TADIPATRI ENGINEERING COLLEGE

(AUTONOMOUS)

Accredited by NAAC ,Approved by AICTE ,New Delhi & Affiliated to JNTUA, Anantapur)

M.Tech(Regular-Full Time)

(Effective for the students admitted into I year I Sem from the Academic Year 2025-26onwards)

M.TECH.-*POWER ELECTRONICS*

I,II,III&IVSEMESTERCOURSESTRUCTURE&SYLLABU

DEPARTMENT ELECTRICAL AND ELECTRONICS ENGINEERING
M. TECH POWER ELECTRONICS
EFFECTIVE FROM ACADEMIC YEAR 2025-26 ADMITTED BATCH
R-25 COURSESTRUCTURE AND SYLLABUS

SEMESTER – I

S. No.	Course codes	Course Name	Category	Hours per week			Credits
				L	T	P	
1.	TEC25MPE0001T	Switched Mode Power Converters	PC	3	0	0	3
2.	TEC25MPE0002T	Machine Modelling and Analysis	PC	3	0	0	3
3.	 TEC25MPEPE001a TEC25MPEPE001b TEC25MPEPE001c	**Program Elective – I** DC Drives Modern Control Theory Energy Auditing and Management	PE	3	0	0	3
4.	 TEC25MPEPE002a TEC25MPEPE002b TEC25MPEPE002c	**Program Elective – II** Solar Energy Conversion Systems Wind Energy Conversion Systems Smart Grid Technologies	PE	3	0	0	3
5.	TEC25MPE0010P	Power Electronics Lab	PC	0	0	4	2
6.	TEC25MPE0020P	Renewable Energy Sources Lab	PC	0	0	4	2
7.	TEC25MPEMC01	**Research Methodology and IPR**	**MC**	**2**	**0**	**0**	**2**
8.	TEC25MPESO01	**Skill Enhancement Course** AI Techniques in Electrical Engineering	SE	2	0	0	2
9.	 TEC25MPEAC01a TEC25MPEAC01b TEC25MPEAC01c	**Audit Course – I** English for Research Paper Writing Disaster Management Essence of Indian Traditional Knowledge	AC	2	0	0	0
Total							**20**

SEMESTER – II

S.No.	Course codes	Course Name	Category	Hours per			Credits
				L	T	P	
1.	TEC25MPE0003T	Advanced Power Electronics	PC	3	0	0	3
2.	TEC25MPE0004T	FACTS Controllers	PC	3	0	0	3
3.	TEC25MPEPE001a TEC25MPEPE001b TEC25MPEPE001c	**Program Elective – III** AC Drives Advanced Power Semiconductor Devices & Protection Applications of Power Converters	PE	3	0	0	3
4.	TEC25MPEPE002a TEC25MPEPE002b TEC25MPEPE002c	**Program Elective – IV** Power Quality EV Charging Infrastructure & Technology Digital Signal Processors and applications	PE	3	0	0	3
5.	TEC25MPE0030P	Electric Drives Lab	PC	0	0	4	2
6.	TEC25MPE0040P	FACTS Devices & Simulation Lab	PC	0	0	4	2
7.	TEC25MRMC02	**Quantum Technologies and Applications**	MC	2	0	0	2
8.	TEC25MCVO01	**Comprehensive Viva Voce**	PC	0	0	0	2
9.	TEC25MAC02A TEC25MAC02B TEC25MAC02C	**Audit Course – II** Pedagogy Studies Personality Development Through Life Enlightenment Skills Yoga For Stress Management	AC	2	0	0	0
Total							**20**

****Students have to undergo an Industry Internship after I Year II Semester for a duration of 6 to 8 weeks**

SEMSTER – III

S.No.	Course codes	Course Name	Category	Hours per			Credits
				L	T	P	
1.	TEC25MPEPE003a TEC25MPEPE003b TEC25MPEPE004c	**Program Elective – V** Control & Integration of Renewable Energy Sources Energy Storage Technologies Hybrid Electric Vehicle Engineering	PE	3	0	0	3
2.	TEC25MPEOE001a	**Open Elective-I**	OE	3	0	0	3
3.	TEC25MDP301	**Dissertation Phase – I**	PR	0	0	20	10
4.	TEC25MII301	**Industry Internship**		0	0	0	2
5.	TEC25MCC301	**Co- Curricular Activities**		0	0	0	1
Total							**19**

Open Elective-I

1. **PHOTOVOLTAIC SYSTEMS**

SEMESTER – IV

S.No.	Corse codes	Course Name	Category	Hours per			Credits
				L	T	P	
1.	TEC25MDP401	**Dissertation Phase – II**	PR	0	0	32	16
Total							**16**

Course Code	SWITCHED MODE POWER CONVERTERS	L	T	P	C
TEC25MPE0001T		3	0	0	3
	Semester	**I**			

Course Objectives: To make the student

- Remember and Understand the concept of advanced converter topologies.
- Apply the concept of topologies for various switching regulators.
- Analyze the working and waveforms of the converters designed.
- Evaluate the operation of converters in continuous and discontinuous modes.

Course Outcomes (CO): Student will be able to

- Remember and understand the concept of Buck and Boost switching regulator topologies push-pull & forward converter, voltage & current fed topologies. L1
- Apply the concept of topologies for various switching regulators. L3
- Analyze the concepts of half & full bridge converter topologies. L4
- Evaluate the operation of continuous and dis-continuous Flyback converter topologies. L2

UNIT - I	FUNDAMENTAL SWITCHING REGULATORS –BUCK AND BOOST TOPOLOGIES	Lec Hrs: 9

Buck Switching Regulator Topology: Basic Operation - Significant Current waveforms -Buck regulator efficiency-Design relations of output filter inductor and capacitor. Boost Switching Regulator Topology: Basic Operation – Quantitative relations –Discontinuous and Continuous modes -Design relations.

UNIT - II	PUSH-PULL AND FORWARD CONVERTER TOPOLOGIES	Lec Hrs: 10

Push-Pull Topology: Basic Operation – Master/slave outputs - Flux imbalance -Power transformer design relations - Primary, secondary peak and RMS currents - output power and input voltage limitations - output filter design relations. Forward Converter Topology: Basic operation -Design relations - Slave output voltages -secondary load -free wheeling diode and inductor currents. Forward converter with unequal power and reset winding turns - power transformer design and output filter design.

UNIT - III	HALF AND FULL BRIDGE CONVERTER TOPOLOGIES	Lec Hrs: 10

Half Bridge Converter Topology: Basic operation-Half bridge magnetic-output filter calculations, blocking capacitor to avoid fluxim balance- Half bridge leakage inductance problems. Full Bridge Converter Topology: Basic Operation-Full Bridge magnetic –out put filter calculations – transformer primary blocking capacitor.

UNIT - IV	FLYBACK CONVERTER TOPOLOGIES	Lec Hrs: 10

Discontinuous-Mode Fly backs: Basic operation - relation between output voltage versus input voltage-on time output load - design relations and sequential decision requirements –fly back converter, disadvantages. Continuous Mode Fly backs: Basic operation - Discontinuous mode to continuous mode transition - design relations– continuous mode fly backs.

UNIT - V	VOLTAGE-FED AND CURRENT- FED TOPOLOGIES	Lec Hrs: 9

Definitions-deficiencies of voltage fed pulse width modulated full wave bridge-buck voltage fed full wave bridge topology – basic operation buck voltage fed full wave bridge– advantages-drawbacks in buck voltage fed full wave bridge - buck current fed full wave bridge topology – basic operation – fly back current fed push pull topology.

Textbooks:

1. Pressman A. I, Switching Power Supply Design, McGraw Hill,3rdedition,2009.
2. Mitchell D. M, DC-DC Switching Regulator Analysis, Mc Graw Hill, 1st edition, 1988

Reference Books:

1. Ned Mohan, Power Electronics, JohnWiley,3rdedition,2011.
2. Otmar Kingenstein, Switched Mode Power Supplies in Practice, John Wiley, 1st edition,1991.
3. Billings K.H., Handbook of Switched Mode Power Supplies, McGrawHill, 3rd edition,

2010.
4. Nave M.J, Power Line Filter Design for Switched- Mode Power Supplies, Mark Nave Consultants, 2nd edition, 2010.

Online Learning Resources:

1. https://ee.iisc.ac.in/wp-content/uploads/2023/01/SMPC_VRamnarayanan.pdf
2. http://acl.digimat.in/nptel/courses/video/108108036/lec1.pdf

Course Code	MACHINE MODELLING & ANALYSIS	L	T	P	C
TEC25MPE0002T		3	0	0	3
	Semester	I			

Course Objectives: To make the student

- Understand the basic principles for machine analysis and reference frame theory.
- Apply the concept of Change of Variables, and Transformation to an Arbitrary Reference Frame.
- Analyze the dynamic analysis of machines.
- Design the modelling of machines.

Course Outcomes (CO): Student will be able to

- Understand the Concept Magnetically Coupled Circuits, Types of DC machines, Commonly used Reference Frames, machines variables, Time domain and state equations, Permanent Magnet Brushless DC Motor Operating principle. L2
- Apply the concept of Change of Variables and Transformation to an Arbitrary Reference Frame, Equal Area Criteria. L3
- Analyze the Free Acceleration Characteristics viewed from Various Reference Frames, Steady-State Analysis and its Operation, dynamic analysis of machines, Mathematical modelling of PM Brushless DC motor. L4
- Design the modelling of DC machines, Three phase Induction machines, Synchronous machine. L5

UNIT - I	BASIC PRINCIPLES AND ANALYSIS OF DC MACHINES	Lec Hrs: 10

Basic Principles for Machine Analysis:
Magnetically coupled circuits - Machine windings - Air-Gap MMF-Winding inductances - Voltage equations.
Modelling and Analysis of DC Machines:
Elementary theory of DC Machine - Voltage and Torque Equations- Types of DC Machines - Permanent and Shunt DC Motors - Time-Domain and State-Equations.

UNIT - II	REFERENCE FRAME THEORY	Lec Hrs: 9

Fundamentals of Transformations - Equations of Transformations - Change of Variables and Transformation to an Arbitrary Reference Frame - Commonly used Reference Frames - Transformation between Reference Frames - Steady-State Phasor Relationships and Voltage Equations

UNIT - III	MODELLING& DYNAMIC ANALYSIS OF THREE PHASE INDUCTION MACHINES	Lec Hrs: 10

Voltage and Torque Equations in Machine Variables - Voltage and Torque Equations in Arbitrary Reference Frame - Steady-State Analysis and its Operation.
Free Acceleration Characteristics viewed from Various Reference Frames - Dynamic Performance during Sudden Changes in Load Torque - Dynamic Performance during A Three-Phase Fault at the Machine Terminals.

UNIT - IV	MODELLING& DYNAMIC ANALYSIS OF SYNCHRONOUS MACHINES	Lec Hrs: 10

Voltage in Machine Variables - Torque equation in Machine Variables - Voltage Equations in Arbitrary and Rotor Reference Frame - Torque Equations in Substitute Variable- Steady-State Analysis and its Operation. Dynamic Performance of Synchronous Machine - Three-Phase Fault, Comparison of Actual and Approximate Transient Torque Characteristics - Equal Area Criteria.

UNIT - V	MODELLING OF SPECIAL MACHINES	Lec Hrs: 9

Modelling of Permanent Magnet Brushless DC Motor - Operating principle – Mathematical modelling of PM Brushless DC motor - PMDC Motor Drive Scheme.

Textbooks:

1. PaulC. Krause, Oleg Wasyzczuk, ScottS, Sudhoff, "Analysis of Electric Machinery and Drive Systems", IEEE Press, 3rd Edition, 2013.
2. R. Krishnan,"Electric Motor Drives, Modeling, Analysis and Control"' , Pearson Education India, 4th edition, 2015.

Reference Books:

1. P. C. Krause, "Analysis of Electric Machinery", McGraw Hill, 3rd edition, 2013
2. Samuel Seely, "Electro mechanical Energy Conversion", Tata Mc Graw Hill Publishing Company,

1st edition, 1962.
3. A.E, Fitzgerald, Charles Kingsley, Jr, and Stephan D ,Umanx, "ElectricMachinery" ,Tata Mc Graw Hill, 7thEdition, 2020.
4. P. Kundur, "Power System Stability and Control", MC Graw Hill Education, 1st edition, 2006.

Online Learning Resources:

1. https://nptel.ac.in/courses/108106023
2. https://www.youtube.com/watch?v=2R4qaiRXvmM

Course Code	DC DRIVES (PE-I)	L	T	P	C
TEC25MPEPE001a		3	0	0	3
	Semester	I			

Course Objectives: To make the student

- Understand the concept of separately excited single phase and three phase rectifier with DC Motor load drives.
- Apply various controlling techniques on DC motor Drives.
- Analyze the operations when various controlling techniques are applied on DC motor drives.
- Design of chopper controlled DC motor Drives working in different Quadrants

Course Outcomes (CO): Student will be able to

- Remember and understand the concept Separately excited single phase and three phase rectifier with DC Motor load drives. L1
- Apply the concept of phase controlled technique for DC motor Drives. L3
- Analyse the current and speed controlled Drives. L4
- Design of chopper controlled DC motor Drives in various quadrants. L5

UNIT - I	CONTROLLED BRIDGE RECTIFIER (1-Φ& 3-Φ) WITH DC MOTOR LOAD	Lec Hrs: 10

Separately excited DC motors with rectified single phase supply-single phase semi converter and single phase full converter for continuous and discontinuous modes of operation–power and power factor.
Three phase semi converter and three phase full converter for continuous and discontinuous modes of operation– power and power factor– Addition of Freewheeling diode.

UNIT - II	THREE PHASE NATURALLY COMMUTATED BRIDGE CIRCUIT AS A RECTIFIER OR AS AN INVERTER	Lec Hrs: 9

Three phase-controlled bridge rectifiers with passive load impedance - resistive load and ideal supply – Highly inductive load and ideal supply for load side and supply side quantities - shunt capacitor compensation – three phase-controlled bridge rectifier inverter.

UNIT - III	PHASE CONTROLLED DC MOTOR DRIVES	Lec Hrs: 9

Three phase-controlled converter - control circuit - control modelling of three phase converter – Steady state analysis of three phase converter control DC motor drive – Two quadrant, three phase converter-controlled DC motor drive – DC motor and load, converter.

UNIT - IV	CURRENT AND SPEED CONTROLLED DC MOTOR DRIVES	Lec Hrs: 10

Current and Speed controllers -current and speed feedback — Design of controllers - Current and Speed controllers – Motor equations– Filter in the speed feedback loop speed controller–current reference generator – current controller and flow chart for simulation – Harmonics and associated problems– sixth harmonics torque.

UNIT - V	CHOPPER CONTROLLED DC MOTOR DRIVES	Lec Hrs: 10

Principle of operation of the chopper– Four quadrant chopper circuit–Chopper for inversion –Chopper with other power devices – model of the chopper –input to the chopper – Steady state analysis of chopper-controlled DC motor drives –rating of the devices– Pulsating torque – Closed loop operation of DC motor Drives - Speed controlled drive system – current control loop – pulse width modulated current controller – hysteresis current controller– modelling of current controller– design of current

Textbooks:

1. Fundamentals of Electric Drives –G.K.Dubey– Narosa Publications -2nd edition, 2020.
2. Power Semiconductor drives–S.B.Dewanand A.Straughen –Wiley India edition-1st edition, 2009.

Reference Books:

1. Power Electronics and motor control–Shepherd, Hulley, Liang, CUPress, 2nd edition 1995
2. Electric motor drives modeling, Analysis and control –R.Krishnan, PHI, 5th edition, 2015

3. Power Electronic Circuits, Devices and Applications-M. H. Rashid, PHI, 4th edition, 2017
Online Learning Resources:
1. https://sravivarman.com/course/power-electronic-control-of-dc-drives/ 2. https://nptel.ac.in/courses/108108077

Course Code	MODERN CONTROL THEORY	L	T	P	C
TEC25MPEPE001B	(PE-III)	3	0	0	3
	Semester	I			

Course Objectives: To make the student

- Remember and understand the concept of state space representation, Solution of state equation, STM, linearization of nonlinear systems, controllability and observability concepts, principles of duality, concepts of optimal and Lyapunov stability.
- Apply the above concepts to analyze controllability, Observability and pole placement by state feedback
- Analyze the concept of regulator, stability and sensitivity using various methods and disturbance rejection
- Design Full order observer and reduced order observer.

Course Outcomes (CO): Student will be able to

- Understand the state space representation, controllability and observability concepts, principles of duality, concepts of optimal and Lyapunov stability. L2
- Apply the state equations, pole placement by state feedback. L3
- Analyze controllability & observability of state models. L4
- Design full order observer and reduced order observer. L5

UNIT - I	STATE VARIABLE DESCRIPTION	Lecture Hrs: 10

Introductory matrix algebra and linear Vector Space, State space representation of systems- Linearization of a non-linear System- Solution of state equations- Evaluation of State Transition Matrix (STM).

UNIT - II	TRANSFORMATION, POLEPLACEMENT AND CONTROLLABILITY	Lecture Hrs: 8

Similarity transformation and invariance of system properties due to similarity transformations. Minimal realization of SISO, SIMO and MISO transfer functions. Discretization of a continuous time state space model- Conversion of state space model to transfer function model using Fadeeva algorithm- Fundamental theorem of feedback control - Controllability and Controllable canonical form - Pole assignment by state feedback using Ackermann's formula– Eigen structure assignment problem.

UNIT - III	OPTIMAL CONTROL	Lecture Hrs: 10

Linear Quadratic Regulator (LQR) problem and solution of algebraic Riccati equation using Eigen value and Eigen vector methods- iterative method- Controller design using output feedback.

UNIT - IV	OBSERVERS	Lecture Hrs:10

Observability and observable canonical form-Design of full order observer using Ackermann's formula -Bass Gura algorithm- Duality between controllability and observability- Full order Observer based controller design- Reduced order observer design.

UNIT - V	STABILITY ANALYSIS AND SENSITIVITY	Lecture Hrs:10

Internal stability of a system- Stability in the sense of Lyapunov- Asymptotic stability of linear time invariant continuous and discrete time systems- Solution of Lyapunov type equation- Model decomposition and decoupling by state feedback- Disturbance rejection- sensitivity and complementary sensitivity functions.

Textbooks:

1. K. Ogata, "Modern Control Engineering", Prentice Hall, India, 5th edition, 2010.
2. T. Kailath, "Linear Systems", Prentice Hall, 2016.
3. N.K. Sinha, "Control Systems", New Age International, 4th edition, 2013.

Reference Books:

1. Panos J Antsaklis, and Anthony N.Michel, "Linear Systems", New-age international (P) LTD. Publishers, 2009.
2. John JD Azzoand C. H. Houpis, "Linear Control System Analysis and Design conventional and Modern", Mc Graw- Hill Book Company, 3rd edition, 1988.
3. B.N.Dutta, "Numerical Methods for linear Control Systems", Elsevier Publication, 2007.
4. C.T. Chen "Linear System Theory and Design-PHI, India,1984.
5. Richard C. Dorf and Robert H. Bishop, "Modern Control Systems", 11th Edition, Pearson Edu., India, 2009

Online Learning Resources:
1. http://www.digimat.in/nptel/courses/video/108103007/L01.html

Course Code	ENERGY AUDITING AND MANAGEMENT (PE-I)	L	T	P	C
TEC25MPE PE001C		3	0	0	3
	Semester	**I**			

Course Objectives: To make the student

- To understand the current energy scenario and importance of energy conservation.
- To acquire the knowledge about different energy efficient devices.
- To measure thermal efficiency and other renewable resources.
- To design suitable energy monitoring system to analyze and optimize the energy consumption in an electrical system.

Course Outcomes (CO): Student will be able to

- Understand the current energy scenario and importance of energy conservation. L2
- Acquire the knowledge about different energy efficient devices. L2
- Measure efficiency in renewable energy resources. L3
- Identify the equipment and areas of a system where energy conservation and Audit is necessary. L3

UNIT - I	ENERGY AUDIT AND DEMAND SIDE MANAGEMENT (DSM) IN POWER UTILITIES	Lecture Hrs: 10

Energy Scenario & Conservation -Demand Forecasting Techniques- Integrated Optimal Strategy for Reduction of T&D Losses - DSM Techniques and Methodologies- Loss Reduction in Primary and Secondary Distribution system and capacitors - Energy Management — Role of Energy Managers – Energy Audit-Metering.

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UNIT - II	ENERGY AUDIT	Lecture Hrs: 9

Energy audit concepts - Basic elements and measurements - Mass and energy balances - Scope of energy auditing in industries - Evaluation of energy conserving opportunities and environmental management - Preparation and presentation of energy audit reports - case studies and potential energy savings.

UNIT - III	INSTRUMENTATION	Lecture Hrs: 10

General Audit Instrumentation –Measuring building losses – Applications of IR thermo graphy – Measurement of electrical system performance – Measurement of heating, ventilation, air conditioning system performance – Measurement of combustion systems.

UNIT - IV	ENERGY CONSERVATION	Lecture Hrs:10

Energy conservation in HVAC systems and thermal power plants, Solar systems, Fan and Lighting Systems - Different light sources and luminous efficiency

UNIT - V	ECONOMIC EVALUATION OF ENERGY CONSERVATION	Lecture Hrs:9

Energy conservation in electrical devices and systems - Economic evaluation of energy conservation measures - Electric motors and transformers - Inverters and UPS - Voltage stabilizers.

Textbooks:

1. Frank kreith and D. Yogi goswamy/ Editors, “Energy Management and conservation handbook”. NewYork,2008.
2. WC Turner: Energy Management Handbook, Seventh Edition, (Fairmont Press Inc., 2007)
3. YP Abbi and Shashank Jain: Handbook on Energy Audit and Environment Management, (TERIPress, 2006)

Reference Books:

1. Albert Thumann, and William J. Younger, “Handbook of Energy Audits”, Marcel Dekker, Inc., Newyork, 6th edition, 2003.
2. D.A.Reay, Industrial Energy Conservation-Pergamon Press, 1980.
3. T.L.Boten, LiptakB.G.,(Ed)Instrument Engineers Handbook, Chinton Book Company, 2004.
4. Hodge B.K, Analysis and Design of Energy Systems, Prentice Hall, 2002.
5. Larry C.Witte, Schmidt & Brown, Industrial energy management and utilization. Hemisphere publishing, Co.NewYork,1988.

Online Learning Resources:
1. https://onlinecourses.swayam2.ac.in/nou23_es05/preview 2. https://onlinecourses.nptel.ac.in/noc25_ar10/preview

Course Code	SOLAR ENERGY CONVERSION SYSTEMS	L	T	P	C
TEC25MPEPE002a	(PE–II)	3	0	0	3
	Semester	I			

Course Objectives: To make the student

- Understand the fundamentals of solar cell.
- Apply the photovoltaic systems and various technologies of solar PV cells, about manufacture, sizing and operating techniques.
- Analyze Series and parallel connection of cells, Hot spots in the module, Algorithms for MPPT.
- Design Solar cells and PV system.

Course Outcomes (CO): Student will be able to

- Understand the fundamentals of solar cell, Solar PV Modules from solar cells, system types, Standalone PV system configuration, Maximum Power Point tracking (MPPT). L2
- Apply the concept of various technologies of solar PV cells, manufacture, sizing and operating techniques. L3
- Analyze the concept of Effect of series and shunt resistance on efficiency, Effect of solar radiation on efficiency, Analytical techniques, Hot spots in the module, Algorithms for MPPT. L4
- Design of PV powered DC fan without battery, Standalone system with DC load using MPPT, PV powered DC pump, standalone system with battery and AC/DC load. L5

UNIT - I	SOLAR CELL FUNDAMENTALS	Lec Hrs: 9

Introduction to solar PV system, history of photovoltaics, photovoltaic effect, photovoltaic cell, PV Cell Material, equivalent circuit, electrical characteristics, PV terminology, maximum power point tracking.

UNIT - II	PARTIAL SHADING	Lec Hrs: 10

Partial shading of PV arrays, causes, effect of partial shading on PV power, hot spots, bypass diode, PV characteristics, interconnection schemes, series and parallel connection, total cross tied (TCT), honey comb (HC), bridge linked (BL), reconfiguration techniques, electrical array reconfiguration techniques, Su Do Ku based reconfiguration technique.

UNIT - III	MPPT	Lec Hrs: 10

Maximum power point tracking algorithm, direct methods, differentiation method, feedback voltage or current method, perturb and observe method, incremental conductance method, parasitic capacitance method, indirect methods, curve fitting method, look up table method, open circuit voltage sensing method, short circuit current sensing method, artificial intelligence techniques, artificial neural network, fuzzy logic, genetic algorithm, algorithm for non-uniform insulation conditions, Fibonacci search method, short current pulse method, two stage method.

UNIT - IV	CONVERTER AND INVERTER OPERATIONS	Lec Hrs: 9

Buck converter, boost converter, buck boost converter, CUK converter, SEPIC converter, charge controller, shunt controller, series controller, inverters, inverter operation, power quality standards, grid interconnection techniques.

UNIT - V	PV SYSTEM DESIGN AND APPLICATIONS	Lec Hrs: 10

Design of PV powered DC fan without battery- Standalone system with DC load using MPPT- Design of PV powered DC pump- Design of standalone system with battery and AC/DC load – Wire sizing in PV system – Precise sizing of PV systems – Hybrid PV systems –Grid connected PV systems, Rooftop Systems.

Textbooks:

1. Chetan Singh Solangi, 'Solar Photovoltaics-Fundamentals, Technologies and Applications', PHI Learning Pvt Ltd, Delhi,2011.
2. Van Overstraeton and Metens R.P,. 'Physics, Technology and use of Photovoltaics', Adam Hilger, Bristol, 1996.

Reference Books:

1. Konrad Mertens, 'Photovoltaics Fundamentals technology and Practice', Wiley publications 2014.
2. Chetan Singh Solangi, 'Solar Photovoltaics Technology and Systems', 2013.

Online Learning Resources:

1. https://onlinecourses.nptel.ac.in/noc20_ph14/preview
2. https://nptel.ac.in/courses/117108141
3. https://nptel.ac.in/courses/108105066
4. https://nptel.ac.in/courses/115103123

Course Code	WIND ENERGY CONVERSION SYSTEMS	L	T	P	C
TEC25MPEPE002a	(PE-II)	3	0	0	3
	Semester	I			

Course Objectives: To make the student

- To Understand the application of wind energy and wind energy conversion system.
- To Design wind turbine blades and know about applications of wind energy for water pumping and electricity generation.
- To apply the concepts of fixed speed and variable speed ,wind energy conversion systems.
- To analyze the grid integration issues.

Course Outcomes (CO): Student will be able to

- Understand the concepts of fixed speed and variable speed wind energy conversion systems. L2
- Analyze the grid integration issues. L4
- Apply variable speed turbines for wind generation. L3
- Design and control principles of wind turbine. L5

UNIT - I	FUNDAMENTALS OF WIND TURBINES	Lec Hrs: 10

Historical background - Basics of mechanical to electrical energy conversion in wind energy -Types of wind energy conversion devices – Definition - Solidity, tip speed ratio, power coefficient, wind turbine ratings and specifications- Aerodynamics of wind rotors - Design of the wind turbine rotor.

UNIT - II	WIND TURBINE CONTROL SYSTEMS & SITE ANALYSIS	Lec Hrs: 9

Wind Turbine-Torque speed characteristics-Pitch angle control –Stall control –Power electronic control – Yaw control – Control strategy – Wind speed measurements – Wind speed statistics –Site and turbine selection.

UNIT - III	BASICS OF INDUCTION AND SYNCHRONOUS MACHINES	Lec Hrs: 10

The Induction Machine – Constructional features - Equivalent circuit model- Performance characteristics - Saturation characteristics – Dynamic d-q model – The wound field synchronous machine – The permanent magnet synchronous machine – Power flow between two synchronous sources – Induction generator versus synchronous generator.

UNIT - IV	GRID CONNECTED AND SELF-EXCITED INDUCTION GENERATOR OPEARTION	Lec Hrs: 10

Constant voltage, constant frequency- Single output system –Double output system with current converter & voltage source inverter–Equivalent circuits–Reactive power and harmonics- Reactive power compensation–variable voltage, variable frequency–The self-excitation process–Circuit model for the self-excited induction generator–Analysis of steady state operation–The excitation requirement–Effect of a wind generator on the network.

UNIT - V	WIND GENERATION WITH VARIABLE- SPEED TURBINES AND APPLICATION	Lec Hrs: 9

Classification of schemes–Operating area–Induction generators–Doubly fed induction generator – Wound field synchronous generator – The permanent magnet generator – Merits and limitations of wind energy conversion systems – Application in hybrid energy systems – Diesel generator and photo voltaic systems – Wind photovoltaic systems.

Textbooks:

1. S.N. Bhadra, D. Kastha, S. Banerjee, "wind electrical systems", Oxford University Press, 1st edition, 2005.
2. Banshi D. Shukla, "Engineering of Wind Energy", Jain Brothers, 1st edition, 2018

Reference Books:

1. S.Rao& B.B. Parulekar, "Energy Technology", Khanna publishers, 4th edition, 2005.
2. N.K.Bansal,M. Kleemann, Michael Meliss, Renewable Energy sources & Conversion Technology, Tata Mcgraw Hill Publishers & Co., 1st edition, 1990

Online Learning Resources:

1. https://onlinecourses.nptel.ac.in/noc25_ae12/preview
2. https://onlinecourses.nptel.ac.in/noc21_ee24/preview

Course Code	SMART GRID TECHNOLOGIES (PE-II)	L	T	P	C
TEC25MPEPE002B		3	0	0	3
	Semester	**I**			

Course Objectives: To make the student

- To know the importance of smart grid technology functions over the present grid.
- To get the knowledge about the measurement system and communication technology of Smart grid.
- To enhance the quality, efficiency and security of power supply.
- To impart an understanding of economics, policies and technical regulations for DG integration.

Course Outcomes (CO): Student will be able to

- Understand the importance of smart grid technology functions over the present grid. L2
- Apply the knowledge about the measurement system and communication technology of Smart grid. L3
- Determine the quality, efficiency and security of power supply. L3
- Impart an understanding of economics, policies and technical regulations for DG integration. L2

UNIT – I	**SMART GRIDS**	Lecture Hrs: 08

Smart grid overview- ageing assets and lack of circuit capacity- thermal constraints, operational constraints, security of supply- national initiatives- early smart grid initiatives- active distribution networks- virtual power plant- other initiatives and demonstrations- overview of the technologies required for the smart grid.

UNIT – II	**TRANSMISSION AND DISTRIBUTION MANAGEMENT**	Lecture Hrs: 10

Data Sources- Energy Management System-Wide Area Applications, Visualization Techniques- Data Sources and Associated External Systems- SCADA- Customer Information System- Modeling and Analysis Tools, Distribution System Modeling- Topology Analysis- Load Forecasting- Power Flow Analysis- Fault Calculations- State Estimation- Applications-System Monitoring- Operation- Management- Outage Management System- Overview of energy storage technologies.

UNIT - III	**SMART METERING AND DEMAND SIDE INTEGRATION**	Lecture Hrs: 10

Overview- Smart metering – Evolution of electricity metering- key components of smart metering- smart meters: an overview of the hardware used – signal acquisition- signal conditioning-analogue to digital conversion-computation-input/output and communication. Communication infrastructure and protocols for smart metering - Home area network, Neighborhood Area Network- Data Concentrator- meter data management system- Protocols for communication. Demand Side Integration- Services Provided by DSI-Implementation of DSI- Hardware Support- Flexibility Delivered by consumers from the Demand Side- System Support from DSI.

UNIT – IV	**COMMUNICATION TECHNOLOGIES FOR THE SMART GRID**	Lecture Hrs: 10

Data Communications: Dedicated and Shared Communication Channels, Switching Techniques, Circuit Switching, Message Switching, Packet Switching- Communication Channels, Introduction to TCP/IP.
Communication Technologies: IEEE 802 Series- Mobile Communications- Multi-Protocol Label Switching- Power line Communication.

UNIT – V	**INFORMATION SECURITY FOR THE SMART GRID**	Lecture Hrs: 10

Overview- Encryption and Decryption, Symmetric Key Encryption- Public Key Encryption- Authentication- Authentication Based on Shared Secret Key- Authentication Based on Key Distribution Center- Digital Signatures- Secret Key Signature-Public Key Signature- Message Digest.

Textbooks:

1. Janaka Ekanayake, Kithsiri Liyanage, et.al., Smart Grid Technology and Applications, Wiley Publications, 1st edition, 2012.
2. James Momoh, Smart Grid: Fundamentals of Design and Analysis, Wiley, IEEE Press, 1st edition, 2012.
3. Bharat Modi, Anuprakash, Yogesh Kumar, Fundamentals of Smart Grid Technology, S.K Kataria& Sons, 1st edition, 2019.

Reference Books:

1. Eric D. Knapp, Raj Samani, Applied Cyber Security and the Smart Grid-Implementing Security Controls into the Modern Power Infrastructure, Syngress Publishers, 1st edition, 2013.
2. Nouredine Hadjsaid, Jean Claude Sabonnadiere, Smart Grids, Wiley Blackwell Publications, 1st edition, 2012.
3. Peter-Fox Penner, Smart Power: Climate Changes, the Smart Grid and the future of electric utilities, Island Press, 1st edition, 2010.

Online Learning Resources:

www.indiasmartgrid.org

Course Code	POWER ELECTRONICS LAB	L	T	P	C
TEC25MPE0010P		0	0	4	2
	Semester	I			

Course Objectives: To make the student

- Understand the operation of Power Electronic converters.
- Gain a fair knowledge on the programming and simulation of Power Electronic converters.
- Apply the MATLAB/ Simulink for various controllers.
- Design a rectifier, inverter, chopper, cycloconverter and AC voltage controller .

Course Outcomes (CO): The student will be able to

- Understand the basic concept and its operation of Power Electronic converters. L2
- Analyse the output waveforms of the various converters designed. L4
- Apply mathematical relations to find THD and verify it practically. L3
- Design different controllers using Simulink. L5

List of Experiments:

1. Single Phase Fully Controlled Converter with R and R-L loads using MATLAB
2. Three Phase Fully Controlled Converter with R and R-L loads using MATLAB
3. Single Phase AC Voltage Controller with R and R-L loads using MATLAB.
4. Three Phase AC Voltage Controller with R and R-L loads using MATLAB.
5. Three Phase Inverter in 180° & 120° Conduction Mode with Star & Delta Connected loads using MATLAB.
6. Buck, Boost and Buck- Boost converter using MATLAB.
7. Closed loop control of Buck and Boost converter
8. Single Phase cycloconverter using MATLAB
9. Three Phase cycloconverter using MATLAB.
10. Single Phase Full Controlled Converter with R and R-L loads.
11. Designing of induction motor using Simulink
12. Performance measurement and analysis of 1-phase IGBT inverter with sinusoidal PWM control
13. Performance measurement and analysis of isolated DC-DC push-pull regulator
14. Hysteresis current control of a single-phase inverter

References:

1. PowerElectronicCircuits,DevicesandApplications-M.H.Rashid–PHI,2017
2. Ned Mohan, Power Electronics, JohnWiley,3rd edition,2011
3. https://pe2-iitd.vlabs.ac.in/List%20of%20experiments.html

Online Learning Resources:

1. **https://pe-iitr.vlabs.ac.in/Introduction.html**
2. **https://pe1-iitd.vlabs.ac.in/Introduction.html**
3. **https://pe2-iitd.vlabs.ac.in/**

Course Code	RENEWABLE ENERGY SOURCES LAB	L	T	P	C
TEC25MPE0020P		0	0	4	2
	Semester	II			

Course Objectives: To make the student

- Understand the characteristics and behavior of renewable energy sources such as solar PV panels, wind generators, and batteries under different operating conditions.
- Develop practical skills in configuring, testing, and analyzing renewable energy systems, including PV arrays, MPPT controllers, inverters, and battery management.
- Gain experience in modeling and simulating renewable energy components, studying the effects of environmental factors like irradiation, temperature, and wind speed on system performance.
- Apply control and power electronics techniques (such as MPPT algorithms and DC-DC converters) for enhancing the efficiency, stability, and integration of renewable energy systems into the grid.

Course Outcomes (CO): Student will be able to

- To observe the I-V and P-V curves and Series and Parallel connection of Solar systems. L3
- To study the sun tracking and MPPT Charge Controllers of Solar systems. L2
- To analyse Power, Voltage & Frequency Measurement of Wind Generator. L4
- To Understand the Effect of temperature variation and Irradiation on Photovoltaic Array. L2

List of Experiments:

1. Draw the I-V and P-V curves of Solar Panel using PV Panel
2. Study of Series and Parallel connection of Solar Panels
3. Study of Sun tracking system
4. Maximum Power Point Tracking Charge Controllers
5. Inverter control for Solar PV based systems
6. Power, Voltage & Frequency Measurement of output of Wind Generator
7. Impact of load and wind speed on power output and its quality
8. Performance of frequency drop characteristics of induction generator at different loading condition
9. Charging and Discharging characteristics of Battery

Simulation Experiments

1. Modelling of PV Cell
2. Effect of temperature variation on Photovoltaic Array
3. Effect of Irradiation on a Photovoltaic Array
4. Design of solar PV boost converter using P&O MPPT technique

Web Sources: https://www.vlab.co.in

Course Code	AI TECHNIQUES IN ELECTRICAL ENGINEERING (SE)	L	T	P	C
TEC25MPESO01		2	0	0	2
	Semester	I			

Course Objectives: To make the student

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

Course Outcomes (CO): Student will be able to

- Understand feed forward neural networks, feedback neural networks and learning techniques. L2
- Apply selected basic AI techniques; judge applicability of more advanced techniques. L3
- Analyze &Develop fuzzy logic control for applications in electrical engineering L4
- Develop genetic algorithm for applications in electrical engineering. L5

UNIT - I	ARTIFICIAL NEURAL NETWORKS	Lec Hrs: 10

Introduction-Models of Neural Network - Architectures – Knowledge representation – Artificial Intelligence and Neural networks – Learning process – Error correction learning – Hebbian learning – Competitive learning – Boltzmann learning – Supervised learning –Unsupervised learning – Reinforcement learning -learning tasks.

UNIT - II	ANN PARADIGMS	Lec Hrs: 9

Multi – layer perceptron using Back propagation Algorithm-Self – organizing Map –Radial Basis Function Network–Functional link network– Hopfield Network.

UNIT - III	FUZZYLOGIC	Lec Hrs: 9

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	Lec Hrs: 10

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

UNIT - V	APPLICATIONS OF AI TECHNIQUES	Lec Hrs: 10

Load forecasting – Load flow studies – Economic load dispatch –Load frequency control – Single area system and two area system – Small Signal Stability (Dynamic stability)- Reactive power control – speed control of DC and AC Motors.

Textbooks:

1.S. Rajasekaran and G.A.V.Pai, "Neural Networks, Fuzzy Logic & Genetic Algorithms" PHI,New Delhi, 2nd edition,2017.

2.Sudarshan K. Valluru and T. Nageswara Rao, "introduction to Neural Networks, Fuzzy Logic & Genetic Algorithms", Jaico Publishing House, 1st edition, 2010.

Reference Books:

1. P.D.Wasserman, VanNostrand Reinhold," NeuralComputingTheory&Practice",NewYork,1st . Eddition ,1989
2. Bart Kosko,"Neural Network & Fuzzy System", Prentice Hall,1992.
3. G.J.Klir and T.A.Folger, "Fuzzy sets, Uncertainty and Information", Pearson, 1st edition, 2015.
4. D.E.Goldberg, "Genetic Algorithms", Pearson Education India, 1st edition, 2008.

Online Learning Resources:

1. **https://onlinecourses.swayam2.ac.in/ntr24_ed08/preview**
2. **https://onlinecourses.nptel.ac.in/noc23_ge36/preview**
3. **https://onlinecourses.nptel.ac.in/noc22_hs59/preview**

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email id : principal@tec.ac.in, Website : www.tec.ac.in

Course Code	ADVANCED POWER ELECTRONICS	L	T	P	C
TEC25MPE0003T		3	0	0	3
	Semester	II			

Course Objectives: To make the student

- Remember and Understand the construction, operation and characteristics of various power semiconductor devices and to analyze the cause of voltage unbalance and necessary actions for equalization of GCTs and IGBTs.
- Analyze the construction and working principle of various types of resonant pulse inverters, resonant converters and multi inverters.
- Analyze the various pulse modulations and advanced modulations techniques available.
- Apply the above concepts to choose appropriate device for a particular converter topology.

Course Outcomes (CO): Student will be able to

- Understand the characteristics of various power semiconductor devices. L2
- Analyze the operation of various types of resonant pulse inverters, resonant converters and multi inverters. L4
- Analyze various pulse modulation and advanced modulation techniques available. L4
- Apply the above concepts to choose appropriate device for particular topology. L3

UNIT - I	HIGH-POWER SEMICONDUCTOR DEVICES	Lec Hrs: 9

Introduction – High Power Switching Devices – Diodes – Silicon-Controlled Rectifier (SCR) – Gate Turn Off (GTO) Thyristor –Gate Commutated Thyristor (GCT) –Insulated Gate Bipolar Transistor (IGBT) – MOSFETS, Other Switching Devices –Operation of Series Connected Devices –Main Causes of Voltage Unbalance –Voltage Equalization for GCTs– Voltage Equalization for IGBTs.

UNIT - II	RESONANT PULSE INVERTERS	Lec Hrs: 9

Resonant pulse inverters–Series resonant inverters-Series resonant inverters with unidirectional and bidirectional switches-Analysis of half bride resonant inverter-Evaluation of currents and Voltages of a simple resonant inverter–Analysis of half bridge and full bridge resonant inverter with bidirectional switches–Frequency response of series resonant inverter for series loaded inverter and parallel resonant inverters–Voltage control of resonant inverters- Class-E resonant inverter–Class-E resonant rectifier-Evaluation of values of C and L for class E inverter and Class E rectifier – Numerical problems.

UNIT - III	RESONANT CONVERTERS	Lec Hrs: 10

Resonant converters- Zero current switching resonant converters – L type - M type– Zero voltage Switching resonant converters – comparison between ZCS and ZVS resonant converters- Two quadrant ZVS resonant converters – Resonant dc link inverters- Evaluation of L and C for zero current switching inverter – Numerical problems.

UNIT - IV	MODULATION TECHNIQUES	Lec Hrs: 10

Sinusoidal PWM –Modulation Scheme –Harmonic Content –Over modulation– Third Harmonic Injection PWM–Space Vector Modulation–Switching States–Space Vectors–Dwell Time Calculation–Modulation Index – Switching Sequence– Spectrum Analysis –Even-Order Harmonic Elimination –Discontinuous Space Vector Modulation– H-Bridge Inverter– Bipolar Pulse Width Modulation – Uni polar Pulse Width Modulation.

UNIT – V	MULTILEVEL INVERTERS	Lec Hrs: 10

Multilevel Inverter Topologies–CHB Inverter with Equal DC Voltage–H-Bridges with Unequal DC Voltages - Carrier Based PWM Schemes – Phase-Shifted Multicarrier Modulation–Level-Shifted Multicarrier Modulation– Comparison Between Phase and Level Shifted PWM Schemes –Staircase Modulation –Diode Clamped Multilevel Inverters – Three Level Inverter – Converter Configuration – Switching State – Commutation–Space Vector Modulation – Stationary Space Vectors–Dwell Time Calculation–Relationship Between V_{ref} Location and Dwell Times – Switching Sequence Design – Inverter Output Wave forms and Harmonic Content– Even-Order Harmonic Elimination.
Textbooks:
1. Mohammed H.Rashid, ―Power Electronics‖, Pearson Education, 4th edition, 2017. 2. NedMohan, Tore M.Undel and and William P.Robbind, ―Power Electronics‖, John wiley &Sons, 3rd edition, 2007.
Reference Books:
1. DanielW. Hart, ―PowerElectronics‖,McGrawHillPublications,1st edition, 2010. 2. V.R.Moorthi,PowerElectronicsDevices,CircuitsandIndustrialapplications‖,OxfordUniversityPress,2005. 3. Dr.P.S.Bimbhra, ―PowerElectronics‖,KhannaPubishers,2006. 4. PhilipT.Krein, ―Elements of Power Electronics‖,OxfordUniversityPress,2nd edition, 2014. 5. BinWu, ―High-Power Converters and AC Drives‖, IEEE Press Ajohn Wiley &Sons, 2ndedition, 2017.
Online Learning Resources:
1. https://nptel.ac.in/courses/108107128 2. https://onlinecourses.nptel.ac.in/noc20_ee28/preview

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email id : principal@tec.ac.in, Website : www.tec.ac.in

Course Code	FACTS CONTROLLERS	L	T	P	C
TEC25MPE0004T		3	0	0	3
	Semester	II			

Course Objectives: To make the student

- To understand the fundamentals of FACTS Controllers, Importance of controllable parameters and types of FACTS controllers & their benefits.
- To explain control of STATCOM and SVC and their comparison and the regulation of STATCOM.
- To remember the objectives of Shunt and Series compensation.
- To analyze the functioning and control of GCSC, TSSC and TCSC.

Course Outcomes (CO): Student will be able to

- Understand various control techniques for the purpose of identifying the scope and for selection of specific FACTS controllers. L2
- Remember different types of controllable VAR generation and variable impedance techniques. L1
- Design simple converters using FACTS controllers. L5
- Understand the operation of Unified Power Controller and Hybrid Arrangements. L1

UNIT – I	FACTS CONCEPTS, VSI AND CSI	Lecture Hrs: 10

Transmission interconnections power flow in an AC system, loading capability limits, Dynamic stability considerations, importance of controllable parameters basic types of FACTS controllers, benefits from FACTS controllers. Single phase three phase full wave bridge converters transformer connections for 12 pulse, 24 and 48 pulse operation. Three level voltage source converter, pulse width modulation converter, basic concept of current source converters, and comparison of current source converters with voltage source converters.

UNIT – II	SHUNT COMPENSATION	Lecture Hrs: 8

Objectives of shunt compensation - Methods of controllable var generation - Variable impedance type static var generators - switching converter type var generators - hybrid var generators – Comparison of SVC and STATCOM.

UNIT – III	SERIES COMPENSATION	Lecture Hrs: 10

Objectives of series compensation – GTO Thyristor Controlled Series Capacitor (GCSC) - Thyristor Switched Series Capacitor (TSSC) - Thyristor Controlled Series Capacitor (TCSC) - Control schemes for TCSC, TSSC and TCSC.

UNIT – IV	UNIFIED POWER FLOW CONTROLLER (UPFC) & INTERLINE POWER FLOW CONTROLLER (IPFC)	Lecture Hrs:10

Introduction - The Unified Power Flow Controller - Basic Operating Principles - Conventional Transmission Control Capabilities - Independent Real and Reactive Power Flow Control - Control Structure - Basic Control System for P and Q Control - Hybrid Arrangements: UPFC With a Phase Shifting Transformer.
Introduction, basic operating principle and characteristics of IPFC, control structure, practical and application considerations, generalized and multifunctional fact controllers.

UNIT – V	SPECIAL FACTS DEVICES	Lecture Hrs:10

TCPAR: Thyristor controlled phase angle regulator, NGH sub-synchronous reactance damper, TCBR: thyristor controlled breaking resistor, D-STATCOM: Distribution STATCOM, UPQC: Unified power quality controller.

Textbooks:

1. Understanding FACTS – Concepts and technology of Flexible AC Transmission systems, Narain G. Hingorani, Laszlo Gyugyi, IEEE Press, WILEY, 1st Edition, 2000, Reprint 2015.
2. FACTS Controllers in Power Transmission and Distribution, Padiyar K.R., New Age International Publishers, 1st Edition, 2007.

Reference Books:

1. Flexible AC Transmission Systems: Modelling and Control, Xiao – Ping Zhang, Christian Rehtanz, Bikash Pal, Springer, 2012, First Indian Reprint, 2015.

2. FACTS – Modelling and Simulation in Power Networks, Enrigue Acha, Claudio R. Fuerte – Esquival, Huge Ambriz – perez, Cesar Angeles – Camacho, WILEY, 1st edition, 2004
Online Learning Resources:
1. **https://nptel.ac.in/courses/108107114** 2. **http://www.digimat.in/nptel/courses/video/108107114/L02.html**

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email id : principal@tec.ac.in, Website : www.tec.ac.in

Course Code	AC DRIVES (PE-III)	L	T	P	C
TEC25MPEPE001a		3	0	0	3
	Semester	II			

Course Objectives: To make the student

- Remember and understand the working principle and control of various AC and Special purpose motor Drives.
- Analyze the control strategies for VSI fed sensor-less induction motor drives, CSI fed induction motor drives, and VSI fed poly– phase induction motors.
- Analyze and apply control schemes for PMSM, BLDC and Switched Reluctance Motor drives.
- Design high performance induction motor drives using the principles of Scalar control and develop vector control, direct torque control and introduction of five phase induction motor drive.

Course Outcomes (CO): Student will be able to

- Understand the working principle and operation of AC and Special purpose motor Drives.L2
- Formulate the control strategies for VSI fed sensor-less induction motor drives, CSI fed induction motor drives, and VSI fed poly– phase induction motors. L3
- Implement control schemes for PMSM, BLDC and Switched Reluctance Motor drives. L3
- Analyze high performance induction motor drives using the principles of Scalar control and develop vector control, direct torque control and introduction of five phase induction motor drive. L4

UNIT - I	INDUCTION MOTOR DRIVES	Lec Hrs: 10

Control of Induction Motor Drive - Scalar control of induction motor-Principle of vector control and field orientation Sensor less control and flux observers - Direct torque and flux control of induction motor Multilevel converter-fed induction motor drive - Utility friendly induction motor drive Implementation of V/f control with slip compensation scheme, Review of dq0 model of 3 – Phase IM with simulation studies.

UNIT - II	CONTROL TECHNIQUES OF IM DRIVES	Lec Hrs: 10

Direct vector control -Indirect vector control with feedback- Indirect vector control with feed–forward-Indirect vector control in various frames of reference -Decoupling of vector control with feed forward compensation - sensor less control of IM, Direct Torque Control of IM - Speed control of wound induction motor with rotor side control - introduction to five phase induction motor drives.

UNIT - III	SYNCHRONOUS MOTOR DRIVES	Lec Hrs: 9

Control of Synchronous Motor - Self controlled synchronous motor – Vector control of synchronous motor - Cycloconverter fed synchronous motor drive -Control of synchronous reluctance motor.

UNIT - IV	PERMANENT MAGNET MOTOR DRIVES	Lec Hrs: 9

PM Synchronous motors: Types – Construction - operating principle-Expression for torque - Model of PMSM - Implementation of vector control for PMSM - BLDC drives- PMDC motor drives.

UNIT – V	SRM DRIVE & ITS CONTROLLER	Lec Hrs: 10

Construction - Operating Principle -Torque expression-SRM configuration and its controller design – converter topologies – control strategies – Sensor less control. Principles of fuzzy logic control and neural network– Design methodology and block diagram implementation of DC drive and vector controlled induction motor. Recent trends in fuzzy control of electrical drives. MATLAB simulation – Fuzzy logic speed control of three phase induction motor drive –Adaptive speed control for induction motor drives using neural network.
Textbooks:
1. Modern Power Electronics & AC Drives – B.K. Bose, Pearson, Second edition,2005. 2. R. Krishnan, ―Electric Motor Drives: Modelling, Analysis and Control‖, Pearson, 1st edition,2015.
Reference Books:
1. Bin-Wu, ―High– Power Converters and AC Drives‖, IEEE Press, John Wiley &Sons, 2nd edition, 2017 2. M. B. Patil, V. Rama Narayanan, V.T. Ranganathan, Simulation of Power Electronic Circuits‖, Narosa Publications,2009, Reprint 2013. 3. Relevant Papers from journals. 4. P.C. Krause,O. Wasynczuk,S. D. Sudhoff and Steven D. Pekarek, ―Analysis of Electric Machinery‖, Wiley, IEEE Press, 3rd edition, 2013. 5. P. S. Bhimbra, ―Generalized Theory of Electric Machines‖, Khanna Publication, 7th edition, 2021. 6. Ion Boldea , Syed A. Nasar ―Electric Drives 3rd Edition, Kindle Edition‖ 3rd Edition,2016.
Online Learning Resources:
1. https://nptel.ac.in/courses/108104011 **2.** https://nptel.ac.in/courses/108104140

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Course Code	ADVANCED POWER SEMI CONDUCTOR DEVICES AND PROTECTION (PE-III)	L	T	P	C
TEC25MPEPE001b		3	0	0	3
	Semester	II			

Course Objectives: To make the student

- Remember and Understand the construction, operation, characteristics and safe operating regions of various power semiconductor devices such as BJT, MOSFET, GTO and IGBT.
- Apply the basics of above to understand the various types of emerging power semi conductor devices such as power JFET and MOS controlled thyristor.
- Analyze the concept of Electro Magnetic Interference, Noise, their sources and effect of them on electronic equipment.
- Design protection devices and circuits like heat sinks, voltage and current protection circuits.

Course Outcomes (CO): Student will be able

- To understand the characteristics of various power semiconductor devices such as BJT, MOSFET, GTO and IGBT. L2
- Apply the basics to understand the various types of emerging power semiconductor devices. L3
- To analyze the concept of Electro Magnetic Interference, Noise, their sources and effect of them on electronic equipment. L4
- To design protection devices and circuits like heat sinks, voltage and current protection circuits. L5

UNIT - I	BJTS & POWER MOSFET	Lec Hrs: 10

Introduction- Vertical power transistor structures- I-V characteristics- Operation – Switching characteristics- Break down voltages-Second break down- ON state losses- Safe Operation Areas- Design of drive circuits for BJTs- Snubber circuits for BJTs and Darling tons.

Power MOSFETs -Introduction-Basic structures- I-V characteristics- Physics of device operation- Switching Characteristics-Operation limitations – Safe Operating Areas- Design of gate drive circuits-Snubber circuits.

UNIT - II	GTO & IGBT	Lec Hrs: 10

Introduction- Basic structures- I-V characteristics- Physics of device operation-GTO switching characteristics- Snubber circuits- Over protection of GTOs.

Insulated Gate Bipolar Transistors - Introduction- Basic structures- I-V Characteristics-Physics of device operation- Latch in IGBT switching characteristics-Device limits and Safe Operating Areas- Snubber circuits.

UNIT – III	EMERGING DEVICES AND CIRCUITS	Lec Hrs: 9

Introduction-Power junction field effect transistors- Field Controlled Thyristor- JFET based devices versus other power devices- MOS controlled Thyristors- High voltage integrated circuits- New Semi conductor materials- Introduction to Gallium Nitride and Silicon Carbide Devices.

UNIT – IV	PASSIVE COMPONENTS AND ELECTROMAGNETIC COMPATIBILITY	Lec Hrs: 9

Introduction- Design of inductor- Transformer design- Selection of capacitors and resistors- Current Measurements-Heatsinking circuit layout– Electromagnetic Interference (EMI)-Sources of EMI Electromagnetic Interference in Power Electronic Equipment.

UNIT – V	NOISE & PROTECTION DEVICES	Lec Hrs: 10

Noise sources in SMPS- Diode Storage Charge Noise- Noise generated due to switching-Common noises sources in SMPS- Noises Due to High frequency transformer- Measurement of Noise- Minimizing EMI-EMI shielding- EMI standards. Protection of Devices& Circuits - Cooling & Heat sinks – Thermal modeling of power switching devices- Snubber circuits – Reverse recovery transients – Supply and load side transients – Voltage protections– Current protections.

Textbooks:

1. **M.H. Rashid, —Power Electronics Circuits, Devices and Applications‖ Pearson Education, 4th edition, 2017.**
2. **Mohanand Undel and, —Power Electronics Converters, Applications and Design‖, JohnWiley &Sons,3rd edition, 2007.**
3. **B.W. Williams ,—Power Electronics Circuit Devices, Drivers and Applications and passive components‖, MC Graw hill higher education, 2nd edition, 1992.**

Reference Books:

1. **Vithayathil, —Power Electronics Circuits‖, MC Graw Hill Education, Indian edition, 2017.**
2. **W.C. Lander, —Power Electronics Circuits‖, Tata MC Graw Hill,3rdEdition, 1995.**
3. **Loganathan Umanand, —Power Electronics: Essentials and Applications‖, Wiley India Pvt . Ltd,2009.**

Online Learning Resources:

1. **http://nptelonlinecourses.iitm.ac.in/courses/108104011/**

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Course Code	APPLICATIONS OF POWER CONVERTERS (PE-III)	L	T	P	C
TEC25MPEPE001c		3	0	0	3
	Semester	II			

Course Objectives: To make the student

- Understand the power electronic application requirements.
- Remember the various power converters used in different applications for high and low voltage power supplies.
- Analyze the various power supplies used in modern microprocessor and computer loads.
- Apply the above concepts to design a bi-directional DC-DC converters for charge/discharge applications.

Course Outcomes (CO): Student will be able

- To understand the power electronic application requirements. L2
- To identify the suitable power converter from the available configurations. L2
- To develop the improved power converters for any stringent application requirements. L4
- To design a bi-directional DC-DC converters for charge/discharge applications. L4

UNIT - I	INVERTERS FOR INDUCTION HEATING	Lec Hrs: 9

For induction cooking – high frequency inverters for induction heating - Induction hardening – Melting – Electric welding control – Welding applications.

UNIT - II	POWER CONVERTERS FOR LIGHTING, PUMPING AND REFRIGERATION SYSTEMS	Lec Hrs: 10

Electronic ballast - LED power drivers for indoor and outdoor applications - PFC based grid fed LED drivers - PV / battery fed LED drivers –PV fed power supplies for pumping/refrigeration -Applications.

UNIT - III	HIGH VOLTAGE POWER SUPPLIES	Lec Hrs: 10

Power supplies for X-ray applications - Power supplies for radar applications-Power supplies for space applications.

UNIT - IV	LOW VOLTAGE HIGH CURRENT POWER SUPPLIES	Lec Hrs: 9

Power converters for modern microprocessor and computer load.

UNIT - V	BI-DIRECTIONAL DC-DC (BDC) CONVERTERS	Lec Hrs: 10

Electric traction - Automotive Electronics and charge/discharge applications -Line Conditioners and Solar Charge Controllers.

Textbooks:

1. Ali Emadi, A. Nasiri and S. B. Bekiarov, ―Uninterruptible Power Supplies and Active Filters‖, CRC Press, 1st edition, 2005.
2. M. Ehsani,Y. Gao, E. G. Sebastien and A. Emadi, ―Modern Electric, Hybrid Electric and Fuel Cell Vehicles‖, Standards media, 2ndEdition,2009.

Reference Books:

1. William Ribbens, ―Understanding Automotive Electronics‖, BH, 8th edition, 2003.
2. N. Mohan, T.M. Undeland and W.P. Robbins, ―Power Electronics Converters, Applications and design‖, John Wiley and Sons, 3rd edition, 2007
3. M. H. Rashid, ―Power Electronics Circuits , Devices and Applications‖, Pearson publications, 3rd Edition, 2004

Online Learning Resources:

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1. https://www.researchgate.net/publication/379065707
2. https://www.researchgate.net/publication/261652332
3. https://www.iqsdirectory.com/articles/power-supply/high-voltage-power-supplies.html
4. https://ieeexplore.ieee.org/document/975371
5. https://onlinelibrary.
6. wiley.com/doi/full/10.1155/jece/9876615

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Course Code	POWER QUALITY (PE- IV)	L	T	P	C
TEC25MPEPE002a		3	0	0	3
	Semester	II			

Course Objectives: To make the student

- To understand power quality definition, power quality standards.
- To remember measuring & solving power quality problems.
- To apply the various types of linear and nonlinear loads.
- To analyse harmonic methodology, mitigation techniques and case study.

Course Outcomes (CO): Student will be able to

- Understand different techniques of measuring & solving power quality problems Understand the fundamentals & terminology of power quality. L2
- Apply the concept of power frequency disturbances, types of transients & transient waveforms. L3
- Analyze the harmonic methodology & Electromagnetic Interference concepts. L4
- Remember the necessity of grounding and methods of grounding. L1

UNIT – I	INTRODUCTION TO POWER QUALITY	Lecture Hrs: 8

Definition of Power Quality - Power Quality Progression - Power Quality Terminology - Power Quality Issues– Voltage swells, sags, flicker, Responsibilities of Power Suppliers and Users-Power Quality Standards.

UNIT – II	POWER FREQUENCY DISTURBANCE & TRANSIENTS	Lecture Hrs: 10

Introduction to Power Frequency Disturbance - Common Power Frequency Disturbances – Characteristics of Low Frequency Disturbances - Voltage Tolerance Criteria- ITIC Graph - Introduction to Transients -Transient System Model - Examples of Transient Models and their Response - Power System Transient Modeling - Types and Causes of Transients -Examples of Transient Waveforms.

UNIT – III	HARMONICS & ELECTROMAGNETIC INTERFERENCE (EMI)	Lecture Hrs: 10

Definition of Harmonics - Harmonic Number (h) - Odd and Even Order Harmonics - Harmonic Phase Rotation and Phase Angle - Voltage and Current Harmonics - Individual and Total Harmonic Distortion -Harmonic Signatures - Effect of Harmonics on Power System Devices - Guidelines for Harmonic Voltage and Current Limitation - Harmonic Current Mitigation - Introduction to EMI - Frequency Classification –Electrical Fields- Magnetic Fields-EMI Terminology-Power Frequency Fields-High Frequency Interference-EMI Susceptibility-EMI Mitigation-Cable Shielding-Health Concerns of EMI.

UNIT - IV	GROUNDING AND BONDING	Lecture Hrs:10

Introduction to Grounding and Bonding-Shock and Fire Hazards-NEC Grounding Requirements-Essentials of a Grounded System-Ground Electrodes-Earth Resistance Tests-Earth Ground Grid Systems-Power Ground System-Signal Reference Ground (SRG)-SRG Methods-Single and Multipoint Grounding –Ground Loops – Electro Chemical Reaction -Examples of Grounding Anomalies.

UNIT - V	MEASURING AND SOLVING POWER QUALITY PROBLEMS	Lecture Hrs:10

Introduction to Power Quality Measurements-Power Quality Measurement Devices-Power Quality Measurements Test Locations-Test Duration-Instrument Setup- Instrument Guidelines – Power quality mitigating concepts and devices.

Textbooks:

1. Power quality by C. Sankaran, CRC Press, 1st Edition, 2001
2. Electrical Power Systems Quality, Roger C. Dugan, Mark F. Mc Granaghan, Surya Santoso, H. Wayne Beaty, 2nd Edition, TMH Education Pvt. Ltd, 1996.

Reference Books:
1. Understanding Power quality problems by Math H. J.Bollen IEEE Press, 1st edition, 2000. 2. Power quality enhancement using custom power devices by Arindam, Ghosh, Gerard Ledwich, Kluwer, Academic publishers, 1st edition, 2002.
Online Learning Resources:
1. https://nptel.ac.in/courses/108106025 2. https://onlinecourses.nptel.ac.in/noc21_ee103/preview

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Course Code	EV CHARGING INFRASTRUCTURE & TECHNOLOGY (PE- IV)	L	T	P	C
TEC25MPEPE002b		3	0	0	3
	Semester	II			

Course Objectives: To make the student

- Understand the fundamentals of EV charging infrastructure, including charging technologies, standards, and power ratings.
- Learn the principles of location planning and spatial allocation for effective establishment of EV charging stations within urban areas.
- Gain knowledge of electricity supply and regulatory frameworks, along with the role of DISCOMs in supporting EV charging infrastructure.
- Evaluate models of EV-grid integration and implementation strategies, including smart charging approaches and deployment models in India.

Course Outcomes (CO): Student will be able to

- Differentiate AC and DC charging systems and explain their technical standards and requirements. L2
- Apply location planning methodologies to identify suitable sites for EV charging infrastructure considering demand and urban planning principles. L3
- Analyze the impact of EV charging on the electricity grid and propose strategies for effective EV-grid integration using smart charging concepts. L4
- Compare different implementation models of EV charging infrastructure in India and recommend suitable approaches for real-world deployment. L2

UNIT – I	AN OVERVIEW OF EV CHARGING INFRASTRUCTURE	Lecture Hrs: 8
Orientation to EV charging infrastructure, brief introduction to technical concepts of electric vehicle supply equipment, AC and DC charging, power ratings, and charging standards.		
UNIT – II	**LOCATION PLANNING AND LAND ALLOCATION**	Lecture Hrs: 10
The location and site planning aspects for EV charging, framing the principles of location planning and demonstrating a methodology for spatial allocation of charging demand, identifying enabling processes and policies to integrate public charging in urban planning.		
UNIT – III	**CONNECTING EVs TO THE ELECTRICITY GRID**	Lecture Hrs: 10
Supply of electricity for charging infrastructure, familiarizing with the regulations that govern electricity supply for EV charging, the role of DISCOMs in provision of EV charging connections and the three methods of arranging for power supply for charging infrastructure.		
UNIT – IV	**ACHIEVING EFFECTIVE EV-GRID INTEGRATION**	Lecture Hrs:10
Site-level considerations for supply of electricity to assess grid-level impacts, highlighting the need for smart charging to minimize adverse impacts of EV charging loads on the grid.		
UNIT – V	**MODELS OF EV CHARGING IMPLEMENTATION**	Lecture Hrs:10
Typical roles within an implementation model for EV charging infrastructure and identifying three models in India – the government-driven model, the consumer-driven model and the charge point operator-driven model – for charging infrastructure implementation.		

Textbooks:
1. Sulabh Sachan, P. Sanjeevikumar, Sanchari Deb, ―Smart Charging Solutions for Hybrid and Electric Vehicles, Wiley Publications, March 2022. 2. Handbook of Electric Vehicle Charging Infrastructure Implementation Version-1
Reference Books:
1. Vahid Vahidinasab, Behnam Mohammadi-Ivatloo, ―Electric Vehicle Integration via Smart Charging, Springer, 2022. 2. Alam, Mohammad Saad, Pillai, Reji Kumar, Murugesan, N, ―Developing Charging Infrastructure and Technologies for Electric Vehicles‖, IGI Global Publisher, December 2021,
Online Learning Resources:
1. https://onlinecourses.nptel.ac.in/noc25_ee134/preview

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Course Code	DIGITAL SIGNAL PROCESSORS AND APPLICATIONS (PE-IV)	L	T	P	C
TEC25MPEPE002c		3	0	0	3
	Semester	II			

Course Objectives: To make the student

- Identify and describe the basic and advanced concepts of various DSP Processors.
- To use the basic and advanced concepts in order to develop various programmable based DSP applications.
- To explain the operation and performance of DSP based designs.
- To create DSP based controllers and processors for various simulation /real time based applications.

Course Outcomes (CO): Student will be able to

- Understand the basic and advanced concepts of different DSP Processors. L2
- Apply the basic and advanced concepts in order to develop various programmable based DSP applications. L3
- Analyze the operation and performance of DSP based designs for various real time issues. L4
- Design / create DSP based controllers and processors for various simulation /real time based applications. L5

UNIT - I	DSP CONTROLLER TMSLF2407	Lec Hrs: 10

Introduction to the TMSLF2407 DSP Controller- Brief Introduction to Peripherals - Types of Physical Memory-Software Tools.

C2XX DSP CPU and instruction set- Introduction to the C2XX DSP Core and Code Generation – The Components of the C2XX DSP Core - Mapping External Devices to the C2XX Core and the Peripheral Interface -System Configuration Registers –Memory -Memory Addressing Modes -Assembly Programming Using the C2XX DSP Instruction Set.

UNIT - II	DATA TRANSFER AND COMMUNICATION	Lec Hrs: 9

Parallel and Serial Data Transfer- Pin Multiplexing (MUX) and General Purpose I/O Overview-Multiplexing and General Purpose I/O Control Registers - Using the General Purpose I/O Ports, Serial Communication.

UNIT - III	DSP CONTROLLER TMS320LF24	Lec Hrs: 9

Interrupt system of TMS320LF2407- Introduction to Interrupts - Interrupt Hierarchy - Interrupt Control Registers- Initializing and Servicing Interrupts in Software- real time control with interrupts.

The analog-to-digital converter (ADC)-ADC Overview- Operation of the ADC and programming modes.

UNIT - IV	DSP CONTROLLER APPLICATIONS	Lec Hrs: 10

Event Managers (EVA, EVB)- Overview of the Event Manager (EV) - Event Manager Interrupts – General Purpose (GP) Timers- Compare Units - Capture Units and Quadrature Encoded Pulse (QEP) Circuitry – General Event Manager Information-PWM Signal Generation with Event Managers and interrupts, Measurement of speed with Capture Units, Implementation of Space Vector Modulation with DSPTMSLF2407A.

UNIT - V	FIELD PROGRAMMABLE GATE ARRAY	Lec Hrs: 10

Field Programmable Gate Arrays- Introduction to Field Programmable Gate Arrays – CPLD Vs FPGA – Types of FPGA, Configurable logic Blocks (CLB), Input/output Block (IOB) –Programmable Interconnect Point (PIP)- HDL programming –Overview of Spartan 6 & ISE Design Suite, Implementation of PWM technique with SPARTAN-6 FPGA.

Textbooks:

1. HamidA.Tolyat,—DSP based Electromechanical Motion Control‖, CRCpress,1st edition, 2004.
2. Wayne Wolf, —FPGAbasedsystemdesign‖,Prenticehall,1st edition, 2004

Reference Books:

1. Application Notes from the website of Texas Instruments
2. Spartan-6FPGA Configurable Logic Block,2010
3. Xilinx Spartan 6 Datasheets

Online Learning Resources:

1. **https://onlinecourses.nptel.ac.in/noc24_ee16/preview**
2. **https://nptel.ac.in/courses/117102060**

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Course Code	ELECTRIC DRIVES LAB	L	T	P	C
TEC25MPE0030P		0	0	4	2
	Semester	II			

Course Objectives: To make the student

- Understand and analyze torque speed characteristics of DC motors, 3 phase Induction Motor and PMSM with various converters connected.
- Apply and analyze various modulation techniques on different drives.
- Analyze performance of Induction Motors when different converters are connected.
- Analyze various types of drives when v/f control method are applied.

Course Outcomes (CO): Student will be able to

- To get practical training and hand on for the hardware and software application used in electric drives. L1
- To understand the practical problems and limitations of the methods used in electric drives. L2
- Apply and analyze various modulation techniques on different motor drives. L3
- Analyze performance of Induction Motors when different converters are connected. L4

List of Experiments:

1. Torque-Speed characteristics of DC motor using DC chopper
2. Symmetrical angle control of 1-phase AC motor connected to AC voltage controller
3. Single-Phase dual converter connected separately excited DC motor drive
4. Speed control of 3-phase induction motor using open-loop V/f control technique
5. Torque-Speed characteristics of a 3-phase induction motor using IM-comprehensive drive system
5. Study of a Neutral Point Clamped in verterfed three-phase induction motor drive
6. Pulse width modulation control of1-phase AC motor connected to AC voltage controller
7. Torque-Speedcharacteristicsofa3-phasePermanent Magnet Synchronous Motor(PMSM) using PMSM- IM comprehensive drive system
8. Torque-speed characteristics of a Separately Excited DC motor Drive fed by a two-pulse centre-tapped thyristor rectifier.
9. Torque-speed characteristics of a 6-pulse fully controlled rectifier fed Separately Excited DC motor drive
10. Study of a four-quadrant Separately excited DC motor drive fed by dual-converter with circulating current control
11. Study Class-D commutated chopper fed Separately Excited DC motor drive
12. Verification of spectral performance of a 3-PhVSI with V/Hz control of 3-Ph IM drives
13. Torque speed characteristics of a 3-Phinduction motor fed by ad3-PhVSI
14. Implementation of Centre spaced space vector modulation with DSP for V/Hz control of induction motor drives
15. Implementation of discontinuous space vector modulation with DSP for V/Hz control of induction motor drives

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Course Code	FACTS DEVICES SIMULATION LAB	L	T	P	C
TEC25MPE0040P		0	0	4	2
	Semester	II			

Course Objectives: To make the student

- Understand how to write the coding in simulation.
- Apply the SVC, STATCOM for voltage profile improvements & UPFC in power system networks.
- Analyze the data related to load flows incorporating SVC & STATCOM.
- Analyze operation of TCSC, STATCOM & SSSC for a transmission line fed by an ac supply.

Course Outcomes (CO): Student will be able to

- Understand Load balancing using compensators. L2
- Apply load balancing using Compensators. L3
- Analyse load flow incorporating SVC & STATCOM. L4
- Develop a Simulation model for STATCOM & UPFC. L5

List of Experiments:

1. Voltage regulation using shunt and series compensation
2. Load balancing in power system network using compensators
3. Simulation of TCSC
4. Voltage profile improvement using SVC
5. Voltage profile improvement using STATCOM
6. Transient Stability enhancement using STATCOM.
7. Simulation of UPFC with mathematical models
8. Load flow incorporating SVC
9. Load flow incorporating STATCOM
10. Simulation of DVR
11. Transmission Line Characteristics (P vs δ, Q vs δ, P vs Distance, Q vs Distance and V vs Distance) with and without Compensation
12. Sizing- simulation and operation of TCR and FC-TCR for a transmission line fed by an ac supply and feeding
    (a) Resistive/inductive/capacitive load one at a time
    (b) A load which can have leading as well as lagging behaviour
13. Sizing- simulation and operation of TCSC for a transmission line fed by an ac supply and feeding
    (a) Resistive/inductive/capacitive load one at a time
    (b) A load which can have leading as well as lagging behaviour
14. Sizing- simulation and operation of STATCOM for a transmission line fed by an ac supply and feeding
    (a) Resistive/inductive/capacitive load one at a time
    (b) A load which can have leading as well as lagging behaviour
15. Sizing- simulation and operation of SSSC for a transmission line fed by an ac supply and feeding
    (a) Resistive/inductive/capacitive load one at a time
    (b) A load which can have leading as well as lagging behaviour

Web Sources: https://www.vlab.co.in

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Course Code	QUANTUM TECHNOLOGIES AND APPLICATIONS	L	T	P	C
TEC25MRMC02		2	0	0	2
	Semester	**II**			

Course Objectives

1. Present core quantum principles such as superposition and entanglement without mathematical formalism.
2. Develop conceptual clarity on qubits, quantum states, and information frameworks.
3. Examine the theoretical challenges in realizing scalable quantum systems.
4. Introduce foundational ideas in quantum communication and computing.

Course Outcomes

Upon completion, the learner will be able to:
Explain fundamental quantum concepts conceptually.
Distinguish classical information systems from quantum information frameworks. Identify the principal theoretical limitations in building quantum computers.
Describe the conceptual basis of quantum communication and computation.
Discuss current applications, technological trajectories, and career opportunities in the quantum domain**.**

Unit 1: Foundations of Quantum Theory and Technologies

Transition from classical to quantum physics. Key conceptual principles: Superposition, Entanglement, Uncertainty, Wave-particle duality. Quantum states and measurement; the role of the observer. Representative quantum systems: electrons, photons, atoms. Concept of quantization and discrete energy levels. Strategic relevance of quantum technologies.

Overview of major domains: Computing, Communication, Sensing. Global quantum initiatives: India's National Quantum Mission, EU Quantum Flagship, USA, China.

Unit 2: Conceptual Structure of Quantum Information

Qubits: qualitative understanding using spin and polarization. Classical bits vs quantum bits: distinctions and implications. Quantum systems (non-engineering perspective): trapped ions, superconducting qubits, photonics. Coherence and decoherence mechanisms. Abstract notions: quantum states, measurement operators, Hilbert space—interpretation without mathematics. Entanglement and non-locality as foundational resources. Quantum vs classical information principles; philosophical considerations.

Unit 3: Building a Quantum Computer – Challenges and Requirements

Conceptual prerequisites for functional quantum hardware. Fragility of quantum states: decoherence, noise,

stability issues. Requirements: isolation, error resilience, scalability, control. Why maintaining entanglement is difficult; theoretical necessity of quantum error correction. Comparative overview of hardware platforms (superconducting circuits, trapped ions, photonics).Current progress vs scientific constraints; conceptual view of quantum software's role.

Unit 4: Quantum Communication and Computing

(Redundant explanations removed, retaining only unique themes.)Quantum vs classical communication paradigms. Essentials of Quantum Key Distribution (QKD) and its security rationale. Entanglement-enabled communication protocols. Concept of the Quantum Internet and secure global networking. Introduction to quantum computing and quantum parallelism.

Conceptual comparison of classical and quantum gate operations. Challenges: decoherence, noise, and the necessity of error correction frameworks.

Unit 5: Applications, Industry, and Future Directions

Application domains: Healthcare and drug discovery, Material science and chemistry, Optimization and logistics, Quantum sensing and precision timing. Case studies: IBM, Google, Microsoft, PsiQuantum. Ethical, societal, and policy considerations. Barriers to adoption: cost, skilled workforce, standards. Emerging research and career landscapes; India's strategic opportunity in the global quantum ecosystem.

Textbooks

Nielsen & Chuang, Quantum Computation and Quantum Information, Cambridge University Press, 2010.
1. Rieffel & Polak, Quantum Computing: A Gentle Introduction, MIT Press, 2011.
2. Chris Bernhardt, Quantum Computing for Everyone, MIT Press, 2019.

Reference Books

David McMahon, Quantum Computing Explained, Wiley, 2008.
Kaye, Laflamme, Mosca, An Introduction to Quantum Computing, OUP, 2007.
Scott Aaronson, Quantum Computing Since Democritus, CUP, 2013.
Susskind & Friedman, Quantum Mechanics: The Theoretical Minimum, Basic Books, 2014.
Rosenblum & Kuttner, Quantum Enigma, OUP, 2011.
Benenti et al., Principles of Quantum Computation and Information, World Scientific, 2004. DST India and MeitY: Official Quantum Mission Reports, 2020 onwards.
Quantum Flagship EU: Roadmaps and Strategy Documents.

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Online Learning Resources
IBM Quantum Experience & Qiskit Textbook Coursera – Quantum Mechanics and Quantum Computation (UC Berkeley) edX – Quantum Internet & Quantum Computers YouTube – Quantum Computing for the Determined (Michael Nielsen)

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Course Code	PEDAGOGY STUDIES	L	T	P	C
		2	0	0	0
TEC25MAC02A					
	Semester	II			

Course Objectives:

1. To enable the students to understand the aims, rationale, policy background, and conceptual frameworks in pedagogy, curriculum, and teacher education research.
2. To develop an understanding of diverse pedagogical practices
3. To make them learn the methodologies for assessing the effectiveness of pedagogical practices and teacher education models.
4. To enable them to learn professional development strategies, including peer support, community engagement, and alignment with curriculum and assessment.

Course Outcomes(CO):Students will be able to

1. Define and explain key concepts, frameworks, and methodologies in pedagogy and teacher education research.
2. Critically analyze pedagogical practices used in diverse classroom settings, with reference to teacher education and curriculum design.
3. Evaluate the effectiveness of pedagogical approaches using quality assessment tools and theory of change models.
4. Apply evidence-based strategies to improve classroom practices, curriculum alignment, and teacher professional development.
5. Identify and address barriers to learning through innovative pedagogical strategies.
6. Design and propose research studies that contribute to filling gaps in pedagogy, curriculum, and teacher education, with focus on dissemination and impact.

UNIT -I	**Foundations of Pedagogy**	

Introduction to pedagogy and its importance in education - Historical and philosophical foundations of pedagogy - Theories of learning and teaching (behaviorist, cognitive, constructivist) - Role of pedagogy in shaping educational practices - Role of technology in modern pedagogy (ICT, e-learning, blended learning)

UNIT – II	**Teaching-Learning Processes**	

Understanding the teaching-learning process - Lesson planning and curriculum design - Strategies for effective teaching and learning (expository, collaborative, experiential) - Use of technology to enhance teaching-learning processes (multimedia, simulations, gamification)

UNIT – III	**Technology Integration in Education**	

Educational technology and system design - Instructional design models (ADDIE, ASSURE, Dick and Carey Model) - Emerging trends in e-learning (social learning, MOOCs, mobile learning) - ICT tools for teaching and learning (Learning Management Systems, online resources)

UNIT – IV	**Pedagogy and Assessment**	

Pedagogy, pedagogical analysis, and assessment - Types of assessment (placement, formative, diagnostic, summative) - Technology-based assessment tools (online quizzes, polls, discussions) - Rubrics for self and peer evaluation- Reflective Practices

UNIT - V	**Contemporary Issues and Trends**	

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Inclusive education and technology (assistive technology, accessibility) - Change management and innovation in education - Quality assurance and evaluation in education (TQM, Six Sigma) - Future trends in pedagogy and technology (AI, AR, VR in education) - Personalized learning and adaptive teaching

Textbooks

1. Alexander, R. J. *Essays on Pedagogy*. Routledge, 2008.
2. Shulman, L. S. *The Wisdom of Practice: Essays on Teaching, Learning, and Learning to Teach*. Jossey-Bass, 2004

Reference Books

1. *Teaching for the Future: Effective Teacher Education and Pedagogical Practices*. OECD Publishing., 2021
2. Fullan, M., & Edwards, M. *System Change in Education: Sustainability and Impact*. Routledge, 2022.
3. Coe, R., Rauch, C., Kime, S., & Singleton, D. *Great Teaching Toolkit: Evidence Review*. Evidence Based Education., 2020
4. Zeichner, K. M. *The Struggle for the Soul of Teacher Education*. Routledge, 2024
5. UNESCO. *Global Education Monitoring Report: Pedagogy, Teachers and Learning*. UNESCO Publishing, 2024
6. Hattie, J. *Visible Learning: A Synthesis of Over 800 Meta-Analyses Relating to Achievement*. Routledge., 2009
7. Darling-Hammond, L. *Teacher Education Around the World: What Can We Learn from International Practice?* Routledge, 2007

Online Resources

- UNESCO Education Resources – https://www.unesco.org/education
- OECD Education and Skills – https://www.oecd.org/education
- ERIC (Education Resources Information Center) – https://eric.ed.gov (peer-reviewed papers, reports).
- World Bank Education – https://www.worldbank.org/en/topic/education (research reports on teacher development in developing countries).
- NPTEL/SWAYAM MOOCs – Teacher education and pedagogy-focused courses.
- Google Scholar Alerts – set alerts for "pedagogical practices", "teacher education", "curriculum research" for the latest academic papers.

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Course Code	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	L	T	P	C
		2	0	0	0
TEC25 MAC02b					
	Semester	II			

Course Objectives: This course will enable students:

- To develop students' self-awareness by identifying their strengths, weaknesses, opportunities, and challenges (SWOC analysis).
- To enable students to understand and apply the principles of emotional intelligence and effective interpersonal communication.
- To cultivate positive thinking, resilience, mindfulness, and a growth-oriented mindset.
- To enhance verbal and non-verbal communication skills, including confidence in public speaking and professional presentations.
- To familiarize students with leadership styles, teamwork strategies, and collaborative problem-solving in personal and professional contexts.

Course Outcomes (CO): Student will be able to

1. Define and explain key concepts of self-awareness, personality, and personal growth.
2. Identify and apply strategies of emotional intelligence to regulate emotions and build effective interpersonal relationships
3. Demonstrate positive thinking, gratitude, and resilience to overcome personal and professional challenges
4. Analyze barriers to effective communication and apply verbal and non-verbal communication techniques in diverse contexts.
5. Prepare, deliver, and evaluate effective presentations and public speeches with confidence
6. Develop leadership and teamwork skills to collaborate, negotiate, and solve problems in group settings.

UNIT –I	Self-Awareness and Personal Growth	

Understanding personality and its development- Identifying strengths, weaknesses, opportunities, and challenges (SWOC analysis)- Setting personal and professional goals- Practicing Self-Reflection and Journaling

(Activities: Personalitya assessments, self-reflection exercises, group discussions, SWOC analysis worksheet, Action Plan, SMART goal activities, Reflective journaling, Self-care Planning)

UNIT – II	Emotional Intelligence and Interpersonal Skills	

Understanding emotional intelligence and its importance - Developing self-awareness, self-regulation, and motivation - Building effective communication and interpersonal skills

- Conflict resolution and negotiation strategies.

(Activities: Emotional Intelligence Quiz, Self-Reflection exercises, feedback sessions, mindfulness exercises, Positive self-talk, Active Listening exercises, conflict-resolution Role-play, Case studies & Group activities)

UNIT – III	Positive Thinking and Attitude	

Understanding the power of positive thinking- Developing a growth mindset and resilience - Practicing gratitude and mindfulness- Overcoming negative thoughts and behaviors (Activities on positive thinking, growth mindset, mindfulness and self-care plan for overcoming negative thoughts)

UNIT – IV	**Effective Communication and Presentation Skills**	
Understanding the importance of effective communication- Developing verbal and non-verbal communication skills- Preparing and delivering effective presentations- Building confidence and public speaking skills (Activities: Group discussions, Case studies, Role-Play, Non-verbal communication exercises, Practice presentations, Peer feedback, public speaking exercises, Storytelling, Debates)		
UNIT – V	**Leadership and Teamwork**	
Understanding leadership styles and qualities - Developing leadership skills and qualities- Building effective teams and teamwork strategies- Practicing collaboration and problem-solving (Activities: Case studies, Group discussions, Debates, Leadership role-playing, team building activities, Group projects, Collaborative problem-solving exercies, feedback sessions)		

Prescribed Books

1. Daniel Goleman, *Emotional Intelligence: Why It Can Matter More Than IQ*, Bantam Books, 2017.
2. Stephen R. Covey, *The 7 Habits of Highly Effective People*, Simon & Schuster, 2020.

Reference Books

1. Dale Carnegie, *How to Win Friends and Influence People*, Simon & Schuster, 2020.
2. Brian Tracy, *Goals!: How to Get Everything You Want Faster Than You Ever Thought Possible*, Berrett-Koehler Publishers, 2021.
3. Robin Sharma, *The 5 AM Club: Own Your Morning, Elevate Your Life*, HarperCollins, 2020.
4. Carol S. Dweck, *Mindset: The New Psychology of Success*, Random House, 2016.
5. Daniel H. Pink, *Drive: The Surprising Truth About What Motivates Us*, Riverhead Books, 2018.
6. John C. Maxwell, *Leader shift: 11 Essential Changes Every Leader Must Embrace*, HarperCollins, 2019.

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Online Resources

1. **Coursera** – *Personal Development Specialization* (https://www.coursera.org)
2. **edX** – *Leadership and Emotional Intelligence Courses* (https://www.edx.org)
3. **Future Learn** – *Mindfulness and Resilience Training* (https://www.futurelearn.com)
4. **MindTools** – Practical resources on leadership, communication, and emotional intelligence (https://www.mindtools.com)
5. **Positive Psychology** – Articles and tools on resilience, gratitude, and well-being (https://positivepsychology.com)
6. **TED Talks** – Inspirational talks on leadership, communication, and self-growth (https://www.ted.com)
7. **Harvard Business Review (HBR)** – Leadership, negotiation, and workplace communication (https://hbr.org)

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Course Code	YOGA FOR STRESS MANAGEMENT	L	T	P	C
		2	0	0	0
TEC25 MAC02c					
	Semester	II			

Course Objectives:

1. To make the students understand the foundational concepts of Yoga, including Ashtanga (eight limbs) as prescribed in classical texts.
2. To enable them analyze the principles of Yama and Niyama, and their role in ethical, personal, and social development.
3. To make them learn do‘s and don‘ts of life through the practice of ahimsa, satya, astheya, brahmacharya, aparigraha, shaucha, santosh, tapa, swadhyaya, and ishwar-pranidhana.
4. To make them practice asanas and pranayama techniques for physical fitness, mental balance, and spiritual awareness.
5. To make them understand the holistic lifestyle through regular yoga practice, leading to personality development.

Course Outcomes (CO): Student will be able to

1. Explain the eight limbs of Yoga (Ashtanga) and their interrelationship in holistic development.
2. Demonstrate understanding of Yama and Niyama as ethical guidelines and apply them in personal and professional life.
3. Differentiate between do‘s and don‘ts in daily life with reference to Yogic principles like ahimsa, satya, and swadhyaya.
4. Perform selected asanas and pranayama techniques with correct posture, breathing, and awareness.
5. Evaluate the physical, mental, and emotional benefits of yoga practices in stress reduction, concentration, and self-discipline.
6. Integrate yoga philosophy and practices into a personal routine for sustainable health and inner growth.

UNIT -I		
Definitions of Eight parts of yoga.(Ashtanga)		
UNIT – II		
Yam and Niyam.		
UNIT – III		
Do‘s and Don‘ts in life. i) Ahinsa ,satya, astheya, bramhacharya and aparigraha ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan		
UNIT – IV		
Asanand Pranayam		
UNIT – V		
i)Various yoga poses and their benefits for mind and body ii)Regularization of breathing techniques and its effects-Types of pranayama		

Textbooks

1. Swami Prabhavananda and Christopher Isherwood (translation & commentary), *Patanjali Yoga Sutras,* Sri Ramakrishna Math, 1953.
2. B.K.S. Iyengar, *Light on Yoga,* Thorsons, 2003.

Reference Books

1. T.K.V. Desikachar, *The Heart of Yoga: Developing a Personal Practice,* Inner Traditions 2nd Edition, 1999.
2. Acharya Yatendra, *Yoga & Stress Management*, Fingerprint Publishers, 2019
3. Yamini Muthanna, *The Power of Yoga,* Om Books International, 2015.
4. Nayaswami Devarshi, *Kriya Yoga: Spiritual Awakening for the New Age,* Ananda Sangha Publications, 2023.

Online Resources

- **NPTEL / SWAYAM Online Courses** – Yoga and Physical Education modules.
- **AYUSH Ministry Website**: https://yoga.ayush.gov.in – official yoga resources, protocols, and research.
- **Yoga Journal**: https://www.yogajournal.com – practical guides, research updates, asana tutorials.
- **Art of Living Foundation**: https://www.artofliving.org – pranayama, meditation, and wellness practices.
- **YouTube Channels** (scholarly & practice-based):
  - *Sivananda Yoga Vedanta Centre*
  - *Yoga with Adriene* (for practical asana guidance)

Textbooks:
1. HamidA.Tolyat,"DSP based Electromechanical Motion Control", CRCpress,1st edition, 2004. 2. WayneWolf, "FPGAbasedsystemdesign",Prenticehall,1st edition, 2004.
Reference Books:
1. Application Notes from the website of Texas Instruments 2. Spartan-6FPGAConfigurableLogicBlock,2010 3. XilinxSpartan6Datasheets

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AUDIT COURSE-II

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Course Code	PEDAGOGY STUDIES	L	T	P	C
TEC25DAC201a		2	0	0	0
	Semester	II			

Course Objectives: This course will enable students:

- Reviewexistingevidenceonthereviewtopictoinformprogrammedesignandpolicy making undertaken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

Course Outcomes (CO): Student will be able to

Students will be able to understand:

- Whatpedagogicalpracticesarebeingusedbyteachersinformalandinformalclassrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- Howcanteachereducation(curriculumandpracticum)andtheschoolcurriculumand guidance materials best support effective pedagogy?

UNIT – I

Introduction and Methodology: Aims and rationale, Policy back ground, Conceptual frame work and terminology Theories of learning, Curriculum, Teacher education. Conceptual frame work, Research questions**.** Overview of methodology and Searching.

UNIT – II

Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

UNIT – III

Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the scho curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT – IV		

Professional development: alignment with classroom practices and follow-up support, Peer support, Support from the head teacher and the community. Curriculum and assessment, Barriers to learning: limited resources and large class
Sizes

UNIT – V		

Research gaps and future directions: Research design**,** Contexts**,** Pedagogy**,** Teacher education**,** Curriculum and assessment**,** Dissemination and research impact.

Suggested Reading

1. Ackers J, Hardman F (2001) Class room interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. AgrawalM(2004)Curricularreforminschools:Theimportanceofevaluation,Journalof
3. Curriculum Studies, 36 (3): 361-379.
4. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
5. Akyeampong K, Lussier K, PryorJ, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal
6. Educational Development, 33 (3): 272–282.
7. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
   Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
8. www.pratham.org/images/resource%20working%20paper%202.pdf.

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Course Code	STRESS MANAGEMENT BY YOGA	L	T	P	C
TEC25DAC201b		2	0	0	0
	Semester	**II**			

Course Objectives: This course will enable students:

- To achieve overall health of body and mind
- To overcome stress

Course Outcomes (CO): Student will be able to

- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

UNIT – I		
Definitions of Eight parts of yog.(Ashtanga)		
UNIT – II		
Yam and Niyam.		
UNIT – III		
Do's and Don'ts in life. i) Ahinsa, Satya, as they a, Bram Acharya and a parigraha ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan		
UNIT – IV		
Asan and Pranayama		
UNIT – V		
i)Various yoga poses and their benefits for mind & body ii)Regularization of breathing techniques and its effects-Types of pranayama		

Suggested Reading

1.'Yogic Asanas for Group Tarining-Part-I": Janardan Swami Yogabhyasi Mandal, Nagpur

2. "Rajayogaor conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

Course Code	PERSONALITY DEVELOPMENT THROUGHLIFE ENLIGHTENMENTSKILLS	L	T	P	C
TEC25DAC201c		2	0	0	0
	Semester	**II**			

Course Objectives: This course will enable students:

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

Course Outcomes (CO): Student will be able to

- StudyofShrimad-Bhagwad-Geetawillhelpthestudentindevelopinghispersonalityand achieve the highest goal in life
- The person who has studied Geeta will lead the nation and mankind to peace and prosperity
- Study of Neetishatakam will help in developing versatile personality of students

UNIT – I

Neetisatakam- Holistic development of personality

Verses-19,20,21,22(wisdom)

Verses-29,31,32(pride &heroism)

Verses-26,28,63,65(virtue)

UNIT – II

Neetisatakam- Holistic development of personality

Verses-52,53,59(dont's)

Verses-71,73,75,78(do's)

UNIT – III

Approach to day-to-day work and duties. ShrimadBhagwadGeeta:Chapter2-Verses41,47,48, Chapter3-Verses13,21,27,35,Chapter6-Verses5,13,17,23,35, Chapter18-Verses45,46,48.		
UNIT – IV		
Statements of basic knowledge. ShrimadBhagwadGeeta:Chapter2-Verses 56,62,68 Chapter12 -Verses13,14,15,16,17,18 Personality of Role model. Shrimad Bhagwad Geeta:		
UNIT – V		
Chapter2-Verses 17,Chapter3-Verses36,37,42, Chapter4-Verses18,38,39 Chapter18– Verses37,38,63		
Suggested Reading		
1. "SrimadBhagavadGita"bySwamiSwarupanandaAdvaitaAshram(PublicationDepartment), Kolkata 2. Bhartrihari'sThree Satakam (Niti-sringar-vairagya) by P. Gopinath, RashtriyaSanskrit Sansthanam, New Delhi.		