Compare HVDC and EHV AC transmission and to describe various types of DC links	3	2	3	1	2	-	-	-	-	-	-	-
Analyze Graetz circuit for rectifier and inverter mode of operation	3	3	3	3	3	-	-	-	-	-	-	-
Describe various methods for the control of converters and HVDC systems	2	3	3	2	1	-	-	-	-	-	-	-
Describe various protection methods for HVDC systems	2	3	2	1	2	2	1	-	-	-	-	-
Classify harmonics and design different types of filters	3	3	3	3	3	-	-	-	-	-	-	-

UNIT-I: BASIC CONCEPTS

Evolution of HVDC transmission system, Comparison of HVDC and EHV AC transmission, Applications of HVDC transmission system, Types of HVDC links, major components in a HVDC converter station.

UNIT-II: ANALYSIS OF HVDC CONVERTERS

Definitions-Pulse number, VA rating of valve, VA rating of transformer, Characteristics of 6 Pulse converter, Analysis of Graetz circuit-without overlap, with overlap less than 60^0, Equivalent circuit of rectifier and inverter.

UNIT-III: CONVERTER AND HVDC SYSTEM CONTROL & REACTIVE POWER CONTROL IN HVDC SYSTEM

Principle of DC link control, Converter control characteristics, System control hierarch, Firing angle control, Current and extinction angle control, Starting and stopping of DC link.

Reactive Power Control in HVDC: Introduction, Reactive power requirements in steady state, Sources of reactive power- Static VAR Compensators.

UNIT-IV: CONVERTER FAULTS AND PROTECTION

Converter faults – Arc back, Arc through, Misfire, Quenching, Commutation failure, Short circuit in a bridge, Protection against over currents and over voltages in a converter station, Surge arresters, Smoothing reactors, DC breakers, Corona and its effects on DC lines – Power loss, Audible noise, Radio interference, Space charge field.

UNIT-V: HARMONICS AND FILTERS

Generation of harmonics, Types of harmonics- Characteristics and Non- Characteristic harmonics, Calculation of AC harmonics, DC voltage harmonics, Non- Characteristic harmonics, Adverse

effects of harmonics, **Filters:** Types of AC filters, Design of single tuned filters –Design of high pass filters.

Suggested Readings:

1. K. R. Padiyar, HVDC Power Transmission Systems: Technology and system Interactions, New Age International (P) Limited, and Publishers, 1990.
2. S K Kamakshaiah, V Kamaraju", HVDC Transmission, TMH Publishers, 2011.

Reference Books:

1. S. Rao, EHVAC and HVDC Transmission Engineering and Practice, Khanna publications, 3rd Edition 1999.
2. Jos Arrillaga", HVDC Transmission, The institution of electrical engineers, IEE power & energy series 29, 2nd edition 1998.
3. E. W. Kimbark", Direct Current Transmission, John Wiley and Sons, volume 1, 1971.
4. E. Uhlmann", Power Transmission by Direct Current, B. S. Publications, 2009.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
B.Tech. in Electrical and Electronics Engineering
VII Semester Syllabus
EE715PE: POWER SYSTEM RELIABILITY (PE-IV)

L	T	P	C
3	0	0	3

Prerequisite: Reliability Engineering, Power Systems-I and Power Systems-II

Course Objectives:

1. To study and understand the basics of probability theory and reliability.
2. To describe the generation system model and recursive relation for capacitive model Building.
3. To explain the equivalent transitional rates, cumulative probability and cumulative frequency
4. To develop the understanding of risk, system and load point reliability indices.
5. To explain the basic and performance reliability indices.

Course Outcomes:

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

1. Study and understand the basics of probability theory and reliability.
2. Describe the generation system model and recursive relation for capacitive model building.
3. Explain the equivalent transitional rates, cumulative probability and cumulative frequency.
4. Develop the understanding of risk, system and load point reliability indices.
5. Explain the basic and performance reliability indices.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To study and understand the basics of probability theory and reliability	2	3	2	3	-	-	-	-	-	-	-	-
To describe the generation system model and recursive relation for capacitive model building	3	3	2	2	-	-	-	-	-	-	-	-
To explain the equivalent transitional rates, cumulative probability and cumulative frequency	2	3	3	2	-	-	-	-	-	-	-	-
To develop the understanding of risk, system and load point reliability indices	3	3	2	2	-	-	-	-	-	-	-	-
To explain the basic and performance reliability indices	3	2	2	3	-	-	-	-	-	-	-	-

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Study and understand the basics of probability theory and reliability	2	3	2	3	-	-	-	-	-	-	-	-
Describe the generation system model and recursive relation for capacitive model building	3	3	2	2	-	-	-	-	-	-	-	-
Explain the equivalent transitional rates, cumulative probability and cumulative frequency	2	3	3	2	-	-	-	-	-	-	-	-
Develop the understanding of risk, system and load point reliability indices	3	3	2	2	-	-	-	-	-	-	-	-
Explain the basic and performance reliability indices	3	2	2	3	-	-	-	-	-	-	-	-

UNIT-I: BASIC PROBABILITY THEORY AND RELIABILITY

Basic Probability Theory: Elements of probability, probability distributions, Random variables, Density and Distribution functions, Binomial distribution, Expected value and standard deviation - Binomial distribution, Poisson distribution, normal distribution, exponential distribution, Weibull distribution.

Definition of Reliability: Definition of terms used in reliability, Component reliability, Hazard rate, derivation of the reliability function in terms of the hazard rate. Hazard models - Bath tub curve, Effect of preventive maintenance. Measures of reliability: Mean Time to Failure and Mean Time between Failures.

UNIT-II: GENERATING SYSTEM RELIABILITY ANALYSIS

Generation system model, capacity outage probability tables, Recursive relation for capacitive model building, sequential addition method, unit removal, Evaluation of loss of load and energy indices, Examples. Frequency and Duration methods, Evaluation of equivalent transitional rates of identical and non-identical units, Evaluation of cumulative probability and cumulative frequency of non-identical generating units, 2-level daily load representation, merge generation and load models, Examples.

UNIT-III: RELIABILITY ANALYSIS

Operating Reserve Evaluation: Basic concepts, risk indices, PJM methods, security function approach ,rapid start and hot reserve units ,Modeling using STPM approach.

Bulk Power System Reliability Evaluation: Basic configuration, conditional probability approach, system and load point reliability indices, weather effects on transmission lines ,Weighted average rate and Markov model ,Common mode failures.

Inter Connected System Reliability Analysis: Probability array method, Two inter connected systems with independent loads , effects of limited and unlimited tie capacity, imperfect tie, Two connected Systems with correlated loads, Expression for cumulative probability and cumulative

frequency.

UNIT-IV: DISTRIBUTION SYSTEM RELIABILITY ANALYSIS

Basic Techniques, Radial networks, Evaluation of Basic reliability indices, performance indices ,load point and system reliability indices, customer oriented, loss and energy-oriented indices, Examples. Basic concepts of parallel distribution system reliability

UNIT-V: SUBSTATIONS AND SWITCHING STATIONS

Effects of short-circuits, breaker operation, Open and Short- circuit failures, Active and Passive failures, switching after faults, circuit breaker model, preventive maintenance, exponential maintenance times.

Suggested Readings:

1. Reliability Evaluation of Power systems by R. Billinton, R.N. Allan, BS Publications, 2007.
2. Reliability Modeling in Electric Power Systems by J. Endrenyi, John Wiley and Sons, 1978.

Reference Books:

1. Reliability Engineering: Theory and Practice by Alessandro Birolini, Springer Publications.
2. An Introduction to Reliability and Maintainability Engineering by Charles Ebeling, TMH Publications.
3. Reliability Engineering by E. Balaguruswamy, TMH Publications.
4. Reliability Engineering by Elsayed A. Elsayed, Prentice Hall Publications.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)

B.Tech. in Electrical and Electronics Engineering

VII Semester Syllabus

EE716PE: ADVANCED ELECTRICAL DRIVES (PE-IV)

L	T	P	C
3	0	0	3

Prerequisite: Power Electronics and Power Semiconductor Drives

Course Objectives:

1. To understand the dynamics of electric drives.
2. To understand the closed loop control of induction motor drives.
3. To analyze the performance of Switched Reluctance Motor Drives.
4. To analyze the performance of Brushless DC Motor Drives.
5. To understand the concepts of Solar and Battery powered Drives.

Course Outcomes:

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

1. Understand the Dynamics of an electric drives.
2. Understand the closed loop control of induction motor drives.
3. Understand the performance and operation of Switched Reluctance Motor Drives.
4. Understand the performance and operation of Brushless DC Motor Drives.
5. Understand the concepts of solar and battery powered drives.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To understand the dynamics of electric drives	2	1	2	-	2	-	-	-	-	-	-	-
To understand the closed loop control of induction motor drives	3	3	2	2	3	-	-	-	-	-	-	-
To analyze the performance of Switched Reluctance Motor Drives	2	3	3	2	2	-	-	-	-	-	-	-
To analyze the performance of Brushless DC Motor Drives	3	3	2	2	2	2	-	-	-	-	-	-
To understand the concepts of Solar and Battery powered Drives	3	2	2	3	2	-	-	-	-	-	-	-

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Understand the Dynamics of an electric drives	2	1	2	-	2	-	-	-	-	-	-	-
Understand the closed loop control of induction motor drives	3	3	2	2	3	-	-	-	-	-	-	-
Understand the performance and	2	3	3	2	2	-	-	-	-	-	-	-

operation of Switched Reluctance Motor Drives												
Understand the performance and operation of Brushless DC Motor Drives	3	3	2	2	2	2	-	-	-	-	-	-
Understand the concepts of solar and battery powered drives	3	2	2	3	2	-	-	-	-	-	-	-

UNIT-I: DYNAMICS OF ELECTRICAL DRIVES

Introduction, choice of electric drives, Fundamental torque equation, speed-torque sign conventions, Multi quadrant operation of Electric drive, Component of load torque, Nature and Classification of load Torque, steady state stability, closed loop control of Drives.

UNIT-II: INDUCTION MOTOR DRIVES

Introduction to scalar and vector control, Open loop volts/Hz control of induction motor using voltage source inverter, Closed loop adjustable speed of induction motor, Speed control of induction motor with slip regulation, closed loop control of induction motor with volts/Hz and slip regulation.

UNIT-III: SWITCHED RELUCTANCE MOTOR DRIVES

Introduction to variable reluctance motor, Construction, Types of Switched Reluctance Motors, performance characteristics, operation and control requirements, Converter circuits, Modes of operation, applications and closed Loop operation of switched Reluctance motor drive**.**

UNIT-IV: BRUSHLESS DC MOTOR DRIVES

Brushless DC motor: construction, operation performance, Characteristics, Control of Brushless DC motor, Comparison of BLDC motor with brushed DC motor, Comparison of BLDC motor with Induction Motor, applications and important features, Voltage source Inverter fed BLDC motor Drive.

UNIT-V: SOLAR AND BATTERY POWERED DRIVES

Introduction to Solar and Battery powered drives, Solar Panels or Photovoltaic Panels, Characteristics of Solar Panels, Motors suitable for pump drives, Solar powered pump drive, Characteristics, Block diagram of Solar powered drive with MPPT, Battery powered vehicles, Battery Powered drive with Voltage Source Inverter.

Suggested Readings:

1. B. K. Bose, “Modern Power Electronics and AC Drives”, Pearson Education, Asia, 2003.
2. P. C. Krause, O. Wasynczuk and S. D. Sudhoff, “Analysis of Electric Machinery and Drive Systems”, John Wiley & Sons, 2013.

Reference Books:

1. H. A. Taliyat and S. G. Campbell, “DSP based Electromechanical Motion Control”, CRC press, 2003.
2. R. Krishnan, “Permanent Magnet Synchronous and Brushless DC motor Drives”, CRC Press, 2009.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
B.Tech. in Electrical and Electronics Engineering
VII Semester Syllabus
MS702HS: FUNDAMENTALS OF MANAGEMENT FOR ENGINEERS

L	T	P	C
2	0	0	2

Course Objectives: The objectives of the course are:

1. To enable the students understand the evolution and functions of Management.
2. To make the students learn planning process and decision making in the organization.
3. To enable the students to learn the application of the principles in an organization.
4. To learn the ability of directing, leading the organization.
5. To study the system and process of effective controlling in the organization.

Course Outcomes: By the end of the course students shall:

1. The students will understand the significance of Management and its functions.
2. To understand the planning process in the organization.
3. To understand the concept of organization.
4. Demonstrate the ability to direct and exhibit leadership qualities effectively.
5. To do analysis and isolate issues and formulate best control methods.

UNIT I: INTRODUCTION TO MANAGEMENT

Definition, Nature and Scope of Management, Functions of management, Managerial Roles, Levels of Management, Managerial Skills, Challenges of Management. Evolution of Management-Classical Approach- Scientific and Administrative Management; The Behavioural Approach; The Quantitative Approach.

UNIT II: PLANNING AND DECISION MAKING

Planning: Concept, Definition, Types of Plans, Planning Process, Importance of Planning, Management by Objectives; Production Planning and Control.

Decision making and Problem Solving – Concept, Types of Decisions - Programmed and Non - Programmed Decisions, Decision making Process, Bounded Rationality and Influence on Decision Making; Group Problem Solving and Decision Making.

UNIT III: ORGANIZATION AND HRM

Organization: Definition, Principles of Organizations, Formal and informal organizations, Importance, Organizational Design & Organizational Structures, Departmentalization, Delegation of authority, Empowerment, Centralization, Decentralization, Recentralization, Span of Control.

Human Resource Management & Business Strategy: Job Analysis, Recruitment – sources of recruitment, recruitment process, Selection process; Training and Development- importance, on-the-job and off-the job training methods; Performance Appraisal-meaning, methods. Job Satisfaction, Job Enrichment, Job Enlargement.

UNIT IV: LEADING AND MOTIVATION

Leading: Definition, Elements of Leading, importance and characteristics of Leader, Leadership, Power and Authority, Leadership Styles- Behavioural Leadership, Situational
Leadership, Leadership Skills, Leader as Mentor and Coach, Leadership during adversity and Crisis; Handling Employee and Customer Grievances, Team Leadership.
Motivation - Definition, importance, Types of Motivation; Content Motivational Theories- Needs Hierarchy Theory, Two Factor Theory, Theory-X and Theory-Y. Relationship between Motivation, Performance and Engagement.

UNIT V: CONTROLLING

Definitions, Importance, Limitations, characteristics, Control Process, Types and Strategies for Control, Establishing control systems, Elements of good Control system, Control frequency and Methods, Budgetary and Non-Budgetary Controls.

Text Books:

1. Andrew DuBrin, Management Essentials, Cengage Learning, 9th Edition 2012.
2. StephenP. Robbins, Fundamentals of Management, Pearson Education, 11th Edition 2019.
3. R. Satyaraju, A. Parthasarthy, Management: Texts and Cases, PHI Learning Pvt. Ltd, 2nd Edition, 2009.

Reference Books:

1. Harold Koontz, Heinz Weihrich, Essentials of Management, Tata McGraw-Hill.
2. Robert N Lussier, Management Fundamentals, CengageLearning,5th Edition2013.
3. T.R. Banga, S.C. Sharma, Industrial Engineering and Management: Including Production Management, Khanna Publishers.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)

B.Tech. in Electrical and Electronics Engineering

VII Semester Syllabus

EE751PC: SIMULATION OF RENEWABLE ENERGY SYSTEMS LABORATORY

L	T	P	C
0	0	4	2

Prerequisites: Power Electronics and Renewable Energy Sources

Course Objectives:

1. To develop proficiency in modeling the steady state and dynamic characteristics of photovoltaic (PV), fuel cell, and wind energy sources.
2. To understand the effect of temperature variation and irradiation, and partial shading effect on Solar PV system.
3. To apply the power converter topologies to PV, fuel cell, and wind energy systems.
4. To explore advanced topics in power electronics, including maximum power point tracking, and ZVS/ZCS configurations.
5. To design hybrid renewable energy system with different combinations of Solar PV, Wind, and Fuel cell.

Course Outcomes:

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

1. Model the steady state and dynamic characteristics of photovoltaic (PV), fuel cell, and wind energy sources.
2. Understand the effect of temperature variation and irradiation, and partial shading effect on Solar PV system.
3. Apply the power converter topologies to PV, fuel cell, and wind energy systems.
4. Explore advanced topics in power electronics, including maximum power point tracking, and ZVS/ZCS configurations.
5. Design hybrid renewable energy system with different combinations of Solar PV, Wind, and Fuel cell.

Course Objectives	**Program Outcomes**											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To develop proficiency in modeling the steady state and dynamic characteristics of photovoltaic (PV), fuel cell, and wind energy sources	3	3	3	3	3	2	3	-	-	-	-	3
To understand the effect of temperature variation and irradiation, and partial shading effect on Solar PV system	3	3	3	3	3	2	3	-	-	-	-	3

To apply the power converter topologies to PV, fuel cell, and wind energy systems	3	3	3	3	3	2	3	-	-	-	-	3
To explore advanced topics in power electronics, including maximum power point tracking, and ZVS/ZCS configurations	3	3	3	3	3	2	3	-	-	-	-	3
To design hybrid renewable energy system with different combinations of Solar PV, Wind, and Fuel cell	3	3	3	3	3	2	3	-	-	-	-	3

Course Outcomes	**Program Outcomes**											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Model the steady state and dynamic characteristics of photovoltaic (PV), fuel cell, and wind energy sources	3	3	3	3	3	2	3	-	-	-	-	3
Understand the effect of temperature variation and irradiation, and partial shading effect on Solar PV system	3	3	3	3	3	2	3	-	-	-	-	3
Apply the power converter topologies to PV, fuel cell, and wind energy systems	3	3	3	3	3	2	3	-	-	-	-	3
Explore advanced topics in power electronics, including maximum power point tracking, and ZVS/ZCS configurations	3	3	3	3	3	2	3	-	-	-	-	3
Design hybrid renewable energy system with different combinations of Solar PV, Wind, and Fuel cell	3	3	3	3	3	2	3	-	-	-	-	3

Any Ten experiments are required to be conducted from the following list of experiments.

1. Simulation study of Solar Cell characteristics.
2. Simulation study of Fuel Cell characteristics.
3. Simulation of Solar PV energy System.
4. Effect of Temperature Variation and irradiation on Photovoltaic Array.
5. Characteristics of PV System under Partial Shading Condition.
6. Simulation study on Wind energy generation.
7. Simulation of solar PV boost converter using P&O MPPT technique.

8. Simulation of solar PV boost converter using Incremental Conductance Method.
9. Simulation of ZVS configuration.
10. Simulation of ZCS configuration.
11. Simulation of Self-Excited Induction Generator (SEIG).
12. Simulation of Fuel Cell Feed to DC Load through Boost Converter.
13. Simulation study on Hybrid (Solar-Wind) Power System using Power Converter.
14. Simulation study on Hybrid (Fuel Cell – PV) Power System using Power Converter.

Suggested Readings:

1. S. N. Bhadra, D. Kastha, & S. Banerjee, “Wind Electrical Systems”, Oxford University Press, 2005.
2. S. N. Bhadra, D. Kastha, & S. Banerjee, “Wind Electrical Systems”, Oxford University Press, 2009.
3. Rashid. M. H, “Power Electronics Hand book”, Academic Press, 2001.

Reference Books:

1. Rai. G. D, “Non-conventional energy sources”, Khanna Publishers, 1993.
2. Rai. G.D,” Solar energy utilization”, Khanna Publishes, 1993.
3. Gray, L. Johnson, “Wind energy system”, Prentice Hall of India, 1995.
4. B.H.Khan "Non-conventional Energy sources", Mc Graw-Hill, 2nd Edition, 2009.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)

B.Tech. in Electrical and Electronics Engineering

VIII Semester Syllabus

EE811PE: UTILIZATION OF ELECTRICAL ENERGY (PE-V)

L	T	P	C
3	0	0	3

Prerequisite: Electrical Machines-I and Electrical Machines-II

Course Objectives:

1. To learn the methods of electric heating.
2. To learn the methods of electric welding.
3. To learn the fundamentals of illumination and good lighting practices and basic principles of Light control and types of lighting schemes.
4. To understand the concepts of electric drives and their application to electrical traction systems.
5. To learn the systems of train lighting.

Course Outcomes:

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

1. Understand basic principles of electric heating.
2. Understand basic principles of electric welding.
3. Understand the lighting requirements for flood lighting, household and industrial needs.
4. Know the Systems of electric traction and track electrification and speed time curves.
5. Acquire the knowledge on the systems of train lighting.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To learn the methods of electric heating	1	1	2	-	2	-	-	-	-	-	-	-
To learn the methods of electric welding	1	1	2	-	2	-	-	-	-	-	-	-
To learn the fundamentals of illumination and good lighting practices and basic principles of Light control and types of lighting schemes	2	2	2	-	2	-	-	-	-	-	-	-
To understand the concepts of electric drives and their application to electrical traction systems	1	2	2	-	2	-	-	-	-	-	-	-
To learn the systems of train lighting	1	2	2	-	2	-	-	-	-	-	-	-

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Understand basic principles of electric heating	1	1	2	-	2	-	-	-	-	-	-	-
Understand basic principles of electric welding	1	1	2	-	2	-	-	-	-	-	-	-
Understand the lighting requirements for flood lighting, household and industrial needs	2	2	2	-	2	-	-	-	-	-	-	-
Know the Systems of electric traction and track electrification and speed time curves	1	2	2	-	-	-	-	-	-	-	-	-
Acquire the knowledge on the systems of train lighting	1	2	2	-	2	-	-	-	-	-	-	-

UNIT-I: ELECTRIC HEATING

Advantages and methods of electric heating, resistance heating, induction heating and dielectric heating.

UNIT-II: ELECTRIC WELDING

Electric welding equipment, resistance welding and arc welding, comparison between AC and DC welding. Electrolysis process: principle of electrolysis, electroplating, metal extraction and metal processing, electromagnetic stirs.

UNIT-III: ILLUMINATION

Terminology, Laws of illumination, coefficient of Utilization and depreciation, Polar curves, Photometry, integrating sphere, sources of light, fluorescent lamps, compact fluorescent lamps, LED lamps discharge lamps, mercury vapor lamps, sodium vapor lamps and neon lamps, comparison between tungsten filament lamps and fluorescent tubes. Basic principles of light control, Types and design of lighting scheme, lighting calculations, factory lighting, streetlighting and flood lighting.

UNIT-IV: ELECTRIC TRACTION

Systems of electric traction and track electrification- DC system, single phase and 3-phase low frequency and high frequency system, composite system, kando system, comparison between AC and DC systems, problems of single-phase traction with current unbalance and voltage unbalance. Mechanics of traction movement, speed – time curves for different services, trapezoidal and quadrilateral speed – time curves, tractive effort, power, specific energy consumption, effect of varying acceleration and braking, retardation, adhesive weight and braking retardation, coefficient of adhesion.

UNIT-V: SYSTEMS OF TRAIN LIGHTING

Special requirements of train lighting, methods of obtaining unidirectional polarity constant output- single battery system, Double battery parallel block system, coach wiring, lighting by

making use of 25KV AC supply.

Suggested Readings:

1. H. Partab: Modern Electric Traction, Dhanpat Rai & Co., 2007.
2. E. Openshaw Taylor: Utilisation of Electric Energy, Orient Longman, 2010.

Reference Books:

1. H. Partab: Art & Science of Utilization of Electric Energy, Dhanpat Rai & Sons, 1998.
2. N.V. Suryanarayana: Utilization of Electrical power including Electric drives and Electric Traction, New Age Publishers, 1997.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
B.Tech. in Electrical and Electronics Engineering
VIII Semester Syllabus
EE812PE: SOLAR POWER BATTERIES (PE-V)

L	T	P	C
3	0	0	3

Prerequisite: Renewable Energy Systems

Course Objectives:

1. To study the basic concepts of Solar PV Systems.
2. To understand the concept of Primary and Secondary Batteries and its operation.
3. To study the coupled storage, design and strengths of Battery systems.
4. To understand Grid Tie and Off-Grid Solar Battery System.
5. To study the environmental impact of batteries.

Course Outcomes:

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

1. Analyze the operation of the solar PV systems.
2. Analyze the performance of the various types batteries.
3. Estimate the performance of the battery and design an effective battery system for solar PV system.
4. Understand the Grid tie and Off Grid solar battery systems.
5. Analyze the environmental impacts of batteries, its life and strengths.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To study the basic concepts of Solar PV Systems	3	-	2	-	-	3	3	-	-	-	-	-
To understand the concept of Primary and Secondary Batteries and its operation	3	-	2	-	-	3	3	-	-	-	-	-
To study the coupled storage, design and strengths of Battery systems	3	-	2	2	-	3	3	-	-	-	-	-
To understand Grid Tie and Off-Grid Solar Battery System	3	-	2	2	-	3	3	-	-	-	-	-
To study the environmental impact of batteries	3	-	2	2	-	3	3	-	-	-	-	-

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Analyze the operation of the solar PV systems	3	-	2	-	-	3	3	-	-	-	-	-
Analyze the performance of the various types batteries	3	-	2	-	-	3	3	-	-	-	-	-
Estimate the performance of the battery and design an effective battery system for solar PV system	3	-	2	2	-	3	3	-	-	-	-	-
Understand the Grid tie and Off Grid solar battery systems	3	-	2	2	-	3	3	-	-	-	-	-
Analyze the environmental impacts of batteries, its life and strengths	3	-	2	2	-	3	3	-	-	-	-	-

UNIT-I: INTRODUCTION TO SOLAR PV SYSTEMS

Introduction to solar PV systems, basics of Storage for solar PV systems, Storage for solar PV systems: the batteries, Introduction to Solar Power Batteries, terminology associated, understanding Solar Battery Specifications, working principle, Series Vs. Parallel, Charging parameters, cycle life, Temperature effects, Battery Design and Construction, Important components in battery construction.

UNIT-II: PRIMARY AND SECONDARY BATTERIES

Primary and Secondary batteries, Classification of Secondary batteries, i.e Lead-Acid, Lead-Antimony, Lead-Calcium, Lead-Acid Battery Chemistry, Nickel-Cadmium Batteries and their types.

UNIT-III: BATTERY SYSTEMS AND DESIGN

AC Coupled Storage vs. DC Coupled Storage, working of Solar Batteries with a Solar Power System and Hybrid Inverter, Main Degradation mechanisms of Solar Batteries, Battery Strengths and Weaknesses, Battery System Design and Selection Criteria, Life Expectancy, Battery standards, Safety precautions,

UNIT-IV: BATTERY COSTS AND BENEFITS

Solar Battery Costs, Declining Cost, factors contribute to the performance of solar battery, selection of suitable batteries based on the application, Grid Tie vs. Off-Grid Solar Battery System, Benefits and disadvantages of using solar batteries,

UNIT-V: ENVIRONMENTAL IMPACTS OF BATTERIES

The environmental impacts of batteries: Introduction, Service life of the components, Energy requirements for production and transport of the PV-battery system components, Contributing components, Influence of different user conditions, Uncertainties, Future research, Energy return

factor, The overall battery efficiency, Different efficiency measures and battery design, The Future of Solar Battery Storage.

Suggested Readings:

1. S. Sumathi and L. Ashok Kumar, Solar PV and Wind Energy Conversion Systems: An Introduction to Theory, Modeling with MATLAB/SIMULINK, and the Role of Soft ComputingTechniques, Springer 2011.
2. H.A. Kiehne, "Battery Technology Handbook" by Publisher: CRC Press 2003.
3. https://core.ac.uk/download/pdf/30044842.pdf.
4. Handbook on Battery Energy Storage System.
5. https://www.adb.org/sites/default/files/publication/479891/handbook-battery-energy-storage-system.pdf.

Reference Books:

1. Cristina Archer and S. Lovejoy, Battery Technology for Electric Vehicles: Public Science and Private Innovation, Springer 2015.
2. Soteris A. Kalogirou, "Solar Energy Engineering: Processes and Systems" by, Academic Press, Year: 2009.
3. https://files.bregroup.com/bre-co-uk-file-librarycopy/filelibrary/nsc/Documents%20Library/NSC%20Publications/88031-BRE_Solar-Consumer-Guide-A4-12pp.pdf.
4. https://www.sunwize.com/tech-notes/solar-battery-basics/.
5. https://palmetto.com/learning-center/blog/how-does-a-solar-battery-work.
6. https://www.letsgosolar.com/faq/what-is-a-solar-battery/.
7. https://www.purevolt.ie/domestic-solar/equipment/solar-storage-batteries.php.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)

B.Tech. in Electrical and Electronics Engineering

VIII Semester Syllabus

EE813PE: AI TECHNIQUES IN ELECTRICAL ENGINEERING (PE-V)

L	T	P	C
3	0	0	3

Prerequisite: Power Systems-I, Power Systems-II and Power Systems Analysis

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
5. To understand the applications of AI in electrical engineering

Course Outcomes:

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

1. Locate soft commanding methodologies, such as artificial neural networks, Fuzzy logic, and genetic Algorithms.
2. Observe the concepts of feed forward neural networks and about feedback neural networks.
3. Practice the concept of fuzziness involved in various systems and comprehensive knowledge of fuzzy logic control and to design the fuzzy control
4. Analyze genetic algorithm, genetic operations and genetic mutations
5. Understand the applications of AI in electrical engineering

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To locate soft commanding methodologies, such as artificial neural networks, Fuzzy logic and genetic Algorithms	2	3	3	3	-	-	-	-	-	-	-	-
To observe the concepts of feed forward neural networks and about feedback neural networks	3	3	2	2	-	-	-	-	-	-	-	-
To practice the concept of fuzziness involved in various systems and comprehensive knowledge of fuzzy logic control and to design the fuzzy control	3	3	3	2	-	-	-	-	-	-	-	-

To analyze genetic algorithm, genetic operations and genetic mutations	3	3	2	3	-	-	-	-	-	-	-	-
To understand the applications of AI in electrical engineering	3	2	3	3	-	-	-	-	-	-	-	-

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Locate soft commanding methodologies, such as artificial neural networks, Fuzzy logic, and genetic Algorithms	2	3	3	3	-	-	-	-	-	-	-	-
Observe the concepts of feed forward neural networks and about feedback neural networks	3	3	2	2	-	-	-	-	-	-	-	-
Practice the concept of fuzziness involved in various systems and comprehensive knowledge of fuzzy logic control and to design the fuzzy control	3	3	3	2	-	-	-	-	-	-	-	-
Analyze genetic algorithm, genetic operations and genetic mutations	3	3	2	3	-	-	-	-	-	-	-	-
Understand the applications of AI in electrical engineering	3	2	3	3	-	-	-	-	-	-	-	-

UNIT-I: ARTIFICIAL NEURAL NETWORKS

Introduction, Models of Neuron Network, Architectures, Knowledge representation, Artificial Intelligence and Neural networks, Learning process -Error correction learning, Hebbian learning, Competitive learning, Boltzman learning, supervised learning, Unsupervised learning, Reinforcement learning, Learning tasks.

UNIT-II: ANN PARADIGMS

Multi-layer perceptron using Back propagation Algorithm (BPA), Self Organizing Map (SOM), Radial Basis Function Network, Functional Link Network (FLN), Hopfield Network.

UNIT-III: FUZZY LOGIC

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.

UNIT-IV: GENETIC ALGORITHMS

Introduction-Encoding, Fitness Function, Reproduction operators, Genetic Modeling, Genetic operators, Cross over-Single site cross over, Two point cross over, Multi point cross over Uniform cross over, Matrix cross over-Cross over Rate-Inversion & Deletion, Mutation operator, Mutation, Mutation Rate-Bit-wise operators, Generational cycle-convergence of Genetic Algorithm.

UNIT-V: APPLICATIONS OF AI TECHNIQUES

Load forecasting, Load flow studies, Economic load dispatch, Load frequency control, Single area system and two area system, Reactive power control, Speed control of DC and AC Motors.

Suggested Readings:

1. S. Rajasekaran and G.A.V. Pai Neural Networks, Fuzzy Logic & Genetic Algorithms, PHI, NewDelhi, 2003.
2. Rober J. Schalkoff, Artificial Neural Networks, Tata McGraw Hill Edition, 2011.

Reference Books:

1. P.D. Wasserman; Neural Computing Theory & Practice, Van Nostrand Reinhold, New York,1989.
2. Bart Kosko; Neural Network & Fuzzy System, Prentice Hall, 1992.
3. D.E. Goldberg, Genetic Algorithms, Addison-Wesley 1999.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
B.Tech. in Electrical and Electronics Engineering
VIII Semester Syllabus
EE814PE: SMART GRID TECHNOLOGIES (PE-VI)

L	T	P	C
3	0	0	3

Prerequisite: Power Systems-I, Power Systems-II and Power Systems Analysis

Course Objectives:

1. To group various aspects of the smart grid.
2. To defend smart grid design to meet the needs of a utility.
3. To select issues and challenges that remain to be solved.
4. To analyze basics of electricity, electricity generation, economics of supply and demand, and the various aspects of electricity market operations in both regulated and deregulated environment.
5. To study and understand the control smart grid power system.

Course Outcomes:

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

1. Group various aspects of the smart grid.
2. Defend smart grid design to meet the needs of a utility
3. Select issues and challenges that remain to be solved
4. Analyze basics of electricity, electricity generation, economics of supply and demand, and the various aspects of electricity market operations in both regulated and deregulated environment.
5. Study and understand the control smart grid power system

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To group various aspects of the smart grid	2	3	3	3	-	-	-	-	-	-	-	-
To defend smart grid design to meet the needs of a utility	3	3	2	2	-	-	-	-	-	-	-	-
To select issues and challenges that remain to be solved	3	3	3	2	-	-	-	-	-	-	-	-
To analyze basics of electricity, electricity generation, economics of supply and demand, and the various aspects of electricity market operations in both regulated and deregulated environment.	3	3	2	3	-	-	-	-	-	-	-	-
To study and understand the control smart grid power system	3	2	3	3	-	-	-	-	-	-	-	-

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Group various aspects of the smart grid	2	3	3	3	-	-	-	-	-	-	-	-
Defend smart grid design to meet the needs of a utility	3	3	2	2	-	-	-	-	-	-	-	-
Select issues and challenges that remain to be solved	3	3	3	2	-	-	-	-	-	-	-	-
Analyze basics of electricity, electricity generation, economics of supply and demand, and the various aspects of electricity market operations in both regulated and deregulated environment.	3	3	2	3	-	-	-	-	-	-	-	-
Study and understand the control smart grid power system	3	2	3	3	-	-	-	-	-	-	-	-

UNIT-I: INTRODUCTION TO SMART GRID

What is Smart Grid? Working definitions of Smart Grid and Associated Concepts, Smart grid Functions, Traditional Power Grid and Smart Grid, New Technologies for SmartGrid, Advantages, Indian Smart Grid, Key Challenges for Smart Grid.

UNIT-II: SMART GRID ARCHITECTURE

Components and Architecture of Smart Grid Design, Review of the proposed architectures for Smart Grid. The fundamental components of Smart Grid designs, Transmission Automation, Distribution Automation, Renewable Integration.

UNIT-III: TOOLS AND TECHNIQUES FOR SMART GRID

Computational Techniques, Static and Dynamic Optimization Techniques, Computational Techniques, Evolutionary Algorithms –Artificial Intelligence techniques.

UNIT-IV: DISTRIBUTION GENERATION TECHNOLOGIES AND SMART GRID

Introduction to Renewable Energy Technologies, Micro grids, Storage Technologies, Electric Vehicles and plug-in hybrids, Environmental impact and ClimateChange, Economic Issues.

Communication Technologies and Smart Grid: Introduction to Communication Technology, Synchro, Phasor Measurement Units (PMUs), Wide Area Measurement Systems (WAMS).

UNIT-V: CONTROL OF SMART POWER GRID SYSTEM

Load Frequency Control (LFC) in Micro Grid System, Voltage Control in Micro Grid System, Reactive Power Control in Smart Grid. Case Studies and Test beds forthe Smart Grids.

Suggested Readings:

1. Stuart Borlase, Smart Grids, Infrastructure, Technology and Solutions, CRC Press, 2013
2. Gil Masters, Renewable and Efficient Electric Power System, Wiley - IEEE Press, 2004.

Reference Books:

1. A.G. Phadke and J.S. Thorp, "Synchronized Phasor Measurements and their Applications",Springer Edition, 2010.
2. T. Ackermann, Wind Power in Power Systems, Hoboken, NJ, USA, John Wiley, 2005.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
B.Tech. in Electrical and Electronics Engineering
VIII Semester Syllabus
EE815PE: ELECTRICAL DISTRIBUTION SYSTEMS (PE-VI)

L	T	P	C
3	0	0	3

Prerequisite: Power System-I, Power System-II and Switchgear & Protection.

Course Objectives:

1. To distinguish between transmission and distribution systems.
2. To understand design considerations of feeders.
3. To compute voltage drop and power loss in feeders.
4. To understand protection of distribution systems.
5. To examine the power factor improvement and voltage control.

Course Outcomes:

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

1. Distinguish between transmission and distribution line and design the feeders.
2. Compute power loss and voltage drop of the feeders.
3. Design protection of distribution systems.
4. Understand the importance of power factor improvement.
5. Understand the voltage control methods.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To distinguish between transmission and distribution systems	2	1	2	1	2	-	-	-	-	-	-	-
To understand design considerations of feeders	3	3	2	2	3	-	-	-	-	-	-	-
To compute voltage drop and power loss in feeders	2	2	3	2	2	-	-	-	-	-	-	-
To understand protection of distribution systems	2	3	3	2	2		-	-	-	-	-	-
To examine the power factor improvement and voltage control	3	2	2	3	2	-	-	-	-	-	-	-

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Distinguish between transmission and distribution line and design the feeders	2	1	2	2	2	-	-	-	-	-	-	-

Compute power loss and voltage drop of the feeders	3	3	2	2	3	-	-	-	-	-	-	-
Design protection of distribution systems	2	3	3	2	2	-	-	-	-	-	-	-
Understand the importance of power factor improvement	3	3	2	2	2	-	-	-	-	-	-	-
Understand the voltage control methods	3	2	2	3	2	-	-	-	-	-	-	-

UNIT – I: GENERAL CONCEPTS AND DISTRIBUTION FEEDERS

General Concepts: Introduction to distribution system, Distribution system planning, Factors effecting the Distribution system planning, Load modelling and characteristics. Coincidence factor - contribution factor - Loss factor - Relationship between the load factor and loss factor. Load growth, Classification of loads (Residential, commercial, Agricultural and Industrial) and their characteristics.

Distribution Feeders: Design Considerations of Distribution Feeders: Radial, loop and network types of primary feeders, voltage levels, Factors effecting the feeder voltage level, feeder loading, basic design practice of the secondary distribution system, secondary banking, secondary network types, secondary mains.

UNIT – II: SUBSTATIONS AND SYSTEM ANALYSIS SUBSTATIONS

Location of Substations: Rating of distribution substation, service area with 'n' primary feeders. Benefits derived through optimal location of substations. Optimal location of Substations (Perpendicular bisector rule and X, Y co-ordinate method).

System Analysis: Voltage drop and power-loss calculations: Derivation for voltage drop and power loss in lines, manual methods of solution for radial networks, three phase balanced primary lines, analysis of non-three phase systems.

UNIT-III: PROTECTION AND COORDINATION

Protection: Objectives of distribution system protection, over current Protective Devices: Principle of operation of Fuses, Auto-Circuit Recloser - and Auto-line sectionalizes.

Coordination: Coordination of Protective Devices: Objectives of protection co-ordination, general coordination procedure, Types of protection coordination: Fuse to Fuse, Auto-Recloser to Fuse, Circuit breaker to Fuse, Circuit breaker to Auto-Recloser.

UNIT - IV: COMPENSATION FOR POWER FACTOR IMPROVEMENT

Different types of power capacitors, shunt and series capacitors, effect of shunt capacitors (Fixed and switched), effect of series capacitors, difference between shunt and series capacitors, Calculation of power factor correction, capacitor allocation - Economic justification of capacitors - Procedure to determine the best capacitor location.

UNIT – V: VOLTAGE CONTROL

Voltage Control: Importance of voltage control, methods of voltage control, Equipment for voltage control, effect of shunt capacitors, effect of series capacitors, effect of AVB/AVR on voltage control, line drop compensation, voltage fluctuations.

Suggested Readings:

1. Turan Gonen, Electric Power Distribution System Engineering, CRC Press, 3rd Edition, 2014.
2. V. Kamaraju, Electrical Power Distribution Systems, Tata Mc Graw Hill Publishing Company, 2nd edition, 2010.

Reference Books:

1. G. Ram Murthy, Electrical Power Distribution handbook, 2nd edition, University press 2004.
2. A.S.Pabla, Electric Power Distribution, Tata McGraw Hill Publishing company, 6th edition, 2013.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)

B.Tech. in Electrical and Electronics Engineering

VIII Semester Syllabus

EE816PE: POWER QUALITY AND FACTS (PE-VI)

L	T	P	C
3	0	0	3

Prerequisite: Power Electronics, Power System Operation and Control and HVDC Transmission

Course Objectives:

1. To understand the power quality and its terms, the causes and effects of power quality problems and the classification of power quality problems.
2. To analyze the uncompensated AC transmission lines, passive reactive power compensation and, shunt and series compensation at the mid-point of an AC line.
3. To understand the objective of static shunt compensation, the basic operating principle and characteristics of SVC, TCR, TSC, FC-TCR, and STATCOM.
4. To know the objective of series compensation, variable impedance type of series compensators, the ffunctioning, and control of TCSC, TSSC, and SSSC.
5. To study the benefits of combined compensators, independent control of real and reactive power, the basic operating principle of Unified Power Flow Controller.

Course Outcomes:

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

1. Know the power quality and its terms, the causes and effects of power quality problems and the classification of power quality problems.
2. Analyze the uncompensated AC transmission lines, passive reactive power compensation and shunt and series compensation at the mid-point of an AC line.
3. Design and analyze the static shunt compensators such as SVC, TCR, TSC, FC-TCR, and STATCOM.
4. Design and analyze the static series compensators such as TCSC, TSSC, and SSSC.
5. Understand the operation of Unified Power Flow Controller.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To understand the power quality and its terms, the causes and effects of power quality problems and the classification of power quality problems	3	3	3	2	3	3		-	-	-	-	-
To analyze the uncompensated AC transmission lines, passive reactive power compensation and, shunt and series compensation at the mid-point of an AC line	3	3	3	2	3	2	-	-	-	-	-	-
To understand the objective of static shunt compensation, the	3	3	3	2	3	2	-	-	-	-	-	-

basic operating principle and characteristics of SVC, TCR, TSC, FC-TCR, and STATCOM												
To know the objective of series compensation, variable impedance type of series compensators, the ffunctioning and control of TCSC, TSSC, and SSSC	3	3	3	2	3	2	-	-	-	-	-	-
To study the benefits of combined compensators, independent control of real and reactive power, the basic operating principle of Unified Power Flow Controller	3	3	3	2	3	3	-	-	-	-	-	-

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Know the power quality and its terms, the causes and effects of power quality problems and the classification of power quality problems	3	3	3	2	3	3		-	-	-	-	-
Analyze the uncompensated AC transmission lines, passive reactive power compensation and shunt and series compensation at the mid-point of an AC line	3	3	3	2	3	2	-	-	-	-	-	-
Design and analyze the static shunt compensators such as SVC, TCR, TSC, FC-TCR, and STATCOM	3	3	3	2	3	2	-	-	-	-	-	-
Design and analyze the static series compensators such as TCSC, TSSC, and SSSC	3	3	3	2	3	2	-	-	-	-	-	-
Understand the operation of Unified Power Flow Controller	3	3	3	2	3	3	-	-	-	-	-	-

UNIT-I: POWER QUALITY PROBLEMS IN DISTRIBUTION SYSTEMS

Power Quality Problems in Distribution Systems: Transient and Steady state variations in voltage and frequency. Unbalance, Sags, Swells, Interruptions, Waveform Distortions: harmonics, noise, notching, dc-offsets, fluctuations. Flicker.

UNIT-II: TRANSMISSION LINES AND SERIES/SHUNT REACTIVE POWER COMPENSATION

Transmission Lines and Series/Shunt Reactive Power Compensation: Basics of AC Transmission. Analysis of uncompensated AC transmission lines. Passive Reactive Power Compensation. Shunt and series compensation at the mid-point of an AC line. Comparison of Series and Shunt Compensation.

UNIT-III: STATIC SHUNT COMPENSATORS

Static Shunt Compensators: Objectives of shunt compensation, Methods of controllable VAR generation, Static Var Compensator, its characteristics, TCR, TSC, FC-TCR configurations, STATCOM, basic operating principle, control approaches and characteristics.

UNIT-IV: STATIC SHUNT COMPENSATORS

Static Series Compensators: Objectives of series compensator, variable impedance type of series compensators, TCSC, TSSC-operating principles and control schemes, SSSC, Power Angle characteristics, Control range and VAR rating, Capability to provide reactive power compensation, external control.

UNIT-V: COMBINED COMPENSATORS

Combined Compensators: Introduction to Unified Power Flow Controller, Basic operating principles, Conventional control capabilities, Independent control of real and reactive power.

Suggested Readings:

1. Electrical Power Systems Quality, Dugan Roger C, Santoso Surya, Mc Granaghan, Marks F. Beaty and H. Wayre, Mc Graw Hill.
2. Power Systems Quality Assessment, J. Arillaga, N.R. Watson, S. Clon, John Wiley.

Reference Books:

1. Power Quality, C. Sankaran, CRC Press.
2. Understanding power quality problems, Math H. Bollen, IEEE press.
3. Understanding FACTS –Concepts and Technology of Flexible AC Transmission Systems" Narain G. Honorani, Laszlo Gyugyi.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
Open Elective offered by EEE Department
VI Semester Syllabus
EE621OE: ELECTRICAL ENGINEERING MATERIALS (OE-I)

L	T	P	C
3	0	0	3

Prerequisite: Engineering Physics, Engineering Chemistry and Basic Electrical Engineering.

Course Objectives:

1. To introduce the fundamental concepts of engineering materials, their properties and applications.
2. To understand the concept of dielectric materials.
3. To describe the various magnetic materials available.
4. To introduce the concept of semiconductor materials.
5. To understand materials used for electric applications.

Course Outcomes:

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

1. Compare and contrast different materials used in the field of engineering.
2. Select the dielectric materials appropriate to the system and field of application.
3. Apply the knowledge of magnetic materials to engineering applications.
4. Understand the use of semiconductor materials.
5. Understand the introductory concepts of materials used in electric applications.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To introduce the fundamental concepts of engineering materials, their properties and applications	2	1	3	1	1	2	2	-	-	-	-	-
To understand the concept of dielectric materials	3	1	2	2	2	2	3	-	-	-	-	-
To describe the various magnetic materials available	2	2	3	2	2	2	3	-	-	-	-	-
To introduce the concept of semiconductor materials	3	2	3	2	2	2	2	-	-	-	-	-
To understand materials used for electric applications	3	3	3	3	2	2	3	-	-	-	-	-

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Compare and contrast different materials used in the field of engineering	2	1	2	-	2	-	2	-	-	-	-	-
Select the dielectric materials appropriate to the system and field of application	3	3	2	2	3	2	1	-	-	-	-	-
Apply the knowledge of magnetic materials to engineering applications	2	3	3	2	2	-	2	-	-	-	-	-
Understand the use of semiconductor materials	3	3	2	2	2	2	3	-	-	-	-	-
Understand the introductory concepts of materials used in electric applications	3	2	2	3	2	3	3	-	-	-	-	-

UNIT-I: INTRODUCTION TO ENGINEERING MATERIALS

Historical perspective of materials, Classification of materials, Properties of materials - Physical, Mechanical, Electrical, Magnetic, and Chemical properties, Bases of materials, Selection of materials, Manufacturing processes.

UNIT-II: DIELECTRIC MATERIALS

Dielectric as electric field medium, leakage currents, dielectric loss, dielectric strength, breakdown voltage, electric conductivity in solids, liquids and gaseous dielectrics.

UNIT-III: MAGNETIC MATERIALS

Introduction, terms connected with magnetic materials, magnetic parameters, classification of magnetic materials – diamagnetic, paramagnetic and ferromagnetic materials, properties of ferromagnetic materials, magnetically soft materials, magnetically hard materials, B-H curves of soft and hard magnetic materials, Losses in magnetic materials, factors affecting permeability and hysteresis loss.

UNIT-IV: SEMICONDUCTOR MATERIALS

Introduction to semiconductors, characteristics of semiconductors, atomic structure, intrinsic and extrinsic semiconductors, energy band diagrams, preparation of semiconductor materials, production of p-type and n-type crystals, thermal conductivity of semiconductors, electrical characteristics of semiconductors.

UNIT-V: MATERIALS FOR ELECTRIC APPLICATIONS

Conductor, general properties of conductors, specific resistance, factors affecting resistivity of electric materials, materials for lamp filaments, materials used for transmission lines, bimetals

electrical contact materials.

Suggested Readings:

1. R. K. Rajput, Electrical Engineering Materials, University Science / Laxmi Publications Press 2009.
2. C.S. Indulkar. S Thiruvengadam, An Introduction To Electrical Engineering Materials, S Chand, 2006.

Reference Books:

1. A. J. Dekker, Electrical engineering materials, PHI, 1970.

Online Resources:

1. https://nptel.ac.in/courses/113102080
2. https://nptel.ac.in/courses/112108150

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
Open Elective offered by EEE Department
VI Semester Syllabus
EE622OE: NON - CONVENTIONAL POWER GENERATION (OE-I)

L	T	P	C
3	0	0	3

Prerequisite: Nil

Course Objectives:

1. To introduce various types of renewable energy technologies.
2. To understand solar electric power generation and tracking.
3. To understand the wind energy conversion and the components of wind turbine.
4. To discuss the concepts of biomass energy conversion.
5. To understand the principles of OTEC and Fuel cells.

Course Outcomes:

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

1. Analyze solar energy radiation and collection.
2. Analyze solar thermal and photovoltaic systems and related technologies for energy conversion.
3. Understand Wind energy conversion and devices available for it.
4. Understand Biomass conversion technologies, Geo thermal resources and energy conversion principles and technologies.
5. To gain knowledge about power generation from oceans and fundamentals of fuel cells.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To introduce various types of renewable energy technologies	1	1	1	-	-	1	3	-	-	-	-	1
To understand solar electric power generation and tracking	1	-	1	-	-	2	3	-	-	-	-	2
To understand the wind energy conversion and the components of wind turbine	1	-	1	-	-	2	3	-	-	-	-	2
To discuss the concepts of biomass energy conversion	1	-	1	-	-	2	3	-	-	-	-	1
To understand the principles of OTEC and Fuel cells	1	-	1	-	2	2	3	-	-	-	1	1

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Analyze solar energy radiation and collection	1	1	1	-	-	1	3	-	-	-	-	1

Analyze solar thermal and photovoltaic systems and related technologies for energy conversion	1	-	1	-	-	2	3	-	-	-	-	2
Understand wind energy conversion and devices available for it	1	-	1	-	-	2	3	-	-	-	-	2
Understand Biomass conversion technologies, Geothermal resources and energy conversion principles and technologies	1	-	1	-	-	2	3	-	-	-	-	1
To gain knowledge about power generation from oceans and fundamentals of fuel cells	1	-	1	-	2	2	3	-	-	-	1	1

UNIT-I: INTRODUCTION TO SOLAR ENERGY AND THERMAL CONVERSION SYSTEMS

Solar Radiation on Earth's surface-Solar radiation geometry, solar radiation measurements, Solar radiation data, Solar radiation on horizontal and tilted surfaces, solar Thermal conversion, Flat plate collectors, concentrated collectors, solar applications - Solar ponds

UNIT-II: SOLAR ELECTRIC POWER GENERATION

Solar-Electric Power generation, Photovoltaic cells, Equivalent circuit, V-I Characteristics, Photovoltaic modules, constructional details, solar tracking system

UNIT-III: HARNESSING WIND ENERGY

Wind Energy, Fundamentals of wind energy-power available in wind, Betz Limit, Wind turbines, Horizontal and vertical axis turbines, Wind Energy conversion systems.

UNIT-IV: BIOMASS

Energy from Bio Mass, Various fuels, Sources-Conversion technologies, Wet Processes, Dry Processes, Bio Gas generation, Aerobic and anaerobic digestion, Factors affecting generation of bio gas, Classification of bio gas plants, Different digesters, Gasification process, Gasifiers, Applications. Geothermal Energy, sources.

UNIT-V: OCEAN ENERGY AND FUEL CELLS

OTEC Systems, Principle of operation, Open and closed cycles, Energy from Tides, Principle of Tidal Power, Components of tidal Power plants, Operation Methods, Energy and Power from Waves, Wave energy conversion devices, Fuel Cells, Principle of operation, Types of Fuel Cells, Advantages and disadvantages, Types of Electrodes, Applications.

Suggested Readings:

1. John Twidell & Wier, "Renewable Energy Resources", CRC Press, 2009.
2. G. D. Rai, "Non-Conventional Energy sources", Khanna publishers, 2004.

Reference Books:

1. D. P. Kothari, Singal, Rakesh and Ranjan, “Renewable Energy sources and Emerging Technologies”, PHI, 2009.
2. F. C. Treble, Generating Electricity from Sun, Pergamon Press, 1st Edition 1991.
3. C. S. Solanki, “Solar Photovoltaics - Fundamentals- Principles and Applications”, PHI, 2009.
4. S. P. Sukhatme, “Solar Energy Principles and Application”, TMH, 2009.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)

Open Elective offered by EEE Department

VII Semester Syllabus

EE721OE: ENERGY CONSERVATION AND GREEN BUILDING (OE-II)

L	T	P	C
3	0	0	3

Prerequisite: Fundamentals of Electrical Energy and Electrical Power

Course Objectives:

1. To understand different forms and types of energy sources.
2. To understand the concept of environmental audit and energy audit.
3. To understand the significance of energy efficiency and need for conservation.
4. To understand the basic concepts of green buildings.
5. To understand the various rating systems of green buildings.

Course Outcomes:

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

1. Can differentiate between renewable and non- renewable energy sources.
2. Will be familiar with the concepts of environmental audit and energy audit.
3. Can understand the need for energy efficiency and conservation.
4. Will get awareness on the concept of green buildings and its advantages.
5. Get acquainted with the various rating systems of green buildings.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To understand different forms and types of energy sources	2	1	-	-	-	2	3	-	-	-	-	1
To understand the concept of environmental audit and energy audit	2	-	1	2	2	2	3	-	-	-	-	1
To understand the significance of energy efficiency and need for conservation	1	-	1	-	-	2	2	-	-	-	-	2
To understand the basic concepts of green buildings	1	-	-	-	-	2	3	-	-	-	-	1
To understand the various rating systems of green buildings	1	1	1	-	1	2	3	-	-	-	-	-

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Can differentiate between renewable and non-renewable energy sources	2	1	-	-	-	2	3	-	-	-	-	1

Will be familiar with the concepts of environmental audit and energy audit	2	-	1	2	2	2	3	-	-	-	-	1
Can understand the need for energy efficiency and conservation	1	-	1	-	-	2	2	-	-	-	-	2
Will get awareness on the concept of green buildings and its advantages	1	-	-	-	-	2	3	-	-	-	-	1
Get acquainted with the various rating systems of green buildings	1	1	1	-	1	2	3	-	-	-	-	-

UNIT-I: ENERGY - RENEWABLE & NON-RENEWABLE

Renewable Energy sources – Solar, wind Ocean, Hydro, Biomass Non-Renewable Energy sources – Coal, Petroleum, Natural Gas, Nuclear Energy, Chemical sources, Hydrogen fuel cells.

UNIT-II: ENVIRONMENTAL AUDIT & ENERGY AUDIT

Environmental Audit – Meaning, necessity, norms. Types - Liabilities audit, Management audit, Activities audit, Energy Audit – Definition, need & Types of energy audit, Energy management approach – understanding energy costs.

UNIT-III: ENERGY EFFICIENCY & CONSERVATION

Growing need for energy, need for energy efficiency & Conservation, Energy Efficiency, Bureau of Energy Efficiency (BEE) Ratings, Leadership in Energy & Environmental Design (LEED) ratings, functions of Government Organizations working for Energy conservation & Audit

UNIT-IV: GREEN BUILDING

Definition, Benefits, Principles of Green buildings, Salient features of Green buildings, planning concepts for green buildings – Maximize comfort, day lighting, ventilation, materials.

UNIT-V: RATING SYSTEMS FOR GREEN BUILDING

Indian Green Building Council (IGBC) ratings, Green Rating for Integrated Habit Assessment (GRIHA), HVAC in Green Buildings, Comparison of different Rating systems.

Suggested Readings:

1. Dr. Dinesh Kumar Gupta, Vaibhao K Sonarkar : Energy Conservation and Green Buildings, Nirali Prakashan 1st Edition, 2019, ISBN : 9789389108316.
2. Michael Montoya - Green Building Fundamentals: A Practical Guide to Understanding and Applying Fundamental Sustainalbe Construction Practice and the Leed Green Building Rating System, Prentice Hall, 1st Edition.

Reference Books:

1. Matilda Schmidt - Green Building and Energy Efficiency, Syrawood Publishing House.
2. IGBC Green Homes Rating Systems – Version 3.0.

3. A Handbook of energy efficiency in buildings – A life cycle approach, Elseiver.
4. Energy Conservation Building Code 2017 – Bureau of Energy Efficiency Publications.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
Open Elective offered by EEE Department
VII Semester Syllabus
EE722OE: CONVENTIONAL POWER GENERATION (OE-II)

L	T	P	C
3	0	0	3

Prerequisites: Basic Electrical Engineering

Course Objectives:

1. To understand the Operation of Hydro Power stations.
2. To know the working of Thermal Power stations.
3. To understand the Operation of Nuclear Power stations.
4. To know the working of Gas Power stations.
5. To illustrate the economic aspects of power generation.

Course Outcomes:

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

1. Draw the layout of hydro power plant, and explain the various components used.
2. Illustrate the layout of steam power plant, and explain various equipment used in the plant.
3. Understand the layout of nuclear power plants and explain the operation of nuclear reactors.
4. Draw the layout of gas power plant and explain its operation.
5. Illustrate various economic aspects of the power plant erection, operation.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To understand the operation of Hydro Power stations	3	2	3	1	2	-	-	-	-	-	-	-
To know the working of Thermal Power stations	3	3	2	2	3	-	-	-	-	-	-	-
To understand the Operation of Nuclear Power stations	2	3	3	2	2	-	-	-	-	-	-	-
To know the working of Gas Power stations	3	3	2	2	2		-	-	-	-	-	-
To illustrate the economic aspects of power generation	3	2	2	3	2	-	-	-	-	-	-	-

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Draw the layout of hydro power plant, and explain the various components used	3	2	2	2	2	-	-	-	-	-	-	-
Illustrate the layout of steam power plant, and explain various equipment used in the plant	3	3	2	2	3	-	-	-	-	-	-	-

Understand the layout of nuclear power plants and explain the operation of nuclear reactors	2	3	3	2	2	-	-	-	-	-	-	-
Draw the layout of gas power plant and explain its operation	3	3	2	2	2		-	-	-	-	-	-
Illustrate various economic aspects of the power plant erection, operation	3	2	2	3	2	-	-	-	-	-	-	-

UNIT- I: HYDROELECTRIC POWER STATIONS

Introduction, Elements of hydroelectric power station-types-concept of pumped storage plants-storage requirements, estimation of power developed from a given catchment area; heads and efficiencies.

UNIT – II: THERMAL POWER STATIONS

Introduction, Line diagram of Thermal Power Station (TPS) showing paths of coal, steam, water, air, ash and flue gasses. - Brief description of TPS components: Economizers, Boilers, Super heaters, Turbines, Condensers, Chimney and cooling towers

UNIT – III: NUCLEAR POWER STATIONS

Introduction, Nuclear Fission and Chain reaction. - Nuclear fuels. - Principle of operation of Nuclear reactor.-Reactor Components: Moderators, Control rods, Reflectors and Coolants.

UNIT-IV: GAS POWER STATIONS

Introduction, Principle of Operation and Components (Block Diagram Approach Only), Advantages of Gas power plants, Disadvantages of gas power plants, Comparison of different power plants.

UNIT-V: ECONOMIC ASPECTS OF POWER GENERATION

Importance of Economic Aspects of Power Generation, Load curve, load duration and integrated load duration curves-load, demand, diversity, capacity, utilization and plant use factors- Numerical Problems.

Suggested Readings:

1. J. B. Gupta, A Course in Power Systems, S.K. Kataria & Sons Publishers, 2013.
2. C. L. Wadhawa, Generation and utilization of Electrical Energy, New Age International (P) Limited, Publishers 1997.
3. V.K Mehta and Rohit Mehta, Principles of Power Systems, S. Chand& Company Ltd, New Delhi, 2004.

Reference Books:

1. M.V. Deshpande, Elements of Power Station design and practice, Wheeler Publishing, 3rd Edition 1999.
2. S. N. Singh, Electrical Power Generation, Transmission and Distribution, PHI, 2003.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)

Open Elective offered by EEE Department

VIII Semester Syllabus

EE821OE: ENERGY STORAGE SYSTEMS (OE-III)

L	T	P	C
3	0	0	3

Prerequisite: Electro chemistry

Course Objectives:

1. To understand the basics of electrical systems and energy storage.
2. To enable the student to understand the need for energy storage devices.
3. To enable the student to understand the classifications of ESS.
4. To understand different types of ESS.
5. To enable the student to understand various technologies available and their applications.

Course Outcomes:

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

1. Analyze the characteristics of energy from various sources.
2. Analyze the need for storage of energy.
3. Classify various types of energy storage and various devices used for the purpose.
4. Identify different types of ESS.
5. Identify various real time applications.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To understand the basics of electrical systems and energy storage	3	2	3	1	2	-	-	-	-	-	-	-
To enable the student to understand the need for energy storage devices	3	3	2	2	3	-	-	-	-	-	-	-
To enable the student to understand the classifications of ESS	2	3	3	2	2	-	-	-	-	-	-	-
To understand different types of ESS	3	3	2	2	2	-	-	-	-	-	-	-
To enable the student to understand various technologies available and their applications	3	2	2	3	2	-	-	-	-	-	-	-

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Analyze the characteristics of energy from various	3	2	2	2	2	-	-	-	-	-	-	-
Analyze the need for storage of energy	3	3	2	2	3	-	-	-	-	-	-	-

Classify various types of energy storage and various devices used for the	2	3	3	2	2	-	-	-	-	-	-	-
Identify different types of ESS	3	3	2	2	2		-	-	-	-	-	-
Identify various real time applications	3	2	2	3	2	-	-	-	-	-	-	-

UNIT-I: BASICS OF ELECTRICAL SYSTEMS AND ENERGY STORAGE

Characteristics of electricity, Electricity and the roles of EES, High generation cost during peak-demand periods, Need for continuous and flexible supply, Long distance between generation and consumption, Congestion in power grids, Transmission by cable.

UNIT-II: NEED FOR ELECTRICAL ENERGY STORAGE

Emerging needs for EES, More renewable energy, less fossil fuel, Smart Grid uses, The roles of electrical energy storage technologies, The roles from the viewpoint of a utility, The roles from the viewpoint of consumers, The roles from the viewpoint of generators of renewable energy.

UNIT-III: CLASSIFICATION OF ENERGY STORAGE SYSTEMS

Classification of EES systems, Mechanical storage systems, Pumped hydro storage (PHS), Compressed air energy storage (CAES), Flywheel energy storage (FES), Electrochemical storage systems, Secondary batteries, Flow batteries, Chemical energy storage, Hydrogen (H2), Synthetic natural gas (SNG).

UNIT-IV: TYPES OF ELECTRICAL ENERGY STORAGE SYSTEMS

Electrical storage systems, Double-layer capacitors (DLC), Superconducting magnetic energy storage (SMES), Thermal storage systems, Standards for EES, Technical comparison of EES technologies.

UNIT-V: APPLICATIONS OF ENERGY STORAGE SYSTEMS

Present status of applications, Utility use (conventional power generation, grid operation & service), Consumer use (uninterruptable power supply for large consumers), New trends in applications, Renewable energy generation, Smart Grid, Smart Micro grid, Smart House, Electric vehicles, Management and control hierarchy of storage systems, Internal configuration of battery storage systems, External connection of EES systems , Aggregating EES systems and distributed generation (Virtual Power Plant), Battery SCADA - aggregation of many dispersed batteries.

Suggested Readings:

1. The Electrical Energy Storage by IEC Market Strategy Board.
2. James M. Eyer, Joseph J. Iannucci and Garth P. Corey, “Energy Storage Benefits and Market Analysis”, Sandia National Laboratories, 2004.

Reference Books:

1. Jim Eyer, Garth Corey, Energy Storage for the Electricity Grid: Benefits and Market Potential Assessment Guide, Report, Sandia National Laboratories, Feb 2010.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)

Open Elective offered by EEE Department

VIII Semester Syllabus

EE822OE: ELECTRICAL SYSTEMS AND SAFETY (OE-III)

L	T	P	C
3	0	0	3

Prerequisite: Ordinary Differential Equations and Vector Calculus, Electrical Circuit Analysis - I

Course Objectives:

1. To understand the electrical wiring systems.
2. To Understand the Electrical safety.
3. To understand the types of Substations.
4. To understand Electrical billing and tariff.
5. To understand the concepts of Illumination schemes.

Course Outcomes:

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

1. Know about the wiring systems and accessories.
2. Know about the Electrical Safety Measures.
3. Get acquainted with different types of Substations.
4. Know about the Electrical billing and different types of tariff.
5. Get familiarized with different Illumination schemes.

Course Objectives	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
To understand the electrical wiring systems	3	1	2	-	-	-	-	-	-	-	-	-
To Understand the Electrical safety	3	1	2	-	-	-	-	-	-	-	-	-
To understand the types of Substations	3	1	-	-	-	-	-	-	-	-	-	-
To understand Electrical billing and tariff	3	2	-	-	-	-	-	-	-	-	-	-
To understand the concepts of Illumination schemes	3	1	2	-	-	-	-	-	-	-	-	-

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Know about the wiring systems and accessories	3	1	2	-	-	-	-	-	-	-	-	-
Know about the Electrical Safety Measures	3	1	2	-	-	-	-	-	-	-	-	-
Get acquainted with different types of Substations	3	1	-	-	-	-	-	-	-	-	-	-

Know about the Electrical billing and different types of tariff	3	2	-	-	-	-	-	-	-	-	-	-
Get familiarized with different Illumination schemes	3	1	2	-	-	-	-	-	-	-	-	-

UNIT-I: ELECTRICAL WIRING SYSTEMS

Types of wires, specifications, types of wiring systems, selection of wire, wiring accessories and protective devices, IE rules for domestic and industrial wiring, types of electrical distribution systems – Radial, Ring / Loop and Interconnected Distributed System, Introduction to UG cables, Types of UG cables and construction of UG cables.

UNIT-II: ELECTRICAL SAFETY

Electricity, its usefulness and Hazards, statutory provisions, Indian standards, effects of electrical parameters on human body, safety measures for electric shock, purpose of Earthing, Types of Earthing.

UNIT-III: SUBSTATIONS

Introduction, types of Substations, Line diagram of substation, outdoor substation - pole mounted type, Description of components, Indoor substation - floor mounted type, Description of components.

UNIT-IV: ELECTRICAL BILLING AND TARIFF

Desirable characteristics of tariff, Objectives of tariff, types of tariff - flat rate, block rate, two part tariff, three part tariff and Power Factor tariff.

UNIT-V: ILLUMINATION

Introduction, terminology in Illumination, laws of Illumination, various types of light sources, practical lighting schemes.

Suggested Readings:

1. J.B.Gupta, “A course in Electrical Technology”, S.K. Kataria & Sons, 2012
2. V.K.Mehta, Rohit Mehta, “Principles of Power System”, S.Chand Publisher, 3rd edition March 2005
3. Dr.S.L.Uppal and G.C. Garg, “Electrical Wiring Estimating and Costing”, Khanna Publishers.

Reference Books:

1. Dr.Sanjeev Singh, Umesh Rathore, “Energy management”, Second Edition, S.K.Kataria and Sons, 2014.
2. S.Sivanagaraju, M.Balasubba Reddy, D.Srilatha, “Generation and Utilisation of Electrical Energy”, Pearson publishers, 2010.