MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)

M.Tech. in Power Electronics and Electrical Drives

Scheme of Instruction and Examination

(Choice Based Credit System)

For the batches to be admitted with effect from the Academic Year 2022-23 onwards

I SEMESTER

S.No.	Course Code	Course Title	Instruction Hours per week			Examination			Credits
						Max Marks		SEE Duration in Hours	
			L	T	P	CIE	SEE		
1	EE101PC	Advanced Power Electronic Converters-I	3	0	0	40	60	3	3
2	EE102PC	Machine Modelling and Analysis	3	0	0	40	60	3	3
3	EE11XPE	Professional Elective-I	3	0	0	40	60	3	3
4	EE11XPE	Professional Elective-II	3	0	0	40	60	3	3
5	EE101MC	Research Methodology & IPR	2	0	0	40	60	3	2
6	AC10XHS	Audit Course – I	2	0	0	40	60	3	0
7	EE151PC	Machine Modelling and Analysis Lab	0	0	4	40	60	3	2
8	EE152PC	Advanced Power Electronic Converters Lab-I	0	0	4	40	60	3	2
		Total Hours/Marks/Credits	**16**	**0**	**8**	**320**	**480**	**-**	**18**

II SEMESTER

S.No.	Course Code	Course Title	Instruction Hours per week			Examination			Credits
						Max Marks		SEE Duration in Hours	
			L	T	P	CIE	SEE		
1	EE201PC	Advanced Power Electronic Converters-II	3	0	0	40	60	3	3
2	EE202PC	Electrical Drives	3	0	0	40	60	3	3
3	EE21XPE	Professional Elective – III	3	0	0	40	60	3	3
4	EE21XPE	Professional Elective – IV	3	0	0	40	60	3	3
5	AC20XHS	Audit Course – II	2	0	0	40	60	3	0
6	EE251PC	Advanced Power Electronic Converters Lab-II	0	0	4	40	60	3	2
7	EE252PC	Electrical Drives Lab	0	0	4	40	60	3	2
8	EE253PC	Mini Project with Seminar	0	0	4	100	-	3	2
		Total Hours/Marks/Credits	**14**	**0**	**12**	**380**	**420**	**-**	**18**

L: Lecture **T**: Tutorial **P**: Practical **CIE:** Continuous Internal Evaluation **SEE:** Semester End Examination

III SEMESTER

S.No.	Course Code	Course Title	Instruction Hours per week			Examination			Credits
						Max Marks		SEE Duration in Hours	
			L	T	P	CIE	SEE		
1	EE31XPE	Professional Elective – V	3	0	0	40	60	3	3
2		Open Elective	3	0	0	40	60	3	3
3	EE351PC	Dissertation Stage - II	0	0	12	100	-	-	6
Total Hours/Marks/Credits			**6**	**0**	**12**	**180**	**120**	**-**	**12**

IV Semester

S.No.	Course Code	Course Title	Instruction Hours per week			Examination			Credits
						Max Marks		SEE Duration in Hours	
			L	T	P	CIE	SEE		
1	EE451PC	Dissertation Stage - III	0	0	12	100	--	-	6
2	EE452PC	Dissertation Viva-Voce	0	0	28	--	100	-	14
Total Hours/Marks/Credits			**0**	**0**	**40**	**100**	**100**	**-**	**20**

L: Lecture **T**: Tutorial **P**: Practical **CIE:** Continuous Internal Evaluation **SEE:** Semester End Examination

Grand Total of Credits

Semester	I	II	III	IV	Total Credits
Credits	**18**	**18**	**12**	**20**	**68**

List of Professional Electives

Professional Elective-I

EE111PE: HVDC Transmission
EE112PE: Microcontroller Applications to Power Electronics
EE113PE: Smart Grid Technologies
EE114PE: Modern Control Theory

Professional Elective-II

EE115PE: Power Semiconductor Devices and Modelling
EE116PE: Reactive Power Compensation and Management
EE117PE: High Frequency Magnetic Components
EE118PE: Hybrid Electric Vehicles and Design

Professional Elective-III

EE211PE: Special Electrical Machines
EE212PE: Advanced Digital Signal Processing
EE213PE: SCADA Systems and Applications
EE214PE: Power Electronics for Renewable EnergySystems

Professional Elective-IV

EE215PE: DSP based Drive Control
EE216PE: Electric Vehicle Charging Techniques
EE217PE: Power Quality Improvement Techniques
EE218PE: Integration of Energy Sources

Professional Elective – V

EE311PE: Reliability Engineering
EE312PE: Flexible AC Transmission System
EE313PE: Dynamics of Electrical Machines
EE314PE: Energy Storage Technologies

Audit Courses

Audit Course-I

AC101HS: English for Research Paper Writing
AC102HS: Disaster Management
AC103HS: Sanskrit for Technical Knowledge
AC104HS: Value Education

Audit Course-II

AC201HS: Constitution of India
AC202HS: Pedagogy Studies
AC203HS: Stress Management by Yoga
AC204HS: Personality Development through Life Enlightenment Skills

Open Elective offered by Electrical and Electronics Engineering Department to other branches:

EE321OE: Photovoltaic Systems

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
M.TECH. IN POWER ELECTRONICS AND ELECTRICAL DRIVES
I Semester Syllabus
EE101PC: ADVANCED POWER ELECTRONIC CONVERTERS-I
(Program Core-I**)**

L	T	P	C
3	0	0	3

Prerequisite: Power Electronics

Course Objectives:
1. To understand the Principle of operation of modern Power Semiconductor Devices
2. To comprehend the design of Phase Controlled Rectifiers
3. To understand the performance of Single Phase PWM Inverters
4. To analyze the three Phase Inverters using different modulation techniques
5. To understand the operation of Multilevel Inverters with switching strategies for high Power applications

Course Outcomes: After completion of the course, students will be able to:
1. Choose the appropriate modern Power Semiconductor Device to design and analyze various Converter Topologies
2. Design the converter for various application such as DC drives, HVDC Transmission
3. Analyze the Inverters using different PWM techniques to reduce the Harmonics
4. Analyze three phase Inverters using different modulation techniques
5. Design Multi-level inverters for Industrial applications

UNIT-I: MODERN POWER SEMICONDUCTOR DEVICES
Modern power semiconductor devices: Symbol, Structure and equivalent circuit of Insulated Gate Bipolar Transistor (IGBT), MOSFET, MOS Turn off Thyristor (MTO), Emitter Turn off Thyristor (ETO), Integrated Gate-Commutated Thyristor (IGCTs), MOS-controlled thyristors (MCTs), Power Integrated Circuits (PICs). Comparison of their features.

UNIT-II: SINGLE PHASE & THREE PHASE CONVERTERS
Single phase converters: Half controlled and Fully controlled converters, Evaluation of input power factor and harmonic factor, continuous and Discontinuous load current, Single phase dual converters, Power factor Improvements Techniques, Extinction angle control, Symmetrical angle control, Single phase sinusoidal PWM, Single phase series converters, Overlap analysis, Applications & Problems.
Three phase converters: Half controlled and fully controlled converters, Evaluation of input power factor and harmonic factor, Continuous and Discontinuous load current, Three phase dual converters, Power factor Improvements Techniques, Three phase PWM, Twelve pulse converters, Applications &Problems.

UNIT-III: PULSE WIDTH MODULATED INVERTERS
Principle of operation, Performance parameters, Single phase bridge inverter, Evaluation of output voltage and current with resistive, inductive and capacitive loads, Voltage control of single phase inverters, Single PWM, Multiple PWM, Sinusoidal PWM, Modified PWM, Phase displacement Control, Advanced modulation techniques for improved performance, Trapezoidal, Staircase, Stepped, Harmonic injection and Delta modulation, Advantages, Applications & Problems.

UNIT-IV: THREE PHASE INVERTERS
Introduction to Three phase inverter, Analysis of 180 degree conduction for output voltage And current with resistive, inductive loads, Analysis of 120 degree Conduction, Voltage control of three phase inverters, Sinusoidal PWM, Third Harmonic PWM, 60 degree PWM, Space vector modulation, Comparison of PWM techniques, Harmonic reductions, Problems.

UNIT-V: MULTILEVEL INVERTERS
Multilevel concept, Classification of multilevel inverters, Principle of operation, main features and comparison of Diode clamped, Improved diode Clamped, Flying capacitors, Cascaded multilevel inverters, Multilevel inverter applications, Reactive power compensation, Back to back intertie system, Adjustable drives, Switching device currents, DC link capacitor voltage balancing.

TEXTBOOKS:

1. Mohammed H. Rashid, “Power Electronics”, Pearson Education, 3rd Edition, 1st Indian reprint2004.
2. Ned Mohan Tore M. Undeland and William P. Robbins, “Power Electronics”, John Wiley & Sons, 2nd Edition.

REFERENCES:

1. Milliman Shepherd and Lizang, “Power converters circuits”, Chapter 14 (Matrix converter) PP- 415-444,
2. M.H.Rashid, “Power Electronics hand book”.
3. Marian P.Kaźmierkowski, Ramu Krishnan, Frede Blabjerg Edition, “Control in Power electronics”, Published by Academic Press, 2002.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)

M.TECH. IN POWER ELECTRONICS AND ELECTRICAL DRIVES

I Semester Syllabus

EE102PC: MACHINE MODELLING AND ANALYSIS

(Program Core-II**)**

L	T	P	C
3	0	0	3

Prerequisite: Electrical Machines

Course Objectives:
1. To identify the methods and assumptions in modeling of machines
2. To understand various transformation techniques
3. To recognize the different frames for modeling of AC machines
4. To analyze the mathematical modeling of three phase synchronous motor
5. To analyze the mathematical modeling of permanent magnet synchronous motor and brushless DC motor

Course Outcomes: After completion of the course, students will be able to:
1. Develop the mathematical models of various AC and DC machines
2. Understand various transformation techniques
3. Analyze the developed models in various reference frames
4. Analyze the mathematical modeling of three phase synchronous motor
5. Analyze the mathematical modeling of permanent magnet synchronous motor and brushless DC motor

UNIT-I:

Basic Two-pole DC machine, Primitive 2-axis machine, Voltage and Current relationship, Torque equation. Mathematical model of separately excited DC motor and DC Series motor in state variable form, Transfer function of the motor, Numerical problems. Mathematical model of D.C. shunt motor, D.C. Compound motor in state variable form, Transfer function of the motor, Numerical Problems.

UNIT-II:

Linear transformation, Phase transformation (a, b, c to α, β, o), Active transformation (α. β, o to d, q), Circuit model of a 3-phase Induction motor, Linear transformation, Phase Transformation, Transformation to a Reference frame, Two axis models for induction motor, "d-q" model based DOL starting of induction motors.

UNIT-III:

Voltage and current Equations in stator reference frame, Equation in Rotor reference frame, Equations in a synchronously rotating frame, Torque equation, Equations in state – space form.

UNIT-IV:

Circuit model of a 3-phase Synchronous motor, two- axis representation of Synchronous Motor. Voltage and current Equations in state – space variable form, Torque equation, and “dq” model based short circuit fault analysis, Emphasis on voltage, Frequency and recovery time.

UNIT-V:

Modeling of Permanent Magnet Synchronous motor, Modeling of Brushless DC Motor.

TEXTBOOKS:

1. P.S. Bimbhra, “Generalized Machine theory”, Khanna Publishers.
2. Paul C. Krause, Oleg wasynezuk, Scott D. Sudhoff, “Analysis of electric machinery and Drives systems”.

REFERENCES:

1. Vedam Subranmanyam, “Thyristor control of Electric Drives”.
2. Prabha Kundur, “Power System Stability and Control”, EPRI.
3. Article in IEEE Transactions on Energy Conversion, “Performance optimization of induction motors during Voltage-controlled soft starting”, July, 2004.
4. Nithin K.S, Dr.Bos Mathew Jos, Muhammed Rafeek, Dr.Babu Paul, “A Novel Method for Starting of Induction Motor with Improved Transient Torque Pulsations”, International Journal of Engineering and Innovative Technology (IJEIT) Volume 2, Issue 8, February 2013.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
M.TECH. IN POWER ELECTRONICS AND ELECTRICAL DRIVES
I Semester Syllabus
EE111PE: HVDC TRANSMISSION
(Program Elective-I.1**)**

L	T	P	C
3	0	0	3

Prerequisite: Power Systems and Power Electronics

Course Objectives:
1. To compare EHV AC and HVDC systems.
2. To analyse Graetz circuit.
3. To control HVDC systems using various methods.
4. To describe various protection methods for HVDC systems.
5. To learn the methods to carry out modeling and analysis of HVDC system.

Course Outcomes: After completion of the course, students will be able to:
1. Compare EHV AC and HVDC system.
2. Analyse Graetz circuit for rectifier and inverter mode of operation.
3. Describe various methods to control the HVDC systems.
4. Describe various protection methods for HVDC systems.
5. Perform power flow analysis in AC/DC systems.

UNIT-I: GENERAL ASPECTS OF DC TRANSMISSION
Evolution of HVDC transmission, Comparison of HVDC and HVAC systems, Types of DC links, Components of a HVDC system, Valve characteristics, Properties of converter circuits, Assumptions, Single phase and Three-phase Converters, Pulse number, Choice of best circuit for HVDC converters.

UNIT-II: ANALYSIS OF BRIDGE CONVERTER
Analysis of simple rectifier circuits, required features of rectification circuits for HVDC transmission. **Analysis of HVDC converter**: Different modes of converter operation, Output voltage waveforms and DC voltage in rectification, Output voltage waveforms and DC in inverter operation, Thyristor/Valve voltages, Equivalent electrical circuit.

UNIT-III: DC LINK CONTROL
Grid control, Basic means of control, Power reversal, Limitations of manual control, Constant current versus Constant Voltage, Desired features of control.
Actual control characteristics: Constant-minimum-ignition-angle control, Constant-current control, Constant-extinction-angle control, Stability of control, Tap-changer control**,** Power control and current limits, Frequency control.

UNIT-IV: CONVERTER FAULTS & PROTECTION

Converter mal-operations, Commutation failure, Starting and shutting down the converter bridge, Converter protection.

UNIT-V: REACTIVE POWER MANAGEMENT & AC-DC POWER FLOW ANALYSIS

Smoothing reactor and DC Lines, Reactive power requirements, Harmonic analysis, Filter design. Power flow Analysis in AC/DC systems, Modelling of DC links, Solutions of AC-DC Power flow.

TEXTBOOKS:

1. J. Arrillaga, "High Voltage Direct Transmission", Peter Peregrinus Ltd. London, 1983.
2. K. R. Padiyar, "HVDC Power Transmission Systems", Wiley Eastern Ltd., 1990.

REFERENCES:

1. E. W. Kimbark, "Direct Current Transmission", Vol. I, Wiley Interscience, 1971.
2. Erich Uhlmann, "Power Transmission by Direct Current", B.S. Publications, 2004.
3. SN.Singh, "Electric Power Generation, Transmission and Distribution, PHI, New Delhi, 2nd Edition, 2008.
4. V. Kamaraju, "HVDC Transmission", Tata McGraw-Hill Education Pvt Ltd, New Delhi, 2011

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)

M.TECH. IN POWER ELECTRONICS AND ELECTRICAL DRIVES

I Semester Syllabus

EE112PE: MICROCONTROLLER APPLICATIONS TO POWER ELECTRONICS

(Program Elective-I.2**)**

L	T	P	C
3	0	0	3

Prerequisite: Power Electronics and Renewable Energy Systems

Course Objectives:

1. To study the architecture and know the instruction set of 8051 Microcontroller
2. To know the assembly Language program 8051 Microcontroller
3. To study the internal structure and operation of PIC 16F876 Microcontroller
4. To learn assembly language programming employing PIC 16F876 Microcontroller
5. To learn device programming using MPLAB IDE and PICSTART plus

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

1. Understand the architecture, addressing modes and apply the instruction set of 8051
2. Write the assembly language program for the generation of firing and control signals using 8051 Microcontroller
3. Understand the architecture and operation of PIC 16F876 Microcontroller
4. Develop assembly language program for the generation of firing and control signals employing PIC 16F876 Microcontroller
5. Analyze device programming using MPLAB IDE and PICSTART plus and develop program for generation of firing pulses for typical Power Converters

UNIT-I

8051 microcontrollers: Architecture, addressing modes, I/O ports, Instruction sets, Simple assembly language programming.

UNIT-II

Use of microcontrollers for pulse generation in power converters, Overview of Zero-Crossing Detectors, Typical firing/gate-drive circuits, Firing/gate pulses for typical single-phase and three-phase power converters.

UNIT III

PIC16F876 Micro-controller: Device overview, Pin diagrams, Memory organization, Special Function Registers, I/O ports, Timers, Capture/ Compare/ PWM modules (CCP).

UNIT-IV

Analog to Digital Converter module, Instruction set, Instruction description, Introduction to PIC microcontroller programming, Oscillator selection, Reset, Interrupts, Watch dog timer.

UNIT-V

Introduction to MPLAB IDE and PICSTART plus, Device Programming using MPLAB and PICSTARTplus, Generation of firing / gating pulses for typical power converters.

TEXTBOOKS:

1. S. N. Bhadra, D.Kastha, S.Banerjee, “Wind Electrical Systems”, Oxford University Press, 2005.
2. B.H.Khan, “Non-conventional Energy sources”, Tata McGraw-hill Publishing Company, NewDelhi, 2009.

REFERENCES:

1. Rashid .M. H, “Power electronics Hand book”, Academic press, 2001.
2. Ion Boldea, “Variable speed generators”, Taylor & Francis group, 2006.
3. Rai. G.D, “Non- conventional energy sources”, Khanna Publishes, 1993.
4. Gray, L. Johnson, “Wind energy system”, Prentice Hall linc, 1995.
5. Andrzej M. Trzynnadlowski, “Introduction to Modern Power Electronics”, 2nd Edition, Wiley IndiaPvt. Ltd, 2012.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
M.TECH. IN POWER ELECTRONICS AND ELECTRICAL DRIVES
I Semester Syllabus
EE113PE: SMART GRID TECHNOLOGIES
(Professional Elective-I 3)

L	T	P	C
3	0	0	3

Prerequisite: Power Systems

Course Objectives:
1. To understand concept of smart grid and its advantages over conventional grid
2. To know smart metering techniques
3. To learn wide area measurement techniques
4. To understand the problems associated with integration of distributed generation & its solution through smart grid.
5. To apply smart metering concepts to industrial and commercial installations

Course Outcomes: After completion of the course, students will be able to:
1. Understand concept of smart grid and its advantages over conventional grid
2. Know smart metering techniques
3. Learn wide area measurement techniques
4. Understand the problems associated with integration of distributed generation & its solution through smart grid.
5. Apply smart metering concepts to industrial and commercial installations

UNIT-I:
Introduction to Smart Grid, Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Concept of Robust & Self-Healing Grid Present development & International policies in Smart Grid

UNIT-II:
Introduction to Smart Meters, Real Time Prizing, Smart Appliances, Automatic Meter Reading (AMR), Outage Management System (OMS), Plug in Hybrid Electric Vehicles (PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation, Smart Substations, Substation Automation, Feeder Automation.

UNIT-III:
Geographic Information System (GIS), Intelligent Electronic Devices (IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System (WAMS), Phase Measurement Unit (PMU).

UNIT-IV:
Concept of micro-grid, Need& applications of micro-grid, Formation of micro-grid, Issues of interconnection, Protection & control of micro-grid, Plastic & Organic solar cells, Thin film solar

cells, Variable speed wind generators, Fuel-cells, micro-turbines, Captive power plants, Integration of renewable energy sources.

UNIT-V:

Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit. Advanced Metering Infrastructure (AMI) and Various Communication means and IP based Protocols.

TEXTBOOKS:

1. Ali Keyhani, "Design of smart power grid renewable energy systems", Wiley IEEE, 2011.
2. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response", CRCPress, 2009.

REFERENCES:

1. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, "Smart Grid: Technology and Applications",Wiley, 2012.
2. Stuart Borlase, "Smart Grid: Infrastructure, Technology and solutions", CRC Press.
3. A.G.Phadke, "Synchronized Phasor Measurement and their Applications", Springer.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
M.TECH. IN POWER ELECTRONICS AND ELECTRICAL DRIVES
I Semester Syllabus
EE114PE: MODERN CONTROL THEORY
(Program Elective-I.4**)**

L	T	P	C
3	0	0	3

Prerequisite: Control Systems

Course Objectives:

1. To explain the concepts of Matrices and state variables analysis as applicable to LTI systems
2. To study the concept of Controllability and Observability and various state transformations
3. To understand the concept of design of systems by state feedback controllers and observers
4. To study and analyze nonlinear systems.
5. To analyze the concept of stability by Lyapunov technique.

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

1. Perform state variables analysis for any real time system.
2. Examine a system for its stability, controllability and observability.
3. Implement basic principles and techniques in designing linear control systems using state feedback and state observers
4. Develop the mathematical models for non linear systems and analyze their performance
5. Perform stability analysis studies on various systems using Lyapunov techniques

UNIT I: MATHEMATICAL PRELIMINARIES AND STATE VARIABLE ANALYSIS
Fields, Vectors and Vector Spaces, Linear combinations and Bases, Linear Transformations and Matrices, Scalar Product and Norms, Eigen values, Eigen Vectors and a Canonical form representation of Linear systems, The concept of state, State space model of Dynamic systems, Time invariance and Linearity, Non uniqueness of state model, State diagrams for Continuous-Time State models, Existence and Uniqueness of Solutions to Continuous-Time State Equations, Solutions of Linear Time Invariant Continuous-Time State Equations, State transition matrix and it's properties. Complete solution of state space model due to zero input and due to zero state.

UNIT II: CONTROLLABILITY AND OBSERVABILITY
General concept of controllability, Controllability tests, Different state transformations such as diagonalization, Jordon canonical forms and Controllability canonical forms for Continuous-Time Invariant Systems, General concept of Observability, Observability tests for Continuous-Time Invariant Systems, Observability of different State transformation forms.

UNIT III: STATE FEEDBACK CONTROLLERS AND OBSERVERS
State feedback controller design through Pole Assignment, using Ackkermans formula. State observers: Full order and Reduced order observers.

UNIT IV: NON-LINEAR SYSTEMS

Introduction to Non-Linear Systems, Types of Non-Linearities, Saturation, Dead-Zone, Backlash, Jump Phenomenon etc., Linearization of nonlinear systems, Singular Points and its types, Describing function, Describing function of different types of nonlinear elements, Stability analysis of Non-Linear systems through describing functions.

Introduction to phase-plane analysis, Method of Isoclines for Constructing Trajectories, Stability analysis of nonlinear systems based on phase-plane method.

UNIT V: STABILITY ANALYSIS

Stability in the sense of Lyapunov, Lyapunov's stability and Lypanov's instability theorems, Stability Analysis of the Linear continuous time invariant systems by Lyapunov second method, Generation of Lyapunov functions, Variable gradient method, Krasooviski's method.

TEXTBOOKS:

1. M.Gopal, "Modern Control System Theory", New Age International, 1984.
2. Ogata. K, "Modern Control Engineering", Prentice Hall, 1997.

REFERENCES:

1. N K Sinha, "Control Systems", New Age International, 3rd Edition.
2. Donald E.Kirk, "Optimal Control Theory an Introduction", Prentice Hall Network series, 1stEdition.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)

M.TECH. IN POWER ELECTRONICS AND ELECTRICAL DRIVES

I Semester Syllabus

EE115PE: POWER SEMICONDUCTOR DEVCES AND MODELLING

(Program Elective-II.1)

L	T	P	C
3	0	0	3

Prerequisite: Power Electronics

Course Objectives:
1. To understand the characteristics of Power diodes and Power BJTs
2. To understand the static and dynamic characteristics of current controlled power semiconductor devices.
3. To understand the static and dynamic characteristics of voltage-controlled Power Semiconductor Devices.
4. To understand the characteristics of IGBT
5. To understand the advanced Power Semiconductor devices

Course Outcomes: After completion of the course, students will be able to:
1. Know the operating characteristics of various basic semiconductor devices and switches
2. Understand the advanced power semiconductor devices operation
3. Know the modelling of basic and advanced semiconductor devices and switches through simulation
4. Analyze the applications of various power semiconductor switches
5. Analye the protection schemes of all semiconductor devices

UNIT-I: POWER DIODES AND POWER BJT'S

POWER DIODES

Basic structure and V-I characteristics, Breakdown voltages and control, On-state losses, switching characteristics, Turn-on, Turn off and reverse recovery transient, Schottky diodes, Snubber requirements for diodes, Diode snubber, Modelling and simulation of Power diodes.

POWER BJT'S

Basic structure and V-I characteristics, Breakdown voltages and control, Secondary breakdown and its control, FBSOA and RBSOA curves, on state losses, switching characteristics, Resistive switching specifications, clamped inductive switching specifications, Turn-on and turn off transient, Storage time, Base drive requirements, switching losses, device protection, Snubber requirements for BJT's and snubber design, Switching aids, Modeling and simulation of power BJT'S.

UNIT-II: SILICON CONTROLLED RECTIFIERS (THYRISTORS) AND TRIACS

SILICON CONTROLLED RECTIFIERS (THYRISTORS)

Basic structure, V-I characteristics, Turn-on process, On-state operation, Turn-off process, Switching characteristics, Turn-on transient and di/dt limitations, Turn-off transient, Turnoff time and re-applied dv/dt limitations, Gate drive requirements, Ratings of thyristors, Snubber requirements and snubber design, Modelling and simulation of Thyristor.

TRIACS

Basic structure and operation, V-I characteristics, Ratings, Snubber requirements, Modelling and simulation of triacs.

UNIT-III: GATE TURNOFF THYRISTOR (GTO) AND POWER MOSFET's

GATE TURNOFF THYRISTOR (GTO)

Basic structure and operation, GTO switching characteristics, GTO turn-on transient, GTO turn-off transient, Minimum on and off state times, Gate drive requirements, Maximum controllable anode current, Overcurrent protection of GTO'S, Modelling and simulation of GTO'S.

POWER MOSFET's

Basic structure, V-I characteristics, Turn-on process, On state operation, Turnoff process, Switching characteristics, Resistive switching specifications, Clamped inductive switching specifications, Turn-on transient and di/dt limitations, Turn-off transient, Turn off time, Switching losses, Effect of reverse recovery transients on switching stresses and losses, dv/dt limitations, Gating requirements, Gate charge, Ratings of MOSFET'S, FBSOA and RBSOA curves, Device protection, Snubber requirements, Modeling and simulation of Power MOSFET'S.

UNIT-IV: INSULATED GATE BIPOLAR TRANSISTOR's (IGBT's)

Basic structure and operation, latch up IGBT, switching characteristics, Resistive switching specifications, clamped inductive switching specification, IGBT turn-on and turn off transient, Current tailing, Gating requirements, Ratings of IGBT'S, FBSOA and RBSOA curves, switching losses, Minimum on and off state times, Switching frequency capability, Overcurrent protection of IGBT'S, Short circuit protection, Snubber requirements and snubber design.

UNIT-V: ADVANCED POWER SEMICONDUCTOR DEVICES

MOS gated thyristors, MOS controlled thyristors or MOS GTO'S, Base resistance-controlled thyristors, Emitter switched thyristor, Thermal design of power electronic equipment, Modelling and simulation, Heat transfer by conduction, Transient thermal impedance, Heat sinks, Heat transfer by radiation and convection, Heat sink selection for power semiconductor devices.

TEXTBOOKS:

1. Ned Mohan, Tore M. Undeland, William P. Robbins, "Power Electronics Converters, Applications,and Design", 3rd Edition, Wiley India Pvt Ltd, 2011.
2. G. Massobrio, P. Antognetti, "Semiconductor Device Modeling with Spice", McGrawHill, 2ndEdition, 2010.

REFERENCES:

1. B. Jayant Baliga, "Power Semiconductor Devices", 1st Edition, International Thompson ComputerPress, 1995.
2. V. Benda, J. Gowar, and D. A. Grant, "Discrete and Integrated Power Semiconductor Devices:Theory and Applications", John Wiley & Sons, 1999.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
M.TECH. IN POWER ELECTRONICS AND ELECTRICAL DRIVES
I Semester Syllabus
EE116PE: REACTIVE POWER COMPENSATION AND MANAGEMENT
(Program Elective-II.2**)**

L	T	P	C
3	0	0	3

Prerequisite: Power Systems

Course Objectives:
1. To identify the necessity of reactive power compensation
2. To describe load compensation
3. To select various types of reactive power compensation in transmission systems
4. To illustrate reactive power coordination system
5. To characterize distribution side and utility side reactive power management.

Course Outcomes: After completion of the course, students will be able to:
1. Distinguish the importance of load compensation in symmetrical as well as unsymmetrical loads
2. Work out on various compensation methods in transmission lines
3. Construct models for reactive power coordination
4. Characterize distribution side and utility side reactive power management.
5. Distinguish demand side reactive power management & user side reactive power management

UNIT-I:
LOAD COMPENSATION
Objectives and specifications, Reactive power characteristics, Inductive and capacitive approximate biasing, Load compensator as a voltage regulator, Phase balancing and power factor correction of unsymmetrical loads, Examples.

UNIT-II:
STEADY–STATE REACTIVE POWER COMPENSATION IN TRANSMISSION SYSTEMS
Uncompensated line, Types of compensation, Passive shunt and series and dynamic shunt compensation, Examples.
TRANSIENT STATE REACTIVE POWER COMPENSATION IN TRANSMISSION SYSTEMS
Characteristic time periods, Passive shunt compensation, Static compensation, Series capacitor compensation, Compensation using synchronous condenser, Examples.

UNIT-III:

REACTIVE POWER COORDINATION

Objective, Mathematical modeling, Operation planning, Transmission benefits, Basic concepts of quality of power supply, Disturbances, Steady–state variations, Effect of under-voltages, Frequency, Harmonics, Radio frequency and electromagnetic interference.

UNIT-IV:

DEMAND SIDE MANAGEMENT

Load patterns, Basic methods load shaping, Power tariffs, KVAR based tariffs penalties for voltage flickers and Harmonic voltage levels.

DISTRIBUTION SIDE REACTIVE POWER MANAGEMENT

System losses, Loss reduction methods, Examples, Reactive power planning, Objectives, Economics Planning capacitor placement, Retrofitting of capacitor banks.

UNIT-V:

USER SIDE REACTIVE POWER MANAGEMENT

KVAR requirements for domestic appliances, Purpose of using capacitors, Selection of capacitors, Deciding factors, Types of available capacitor, Characteristics and Limitations.

REACTIVE POWER MANAGEMENT IN ELECTRIC TRACTION SYSTEMS AND ARCFURNACES

Typical layout of traction systems, Reactive power control requirements, Distribution transformers, Electric arc furnaces, Basic operation, Furnaces transformer, Filter requirements, Remedial measures, Power factor of an arc furnace.

TEXTBOOKS:

1. T.J.E.Miller, "Reactive power control in Electric power systems", John Wiley and sons, 1982.
2. D.M. Tagare," Reactive power Management", Tata McGraw Hill, 2004.

REFERENCES:

1. Wolfgang Hofmann, Jurgen Schlabbach, Wolfgang Just, "Reactive Power Compensation: A Practical Guide", Wiley Publication, April2012.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
M.TECH. IN POWER ELECTRONICS AND ELECTRICAL DRIVES
I Semester Syllabus
EE117PE: HIGH FREQUENCY MAGNETIC COMPONENTS
(Program Elective-II.3)

L	T	P	C
3	0	0	3

Prerequisite: None

Course Objectives:
1. To understand the fundamentals of Magnetic devices and magnetic circuits
2. To know the skin effect and proximity effect
3. To design high frequency transformers
4. To analyze and design the various components of Integrated Inductors
5. To understand the concepts of Self capacitance

Course Outcomes: After completion of the course, students will be able to:
1. Understand the operation of Magnetic devices
2. Know the design of magnetic components (i.e., inductor and transformer) in a converter.
3. Analyze the skin and proximity effects in various windings
4. Understand core loss in an electromagnetic device, recognize& describe its effect.
5. Describe the engineering uses of electromagnetic waves, by frequency band, and the respective hazards associated with them.

UNIT-I:
FUNDAMENTALS OF MAGNETIC DEVICES
Introduction, Magnetic Relationships, Magnetic Circuits, Magnetic Laws, Eddy Currents, Core Saturation, Volt-Second Balance, Inductance, Inductance Factor, Magnetic Energy, Self-Resonant Frequency, Classification of Power Losses in Magnetic Components, Non-inductive Coils.

MAGNETIC CORES
Introduction, Properties of Core Materials, Magnetic Dipoles, Magnetic Domains, Curie Temperature, Magnetization, Magnetic Materials, Hysteresis, Core Permeability, Core Geometries, Iron Alloy Cores, Amorphous Alloy Cores, Nickel–Iron and Cobalt–Iron Cores, Ferrite Cores, Powder Cores, Nano- crystalline Cores, Superconductors, Hysteresis Core Loss, Eddy-Current Core Loss, Total Core Loss, Complex Permeability.

UNIT-II:
SKIN EFFECT & PROXIMITY EFFECT
Introduction, Magnet Wire, Wire Insulation, Skin Depth, Ratio of AC-to-DC Winding Resistance, Skin Effect in Long Single Round Conductor, Current Density in Single Round Conductor, Impedance of Round Conductor, Magnetic Field Intensity for Round Wire, Other Methods of Determining the Round Wire Inductance, Power Density in Round Conductor, Skin

Effect on Single Rectangular Plate. Proximity and Skin Effects in Two Parallel Plates, Anti-proximity and Skin Effects in Two Parallel Plates, Proximity Effect in Multiple-Layer Inductor, Appendix: Derivation of Proximity Power Loss.

WINDING RESISTANCE AT HIGH FREQUENCIES

Introduction, Winding Resistance, Square and Round Conductors, Winding Resistance of Rectangular Conductor, Winding Resistance of Square Wire, Winding Resistance of Round Wire, Leakage Inductance, Solution for Round Conductor Winding in Cylindrical Coordinates, Litz Wire, Winding Power Loss for Inductor Current with Harmonics, Effective Winding Resistance for Non-sinusoidal Inductor Current, Thermal Model of Inductors.

UNIT-III:

TRANSFORMERS

Introduction, Neumann's Formula for Mutual Inductance, Mutual Inductance, Energy Stored in Coupled Inductors, Magnetizing Inductance, Leakage Inductance, Measurement of Transformer Inductances, Stray Capacitance, High-Frequency Transformer Model, Non-interleaved Windings, Interleaved Windings, AC Current Transformers, Winding Power Losses with Harmonics, Thermal Model of Transformers.

DESIGN OF TRANSFORMERS

Introduction, Area Product Method, Optimum Flux Density, Transformer Design for Fly-back Converter in CCM, Transformer Design for Fly-back Converter in DCM.

UNIT-IV:

INTEGRATED INDUCTORS

Introduction, Resistance of Rectangular Trace, Inductance of Straight Rectangular Trace, Construction of Integrated Inductors, Meander Inductors, Inductance of Straight Round Conductor, Inductance of Circular Round Wire Loop, Inductance of Two-Parallel Wire Loop, Inductance of Rectangle of Round Wire, Inductance of Polygon Round Wire Loop, Bond-wire Inductors, Single-Turn Planar Inductor, Inductance of Planar Square Loop, Planar Spiral Inductors, Multi-metal Spiral Inductors, Planar Transformers, MEMS Inductors, Inductance of Coaxial Cable, Inductance of Two-Wire Transmission Line, Eddy Currents in Integrated Inductors, Model of RF Integrated Inductors, PCB Inductors.

DESIGN OF INDUCTORS

Introduction, Restrictions on Inductors, Window Utilization Factor, Temperature Rise of Inductors, Mean Turn Length of Inductors, Area Product Method, AC Inductor Design, Inductor Design for Buck Converterin CCM, Inductor Design for Buck Converter in DCM method.

UNIT-V:

SELF-CAPACITANCE

Introduction, High-Frequency Inductor Model, Self-Capacitance Components, Capacitance of Parallel- Plate Capacitor, Self-Capacitance of Foil Winding Inductors, Capacitance of Two Parallel Round Conductors, Capacitance of Round Conductor and Conducting Plane, Self-Capacitance of Single-Layer Inductors, Self-Capacitance of Multi-layer Inductors, Capacitance of Coaxial Cable.

TEXTBOOKS:

1. Umanand L, Bhat, S.R, "Design of Magnetic Components for Switched Mode Power Converters", ISBN: 978-81-224-0339-8, Wiley Eastern Publication, 1992.
2. Marian K. Kazimierczuk, "High-Frequency Magnetic Components", ISBN: 978-0-470-71453-9,John Wiley& Sons, Inc.

REFERENCES:

1. G.C. Chryssis, "High frequency switching power supplies", McGraw Hill, 1989 (2nd Edition.)
2. Eric Lowdon, "Practical Transformer Design Handbook", Howard W. Sams & Co., Inc., 1980
3. Thompson, "Electrodynamic Magnetic Suspension.pdf"
4. Witulski, "Introduction to modeling of transformers and coupled inductors"
5. Beattie,"Inductance 101.pdf"
6. P. L. Dowell, "Effects of eddy currents in transformer windings" (pdf)
7. Dixon, "Eddy current losses in transformer windings.pdf"
8. J J Ding, J S Buckkeridge, "Design Considerations for A Sustainable Hybrid Energy System"IPENZ Transactions, 2000, Vol. 27, No. 1/EMCh.
9. Ferroxcube, "Ferrite selection guide.pdf", Magnetics, Inc., Ferrite Cores (www.mag-inc.com).

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
M.TECH. IN POWER ELECTRONICS AND ELECTRICAL DRIVES
I Semester Syllabus
EE118PE: HYBRID ELECTRIC VEHICLES AND DESIGN
(Program Elective-II.4**)**

L	T	P	C
3	0	0	3

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

Course Objectives:
1. To understand the fundamental concepts, principles and analysis of Vehicles.
2. To know the various aspects of hybrid and electric drive train topologies
3. To know the various types of electric machine used as drives.
4. To know the various types of energy storage devices.
5. To know the various energy management strategies and their comparison.

Course Outcomes: After completion of the course, students will be able to:
1. Understand the models to describe vehicles and their performance.
2. Understand the aspects of hybrid and electric drive train topologies.
3. Understand the different electric machines used as drives.
4. Understand the different possible ways of energy storage.
5. Understand the different strategies related to energy storage systems.

UNIT-I:
INTRODUCTION
Conventional Vehicles: Basics of vehicle performance, Vehicle power source characterization, Transmission characteristics, Mathematical models to describe vehicle performance.

UNIT-II:
INTRODUCTION TO HYBRID ELECTRIC VEHICLES
History of hybrid and electric vehicles, Social and environmental importance of hybrid and electric vehicles, Impact of modern drive-trains on energy supplies.
Hybrid Electric Drive-Trains: Basic concept of hybrid traction, Introduction to various hybrid drive-train topologies, Power flow control in hybrid drive-train topologies, Fuel efficiency analysis.

UNIT-III:
ELECTRIC TRAINS
Electric Drive-Trains: Basic concept of electric traction, introduction to various electric drive train topologies, Power flow control in electric drive-train topologies, Fuel efficiency analysis.
Electric Propulsion Unit: Introduction to electric components used in hybrid and electric

vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, Configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, Drive system efficiency.

UNIT-IV:

ENERGY STORAGE

Energy Storage: Introduction to Energy Storage, Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices.

Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, Sizing the power electronics, selecting the energy storage technology, Communications, Supporting subsystems.

UNIT-V:

ENERGY MANAGEMENT STRATEGIES

Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, Classification of different energy management strategies, Comparison of different energy management strategies, Implementation issues of energy management strategies.

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

TEXTBOOKS:

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

REFERENCES:

1. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, “Modern Electric, Hybrid Electric, and Fuel CellVehicles: Fundamentals, Theory, and Design”, CRC Press, 2004.
2. T. Denton, “Electric and Hybrid Vehicles”, Routledge, 2016.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)

M.TECH. IN POWER ELECTRONICS AND ELECTRICAL DRIVES

I Semester Syllabus

EE101MC: RESEARCH METHODOLOGY & IPR

L	T	P	C
2	0	0	2

Prerequisite: None

Course Objectives:
1. To understand the research problem
2. To know the literature studies, plagiarism and ethics
3. To get the knowledge about technical writing
4. To analyze the nature of intellectual property rights and new developments
5. To know about the patent rights

Course Outcomes: After completion of the course, students will be able to:
1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics
4. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept and creativity.
5. Understanding that when IPR would take such important place in growth of individuals &nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.

UNIT-I:

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.

Approaches of investigation of solutions for research problem, Data collection, Analysis, Interpretation, Necessary instrumentations.

UNIT-II:

Effective literature studies approaches, Analysis, Plagiarism, Research ethics.

UNIT-III:

Effective technical writing, How to write a report, paper in developing a research proposal, Format of research proposal, A presentation and assessment by a review committee.

UNIT-IV:

Nature of Intellectual Property: Patents, Designs, Trade and Copyright.

Process of Patenting and Development: Technological research, Innovation, Patenting, Development. **International Scenario:** International cooperation on Intellectual Property, Procedure for grant of patents, Patenting under PCT.

UNIT-V:

Patent Rights: Scope of Patent Rights, Licensing and transfer of technology, Patent information and databases, Geographical Indications.

New Developments in IPR: Administration of Patent System, New developments in IPR, IPR of Biological Systems, Computer Software etc. Traditional knowledge, Case Studies, IPR and IITs.

TEXTBOOKS:

1. Stuart Melville and Wayne Goddard, "Research methodology: An Introduction for science &engineering students".
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction".

REFERENCES:

1. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step-by-Step Guide for beginners".
2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
3. Mayall , "Industrial Design", McGraw Hill, 1992.
4. Niebel, "Product Design", McGraw Hill, 1974.
5. Asimov, "Introduction to Design", Prentice Hall, 1962.
6. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New TechnologicalAge", 2016.
7. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)

M.TECH. IN POWER ELECTRONICS AND ELECTRICAL DRIVES

I Semester Syllabus

AC101HS: English for Research Paper Writing

(Audit-I)

L	T	P	C
2	0	0	0

Prerequisite: None

Course objectives:

- To Understand that how to improve your writing skills and level of readability
- To Learn about what to write in each section
- To Understand the skills needed when writing a Title Ensure the good quality of paper at very first-time submission

UNIT-I:

Planning and Preparation, Word Order, breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT-II:

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

UNIT-III:

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

UNIT-IV:

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,

UNIT-V:

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, and skills are needed when writing the Conclusions

UNIT-VI:

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

TEXTBOOKS/ REFERENCES:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
M.TECH. IN POWER ELECTRONICS AND ELECTRICAL DRIVES
I Semester Syllabus
AC102HS: DISASTER MANAGEMENT
(Audit-I)

L	T	P	C
2	0	0	0

Prerequisite: None

Course Objectives:

- To learn to demonstrate a critical understanding of key concepts in disaster risk reduction andhumanitarian response.
- To evaluate disaster risk reduction and humanitarian response policy and practice from multipleperspectives.
- To develop an understanding of standards of humanitarian response and practical relevance inspecific types of disasters and conflict situations.
- To understand the strengths and weaknesses of disaster management approaches,
- To plan and program in different countries, particularly their home country or the countries they work

UNIT-I:

Introduction:

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural andManmade Disasters: Difference, Nature, Types and Magnitude.

UNIT-II:

Repercussions of Disasters and Hazards:

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

UNIT-III:

Disaster Prone Areas in India:

Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics

UNIT-IV:

Disaster Preparedness and Management:

Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT-V:

Risk Assessment Disaster Risk:

Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation In Risk Assessment. Strategies for Survival.

UNIT-VI:

Disaster Mitigation:

Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.

TEXTBOOKS/ REFERENCES:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'NewRoyal book Company.
2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences and Reflections", Prentice Hall OfIndia, New Delhi.
3. Goel S. L., Disaster Administration and Management Text and Case Studies", Deep &DeepPublication Pvt. Ltd., New Delhi.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
M.TECH. IN POWER ELECTRONICS AND ELECTRICAL DRIVES
I Semester Syllabus

AC103HS: SANSKRIT FOR TECHNICAL KNOWLEDGE
(Audit-I**)**

L	T	P	C
2	0	0	0

Prerequisite: None

Course Objectives:
- To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- To learn of Sanskrit to improve brain functioning
- To Learn of Sanskrit to develop the logic in mathematics, science & other subjects enhancing thememory power
- To equip engineering scholars with Sanskrit will be able to explore the huge knowledge from ancientliterature

Course Outcomes: After completion of the course, students will be able to:
- Understand basic Sanskrit language
- Know ancient Sanskrit literature about science & technology can be understood
- Get logical language will help to develop logic in students

UNIT-I:
Alphabets in Sanskrit,

UNIT-II:
Past/Present/Future Tense, Simple Sentences

UNIT-III:
Order, Introduction of roots,

UNIT-IV:
Technical information about Sanskrit Literature

UNIT-V:
Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

TEXTBOOKS/ REFERENCES:

1. "Abhyaspustakam", Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya SanskritSansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)

M.TECH. IN POWER ELECTRONICS AND ELECTRICAL DRIVES

I Semester Syllabus

AC104HS: VALUE EDUCATION

(Audit-I**)**

L	T	P	C
2	0	0	0

Prerequisite: None

Course Objectives:

- To understand value of education and self- development
- To imbibe good values in students
- To know about the importance of character

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

- Get Knowledge of self-development
- Learn the importance of Human values
- Develop the overall personality

UNIT-I:

Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgements

UNIT-II:

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline

UNIT-III:

Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline, Punctuality, Love and Kindness -Avoid fault Thinking. Free from anger, Dignity of labor- Universal brotherhood and religious tolerance - True friendship - Happiness Vs suffering, love for truth - Aware of Self-destructive habits - Association and Cooperation - Doing best for saving nature

UNIT-IV:

Character and Competence –Holy books vs. Blind faith - Self-management and good health - Science of reincarnation - Equality, Nonviolence, Humility, Role of Women - All religions and same message - Mind your Mind, Self-control - Honesty, Studying effectively

TEXTBOOKS/ REFERENCES:

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford UniversityPress, New Delhi

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)

M.TECH. IN POWER ELECTRONICS AND ELECTRICAL DRIVES

I Semester Syllabus

EE151PC: MACHINE MODELLING AND ANALYSIS LAB

L	T	P	C
0	0	4	2

Prerequisite: Electrical Machines, Machine Modelling Analysis

Course Objectives:
1. To identify the methods and assumptions in modeling of machines
2. To recognize the different frames for modeling of AC machines
3. To write voltage and torque equations in state space form for different machines
4. To develop dynamic model of electrical machines
5. To develop mathematical model of electrical machines

Course Outcomes: After completion of the course, students will be able to:
1. Identify the methods and assumptions in modeling of machines
2. Recognize the different frames for modeling of AC machines
3. Write voltage and torque equations in state space form for different machines
4. Develop dynamic model of electrical machines
5. Develop the mathematical models of various electrical machines

List of Experiments
1. Develop a dynamic model of open loop-controlled dc motor
2. Develop a dynamic model of closed loop-controlled dc motor
3. Convert ABC voltages into stationary frame
4. Convert ABC voltages into synchronous frames
5. Convert ABC voltages into rotor reference frames
6. Develop dynamic model of 3-phase Induction motor and generator
7. Develop a mathematical model for V/f controlled 3-phase Induction motor
8. Develop a mathematical model for 3-phase Synchronous motor
9. Develop a mathematical model for3-phase Permanent Magnet Synchronous motor
10. Develop a mathematical model for Brushless DC Motor
11. Develop a dynamic model for closed loop control of Induction Motor
12. Develop a dynamic model for closed loop control of Synchronous motor

Note: From the above list, minimum of 10 experiments are to be conducted using any simulation tool.

M.TECH. IN POWER ELECTRONICS AND ELECTRICAL DRIVES
I Semester Syllabus
EE152PC: ADVANCED POWER ELECTRONIC CONVERTERS LAB-I

L	T	P	C
0	0	4	2

Prerequisite: Power Electronic Converters

Course Objectives:
1. To understand the Characteristics of modern Power Semiconductor Devices
2. To simulate the Phase Controlled Rectifiers using different control methods
3. To simulate the dc-ac converters using SPWM technique
4. To simulate the three phase inverter using Space Vector Modulation
5. To simulate various Multi-level Inverter topologies

Course Outcomes: After completion of the course, students will be able to:
1. Choose the appropriate modern Power Semiconductor Device to design and analyze various Converter Topologies
2. Design the controlled rectifiers for various application such as DC drives, HVDC Transmission
3. Analyze the Inverters using different PWM techniques to reduce the Harmonics
4. Analyze three phase Inverters using different modulation techniques
5. Design Multi-level inverters for Industrial applications

List of Experiments
1. Characteristics of IGBT, MTO, ETO, IGCT, MCT
2. Single phase and three-phase fully controlled converter.
3. Single phase and three-phase Half controlled converter.
4. Single phase Extinction angle control.
5. Single phase symmetrical angle control.
6. Single phase PWM controlled full converter.
7. Sinusoidal pulse width modulated single phase inverter.
8. Sinusoidal pulse width modulated three phase inverter.
9. Space vector modulated three phase inverter.
10. Single phase diode clamped Multi-level inverter.
11. Single phase flying capacitor Multi-level inverter.
12. Single phase cascaded Multi-level inverter.

Note: From the above list, minimum of 10 experiments are to be conducted using suitable software.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
M.TECH. IN POWER ELECTRONICS AND ELECTRICAL DRIVES
II Semester Syllabus
EE201PC: ADVANCED POWER ELECTRONIC CONVERTERS-II
(Program Core-III**)**

L	T	P	C
3	0	0	3

Prerequisite: Power Electronics, Power Electronic Converters

Course Objectives:
1. To analyze and design the non-isolated dc-dc Converters
2. To analyze the Isolated dc-dc converters
3. To analyze and design switched mode regulators for various industrial applications
4. To develop resonant Power converters with better performance
5. To comprehend the concepts of different power converters and their applications

Course Outcomes: After completion of the course, students will be able to:
1. Select an appropriate Power Semiconductor device and design a Power Converter for the required applications
2. Design existing and modified Power Converters based on real time applications
3. Design Resonant Pulse Converters
4. Apply the concepts of Zero Voltage and Zero Current Switching for Resonant Converters
5. Analyze and design Power converters and feedback loops

UNIT-I: NON-ISOLATED D.C. TO D.C. CONVERTERS
Analysis of step-down and step-up dc to dc converters with Resistive and Resistive-Inductive loads, Switched mode regulators, Analysis of Buck Regulators, Boost regulators, Buck and boost regulators, Cuk regulators, Condition for continuous inductor current and capacitor voltage, Comparison of regulators, Multi output boost converters, Advantages, Applications, Problems, State space analysis of regulators.

UNIT-II: ISOLATED D.C. TO D.C. CONVERTERS
Classification, switched mode dc power supplies, Fly back Converter, Forward converter, Push-pull converter, Half bridge converter, Full bridge converter, Control circuits, Magnetic design considerations, Applications.

UNIT-III: RESONANT PULSE INVERTERS
Resonant pulse inverters, Series resonant inverters, Series resonant inverters with unidirectional switches, Series resonant inverters with bidirectional switches, Analysis of half bridge 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, Parallel resonant, Series loaded, Parallel loaded, Series and Parallel loaded 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-IV: ZCS & ZVS RESONANT CONVERTERS

Resonant converters, zero current switching resonant converters, L-type and M-type ZCS resonant converter, 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 a zero current switching inverter, Numerical problems.

UNIT-V: POWER CONDITIONERS AND ADVANCED CONVERTERS

POWER CONDITIONERS

Power line disturbances, Power conditioners, Uninterruptible Power supplies, Applications

ADVANCED CONVERTERS

Principle of operation of SEPIC converter, Matrix Converter, Luo Converter, Interleaved Converter.

TEXTBOOKS:

1. Mohammed H. Rashid, "Power Electronics", Pearson Education, 3rdEdition, 1stIndian reprint, 2004.
2. Ned Mohan Tore M. Undeland and William P. Robbins, "Power Electronics", John Wiley & Sons, 2nd Edition.

REFERENCES:

1. Milliman Shepherd and Lizang, "Power converters circuits", Chapter 14 (Matrix converter) pp.415-444.
2. M.H.Rashid,"Power Electronics Hand Book".
3. Marian P. Kaźmierkowski, Ramu Krishnan, Frede Blabjerg Edition, "Control in Power Electronics",Published by Academic Press, 2002.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
M.TECH. IN POWER ELECTRONICS AND ELECTRICAL DRIVES
II Semester Syllabus
EE202PC: ELECTRICAL DRIVES
(Program Core-IV**)**

L	T	P	C
3	0	0	3

Prerequisite: Power Electronic Converters, Electrical Machines

Course Objectives:
1. Understand the concept controllers and chopper controlled drives.
2. Understand principle of operation of scalar control of AC motor and corresponding speed-torque characteristics
3. Comprehend the vector control for Induction motor drive.
4. Explain the static resistance control and Slip power recovery drive
5. Explain synchronous motor drive characteristics and its control strategies

Course Outcomes: After completion of the course, students will be able to:
1. Develop controllers for controlled rectifiers and choppers for DC motor drives.
2. Develop induction motor for variable speed operations using scalar vector control
3. Develop induction motor for vector control techniques
4. Identify the difference between the rotor resistance control and static rotor resistance control method and significance of slip power recovery drives.
5. Knowledge about the control of synchronous motor.

UNIT–I: RECTIFIER CONTROLLED DC MOTOR

Separately excited DC motors and DC series motors with single phase semi converter and single-phase full converter, Three-phase controlled converter, control circuit, control modeling 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, load and converter.

CLOSED LOOP CONTROL OF DC DRIVE

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 flowchart for simulation.

UNIT–II: CHOPPER CONTROLLED DC MOTOR DRIVES

Principle of operation of the chopper, Chopper with other power devices, Model of the chopper, Input to the chopper, Steady state analysis of chopper-controlled DC motor drives.

Closed loop operation: Speed controlled drive system, Current control loop, Pulse width modulated current controller, Hysteresis current controller, Modeling of current controller, Design of current controller.

UNIT–III: CONTROL OF INDUCTION MOTOR

CONTROL OF INDUCTION MOTOR

Introduction to motor drive, Torque production, Equivalent circuit analysis, Speed – Torque characteristics with Variable voltage, Variable frequency, Constant v/f, Variable stator current operation, Induction motor characteristics in constant torque and field weakening regions.

STATOR SIDE CONTROL

Scalar control, Voltage fed inverter control, Open loop v/f control, Speed control slip regulation, Speed control with torque and flux control, Current controlled voltage fed inverter drive.

ROTOR SIDE CONTROL OF INDUCTION MOTOR DRIVES

Slip power recovery drives, Static Kramer Drive, Phasor diagram, Torque expression, Speed control of Kramer Drive, Static Scheribus Drive, and Modes of operation.

UNIT–IV: VECTOR CONTROL OF INDUCTION MOTOR DRIVES

Principles of Vector control, Direct and Indirect methods of vector control, Adaptive control principles, Self-tuning regulator Model referencing control, Direct torque control of AC motors.

UNIT–V: CONTROL OF PERMENANT MAGNET SYNCHRONOUS MOTOR DRIVES

Synchronous motor and its characteristic, Control strategies, Constant torque angle control, Unity powerfactor control, Constant mutual flux linkage control, Closed loop operation.

TEXTBOOKS:

1. R. Krishnan, "Electric Motor Drives Pearson Modeling, Analysis and control", 1st Edition, 2002.
2. B K Bose, "Modern Power Electronics and AC Drives", Pearson Publications, 1st Edition.

REFERENCES:

1. MD Murthy and FG Turn, "Power Electronics and Control of AC Motors", Bull Pergman Press 1stEdition.
2. BK Bose, "Power Electronics and AC Drives", Prentice Hall Eagle wood diffs New Jersey, 1stEdition.
3. M H Rashid, "Power Electronic circuits Deices and Applications", PHI, 1995.
4. G. K. Dubey, "Fundamentals of Electrical Drives", Narosa publications, 1995.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
M.TECH. IN POWER ELECTRONICS AND ELECTRICAL DRIVES
II Semester Syllabus
EE211PE: SPECIAL ELECTRICAL MACHINES
(Program Elective-III.1)

L	T	P	C
3	0	0	3

Prerequisite: Electrical Machines

Course Objectives:
1. To understand the concepts and control strategies of permanent magnet synchronous motors and BrushlessDC motors.
2. To study the operating principles and control methods of switched reluctance motors.
3. To design and conduct experiments towards research and to solve practical problems
4. To introduce the concepts and control of different types of stepper motors and its applications.
5. To analyze the working of linear induction and linear synchronous machines

Course Outcomes: After completion of the course, students will be able to:
1. Optimally design magnetics required in special machines-based drive systems
2. Develop new control strategies open and closed loop control for different types of special machines.
3. Design and conduct experiments towards research and to solve practical problems
4. Develop and analysis of the controllers for special electrical machine.
5. Analyze and Design Power converters and control techniques for control of special machines.

UNIT-I: STEPPER MOTORS
Constructional features, Principle of operation, Variable Reluctance (VR) stepping motor-Single Stack, Multi-Stack, Permanent Magnet Step motor, Hybrid Step Motor, Torque Equation Open Loop Drive, Open loop and closed loop control of Step Motor, Applications.

UNIT-II: SWITCHED RELUCTANCE MOTORS
Constructional features, Principle of Operation, Torque equation, Torque-speed characteristics, Power Converter for SR Motor-Asymmetrical converter, DC Split converter, Control of SRM, Rotor Position sensors, Current Controllers, Applications.

UNIT-III: PERMANENT MAGNET SYNCHRONOUS MOTOR
Permanent magnets and their characteristics, Machine Configurations-SPM, SIPM, IPM and Interior PM with circumferential, Sensorless control, Applications**.**

UNIT-IV: BRUSHLESS DC MOTOR

Construction, Principle of Drive operation with inverter, Torque speed Characteristics, Closed loop control, Sensorless control, Applications.

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UNIT-V: LINEAR INDUCTION MOTORS AND LINEAR SYNCHRONOUS MOTORS

Linear induction motor, Construction details, LIM Equivalent Circuit, Steps in design of LIM, Linear Synchronous Motor: Principle and Types of LSM, LSM Control, Applications.

TEXTBOOKS:

1. R.Krishnan, Electric Motor Drives, Pearson, 2007
2. B.K.Bose, Modern Power Electronics and AC Drives, PHI, 2005

REFERENCES:

1. Venkataratnam, Special electrical Machines, University Press, 2008
2. E.G.Janardanan, Special Electrical Machines, PHI, 2014.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
M.TECH. IN POWER ELECTRONICS AND ELECTRICAL DRIVES
II Semester Syllabus
EE212PE: ADVANCED DIGITAL SIGNAL PROCESSING
(Program Elective-III.2**)**

L	T	P	C
3	0	0	3

Prerequisite: Digital Signal Processing

Course Objectives:
1. To understand the Discrete time signals and Z-transforms
2. To understand and apply Discrete Fourier Transforms (DFT)
3. To understand the IIR and FIR digital filters
4. To understand the difference between discrete-time and continuous-time signals
5. To understand Optimum FIR and IIR Filters.

Course Outcomes: After completion of the course, students will be able to:
1. Acquire knowledge about the time domain and frequency domain representations as well analysisof discrete-time signals and systems
2. Study the design techniques for IIR and FIR filters and their realization structures.
3. Acquire knowledge about the finite word length effects in implementation of digital filters.
4. Gain knowledge about the various linear signal models and estimation of power spectrum ofstationary Random signals
5. Design of optimum FIR and IIR filters

UNIT-I:
Discrete time signals, Linear shift invariant systems, Stability and causality, Sampling of continuous time signal, Discrete time Fourier transforms, Discrete Fourier series, Discrete Fourier transform, Z-transforms, Properties of different transforms.

UNIT-II:
Linear convolution using DFT, Computation of DFT Design of IIR digital filters from analog filters, Impulse invariance method, Bi-linear transformation method.

UNIT-III:
FIR filter design using window functions, Comparison of IIR and FIR digital filters, Basic IIR and FIR filter realization structures, Signal flow graph representations, Quantization process and errors, Coefficient quantization effects in IIR and FIR filters.

UNIT-IV:
A/D conversion noise, Arithmetic round-off errors, Dynamic range scaling, Overflow oscillations and zero Input limit cycles in IIR filters, Linear Signal Models.

UNIT-V:

All pole, All zero and Pole-zero models, Power spectrum estimation, Spectral analysis of deterministic signals, Estimation of power spectrum of stationary random signals, Optimum linear filters, Optimum signal estimation, Mean square error estimation, Optimum FIR and IIR Filters.

TEXTBOOKS:

1. Sanjit K Mitra, "Digital Signal Processing: A computer-based approach ", TMH Edition, 1998.
2. Dimitris G.Manolakis, Vinay K. Ingle and Stephen M. Kogon, "Statistical and Adaptive SignalProcessing", TMH International Editions, 2000.

REFERENCES:

1. S Salivahanan. A. Vallavaraj C. Gnanapriya, "Digital Signal Processing", TMH, 2nd reprint 2001.
2. Lourens R Rebinarand Bernold, "Theory and Applications of Digital Signal Processing".
3. Auntoniam, "Digital Filter Analysis and Design", TMH.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
M.TECH. IN POWER ELECTRONICS AND ELECTRICAL DRIVES
II Semester Syllabus
EE213PE: SCADA SYSTEMS AND APPLICATIONS
(Program Elective-III.3**)**

L	T	P	C
3	0	0	3

Prerequisite: -

Course Objectives:
1. To understand what is meant by SCADA and its functions.
2. To understand Intelligent Electronic Devices and Programmable Logic Controller
3. To know SCADA Architecture
4. To know SCADA communication.
5. To get an insight into its application**.**

Course Outcomes: After completion of the course, students will be able to:
1. Describe the basic tasks of Supervisory Control Systems (SCADA) as well as their typical Applications.
2. Acquire knowledge about SCADA architecture, various advantages and disadvantages of each system.
3. Acquire knowledge about single unified standard architecture IEC 61850.
4. Learn about SCADA system components: remote terminal units, PLCs, intelligent electronic devices, HMI systems, SCADA server.
5. Learn and understand about SCADA applications in transmission and distribution sector, industries etc.

UNIT–I:
Introduction to SCADA, Data acquisition systems, Evolution of SCADA, Communication technologies. Monitoring and supervisory functions, SCADA applications in utility Automation, Industries SCADA.

UNIT–II:
Industries SCADA System Components, Schemes, Remote Terminal Unit (RTU), Intelligent Electronic Devices (IED), Programmable Logic Controller (PLC), Communication Network, SCADA Server, SCADA/HMI Systems.

UNIT–III:
SCADA Architecture**,** Various SCADA architectures, Advantages and disadvantages of each System, Single unified standard architecture -IEC 61850.

UNIT–IV:
SCADA Communication, Various industrial communication technologies, Wired and wireless methods and fiber optics, Open standard communication protocols.

UNIT–V:

SCADA Applications: Utility applications, Transmission and Distribution sector operations, Monitoring, analysis and improvement. Oil, gas and water industries case studies: Implementation, Simulation exercises.

TEXTBOOKS:

1. Stuart A. Boyer, "SCADA-Supervisory Control and Data Acquisition", Instrument Society ofAmerica Publications, USA, 2004.
2. Gordon Clarke, Deon Reynders, "Practical Modern SCADA Protocols: DNP3, 60870.5 andRelated Systems", Newnes Publications, Oxford, UK, 2004.

REFERENCES:

1. William T. Shaw, "Cyber Security for SCADA systems", PennWell Books, 2006.
2. David Bailey, Edwin Wright, "Practical SCADA for industry", Newnes, 2003.
3. Michael Wiebe, "A guide to utility automation: AMR, SCADA, and IT systems for electricpower", PennWell, 1999

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
M.TECH. IN POWER ELECTRONICS AND ELECTRICAL DRIVES
II Semester Syllabus
EE214PE: POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS
(Program Elective-III.4**)**

L	T	P	C
3	0	0	3

Prerequisite: Power Electronics, Renewable Energy Sources

Course Objectives:
1. To impart knowledge on solar cell and extraction of solar energy using Maximum Power Point Tracking algorithms.
2. To know the operation of AC-DC, DC-DC & AC-AC power converters used in renewable energy systems.
3. To analyze the operation of wind turbines and generators used in wind energy conversion system.
4. To impart knowledge on control of power converters topologies used in renewable energy systems.
5. To know the principle and operation of standalone, grid connected and hybrid renewable energy systems.

Course Outcomes: After completion of the course, students will be able to:
1. Acquire knowledge on solar energy extraction that are used to harness electrical power.
2. Understand the knowledge of identifying suitable converters and derive the criteria for the design of power converters for renewable energy applications.
3. Design and comprehend the various operating mode of wind electrical generators and turbine used in wind energy conversion system.
4. Ability to understand and analyze the control of power converters topologies used in wind energy conversion system.
5. Demonstrate & analyze the various standalone, grid connected & hybrid renewable energy systems.

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

UNIT-II:
Centralized Inverters, String Inverters, Multi-string Inverters, Module Integrated Inverter/Micro-inverters, Inverter Topology, Model of Inverter, Sizing Batteries and Inverters for a Solar PV System.
Types of PV Systems: Grid-Connected Solar PV System, Stand-Alone Solar PV System.

UNIT-III:

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

UNIT-IV:

Modeling of Permanent Magnet Synchronous Generators, Doubly Fed Induction Generators, Squirrel cage Induction Generators wind turbine, Control of Power converters for WECS.

UNIT-V:

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

TEXTBOOKS:

1. S. N. Bhadra, D.Kastha, S.Banerjee, “Wind Electrical Systems”, Oxford University Press, 2005.

REFERENCE BOOKS:

1. S.N.Bhadra, D. Kastha, & S. Banerjee “Wind Electrical Systems”, Oxford University Press, 2009.
2. Rashid .M. H, “Power Electronics Hand book”, Academic Press, 2001.
3. Rai. G.D, “Non- conventional energy sources”, Khanna Publishers, 1993.
4. Rai. G.D,” Solar energy utilization”, Khanna Publishes, 1993.
5. Gray, L. Johnson, “Wind energy system”, Prentice Hall of India, 1995.
6. B.H.Khan "Non-conventional Energy sources", Mc Graw-hill, 2nd Edition, 2009.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
M.TECH. IN POWER ELECTRONICS AND ELECTRICAL DRIVES
II Semester Syllabus
EE215PE: DSP BASED DRIVE CONTROL
(Program Elective-IV.1**)**

L	T	P	C
3	0	0	3

Prerequisite: Signals and Systems, Digital Signal Processing

Course Objectives:
1. To impart knowledge on DSP core and code generation
2. To understand I/O operations
3. To understand Operation of the ADC in the DSP
4. To enrich the learner with digital controller concepts and its application in the field of PowerElectronic drives
5. To understand the control of motors

Course Outcomes: After completion of the course, students will be able to:
1. Understand the architecture of DSP core and its functionalities.
2. Acquire knowledge on operation of interrupts and peripherals
3. Explore the possibilities of hardware implementation using PLDs and FPGAs.
4. Design controllers for power electronic drives.
5. Control of electrical motors

UNIT-I
Introduction to the C2xx DSP core and code generation, the components of the C2xx DSP core, mapping external devices to the C2xx core, Peripherals and Peripheral Interface, System configuration registers, Memory, Types of Physical Memory, Memory addressing Modes, Assembly Programming using C2xx DSP, Instruction Set, Software Tools.

UNIT II
Pin Multiplexing (MUX) and General Purpose I/O Overview, Multiplexing and General Purpose I/O Control Registers, Introduction to Interrupts, Interrupt Hierarchy, Interrupt Control Registers, Initializing and Servicing Interrupts in Software.

UNIT III
ADC Overview, Operation of the ADC in the DSP, Overview of the Event manager (EV) , Event Manager Interrupts, General Purpose (GP) Timers, Compare Units, Capture Units and Quadrature Enclosed Pulse (QEP) Circuitry, General Event Manager Information.

UNIT IV
Introduction to Field Programmable Gate Arrays (FPGA), CPLD Vs FPGA, Types of FPGA, Xilinx XC3000 series, Configurable logic Blocks (CLB), Input/output Block (IOB),

Programmable Interconnect Point (PIP), Xilinx 4000 series, HDL programming, Overview of Spartan 3E and Virtex II pro FPGAboards case study.

UNIT V

Control of DC motor, Permanent magnet Brushless DC motor, Permanent magnet synchronous motor.

TEXTBOOKS:

1. John.F.Wakerly, "Microcomputer Architecture and Programming", John Wiley and Sons, 1981.
2. Ramesh S.Gaonker, "Microprocessor Architecture, Programming and Applications with the8085",Penram International Publishing (India), 1994.

REFERENCE BOOKS:

1. Hamid.A.Toliyat and Steven G.Campbell, "DSP Based Electro Mechanical Motion Control", CRCPress New York, 2004.
2. XC 3000 series datasheets (version 3.1). Xilinx, Inc., USA, 1998.
3. XC 4000 series datasheets (version 1.6). Xilinx, Inc., USA, 1999.
4. Wayne Wolf, "FPGA based system design, Prentice Hall, 2004.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
M.TECH. IN POWER ELECTRONICS AND ELECTRICAL DRIVES
II Semester Syllabus
EE216PE: ELECTRIC VEHICLE CHARGING TECHNIQUES
(Program Elective-IV.2**)**

L	T	P	C
3	0	0	3

Prerequisite: Electric and Hybrid Vehicles, Power Electronics, Smart Grid Technologies

Course Objectives:
1. To understand the charging infrastructure for EV's.
2. To understand the location and site planning aspects for EV charging.
3. To understand the supply of electricity for charging infrastructure.
4. To explore the working of grid connected with EV's.
5. To understand the models for EV charging infrastructure.

Course Outcomes: After completion of the course, students will be able to:
1. Understand the planning and operational issues related to EV's charging.
2. Understand the location and site planning aspects for EV charging.
3. Understand the supply of electricity for charging infrastructure.
4. Understand the working of grid connected with EV's.
5. Acquire knowledge about EV's charging implementation models.

UNIT-I:
AN OVERVIEW OF EV CHARGING INFRASTRUCTURE:
Orients the reader to EV charging infrastructure, providing a 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:
Covers the location and site planning aspects for EV charging, by framing the principles of location planning and demonstrating a methodology for spatial allocation of charging demand, and identifies enabling processes and policies to integrate public charging in urban planning.

UNIT-III:
CONNECTING EVs TO THE ELECTRICITY GRID:
Focuses on supply of electricity for charging infrastructure, familiarizing readers 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:

Zooms out from site-level considerations for supply of electricity to assess grid-level impacts, and then highlights the need for smart charging to minimize adverse impacts of EV charging loads on the grid.

UNIT-V:

MODELS OF EV CHARGING IMPLEMENTATION

Defines the typical roles within an implementation model for EV charging infrastructure and identifies 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

REFERENCES:

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

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
M.TECH. IN POWER ELECTRONICS AND ELECTRICAL DRIVES
II Semester Syllabus
EE217PE: POWER QUALITY IMPROVEMENT TECHNIQUES
(Program Elective-IV.3)

L	T	P	C
3	0	0	3

Prerequisite: Power Systems and Power Electronics

Course Objectives:
1. To familiarize with standard terminology in power quality phenomena.
2. To classify and analyses power quality issues from nonlinear loads.
3. To study of the different passive filters for power quality improvement.
4. To know the different active filter compensation techniques along with control algorithms
5. To understand the operation of UPQC.

Course Outcomes: After completion of the course, students will be able to:
1. Know the causes of power quality issues in distribution system.
2. Understand the power quality problems caused by non-linear loads.
3. Analyze and design a passive filter for 1-Phase and 3-Phase systems
4. Analyze and design a shunt and series active filters with different control mechanism.
5. Understand the operation of multifunctional power conditioner - UPQC.

UNIT-I:
INTRODUCTION AND POWER QUALITY STANDARDS
Introduction, Classification of Power Quality Problems, Causes, Effects and Mitigation Techniques of Power Quality Problems, Power Quality Terminology, Standards, Definitions, Monitoring and Numerical Problems.

UNIT-II:
CAUSES OF POWER QUALITY PROBLEMS
Introduction to Non-Linear Loads, Power Quality Problems caused by Non-Linear Loads, Analysis of Non- Linear Loads, Numerical Problems.

UNIT-III:
PASSIVE SHUNT AND SERIES COMPENSATION
Introduction, Classification and Principle of operation of Passive Shunt and Series Compensators, Analysis and Design of Passive Shunt Compensators for Single-Phase System, Three-Phase Three Wire System and Three-Phase Four Wire System.

UNIT-IV:
ACTIVE SHUNT AND SERIES COMPENSATION
Introduction to Shunt compensators: Classification of DSTATCOM's, Principle of Operation of DSTATCOM.

Different Control Algorithms of DSTATCOM: PI Controller, I-Cosφ Control Algorithm, Synchronous Reference Frame Theory, Single-Phase PQ theory and DQ Theory Based Control Algorithms, Analysis and Design of Shunt Compensators, Numerical Problems.

Introduction to Series Compensators: Classification of Series Compensators, Principle of Operation of DVR.

Different Control Algorithms of DVR: Synchronous Reference Frame Theory-Based Control of DVR,Analysis and Design of Active Series Compensators, Numerical Problems.

UNIT-V:

UNIFIED POWER QUALITY COMPENSATORS

Introduction to Unified Power Quality Compensators (UPQC), Classification of UPQCs, Principle ofOperation of UPQC.

Control of UPQCs: Synchronous Reference Frame Theory-Based UPQC, Analysis and Design of UPQCs,Numerical Problems.

TEXTBOOKS:

1. Bhim Singh, Ambrish Chandra, Kamal Al-Haddad, "Power Quality Problems and MitigationTechniques", Wiley Publications, 2015.
2. Math H J Bollen, "Understanding Power Quality Problems", IEEE Press, 2000.

REFERENCES:

1. R.C. Dugan, M.F. McGranaghan and H.W. Beaty, "Electric Power Systems Quality", New York,McGraw-Hill, 1996.
2. G.T. Heydt, "Electric power quality", McGraw-Hill Professional, 2007.
3. J. Arrillaga, "Power System Quality Assessment", John wiley, 2000.
4. G.T. Heydt," Electric Power Quality", 2ndEdition, West Lafayette, IN, Stars in Circle Publications,1994.
5. R. SastryVedamMulukutlaS.Sarma, "Power Quality VAR Compensation in Power Systems",CRC Press.
6. A Ghosh, G. Ledwich," Power Quality Enhancement Using Custom Power Devices", KluwerAcademic, 2002

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
M.TECH. IN POWER ELECTRONICS AND ELECTRICAL DRIVES
II Semester Syllabus
EE218PE: INTEGRATION OF ENERGY SOURCES
(Program Elective-IV.4**)**

L	T	P	C
3	0	0	3

Prerequisite: Power Electronics and Renewable Energy Systems

Course Objectives:

1. To introduce the characteristics of various types of renewable energy sources and converters.
2. To explain the importance of Converter Topologies
3. To explain the importance of storage and sizing of hybrid systems.
4. To introduce the control issues of isolated systems.
5. To explain the harmonics, power quality, voltage imperfections, power injection issues on the grid by integrating renewable energy sources.

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

1. Identify the characteristics of renewable energy sources and converters.
2. Realize the different converter topologies in integration of energy sources.
3. Analyze the importance of storage and sizing of hybrid systems.
4. Realize the problems related to isolated systems.
5. Analyze the challenges faced by the grid by integrating renewable energy sources

UNIT- I:
REVIEW OF CHARACTERISTICS OF POWER SOURCES
Basic review of power generation from wind, Solar PV, Thermal, Small hydro, Biomass, Power strategies in each of these energy conversion systems, Review of maximum power point tracking techniques in solar PV and wind (perturb & observe, hill climbs, incremental conductance).

UNIT-II:
CONVERTER TOPOLOGIES
DC/DC converter (buck, boost, buck boost), DC/AC inverters (sine, triangular, PWM techniques), Phase locked loop for inverters.

UNIT-III:
HYBRID SYSTEMS
Advantages of hybrid power systems, Importance of storage in hybrid power systems, Design of hybrid power system based on load curve, Sizing of hybrid power systems.

UNIT-IV:
ISOLATED SYSTEMS
Control issues in isolated systems for voltage and frequency, Small signal stability in isolated power systems, Importance of storage and dump load in isolated systems.

UNIT-V:

ISSUES IN INTEGRATION OF RENEWABLE ENERGY SOURCES

Overview of challenges in integrating renewable sources to the grid, Impact of harmonics on power quality, need to maintain voltage within a band and fluctuations in voltage because of renewable integration, Power inverter and converter technologies, Mechanism to synchronize power from renewable sources to the grid, Overview of challenges faced in designing power injection from offshore generation sources, Challenges in modeling intermittent nature of renewable power in a power system.

TEXTBOOKS:

1. N. Mohan, "Power Electronics, Converters, Applications and Design",T.M.Undeland, W.P.Robbins, John Wiley and Sons, 1995.
2. Hossain, Jahangir, Mahmud, "Renewable Energy Integration Challenges and Solutions Series:Green Energy and Technology", Apel (Eds.).

REFERENCES:

1. Felix A. Farret, M. Godoy Simões," Integration of Alternative Sources of Energy", Wiley-IEEEPress December, 2005.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
M.TECH. IN POWER ELECTRONICS AND ELECTRICAL DRIVES
II Semester Syllabus
AC201HS: CONSTITUTION OF INDIA
(Audit-II)

L	T	P	C
2	0	0	0

Prerequisite: None

Course Objectives:

- To understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

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

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

UNIT-I:
History of Making of the Indian Constitution: History Drafting Committee, (Composition& Working)

UNIT-II:
Philosophy of the Indian Constitution: Preamble, Salient Features

UNIT-III:
Contours of Constitutional Rights & Duties: Fundamental Rights Right to Equality, Right to Freedom, right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT-IV:
Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualification, Powers and Functions

UNIT-V:

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: ZilaPachayat. Elected officials and their roles, CEO ZilaPachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

UNIT-VI:

Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

TEXTBOOKS/ REFERENCES:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn. Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)

M.TECH. IN POWER ELECTRONICS AND ELECTRICAL DRIVES

II Semester Syllabus

AC202HS: PEDAGOGY STUDIES

(Audit-II)

L	T	P	C
2	0	0	0

Prerequisite: None

Course Objectives:
- To review existing evidence on the review topic to inform programme design and policy makingundertaken by the DfID, other agencies and researchers.
- To identify critical evidence gaps to guide the development.

Course Outcomes: After completion of the course, students will be able to:
- Understand what pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
- Understand what is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- Understand how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

UNIT-I:

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum, Teacher education. Conceptual framework, 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 school 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.

TEXTBOOKS/ REFERENCES:

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

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)

M.TECH. IN POWER ELECTRONICS AND ELECTRICAL DRIVES

II Semester Syllabus

AC203HS: STRESS MANGEMENT BY YOGA

(Audit-II)

L	T	P	C
2	0	0	0

Prerequisite: None

Course Objectives:
- To achieve overall health of body and mind
- To overcome stress

Course Outcomes: After completion of the course, students 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't's in life.
i) Ahinsa, satya, astheya, bramhacharya and aparigraha
ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

UNIT-IV:
Asan and Pranayam

UNIT-V:
i) Various yoga poses and their benefits for mind & body
ii) Regularization of breathing techniques and its effects-Types of pranayam

TEXTBOOKS/ REFERENCES:

1. Janardan Swami Yogabhyasi Mandal, "Yogic Asanas for Group Tarining" Part-I, Nagpur
2. Swami Vivekananda, AdvaitaAshrama, "Rajayoga or conquering the Internal Nature", PublicationDepartment, Kolkata.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)

M.TECH. IN POWER ELECTRONICS AND ELECTRICAL DRIVES

II Semester Syllabus

AC204HS: PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

(Audit-II)

L	T	P	C
2	0	0	0

Prerequisite: None

Course Objectives:

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

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

- Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and 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.

- Shrimad BhagwadGeeta : Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
- Chapter 18-Verses 45, 46, 48.

UNIT-IV:

Statements of basic knowledge.

- Shrimad BhagwadGeeta: Chapter2-Verses 56, 62, 68
- Chapter 12 -Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad BhagwadGeeta:

UNIT-V:

- Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4-Verses 18, 38,39
- Chapter18 – Verses 37,38,63

TEXTBOOKS/ REFERENCES:

1. Swami Swarupananda Advaita Ashram, “Srimad Bhagavad Gita”, Publication Departmen, Kolkata.
2. P.Gopinath, Rashtriya Sanskrit Sansthanam, “Bhartrihari’s Three Satakam (Niti-sringar-vairagya),New Delhi.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
M.TECH. IN POWER ELECTRONICS AND ELECTRICAL DRIVES
II Semester Syllabus
EE251PC: ADVANCED POWER ELECTRONIC CONVERTERS LAB-II

L	T	P	C
0	0	4	2

Prerequisite: Power Electronic Converters

Course Objectives:
1. To simulate and understand gate drive circuit configurations for converter circuits
2. To simulate the Isolated dc-dc converters
3. To simulate and analyze switched mode regulators
4. To simulate resonant Power converters with better performance
5. To analyze advanced converter topologies

Course Outcomes: After completion of the course, students will be able to.
1. Design the gate driver circuits for converter topologies
2. Design existing and modified Power Converters based on real time applications
3. Design Resonant Pulse Converters
4. Apply the concepts of Zero Voltage and Zero Current Switching for Resonant Converters
5. Design concerned topologies based on Industrial applications

List of Experiments:
1. Buck Converter
2. Boost Converter
3. Cuk converter
4. Push pull converter
5. Fly back converter
6. Forward converter
7. Series resonant converter
8. Parallel resonant converter
9. ZVS
10. ZCS
11. UPS
12. SEPIC Converter

Note: From the above list, minimum of 10 experiments are to be conducted using any simulation tool

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
M.TECH. IN POWER ELECTRONICS AND ELECTRICAL DRIVES
II Semester Syllabus
EE252PC: ELECTRICAL DRIVES LAB

L	T	P	C
0	0	4	2

Prerequisite: Power Electronic Devices and Circuits and Electrical Machines

Course Objectives:
1. To understand principles of operation of scalar control of AC motor and corresponding speed- torque characteristics.
2. To comprehend the vector control of AC motor drive (IM and SM).
3. To explain the static resistance control and slip power recovery drive.
4. To explain synchronous motor drive characteristics and its control strategies.
5. To comprehend principle of operation of brushless DC motor.

Course Outcomes: After completion of the course, students will be able to:
1. Develop induction motor for variable speed operations using scalar and vector control techniques.
2. Identify the difference between the rotor resistance control and static rotor resistance control method and significance of slip power recovery drives.
3. Develop controllers for synchronous motor and variable reluctance motor.
4. Develop closed loop control of PMDC Motor Drive with thyristor circuit.
5. Develop different converter circuits using matrix converter.

List of Experiments:
1. Speed control of separately excited DC Motor Drive with 1 quadrant chopper
2. Speed control of separately excited DC Motor Drive with 4 quadrant chopper.
3. Speed control of BLDC Motor Drive.
4. Multi-level inverter-based AC Induction Motor Drive control equipment.
5. Speed control of 3-phase wound rotor Induction Motor Drive.
6. Speed control of 3-phase doubly fed Induction Motor Drive.
7. Speed control of 5-phase Induction Motor Drive.
8. Speed control of 3-phase Induction Motor Drive using V/F control.
9. Speed control of 3-phase Induction Motor Drive using Vector Control technique.
10. Speed Measurement and closed loop control using PMDC Motor Drive.
11. Speed measurement and closed loop control of PMDC Motor Drive with thyristor circuit.
12. Matrix Converter
13. Speed measurement and closed loop control of IGBT used single 4 quadrant chopper for PMDCMotor Drive.
14. Isolated Gate Drive circuits for MOSFET / IGBT based circuits.

Note: From the above list, minimum of 10 experiments are to be conducted

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
M.TECH. IN POWER ELECTRONICS AND ELECTRICAL DRIVES
III Semester Syllabus
EE311PE: RELIABILITY ENGINEERING
(Program Elective-V.1**)**

L	T	P	C
3	0	0	3

Prerequisite: Mathematics

Course Objectives:
1. To comprehend the concept of Reliability and Unreliability.
2. To derive the expressions for probability of failure, expected value and standard deviation of Binominal distribution, Poisson distribution, Normal distribution and Weibull distributions.
3. To formulate expressions for reliability analysis of series-parallel and non-series parallel systems.
4. To derive expressions for time dependent and limiting state probabilities using Markov models.
5. To u nderstand or become aware of various failures, causes of failures and remedies for failures inpractical systems

Course Outcomes: After completion of the course, students will be able to:
1. Comprehend the concept of Reliability and Unreliability
2. Apply fundamental knowledge of Reliability to modeling and analysis of series-parallel and non-series parallel systems.
3. Derive expressions for time dependent and limiting state probabilities using Markov models.
4. Solve some practical problems.
5. Understand or become aware of various failures, causes of failures and remedies for failures inpractical systems.

UNIT-I:
RELIABILITY AND PROBABILITY
Rules for combining probabilities of events, Definition of Reliability, Significance of the terms appearing in the definition, Probability distribution, Random variables, Probability density and distribution functions, Mathematical expectation, Binominal distribution, Poisson distribution, Normal distribution, Exponential distribution, Weibull distribution.

UNIT-II:
HAZARD RATE
Derivation of the reliability function in terms of the hazard rate, Failures, causes of failures, Types of failures (early failures, chance failures and wear-out failures), Bath tub curve, Preventive and corrective maintenance, Modes of failure, Measures of reliability, Mean time to failure and Mean time between failures.

UNIT-III:

CLASSIFICATION OF ENGINEERING SYSTEMS

Series, Parallel and Series-Parallel systems, Expressions for the reliability of the basic configurations. **Reliability evaluation of non-series-parallel configurations:** Decomposition, Path based and cutest based methods, Deduction of the Paths and cut-sets from Event tree.

UNIT-IV:

DISCRETE MARKOV CHAINS

General modeling concepts, stochastic transitional probability matrix, Time dependent probability evaluation and limiting state probability evaluation of one component repairable model, Absorbing states. **Continuous Markov Processes:** Modeling concepts, State space diagrams, Stochastic Transitional Probability Matrix, evaluating time dependent and limiting state, Probabilities of one component repairable model. Evaluation of limiting state probabilities of two component repairable model.

UNIT-V:

FREQUENCY AND DURATION TECHNIQUES

Frequency and duration concepts, Application to multi-state problems, Frequency balance approach. **Approximate System Reliability Evaluation:** Series system, Parallel system, Network reduction techniques, Cut set approach, Common mode failures, modeling and evaluation techniques, Examples.

TEXTBOOKS:

1. Roy Billinton and Ronald N Allan, “Reliability Evaluation of Engineering Systems”, BS Publications. Elsayed, “Reliability Engineering”, Prentice Hall Publications.

REFERENCES:

1. Alessandro Birolini, “Reliability Engineering: Theory and Practice”, Springer Publications.
2. Charles Ebeling, “An Introduction to Reliability and Maintainability Engineering”, TMH Publications.
3. E. Balaguruswamy, “Reliability Engineering”, TMH Publications.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
M.TECH. IN POWER ELECTRONICS AND ELECTRICAL DRIVES
III Semester Syllabus
EE312PE: FLEXIBLE AC TRANSMISSION SYSTEMS
(Program Elective-V.2**)**

L	T	P	C
3	0	0	3

Prerequisite: Power Electronics and Power Systems

Course Objectives:

1. To understand the concept and importance of controllable parameters of FACTS controllers.
2. To understand the basic concept of voltage source converters and current source converters.
3. To emphasize the objectives of Shunt compensation
4. To understand the basic operation of SVC and STATCOM.
5. To analyze the functioning of series controllers like GCSC, TSSC and TCSC

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

1. Choose proper controller for the specific application based on system requirements.
2. Understand various converters thoroughly and their requirements.
3. Understand the objectives of shunt compensation.
4. Interpret the control circuits of Shunt Controllers like SVC & STATCOM for various functions viz. Transient stability Enhancement, voltage instability prevention and power oscillation damping.
5. Detect the Power and control circuits of Series Controllers like GCSC, TSSC and TCSC.

UNIT-I:
FACTS CONCEPTS
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.

UNIT-II:
VOLTAGE SOURCE CONVERTERS
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, Comparison of current source converters with voltage source converters.

UNIT-III:
STATIC SHUNT COMPENSATION
Objectives of shunt compensation, Mid-point voltage regulation, Voltage instability prevention, Improvement of transient stability, Power oscillation damping, Methods of controllable VAR generation, Variable impedance type static VAR generators, switching converter type VAR generators, Hybrid VAR generators.

UNIT-IV:

SVC AND STATCOM

The regulation and slope transfer function and dynamic performance, Transient stability enhancement and power oscillation damping, operating point control and summary of compensator control.

UNIT-V:

STATIC SERIES COMPENSATORS

Concept of series capacitive compensation, Improvement of transient stability, Power oscillation damping and functional requirements of GTO thyristor-controlled Series Capacitor (GSC), Thyristor Switched Series Capacitor (TSSC) and Thyristor Controlled Series Capacitor (TCSC). Control schemes for GSC, TSSC and TCSC.

TEXTBOOKS:

1. Hingorani H G and Gyugyi. L, "Understanding FACTS-Concepts and Technology of Flexible AC Transmission Systems", New York, IEEE Press, 2000.
2. Padiyar.K.R, "FACTS Controllers in Power Transmission and Distribution", New Age Int. Publishers, 2007.

REFERENCES:

1. Zhang, Xiao-Ping, Rehtanz, Christian, Pal, Bikash, "Flexible AC Transmission Systems: Modeling and Control", Springer, 2012.
2. Yong-Hua Song, Allan Johns, "Flexible AC Transmission Systems", IET, 1999.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
M.TECH. IN POWER ELECTRONICS AND ELECTRICAL DRIVES
III Semester Syllabus
EE313PE: DYNAMICS OF ELECTRICAL MACHINES
(Program Elective-V.3**)**

L	T	P	C
3	0	0	3

Prerequisite: Machine Modeling and Analysis

Course Objectives:
1. To introduce generalized modeling of electrical machines
2. Understand the basic mathematical analysis of electrical machines and its characteristics.
3. Understand behavior of electrical machines under steady state and transient state.
4. Understand dynamic modeling of electrical machines.
5. To analyze different electrical machines with dynamic modeling

Course Outcomes: After completion of the course, students will be able to:
1. Introduce generalized modeling of electrical machines
2. Understand the basic mathematical analysis of electrical machines and its characteristics.
3. Understand behavior of electrical machines under steady state and transient state.
4. Understand dynamic modeling of electrical machines.
5. Analyze different electrical machines with dynamic modeling

UNIT-I:
BASIC MACHINE THEORY
Electromechanical Analogy, Magnetic Saturation, Rotating field theory, Operation of Inductor motor, Equivalent circuit, Steady state equation of DC machines, Operation of synchronous motor, Power angle characteristics.

UNIT-II:
ELECTRODYNAMICAL EQUATION & THEIR SOLUTIONS
Spring and Plunger system, Rotational motion, mutually coupled coils, Lagrange's equation, Application of Lagrange's equation, and Solution of Electro dynamical equations.

UNIT-III:
DYNAMICS OF DC MACHINES
Separately excited DC generator and motors, Steady-state and Transient analysis, Interconnection of machines, Ward Leonard system of speed control.

UNIT-IV:
INDUCTION MACHINE DYNAMICS
Induction machine dynamics during starting and braking, Accelerating time, Induction machine dynamic during normal operation, Equation for dynamical response of the induction motor.

UNIT-V:

SYNCHRONOUS MACHINE DYNAMICS

Electromechanical equation, Motor operation, Generator operation, Small oscillations, General equations for small oscillations, Representation of the oscillation equations in state variable form.

TEXTBOOKS:

1. Sen GuptaD.P. and J.W, "Electrical Machine Dynamics ", Macmillan Press Ltd., 1980.
2. Bimbhra P.S., "Generalized Theory of Electrical Machines", Khanna Publishers, 2002.

REFERENCES:

1. Vedam Subranmanyam, "Thyristor control of Electric Drives".
2. Article in IEEE Transactions on Energy Conversion, "Performance Optimization of Inductionmotors during Voltage-controlled soft starting", July 2004.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
M.TECH. IN POWER ELECTRONICS AND ELECTRICAL DRIVES
III Semester Syllabus
EE314PE: ENERGY STORAGE TECHNOLOGIES
(Program Elective-V.4**)**

L	T	P	C
3	0	0	3

Prerequisite: -

Course Objectives:
1. To introduce generalized storage techniques
2. To analyze the different features of energy storage systems
3. To know the applications of electrical energy storage
4. To know the management, hierarchy, demand for energy storage and valuation techniques
5. To have an idea about electrical energy storage market potential by different forecasting methods

Course Outcomes: After completion of the course, students will be able to:
1. Understand the role of electrical energy storage technologies in electricity usage
2. Know the behavior and features of electrical energy storage systems
3. Analyze the applications of energy storage system
4. Understand the management, hierarchy, demand for energy storage and different valuation techniques.
5. Get knowledge about energy storage forecasting methods

UNIT-I:
THE ROLES OF ELECTRICAL ENERGY STORAGE TECHNOLOGIES IN ELECTRICITY USE
Characteristics of electricity, Electricity and the roles of EES, High generation cost during peak-demand periods, Need for continuous and flexible supply, Long distance between generation and consumption, Congestion in power grids, Transmission by cable, Emerging needs for EES, More renewable energy, Less fossil fuel, Smart Grid uses, The roles of electrical energy storage technologies, The roles from the viewpoint of a utility, The roles from the viewpoint of consumers, The roles from the viewpoint of generators of renewable energy.

UNIT-II:
TYPES AND FEATURES OF ENERGY STORAGE SYSTEMS
Classification of EES systems, Mechanical storage systems, Pumped hydro storage (PHS), Compressed air energy storage (CAES), Flywheel energy storage (FES), Electrochemical storage systems, Secondary batteries, Lead-Acid Batteries, Lithium-Ion Batteries, Flow batteries, Other Batteries in Development, Chemical energy storage, Hydrogen (H2), Synthetic Natural Gas (SNG), Electrical storage systems, Double- Layer Capacitors (DLC), Superconducting Magnetic Energy Storage (SMES),Thermal storage systems, Standards for EES, Technical comparison of EES technologies.

UNIT-III:

APPLICATIONS OF EES

Present status of applications, Utility use (conventional power generation, grid operation & service), Consumer use (uninterruptable power supply for large consumers), EES installed capacity worldwide, New trends in applications, Renewable energy generation, Smart Grid, Smart Micro grid, Smart House, Electric vehicles.

UNIT-IV:

MANAGEMENT AND CONTROL HIERARCHY OF EES

Internal configuration of battery storage systems, External connection of EES systems, Aggregating EES systems and distributed generation (Virtual Power Plant), "Battery SCADA" aggregation of many dispersed batteries.

DEMAND FOR ENERGY STORAGE

Growth in Variable Energy Resources, Relationship between balancing services and variable energy resources, Energy Storage Alternatives, Variable Generator Control, Demand Management, Market Mechanisms, Longer Term Outlook.

VALUATION TECHNIQUES

Overview, Energy Storage Operational Optimization, Market Price Method, Power System Dispatch Model Method, Ancillary Service Representation, Energy Storage Representation, Survey of Valuation Results.

UNIT-V:

FORECAST OF EES MARKET POTENTIAL BY 2030

EES market potential for overall applications, EES market estimation by Sandia National Laboratory (SNL), EES market estimation by the Boston Consulting Group (BCG), EES market estimation for Li-ion batteries by the Panasonic Group, EES market potential estimation for broad introduction of renewable energies, EES market potential estimation for Germany by Fraunhofer, Storage of large amounts of energy in gas grids, EES market potential estimation for Europe by Siemens, EES market potential estimation by the IEA, Vehicle to grid concept, EES market potential in the future.

TEXTBOOKS:

1. Paul Breeze, "Power System Energy Storage Technologies", 1st Edition, Academic Press.
2. Alfred Rufer, "Energy Storage: Systems and Components", CRC Press, 2017.

REFERENCES:

1. Huggins and Robert, "Energy Storage Fundamentals, Materials and Applications", Springer.
2. andreasoberhofer@gmx.de
3. www.ecofys.com/com/publications
4. www.iec.ch.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)

III Semester Syllabus

EE321OE: PHOTOVOLTAIC SYSTEMS

(Open Elective offered by EEE Department)

L	T	P	C
3	0	0	3

Prerequisite: None

Course Objectives:

1. To introduce the concepts of Solar Energy and radiation
2. To deal with various technologies of solar PV cells
3. To understand details about manufacture, sizing and operating techniques
4. To introduce photovoltaic systems
5. To have knowledge of Maximum power point trackers and design considerations.

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

1. Understand the concepts of Solar energy and radiation
2. Realize different PV modules and design requirements
3. Correctly size system components, design considerations of solar equipment
4. Identify photovoltaic system components and system types
5. Design a basic grid-tie PV system.

UNIT-I:

SOLAR ENERGY

Sun and Earth, Solar Spectrum, Solar Geometry, Solar radiation on horizontal and inclined planes, Instruments for measurement of solar radiation, Solar cell, Equivalent circuit, V-I characteristics, Performance improvement.

UNIT-II:

SOLAR CELLS

Manufacture of Solar Cells-Technologies, Design of Solar cells, Photovoltaic modules, Design requirements, Encapsulation systems, Manufacture, Power rating, Hotspot effect, Design qualifications.

UNIT-III:

PROTECTION AND MEASUREMENTS

Flat plate arrays, Support structures, Module interconnection and cabling, Lightning protection, Performance measurement using natural sun light and simulator, Determination of temperature coefficients, Internal series resistance, Curve correction factor.

UNIT-IV:

PHOTOVOLTAIC SYSTEMS

Photovoltaic systems, Types, General design considerations, System sizing, Battery sizing, Inverter sizing, Design examples, Balance of PV systems.

UNIT-V:

MAXIMUM POWER POINT TRACKERS

Maximum power point trackers, Perturb and observe, Incremental conductance method, Hill climbing method, , Hybrid and complex methods, Data based and other approximate methods, Instrument design, Other MPP techniques, Grid interactive PV system.

TEXTBOOKS:

1. F.C.Treble, "Generating electricity from Sun", Pergamon Press.
2. A.K.Mukherjee, Nivedita Thakur,"Photovoltaic systems: Analysis and design", PHI, 2011.

REFERENCES:

1. C.S.Solanki," Solar Photovoltaic's: Fundamentals, Technologies and applications", PHI, 2009.