B.M.S. COLLEGE OF ENGINEERING

(Autonomous college under VTU)

BANGALORE-560019

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

M. Tech - Power Electronics

Scheme & Syllabus : I - IV Semester

(2024 onwards)

Electrical & Electronics Engineering

INSTITUTE VISION

Promoting Prosperity of mankind by augmenting human resource capital through Quality Technical Education & Training

INSTITUTE MISSION

Accomplish excellence in the field of Technical Education through Education, Research and Service needs of society

DEPARTMENT VISION

Facilitating the development of competent professionals capable of adapting to the constantly changing global scenario in the field of Electrical Sciences.

DEPARTMENT MISSION

- Impart quality technical education and encourage research in the field of Electrical Sciences.
- Empower every individual to develop as a professional with an ability to apply his/her knowledge and skills to adapt to the evolving technological requirements of society.

Electrical & Electronics Engineering

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

The PEOs of the program are as Follows:

PEO-1	Excel professionally in Power Electronics and allied domains.
PEO-2	Undertake research and development that addresses technological requirements of Industry and Institutes of higher learning
PEO-3	Adapt to the changing needs of Industry/Society through lifelong learning.

PROGRAM OUTCOMES (POs)

Program Outcomes (POs) are as under:

PO-1	An ability to independently carry out research /investigation and development work to solve practical problems.
PO-2	Ability to write and present a substantial technical report/document.
PO-3	Students should be able to demonstrate a degree of mastery over the areas per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

Electrical & Electronics Engineering

Semester-I

Course Type	Code	Course Title	Credits			Total Credits	Total Hours
			L	T	P		
BSC	MEE101	Advanced Engineering Mathematics	3	0	0	3	3
IPCC	MEE102	Advanced Modelling Methods in Power Electronics Systems	3	0	1	4	5
PCC	MEE103	Power Devices and Solid-State Power Converters	3	0	0	3	3
PEC	MEE104	Energy Ecology and Environment	3	0	0	3	3
PEC	MEE105	Embedded Controllers for Energy Management	3	0	0	3	3
PCCL	MEEL106A	Power Converters Laboratory	0	0	2	2	4
	MEEL106B	Energy Laboratory					
NCMC	MRMI107	Research Methodology and IPR (Online)	Online course (online.vtu.ac.in)			PP	
TOTAL			**15**	**0**	**3**	**18**	**21**

Electrical & Electronics Engineering

Semester-II

Course Type	Code	Course Title	Credits			Total Credits	Total Hours
			L	T	P		
IPCC	MEPE201	AC and DC drives	3	0	1	4	5
OEC	MEPE212	Python Programming	2	0	1	3	4
PCC	MEPE203	Switched Mode Power Conversion	3	0	0	3	3
PCC	MEPE204	PWM converters and applications	3	0	0	3	3
PEC	MEPE215x	Professional Elective III	3	0	0	3	3
PEC	MEPE216x	Professional Elective IV	2	1	0	3	4
PCCL	**MEPEL207**	SMPC laboratory	0	0	2	2	4
AEC	**24EPE258A**	Ki CAD software	0	0	1	1	2
TOTAL			**16**	**1**	**5**	**22**	**28**

Professional Elective III		**Professional Elective IV**	
MEPE215A	Power Electronics System design using ICs	MEPE216A	HVDC and FACTS
MEPE215B	Power quality enhancement using custom power devices	MEPE216B	Renewable Energy & Photovoltaics
MEPE215C	Advanced control systems	MEPE216C	Advanced Micro fabrication & Device Manufacturing

Electrical & Electronics Engineering

Semester-III

Course Type	Code	Course Title	Credits			Total Credits	Total Hours
			L	T	P		
PEC	MPE311A	Electric Vehicles	3	0	0	3	3
	MPE311B	Modelling of Electrical Machines					
	MPE311C	Wide Bandgap Devices in Power Electronics systems					
PEC	MPE312A	Advanced Control Techniques to Power Electronics	3	0	0	3	3
	MPE312B	DSP Applications to drives					
	MPE312C	Power Electronics in Smart Grid *					
INT	MINT384	INTERNSHIP-1 Research Internship /Industry-Internship leading to project work/ Startup	0	0	6	03	6
Project	MPRJ385	Project phase-1	0	0	6	03	6
TOTAL			**6**	**0**	**14**	**12**	**18**

- **Option is also provided for Online course of this course from VTU**

Semester-IV

Course Type	Code	Course Title	Credits			Total Credits	Total Hours
			L	T	P		
PEC	MPE411A	Soft Switching Techniques for Converters	3	0	0	3	3
	MPE411B	Electromagnetic Compatibility					
	MPE411C	Energy Storage Technologies					
	MINT481	INTERNSHIP-2 Research Internship /Industry-Internship leading to project work/ Startup				12	24
Project	MPRJ482	Project phase-2	0	0	26	13	26
TOTAL			**3**	**0**	**17**	**28**	53

Electrical & Electronics Engineering

Syllabus- Semester-I

Course Title:	**Advanced Engineering Mathematics**		
Course Code:	**MEE101**	**CIE MARKS**	**50**
L:T:P :	**(3:0:0)**	**SEE MARKS**	**100**
Credits:	**03**	**EXAM HOURS**	**03**
Course Learning objectives: • To have an insight into solving Linear Algebraic Equations and the importance of Eigen values and Eigen vectors in singular value decompositions. • To develop proficiency in vector spaces and linear transformations • To enable learning concepts of probability theory and their implication in Electrical and Electrical Engineering			
UNIT - 1			
Linear Algebra: Solution of Systems of Linear Equations: Direct methods-Partition method, Croute's Triangularisation method. Iterative method- relaxation method. Eigen values and Eigen vectors. Bounds on Eigen Values. Jacobi method & Givens method for symmetric matrices.			**08 Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, Demonstration through simulation, Problem based learning.		
UNIT - 2			
Vector Space 1: Introduction to vectors paces and sub-spaces, definitions column , Null spaces, spaces illustrative example. Linearly independent and dependent vectors-Basis definition and problems. Linear transformations definitions. Matrix form of linear Transformations-Illustrative examples.			**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, Demonstration through simulation, Problem based learning.		
UNIT - 3			
Vector Space 2: Orthogonal vectors and orthogonal bases. Gram-Schmidt Orthogonalization process. QR decomposition, Least square problems, Singular value decomposition. Applications			**08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Demonstration through simulation, Problem based learning.

UNIT –4

Probability distribution functions: Review of basic probability theory. Random variables, Probability distributions: Binomial, Poisson, uniform, and Normal (Gaussian) and Erlang distributions. Joint probability distribution (discrete and continuous)-Illustrative examples. Independent random variables, covariance and correlation.	**08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT- 5

Data-Driven Approaches in AI: Importance of Data in AI Applications, Data Acquisition, Data Preprocessing, normalization, and feature extraction **Machine Learning concepts**: Overview of Machine Learning Algorithms, Supervised learning, unsupervised learning **Deep Learning Techniques**: Fundamentals of Neural Networks and Deep Learning Architecture: feedforward, CNNs, RNNs, LSTM Activation functions and loss functions	**08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning, self-study activity based on IEEE papers

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

CO1	Solve system of linear equations using direct and iterative methods
CO2	Conceptualize the fundamentals of vector space and bases in reference to transformations
CO3	Use the idea of Eigen values and Eigen vectors for the application of Singular value decomposition
CO4	Interpret the concepts of Artificial intelligence and Machine Learning

Choice:

Textbooks:

Sl No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Linear Algebra and its Applications, David	C.Lay et al	Pearson	5th Edition, 2015.
2	Numerical Methods for Scientific and Engineering Computation	M. K. Jain et al	New Age International	9^{th} Edition, 2014

3	Probability and Random Processes	Scott L. Miller, Donald G.Childers	Elsevier	2004
Reference Books				
1	Numerical methods for Engineers	Steven C Chapra and Raymond P Canale	McGrawHill	7th Edition, 2015
2	Higher Engineering Mathematics	B.S. Grewal	Khanna Publishers	44th Edition, 2017
3	Advanced Engineering Mathematics	E.Kreyszig	Wiley	10th edition, 2015

Electrical & Electronics Engineering

Course Title:	**Advanced Modelling Methods In Power Electronics Systems**		
Course Code:	**MEE102**	**CIE MARKS**	**50**
L:T:P :	**(3:0:1)**	**SEE MARKS**	**100**
Credits:	**04**	**EXAM HOURS**	**03**
UNIT - 1			
Modeling of Systems: Input-Output relations, differential equations and linearization, state space representation, transfer function representation, modeling of an armature controlled DC Motor, poles and zeroes circuit averaging method of modeling approach for switched power electronic circuits.			**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, Demonstration through simulation.		
UNIT - 2			
Control System Essentials: Representation of system in digital domain, Z transform, Mapping between s- plane and Z- plane, Digital filter, Continuous to Discrete domain conversion, Hold equivalence, measures for performance parameters,			**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, Demonstration through simulation.		
UNIT - 3			
Digital Controller Design: Controller design techniques, Bode diagram method, PID controller, state space method. Voltage control, **C**ontrolling current-Unity Power Factor converter, Unity Power Factor converter, Single phase Front End Converter.			**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, Demonstration through simulation, Problem based learning.		
UNIT –4			
Discrete Computation Essentials: Numeric formats, fixed -point numeric format, floating -point numeric format, tracking the base point in the fixed point system, addition of numbers, subtraction of numbers, multiplication of numbers, normalization and scaling, multiplication algorithm. **Implementation examples**: PI controller, sine and cosine, pulse width modulation			**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.		
UNIT- 5			

Power Electronics in Power Systems: Modeling of HVDC transmission system – Brief review of HVDC system, modelling of converter topologies and controllers.	**08Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Demonstration through simulation.

Lab experiments:

- Modeling of a circuit using Differential equations, state space representation and transfer function representation.
- Modeling of an armature controlled DC motor
- Modeling of a Buck converter – large signal, small signal and average modeling
- Controllers design techniques – PI controller, Bode analysis of controller
- PID controllers for voltage and current control
- Design and Simulation of a Unity Power Factor converter
- Modeling of a HVDC system

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

CO1	Apply mathematical skills and modelling methods to represent a physical system.
CO2	Design, develop and analyze the performance of digital controllers and various Power Electronics circuits.
CO3	Model and develop Power Electronics circuits using modern engineering software tools and prepare a technical report.

Choice:

Textbooks:

Sl No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Power Electronics Converters, Applications, and design	Ned Mohan, Tore M. Undeland, William P. Robbins	John Wiley & Sons	3rd Edition, 2009
2	Power Electronics Essentials and Applications	L. Umanand	John Wiley & Sons	1st Edition, 2009.
3	HVDC Power Transmission Sysytems	HVDC transmission system	New Age International Publishers	3rd Edition, 2015

Electrical & Electronics Engineering

Course Title:	**Power Devices and Solid State Power Converters**		
Course Code:	**MEE103**	**CIE MARKS**	**50**
L:T:P :	**(3:0:0)**	**SEE MARKS**	**100**
Credits:	**03**	**EXAM HOURS**	**03**

UNIT - 1	
Review of Power Semiconductor Devices: **Power Diodes:** Basic Structure and I-V Characteristics, Switching Characteristics, Turn on Transient. Turn off Transient. Reverse Recovery Transient. **MOSFETs** - 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 Turn off time. Switching Losses. Effect of Reverse Recovery Transients on Switching Stresses and Losses **Insulated Gate Bipolar Transistors (IGBTs):** Basic Structure and Operation. Latch up IGBT Switching Characteristics, IGBT Turn on Transient. IGBT Turn off Transient- Current Tailing. FBSOA and RBSOA Curves. Switching Losses	**08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Demonstration through simulation, Problem based learning.

UNIT - 2	
Thyristors: - Basic Structure. V-I Characteristics. Turn on Process. On State operation. Turn off process, Switching Characteristics **Introduction to Wide Band Gap Devices:** Structure, Operation and characteristics of SiC MOSFETS **Diode Rectifiers:** Half wave rectifier with R load, R-L load and capacitor filter, single phase full wave rectifier with R load, RL load, Capacitor filter, LC filter, Effect of source inductance, three-phase rectifier	**08Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Demonstration through simulation, Problem based learning.

UNIT - 3	
Controlled Converters: Single phase full converter with R load, RL load (continuous and discontinuous current modes), three phase fully controlled converter **Power factor improvement methods:** Power factor improvement in controlled converters **DC-DC Converters:** Principle of operation, analysis of step-down and step-up converters, classification of chopper & chopper circuit design.	**08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Demonstration through simulation, Problem based learning.

UNIT –4

Inverters: Principle of operation, performance parameters, single phase bridge inverters and three phase inverters. Voltage Control of Single Phase Inverters: Single/multiple, pulse/SPWM/ modified SPWM methods, voltage control of three phase inverter, SPWM/third harmonic PWM, harmonic reduction, current source inverter, comparison between VSI & CSI.	**08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT- 5

Multilevel Inverters: Introduction, types, diode clamped, flying capacitor, cascaded multilevel inverters, features & applications. **AC-AC Converters:** AC Voltage Controllers, Cyclo-converters	**08 Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning, self-study activity based on IEEE papers

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

CO1	Apply knowledge of physics of semiconductor and electronic devices to develop Describe, analyze characteristics and compare various types of power semiconductor devices to control power electronic systems.
CO2	Interpret the working principles of AC- DC, DC-DC, AC-AC and DC-AC converters
CO3	Analyze and evaluate the performance of AC- DC, DC-DC, AC-AC and DC-AC converters in all the modes of operation.
CO4	Identify and design different power converters for specific applications

Choice:

Textbooks:

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Power Electronics Converters, Applications, and Design	Ned Mohan, Tore M. Undeland, William P. Robbins	Wiley India Pvt Ltd,	3rd Edition, 2011
2	Power Electronics: Circuits Devices and Applications	Rashid M.H	Pearson	3rd Edition, 2011.

3	Semiconductor Device Modeling with Spice,	G. Massobrio, P. Antognetti	McGraw-Hill	2nd Edition, 2010
4	Power Semiconductor Devices	B. Jayant Baliga	PWS Publication	1st Edition, 1995
5	Microelectronic Circuits	Sedra/Smith	The Oxford Series in Electrical and Computer Engineering	6th Edition, 2009
Reference Books				
1	Power Converter,	William Shepherd, Li Zhang	Circuits Marcel Dekker Inc.	2004
2	Modern Power Electronics & AC Drives	B. K. Bose	PHI	2012

Electrical & Electronics Engineering

Course Title:	**Energy, Ecology and Environment**		
Course Code:	**MEE104**	**CIE MARKS**	**50**
L:T:P :	**(3:0:0)**	**SEE MARKS**	**100**
Credits:	**03**	**EXAM HOURS**	**03**
Course Learning objectives: This course introduces students to environment concerns. Students are expected to learn about environment, factors affecting it, environmental ethics and its protection through lectures, presentations, documentaries and field visits			
UNIT - 1			
Interrelation between energy, ecology and environment. Sun as a source of energy, nature of its radiations. Interrelationship between energy and environment, Sun as a source of energy, nature of its radiation, Biological processes, photosynthesis, Autecology and Synecology.			**08 Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, Demonstration through simulation, Problem based learning.		
UNIT - 2			
Population, Community Ecosystem (wetland, terrestrial, marine). Population, Community Ecosystem(wetland, terrestrial, marine) Food chains, Ecosystem theories.			**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, Demonstration through simulation, Problem based learning.		
UNIT - 3			
Sources of energy, Classification of energy sources. Environmental issues related to harnessing to fossil fuels (coal, oil, natural gas), geothermal, tidal, nuclear energy, solar, wind, hydropower, biomass			**08 Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, Demonstration through simulation, Problem based learning.		
UNIT –4			
Energy flow and nutrient cycling in ecosystem and environmental, Degradation. Air and water pollution.			**08 Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.		

UNIT- 5	
Environmental issues related to harnessing to fossil fuels (coal, oil, natural gas), geothermal, tidal, nuclear energy, solar, wind, hydropower, biomass, Energy flow and nutrient cycling in ecosystems	**08 Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning, self-study activity based on IEEE papers

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

CO1	To apply the knowledge of energy and ecology in the field of power electronics
CO2	To interpret the concept of Ecosystem, energy usage in communities and sources of energy
CO3	To analyse the working of various sources of energy

Choice:

Textbooks:

Sl No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Introduction to Environmental Engineering and Science	G. M. Masters, W. P. Ela	Prentice Hall	2007
2	Air Pollution Control Engineering	D. Nevers	McGraw Hill	2001
3	Instant Notes: Ecology, BIOS	A. Mackenzie, A. S. Ball, S. Virdee	Scientific Publishers Ltd	2001

Reference Books

1	Energy Beyond oil	F. Armstrong, K. Blunde	Oxford University Press	2007
2	Environmental Science	G. T. Miller, Spoolman S	Yolanda Cossio	2010
3	Ecology Principles and Applications	J. L. Chapman, W. J. Reiss	Cambridge University Press	2008

Electrical & Electronics Engineering

Course Title:	**Embedded Controllers for Energy Management**		
Course Code:	**MEE105**	**CIE MARKS**	**50**
L:T:P :	**(3:0:0)**	**SEE MARKS**	**100**
Credits:	**03**	**EXAM HOURS**	**03**
UNIT - 1			
INTRODUCTION: Embedded v/s General Computing System, classification, application of ES. Processor Core of an Embedded System, Memory, I/O Units, Reset, Clock, Timers, WDT, Interrupts Controller, ADC, DAC, Sensors, Data Acquisition System, Kernel, real time and embedded OS, ROM Image Creation from Assembly & Higher Level Languages.			**09Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, case studies.		
UNIT - 2			
Embedded Controllers: ARM - 32 bit Microcontroller: ARM Cortex M3 technologies and applications of ARM, Architecture of ARM Cortex M3, Various Units in the architecture, General Purpose Registers, Special Registers, Exceptions, Interrupts, Stack operation. **Few IEEE Papers AS CASE Studies**			**09Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, case studies.		
UNIT - 3			
Microchip Controller – SAM 4C: General Architecture - Block Diagram & Features, Global Smart meter Architecture, Smart Energy Platform Core – SAM 4C: Functional Diagram & Features, SOC Feature Comparison, SAM 4C S/W Features, Hardware Details, PLC Connectivity. **Few IEEE Papers as CASE Studies**			**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, case studies.		
UNIT –4			
Introduction and Metering For Energy management: Introduction to energy management system, background of metering and measuring, Relationships between parameters-Units of measure-Typical cost factors- Utility meters - Timing of meter disc for kilowatt measurement - Demand meters - Paralleling of current transformers - Instrument transformer burdens-Multitasking solid-state meters - Metering location vs. requirements- Metering techniques.			**07Hrs**
	Chalk and Talk/PPT Presentation, case studies.		

Teaching - Learning Process	

UNIT- 5

Lighting Systems: Concept of lighting systems - The task and the working space -Light sources - Ballasts - Luminaries - Lighting controls-Optimizing lighting energy - Power factor and effect of harmonics on power quality - Cost analysis techniques-Lighting and energy standards.	**09Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, case studies, real-time problems: optimized design

Course outcomes:

At the end of the course the student will be able to:

CO1	Apply the basic concepts to design and analyze an Energy Management System for Domestic and Industrial Loads
CO2	Evaluate and select an Embedded processor for an Energy Management system.
CO3	Present and prepare a technical report for a specific case study.

Choice:

Textbooks:

Sl No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Embedded System Architecture: Programming & Design	Rajkamal	TMH	2010
2	Industrial Energy Conservation, first edition	Reay D.A	Pergamon Press	1977
3	Handbook on Energy Audits and Management	Amit K. Tyagi	TERI	2003

Reference Books

1	Embedded Real Time Systems: Concepts Design and Programming	K.V.K K Prasad	Dreamtech Press New Delhi	2003
2	IEEE Recommended Practice for Energy Management in Industrial and Commercial Facilities, ,.		IEEE	1996
3	Guide to Energy Management, Fifth Edition	Barney L. Capehart, Wayne C. Turner, and William J. Kennedy	The Fairmont Press, Inc	2006

Electrical & Electronics Engineering

Course Title:	**Power Converters Laboratory**		
Course Code:	**MEEL106A**	**CIE MARKS**	**50**
L:T:P :	**(0:0:2)**	**SEE MARKS**	**100**
Credits:	**02**	**EXAM HOURS**	**03**

UNIT - 1

Simulation based Experiments: (MATLAB/LTSpice)

Simulate, analyse and plot waveforms for both CCM and DCM modes of operation for the following circuits

1. Single phase half wave & full wave diode rectifier with R and RL load
2. Single phase half wave & full wave controlled rectifier with R and RL load
3. Three phase half wave & full wave diode rectifier with R and RL load
4. Three phase half wave & full wave controlled rectifier with R and RL load
5. Step-down and Step-up chopper with R and RL load
6. Single phase inverter with R and RL load
7. Three phase inverter with R and RL load

Hardware Experiments

8. Single phase half wave & full wave diode rectifier with R and RL load
9. Single phase half wave & full wave controlled rectifier with R and RL load
10. Three phase half wave & full wave controlled rectifier with R and RL load
11. Step-down and Step-up chopper with R and RL load
12. Single phase inverter with R and RL load
13. Three phase inverter with R and RL load

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

CO1	Conduct simulation studies on single phase and three phase power electronic converter
CO2	Conduct hardware experiments on single phase and three phase power electronic converters
CO3	Prepare and present a technical report and present

Electrical & Electronics Engineering

Course Title:	**Energy Laboratory**		
Course Code:	**MEEL106B**	**CIE MARKS**	**50**
L:T:P :	**(1:0:1)**	**SEE MARKS**	**100**
Credits:	**02**	**EXAM HOURS**	**03**
UNIT - 1			
1. Study of Characteristics of Francis Turbine 2. Characterization of solid fuel (Proximate Analysis) 3. Determination of calorific value of solid fuel 4. Performance study of heat pump system & Thermoelectric Generator and Refrigerator 5. To study the performance and emission characteristics of a spark ignition engine for ethanol/butanolgasoline blend. 6. Fractional distillation of Petroleum 7. Performance of Solar Still & I-V Characteristics a Solar Cell 3, Performance of Photo-voltaic Thermal titles 3, Photovoltaic-Roof Top on Synergy Building 8. To study the performance and emission characteristics of a diesel engine for biodiesel-diesel blend			

Syllabus- Semester II

Course Title:	AC and DC DRIVES		
Course Code:	MEPE201	CIE MARKS	50
L:T:P :	(3:0:1)	SEE MARKS	100
Credits:	04	EXAM HOURS	03
UNIT - 1			
Electric Drives: Introduction – block diagram-classification of electrical drives-choice of electrical drives-fundamental torque equation- components of load torque- steady state stability, Applications in Industry.			**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning, case studies.		
UNIT - 2			
Chopper Fed DC Drives: Single Quadrant, Two Quadrant & Four Quadrant Drives: Problems and Industry Applications.			**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning, case studies.		
UNIT - 3			
Two and Four Quadrant drive: Single-phase and Three- phase dual converter drives, Industry Applications, Different braking methods and closed loop control of DC drives: Closed Loop speed control with inner current loop, PLL Control, Microcomputer based Speed Control.			**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.		
UNIT –4			
AC Drives: Three Phase Voltage Source Inverter, V/F Control, Slip Regulation, Open Loop Control of Induction motor drives and stator and rotor voltage control methods, Current source inverter fed induction motor drives, Slip energy recovery drives, Applications.			**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning, case studies.		
UNIT- 5			

Closed Loop Control of AC Drives: Current control, Brushless DC motor, Stepper motor and Switched reluctance motor drives, Industry Applications of AC drives, Synchronous motor drives – Basic Operation & Applications.	**08Hrs**

Lab experiments:

Experimental/Simulation studies on

- Converter fed separately excited Three Phase DC drives – Speed Control
- Chopper drives (Three Phase) – Speed Control
- Speed control of 3 phase Induction motor
- Chopper/Inverter Circuit design using TL 494 CHIP.
- Chopper/Inverter Circuit design using SG 3524 CHIP.
- Recent IEEE paper review, analysis and simulation study of concept presented in the paper followed by presentation and report submission.

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

CO1	Analyze and choose the appropriate converter topology for different AC-DC drives circuits.
CO2	Develop simulation models for AC-DC drives systems prescribed in the curriculum.
CO3	Apply design tools to conduct experiments, compare and analyze the hardware results with that of simulation results and prepare a technical report.

Choice:

Textbooks:

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Electric Motor Drives	R. Krishanan	PHI	2010

Reference Books

1	High Performance Control of AC Drives	Haitham Abu - Rub, AtifIqbal, Jaroslaw Guzinski	Wiley,	2012
2	Power Electronics, Circuits, Devices & Applications	M.H Rashid	PHI, New Delhi	Third Edition, 2004.

Electrical & Electronics Engineering

Course Title:	Advanced Python Programming		
Course Code:	MEPE212	CIE MARKS	50
L:T:P :	(2:0:1)	SEE MARKS TOTAL MARKS	50 100
Credits:	03	EXAM HOURS	03

PRE-REQUISITES: C Programming

UNIT – 1

Introduction to Python and Computer Programming, Data Types, Variables, Basic Input-Output Operations, Conditional Execution, Loops **05 Hrs**

UNIT – 2

Lists and List Processing, Logical and Bitwise Operations, Tuples, Dictionaries, Functions. **05 Hrs**

UNIT – 3

Modules, OOPs in python: Features of Object Oriented Programming system : Classes, Methods, Objects. **05 Hrs**

UNIT – 4

Files: File Operations, Files and Streams, Creating a File, Reading From a File, Iterating through Files, Seeking, Serialization. **05 Hrs**

UNIT – 5

Database in python: creating database tables through python, Exception handling in databases.
Graphical user interface: Creating a GUI in python, Widget classes, Working with Fonts and Colours, working with Frames, Layout manager, Event handling. **06 Hrs**

UNIT CHOICE: UNIT II AND UNIT III

TEXT BOOKS:

1. Mark Lutz,“ Programming Python”, Prentice Hall India, 7th Edition, 2017
2. Allen Downey, “Think Python”, O'Reilly Media, 1st Edition, 2012
3. Marl Pilgrim, “Dive into Python”, APress Media LLC, 1 st Edition, 2005
4. Paul Gries , Jennifer Campbell, Jason Montojo, “Practical Programming: An Introduction to Computer Science Using Python 3”, Pragmatic Bookshelf, 3rd Edition, 2018
5. M. T Savaliya, R. K. Maurya, G M Magar , “Programming through Python”, Revised Edition, Sybgen Learning India, 2020

Reference books:

1. Advanced Python Programming, Dr. Gabriele Lanaro, Quan Nguyen, SakisKasampalis, Packt Publishing, 2019

2. Mark Lutz, “Learning Python”, McGraw-Hill publication, 2nd Edition, 2010

3. Luciano Ramalho, “Fluent Python”, O'Reilly Media, 1st Edition, 2015

4. Brett Slatkin , “Effective Python: 59 Specific Ways to Write Better Python”, Pearson Education, Inc, 1 st Edition 2015

Electrical & Electronics Engineering

Course outcomes: At the end of the course the student will be:

CO1	Able to understand the basic concepts of Python programming.
CO2	Able to analyze and interpret programs written using Python language.
CO3	Able to apply the concepts of Python programming to solve real world problems.
CO4	Able to design and develop Electrical and Electronic Engineering applications using Python programming concepts.

Lab Programs:

1. Write a program in Python to illustrate usage of Dictionaries and Tuples
2. Write a program in Python to implement various file operations.
3. Write a program in Python to create classes and objects.
4. Write a program in Python to demonstrate the use of functions.
5. Write a Python Program to work with databases in Python to perform operations such as
    a. Connecting to database
    b. Creating and dropping tables
    c. Inserting and updating into tables.
6. Write a Python Program to demonstrate different types of exception handing.
7. Write a GUI Program in Python to design application that demonstrates
    a. Different fonts and colors
    b. Different Layout Managers
    c. Event Handling
8. Write Python Program to create application which uses date and time module in Python.
9. Write a program to Python program to implement concepts of OOP such as
    a. Types of Methods
    b. Inheritance
    c. Polymorphism
10. Write a program to Python program to implement concepts of OOP such as
    a. Abstract methods and classes
    b. Interfaces

<table>
<tr><td>Course Title:</td><td colspan="3">SWITCHED MODE POWER CONVERSION</td></tr>
<tr><td>Course Code:</td><td>MEPE203</td><td>CIE MARKS</td><td>50</td></tr>
<tr><td>L:T:P :</td><td>(3:0:0)</td><td>SEE MARKS</td><td>100</td></tr>
<tr><td>Credits:</td><td>03</td><td>EXAM HOURS</td><td>03</td></tr>
<tr><td colspan="3">UNIT - 1</td><td></td></tr>
<tr><td colspan="3">DC – DC Converters (Non isolated Converters): Principle of operation and analysis of buck converter analysis, inductor current ripple and output voltage ripple, capacitor resistance effect, synchronous rectification, design considerations, buck converter for discontinuous current operation, principle of operation and analysis of buck-boost converter analysis, inductors current ripple and output voltage ripple, design considerations, buckboost converter for discontinuous current operation, principle of operation and analysis of CUK converter , inductor current ripple and output voltage ripple, capacitor resistance effect, design considerations, single ended primary inductance converter (SEPIC).</td><td>08Hrs</td></tr>
<tr><td>Teaching - Learning Process</td><td colspan="3">Chalk and Talk/PPT Presentation, Problem based learning, demonstration through simulation.</td></tr>
<tr><td colspan="3">UNIT - 2</td><td></td></tr>
<tr><td colspan="3">Isolated Converters: Introduction, transformer models, principle of operation and analysis of fly back converter-continuous and discontinuous current mode of operation, design considerations, principle of operation and analysis of forward converter, design considerations, double ended(Two switch) forward converter, principle of operation and analysis of push-pull converter, design considerations, principle of operation and analysis of full bridge and half-bridge DC-DC converters, design considerations, current fed converters, multiple outputs.</td><td>08Hrs</td></tr>
<tr><td>Teaching - Learning Process</td><td colspan="3">Chalk and Talk/PPT Presentation, Problem based learning, demonstration through simulation.</td></tr>
<tr><td colspan="3">UNIT - 3</td><td></td></tr>
<tr><td colspan="3">Control of DC-DC Converter: Modeling of DC-DC converters, power supply control, control loop stability, small signal analysis, switch transfer function, filter transfer function, PWM transfer function, Type-2 error amplifier with compensation, design, Type-3 error amplifier with compensation, design.</td><td>08Hrs</td></tr>
<tr><td>Teaching - Learning Process</td><td colspan="3">Chalk and Talk/PPT Presentation, Problem based learning, demonstration through simulation.</td></tr>
<tr><td colspan="4">UNIT –4</td></tr>
</table>

Resonant Converters: Introduction, resonant switch ZCS converter, principle of operation and analysis, resonant switch ZVS converter, principle of operation and analysis, series resonant inverter, series resonant DCDC converter, parallel resonant DC-DC converter, series- parallel resonant DC-DC converter, resonant converters comparison, resonant DC link converter.	**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning, demonstration through simulation.
UNIT- 5	
Introduction on design of Inductors and transformers: Design of inductor for Buck converter and transformer design for Forward converter as case studies. **Design of power supplies to meet the specifications:** Input filter, bulk capacitor and hold-up time, Limiting inrush current, ESR considerations, EMI considerations	**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning, demonstration through simulation.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

CO1	Illustrate the working of DC-DC converters.
CO2	Analyse and evaluate the performance of basic and derived switched mode power converters.
CO3	Design magnetic components for high frequency SMPS and submit a report.
CO4	Conduct experiment/simulation studies on basic converters and derived converters for CCM/DCM operation and prepare a technical report.

Textbooks:

Sl No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Power Electronics	Daniel W Hart	Tata McGraw Hill	2011
2	Power Electronics – Circuits, Devices and Applications	Rashid M.H	Pearson	3rd Edition, 2011
3	DC-DC Switching Regulator Analysis	D M Mitchel	McGraw-Hill Ltd	1988

Reference Books				
1	Power Electronics Converters, Applications, and Design	Ned Mohan, Tore M. Undeland, William P. Robbins	Wiley India Pvt. Ltd	3rd Edition, 2010
	Design of Magnetic Components for Switched Mode Power Converters	Umanand L and Bhatt S R	New Age International, New Delhi,	2001

Electrical & Electronics Engineering

Course Title:	**PWM Converters and Applications**		
Course Code:	**MEPE204**	**CIE MARKS**	**50**
L:T:P :	**(3:0:0)**	**SEE MARKS**	**100**
Credits:	**03**	**EXAM HOURS**	**03**
UNIT - 1			
AC/DC and DC/AC Power Conversion: Overview of switching devices, Voltage Source Converter (VSC) topologies and overview of VSC applications.			**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation.		
UNIT - 2			
PWM Techniques: Pulse modulation techniques for I – phase bridges, bus clamping PWM, space vector based PWM, advanced PWM techniques.			**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning, simulation demonstration		
UNIT - 3			
Loss Calculations: Practical devices in converters, calculation of switching and conduction losses, compensation for dead time and DC voltage regulation.			**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.		
UNIT –4			
Modeling: Dynamic model of PWM converters; constant V/F induction motor drives; estimation of current ripple and torque ripple in inverter fed drives.			**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.		
UNIT- 5			
Electric Utility application of Converters: STATIC var Compensators, Interconnection of energy storage systems for utility load levelling, wind and small Hydro interconnections			**08Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

CO1	Develop and analyze various PWM Techniques for converters
CO2	Analyze & estimate the various losses in converters**.**
CO3	Model the PWM Converters and Induction motor drives

Choice:

Textbooks:

Sl No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Power Electronics: Converter, Applications and Design	Mohan, Undeland and Robbins	Wiley India	2011
2	Fundamentals of Power Electronics	Erickson RW	Chapman Hall	1997
3	NPTEL lectures by Dr. G. Narayanan, Department of EE, IISc, Bangalore			

Electrical & Electronics Engineering

Course Title:	**POWER ELECTRONICS SYSTEM DESIGN USING ICs**		
Course Code:	**MPE215A**	**CIE MARKS**	**50**
L:T:P :	**(3:0:0)**	**SEE MARKS**	**100**
Credits:	**03**	**EXAM HOURS**	**03**
UNIT - 1			
Switching Regulator Control Circuits: Introduction, isolation techniques of switching regulator systems, PWM systems.			**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, design based learning, case studies.		
UNIT - 2			
Switching Power Supply Ancillary, Supervisory & Peripheral Circuits and Components: Introduction, Opto-couplers, self-biased techniques used in primary side of reference power supplies, Soft/Start in switching power supplies, current limit circuits, over voltage protection, AC line loss detection, Implementation of different gating circuits.			**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, design based learning, case studies.		
UNIT - 3			
Microcontroller and Digital ICs for control of Power Electronic Systems: Microcomputer control of Power Electronic Systems, Digital vs Analog control, Real time control using Microcomputer, Advanced Microprocessor and DSP based control of P. E Systems, ASICs for control, Digital control using FPGA & PLDs, Design of Microprocessor based Control Systems, Application examples.			**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, design based learning, case studies.		
UNIT –4			

Commercial PWM Control ICs and their Applications: TL 494 PWM Control IC, UC 1840 Programmable off line PWM controller, UC 1524 PWM control IC, UC 1846 current mode control IC, UC 1852 resonant mode power supply controller.	**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, design based learning, case studies.
UNIT- 5	
Programmable Logic Controllers (PLC): Basic configuration of a PLC, Programming using Ladder diagram for PLC, program modification, power plant control using PLCs.	**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, design based learning, case studies.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

CO1	Design high performance power electronic circuits using different ICs for various applications.
CO2	Design a Power Electronic System using Microcomputer and DSP Control.
CO3	Think laterally and originally to solve power electronic circuits, and evaluate problems for Practical switching power supplies.

Choice:

Textbooks:

Sl No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Thyristorised Power Controllers	G. K. Dubey, S. R. Doradla, A. Johsi, and R. M. K. Sinha	New Age International	2nd Edition, 2010.
2	High Frequency Switching Power Supplies	Chryssis	MGH	2nd Edition, 1989
3	Unitrode application notes:		http://www.smps.us/Unitrode.html’	

Course Title:	**POWER QUALITY ENHANCEMENT USING CUSTOM POWER DEVICES**		
Course Code:	**MPE215B**	**CIE MARKS**	**50**
L:T:P :	**(3:0:0)**	**SEE MARKS**	**100**
Credits:	**03**	**EXAM HOURS**	**03**
UNIT - 1			
Introduction and Characterization of Electric Power Quality: Electric Power Quality, Power Electronic applications in Power Transmission Systems, Power Electronic applications in Power Distribution Systems. Power Quality terms and Definitions, Power Quality Problems. **Analysis and Conventional Mitigation Methods:** Analysis of Power Outages, Analysis of Unbalance, Analysis of Distortion, Analysis of Voltage Sag, Analysis of Voltage Flicker, Reduced Duration and Customer impact of Outages, Classical Load Balancing Problem, Harmonic Reduction, Voltage Sag or Dip Reduction.			**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.		
UNIT - 2			
Custom Power Devices: Introduction, Utility-Customer Interface, Custom Power Devices, Custom Power Park, Status of Application of CP Devices, Closed-Loop Switching Control, Second and higher order Systems.			**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.		
UNIT - 3			
Solid State Limiting, Breaking and Transferring Devices: Solid State Current Limiter, Solid State Breaker, Issues in Limiting and Switching operations, Solid State Transfer Switch, Sag/Swell Detection Algorithms.			**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.		
UNIT –4			

Generation of Reference Parameter : Generating Reference Currents Using Instantaneous PQ Theory, Generating reference currents using instantaneous Symmetrical Components, General Algorithm for generating reference currents, Generating Reference currents when the Source is Unbalanced.	**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.
UNIT- 5	
Active Power Filters: Series Active Filter, Shunt Active Filter, UPQC Configurations, Right-Shunt UPQC Characteristics, Left-Shunt UPQC Characteristics, Structure and Control of Right-Shunt UPQC, Structure and Control of Left-Shunt UPQC.	**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

CO1	Analyze the Power quality issues and concerns of the country.
CO2	Identify the type of Power quality problems with reference to IEEE/IET standards.
CO3	Analyze, evaluate and realize the control techniques for power quality problems.

Choice:

Textbooks:

Sl No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Power Quality Enhancement Using Custom Power Devices	Arindam Ghosh et.al	Kluwer Academic Publishers	2002
2	Understanding Power Quality Problems, Voltage Sags and Interruptions	Math H J Bollen	Wiley India	2011
3	Electrical Power Systems Quality	Roger C Dugan, et.al	TMH	3rd Edition, 2012

4	Electric Power Quality	G T Heydt	Stars in Circle Publications	1991
Reference Books				
1	Power Quality in Power System and Electrical Machines	Ewald F Fuchs, et. el	Academic Press, Elsevier	2009
2	Power Quality	C. Shankaran	CRC Press	2013
	Power Quality in Power System and Electrical Machines	Ewald F Fuchs, et. el	Academic Press, Elsevier	2009

Course Title:	**ADVANCED CONTROL SYSTEM**		
Course Code:	**MPE215C**	**CIE MARKS**	**50**
L:T:P :	**(3:0:0)**	**SEE MARKS**	**100**
Credits:	**03**	**EXAM HOURS**	**03**
UNIT - 1			
Digital Control Systems: Review of difference equations and Z - transforms, Z- transfer function (Pulse transfer function), Z - Transforms analysis, sampled data systems.			**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.		
UNIT - 2			
Stability analysis (Jury's Stability Test and Bilinear Transformation), pulse transfer functions and different configurations for closed loop discrete-time control systems.			**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.		
UNIT - 3			
Modern Control Theory: State model for continuous time and discrete time systems, solutions of state equations (for both continuous and discrete systems), concepts of controllability and observability (for both continuous and discrete systems), pole placement by state feedback (for both continuous and discrete systems), full order and reduced order observes (for both continuous and discrete systems), dead beat control by state feedback.			**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.		
UNIT –4			
Optimal control problems using state variable approach, state regulator and output regulator, concepts of model reference control systems, adaptive control systems and design.			**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.		
UNIT- 5			
Non Linear Control Systems: Common nonlinearities, singular points, stability of nonlinear systems - phase plane analysis and describing function analysis, Lyapunov's stability criterion, Popov's criterion.			**08Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

CO1	Create state models for continuous and discrete time systems
CO2	Identify appropriate techniques to analyze both continuous and discrete systems for controllability and observability
CO3	Apply relevant concepts to design continuous and discrete systems with state feedback to meet the specifications.

Choice:

Textbooks:

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Modern Control Engineering	Ogata. K	PHI	5th Edition, 2010.
2	Discrete Time Control Systems	Ogata K	PHI	2nd Edition, 2011
3	Control Systems Engineering	Nagarath and Gopal	New Age International Publishers	2012
4	Modem Control System Theory	M Gopal	New Age International	2011

Reference Books

1	Digital Control & State Variable Methods	M. Gopal	TMH	2011

Electrical & Electronics Engineering

Course Title:	**HVDC & FACTS**		
Course Code:	**MEPE216A**	**CIE MARKS**	**50**
L:T:P :	**(2:1:0)**	**SEE MARKS**	**100**
Credits:	**03**	**EXAM HOURS**	**03**
UNIT - 1			
Introduction: Basics of power transmission networks - control of power flow in AC - transmission line- flexible AC transmission system controllers – application of FACTS controllers in distribution systems. Analysis of uncompensated AC Line – passive reactive power compensation - compensation by a series capacitor connected at the midpoint of the line; shunt compensation connected at the midpoint of the line; comparison between series and shunt capacitor. **Static Var Compensator:** Analysis of SVC - Configuration of SVC- SVC Controller			**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation		
UNIT - 2			
Static Synchronous Compensator (STATCOM): Introduction - principle of operation of STATCOM - a simplified analysis of a three phase six pulse STATCOM; multi-pulse converters control of type I Converters - Multilevel Voltage Source Converters; Applications of STATCOM. **Unified Power Flow Controller (UPFC)** – Introduction, Operation of a UPFC, Control of series and shunt converters.			**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, Demonstration through simulation.		
UNIT - 3			
Custom Power Devices: Introduction, Active filters. **Dynamic Voltage Restorer:** Introduction, Dynamic voltage restoration, Open loop controller for DVR. **Load Compensation and DSTATCOM:** Introduction, Compensation using DSTATCOM for a three phase three wire system, Expression for current and power components using Phase coordinates.			**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation		

UNIT –4		
DC Power Transmission Technology: Introduction, comparison with AC transmission, application of DC transmission, description of DC transmission system, modern trends in DC transmission, operating problems. **HVDC Converters:** Analysis of 6 pulse Graetz bridge converter without overlap, effect of smoothing reactor, Analysis of 6 pulse converter in two and three, and three and four valve conduction modes, Analysis of a twelve pulse converter. **Voltage sourced converter based HVDC:** Two and Three level voltage source converters, Pulse Width Modulation, HVDC transmission based on Voltage Source Converters.		**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, Demonstration through simulation.	
UNIT- 5		
Converter and HVDC system control: Principles of DC link control, converter control characteristics, firing angle control, current and extinction angle control, Power control, Control of Voltage Source Converter. **Harmonics and filters:** Characteristics and Non characteristics harmonics (Excluding derivation), Design of AC filters: criteria of design, single tuned passive AC filter, passive DC filters. **Multi Terminal DC Systems:** Introduction, applications, types. Basic concepts of Multi-infeed DC systems		**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation	

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

CO1	Develop shunt, series compensators for a transmission and distribution system
CO2	Design various types of converters, controllers and filters for HVDC systems and FACTS.
CO3	Analyze the effects of FACTS controllers on Transmission and Distribution systems.

Choice:

Textbooks:

Electrical & Electronics Engineering

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems	Narain G Hingorani and L. Gyugyi	Wiley India	2011
2	Direct Current Transmission	E.W. Kimbark	Wiley Inter-Science, London	Vol.1, 2006.
3	Multilevel converters for Industrial applications	Sergio Alberto Gonzalez Santiago Andres Verne Maria Ines Valla (z-lib.org)		

Electrical & Electronics Engineering

Course Title:	**RENEWABLE ENERGY & SOLAR PHOTOVOLTAICS SYSTEM**		
Course Code:	**MPE216B**	**CIE MARKS**	**50**
L:T:P :	**(2:1:0)**	**SEE MARKS**	**100**
Credits:	**03**	**EXAM HOURS**	**03**
UNIT - 1			
Introduction: Energy sources and their availability, commercial or conventional energy sources- thermal, hydro and nuclear, veri energy sources, Concept of co-generation, prospects of renewable energy sources.			**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, case studies.		
UNIT - 2			
Physics of Photovoltaic Systems: Review of diodes, construction, p-n junction, solar cell manufacturing process, photo voltaic effect, equivalent circuit model of PV cells, characteristic of diode, I-V and P-V characteristics, solar cell efficiency, fill factor, shading effect on cell and module, effect of temperature on PV cell characteristics, classification of solar cells.			**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning, case studies		
UNIT - 3			
Solar energy conversion and solar thermal: Solar radiation and measurements, solar constant, basic sun earth angles-definitions and their representation, solar thermal system, physical principles of the conversion of solar radiation into heat, flat plate collectors: construction, principle of operation and applications.			**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning, case studies		
UNIT –4			
Solar electric system: Basics of converters, simplified model of battery, Charge controllers, Maximum power point tracking, design of roof top solar PV systems, inverter types and plant design, standalone photo voltaic systems, economic analysis of PV systems.			**08Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning, case studies

UNIT- 5

Application of solar energy and photovoltaic: Solar water pumping system, solar water heating, rural electrification, grid integration, different topologies for single phase and three phase grid integration, future developments.	**08Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning, case studies

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

CO1	Acquire in depth knowledge about different types of renewable & non-renewable sources, the physics of photovoltaic systems, fabrication of solar photovoltaic system, application of solar energy system, MPPT concept and grid integration.
CO2	Apply knowledge of mathematics to solve problems related to semiconductor physics, solar radiation, basic sun earth angles, and economic aspects of PV systems. Design of charge controller, cells & modules for roof top PV systems.
CO3	Prepare and present technical reports about different renewable and non-renewable energy sources.

Choice:

Textbooks:

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Non-Conventional Energy Sources	G.D. Rai	Khanna publishers.	
2	Solar Cells from Basics to Advanced Systems	Chenming Hu and R.M. White	McGraw Hill Book Co.	
3	Non-Conventional Energy Resources	B.H. Khan	Tata MsGraw Hill Education Private Limited	

Electrical & Electronics Engineering

CourseTitle:	Advanced Microfabrication & Device Manufacturing		
Course Code:	MPE216C	CIE MARKS	50
L:T:P :	(2:1:0)	SEE MARKS	100
Credits:	03	EXAM HOURS	03
UNIT - 1			
Introduction: Understand the semiconductor manufacturing ecosystem – the difference between design, fabrication, packaging, system manufacturing and product. Understand the advantages of microfabrication and scaling.			08Hrs
Teaching - Learning Process	Chalk and Talk/PPT Presentation.		
UNIT - 2			
Basics of few semiconductor devices: Construction, working and basic characteristics of MOSFETs, and CMOS FinFETs.			08Hrs
Teaching - Learning Process	Chalk and Talk/PPT Presentation.		
UNIT - 3			
Micro fabrication processes: Manufacturing process from SiO2 to the wafer, Wafer modification: doping, diffusion, implantation, native-oxide (SiO2) growth, Deposition: CVD, ALD, PVD, electroplating, Etch: Wafer RCA cleaning, wet etch, dry etch, isotropic versus anisotropic etch. Basics of lithography, resolution limit, evolution from i-line to EUV, multiple patterning (SADP and SAQP).			08Hrs
Teaching - Learning Process	Chalk and Talk/PPT Presentation.		
UNIT –4			
Module-level understanding of advanced CMOS FinFET process I: Isolation module: Advantages and challenges of STI versus LOCOS, Device architecture: Planar to FinFET, use of SiGe and strain, Gate module: SiO2 versus Hi-k dielectrics, polysilicon versus metal gate, gate-first versus gate-last, integration challenges of replacement metal gate, Well & junction module: Basics of implantation, source-drain and well implants, other implants.			08Hrs
Teaching - Learning Process	Chalk and Talk/PPT Presentation.		
UNIT- 5			

Module-level understanding of advanced CMOS FinFET process II: Contact module: contact resistance issues of simple metal-silicon contact, metal silicides, salicidation, evolution from Ti to Co to Ni silicide, Interconnect module: Need for multiple metal layers, RC delay, challenge of electromigration, evolution from Al vs Cu, Damascene and dual-Damascene process, W plugs and via, Intermediate dielectric: Need for ILD, low-k due to RC delay, SiO2 to SiOF to SiOC to porous SiOC, material and integration challenges.	**08Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

CO1	Acquire in depth knowledge about different micro fabrication processes like doping, diffusion, implantation, etching etc.
CO2	Acquire in depth knowledge on Module level design of advanced CMOS Process.
CO3	Apply knowledge to fabricate advanced CMOS device using SIMulator 3D

Choice:

Textbooks:

Sl No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	, "System Verilog for Verification – A guide to learning the Test bench language features", ,	Chris Spear	Springer Publications Second Edition	2010.
2	System Verilog for Design- A guide to using system Verilog for Hardware design and modelling	Stuart Sutherland, Simon Davidmann, Peter Flake,	Springer Publications Second Edition	2006

Electrical & Electronics Engineering

Course Title:	**SMPC Laboratory**		
Course Code:	**MEPEL207**	**CIE MARKS**	**50**
L:T:P :	**(0:0:2)**	**SEE MARKS**	**100**
Credits:	**02**	**EXAM HOURS**	**03**

Experimental/Simulation studies on

- Buck converter
- Boost converter
- Buck/Boost converter for CCM & DCM mode
- Flyback and forward converter
  - Resonant converter

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

CO1	Conduct simulation studies on switched mode power converters
CO2	Conduct hardware experiments on switched mode power converters
CO3	Prepare and present a technical report and present

Electrical & Electronics Engineering

Course Title:	**KiCAD Software**		
Course Code:	**24MEPE258A**	**CIE MARKS**	**50**
L:T:P :	**(0:0:1)**	**SEE MARKS**	**100**
Credits:	**01**	**EXAM HOURS**	**03**

Syllabus:

1. Introduction to KiCad
2. KiCad Workflow overview, Forward and backward annotation,
3. Draw electronic schematics, Bus connections in KiCad,
4. Layout printed circuit boards Using Pcbnew, Generate Gerber files Using GerbView,
5. Make schematic components in KiCad, Export, import and modify library, Make schematic components with quicklib, make a high pin count schematic component, Make component Using Footprint Editor.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

CO1	To familiarize KiCAD software for circuit rig up and simulation
CO2	To analyse electrical circuits using KiCAD software
CO3	To design various electrical circuit and construct PCB layout

Electrical & Electronics Engineering

Course Title	ELECTRIC VEHICLES		
Course Code	MPE311A	CIE MARKS	50
Credits	03	SEE MARKS	100
L–T-P	(3:0:0)	EXAM HOURS	03

UNIT - 1

Electric Propulsion: EV consideration, DC motor drives and speed control, Induction motor drives, Permanent Magnet Motor Drives, Switch Reluctance Motor drives for Electric Vehicles, Configuration and control of Drives.
08 Hrs

UNIT - 2

Power Electronics in HEV: Rectifiers used in HEV, DC-DC converters used in HEV, PWM Rectifier in HEV, EV and PHEV battery chargers, Thermal management of HEV power electronics
08 Hrs

UNIT - 3

Energy Storage: Introduction to Battery Parameters, Types of batteries, Li-Ion battery cells, SoH and SoC estimation, battery pack development for a given vehicle specification, Battery Management System (BMS) Design **08 Hrs**

UNIT - 4

Modeling and control: Dynamic model of PWM converters; constant V/F induction motor drives; estimation of current ripple and torque ripple in inverter fed drives.

08 Hrs

UNIT - 5

Renewable Energy for EV applications, Solar Powered Electric Vehicle Charging Station - Calculation and Selection - Components of Charging Station - Earth protection system for charging stations - Requirement to prevent fire for EVs Charging Stations. Basic charging Block Diagram of Charger - Difference between Slow charger and fast charger **08 Hrs**

Course outcomes (Course Skill Set):
At the end of the course the student will be able to:

CO1 Estimate and analyze the performance parameters, power converters & machines used in EVs and the energy storage systems
CO2 Choose and design suitable power electronic converter and various types of electric drive systems suitable for electric vehicle operation.
CO3 Design battery-operated hybrid electric vehicle for a given specification.

Textbooks:

1. Hybrid Electric Vehicles, Principles and Applications with Practical Perspectives- Chris Mi, M. Abdul Masrur, David Wenzhong Gao, Wiley
2. Hybrid Electric and Fuel Cell Vehicles; Fundamentals Theory and Design-

Mehrdad Ehsani, Yimin CRC Press Gao, Ali Emadi, “Modern Electric, Second Edition.

3. Electric and Hybrid Vehicles-Design Fundamentals- Iqbal Husain, CRC Press
4. Fundamentals of Electric vehicles: Technology & Economics, NPTEL Course

Electrical & Electronics Engineering

Course Title:	**Modelling of Electrical Machines**		
Course Code:	MPE311B	**CIE MARKS**	**50**
L:T:P :	**(3:0:0)**	**SEE MARKS**	**100**
Credits:	**03**	**EXAM HOURS**	**03**
UNIT - 1			
Basic Concepts of Modeling: Basic two pole machine representation of commutator machines, 3-phase synchronous machine with and without damper bar and 3-phase induction machine, Kron's primitive machine-voltage, current and torque equations.			**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.		
UNIT - 2			
DC Machine Modeling: Mathematical model of separately excited DC motor-steady state and transient state analysis, sudden application of inertia load, transfer function of separately excited DC motor, mathematical model of dc series motor, shunt motor, linearization techniques for small perturbations.			**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.		
UNIT - 3			
Reference Frame Theory: Real time model of a two phase induction machine, transformation to obtain constant matrices, three phase to two phase transformation, power equivalence. **Dynamic Modeling of Three Phase Induction Machine:** Generalized model in arbitrary frame, electromagnetic torque, deviation of commonly used induction motor models-stator reference frames model, rotor reference frames model, synchronously rotating reference frames model, equations in flux linkages, per unit model, dynamic simulation.			**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.		
UNIT –4			
Small Signal Equations of the Induction Machine: Derivation of small signal equations of induction machine, space phasor model, DQ flux linkages model derivation, control principle of the induction motor.			**08Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT- 5

Modeling of Synchronous Machines: Introduction, voltage equations and torque equation in machine variables, stator voltage equations in arbitrary and rotor reference frame variables, Park's equations, torque equations in substitute variables, rotor angle and angle between rotors, per unit system, analysis of steady state operation.	**08Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

CO1	Apply basic concepts of modeling for DC Machines, three phase induction machine and synchronous machines.
CO2	Model a single phase & three phase transformers, autotransformers and transmission line.
CO3	Carry out the dynamic performance analysis of synchronous machines.

Choice:

Textbooks:

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Generalized Theory of Electrical Machines	P.S.Bimbra	Khanna Publications	5th Edition, 1995
2	Electric Motor Drives - Modeling, Analysis & Control	R. Krishnan	PHI Learning Private Ltd	2009
3	Analysis of Electrical Machinery and Drive Systems	P.C.Krause, Oleg Wasynczuk, Scott D. Sudhoff	Wiley (India)	2nd Edition, 2010

4	Power System Analysis	Arthur R Bergen and Vijay Vittal	Pearson	2nd Edition, 2009.
Reference Books				
1	Power System Stability and Control	PrabhaKundur	TMH	2010
2	Dynamic Simulation of Electric Machinery using MATLAB / Simulink	Chee-MunOng	Prentice Hall	1998

Electrical & Electronics Engineering

Course Title:	**Wide Bandgap Devices in Power Electronics systems**		
Course Code:	MPE311C	**CIE MARKS**	**50**
L:T:P :	**(3:0:0)**	**SEE MARKS**	**100**
Credits:	**03**	**EXAM HOURS**	**03**
UNIT - 1			
Introduction to Wide Bandgap (WBG) Devices: - Ideal and Typical Power Device Characteristics Material Properties -Fundamental Properties Energy Band Gap, Intrinsic Carrier Concentration, Junction Built-in Potential, Zero Bias Depletion Width Impact Ionization Coefficients Bulk Electron Mobility Bulk Hole Mobility, Hole Velocity-Field Curve, advantages and challenges in designing converters with wide band gap devices.			**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation.		
UNIT - 2			
Characteristics of WBG Devices: - Turn ON and Turn OFF switching characteristics of WBG devices, The Baliga-Pair (Cascode) Configuration, Voltage Blocking Mode, Forward Conduction Mode, Current Saturation Mode, Switching Characteristics, Fly-Back Diode. **Gate Drivers for Wide Band gap Devices**: - Gate driver requirements, Basic functional block of gate driver, Gate driver design based on device static and dynamic characteristics, Impact of gate resistance, dv/dt and di/dt gate driver protection, Double pulse test protection.			**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation.		
UNIT - 3			
Thermal Management in WBG based Power Converters: - Thermal design aspect in power electronics converter, Heat sources, basics of thermal system modelling, Types of heat sinks- Active, passive and hybrid.			**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation.		
UNIT –4			

High frequency magnetics: - The impact of parasitic inductance and capacitance, magnetic elements and PCB design for high-frequency power converters, and Heat sink design. **PCB Design:** Power circuit design, Driver circuit design, Single layer and Multilayer PCBs, separation of the power circuit and driver circuit, High-frequency power loop optimization.	**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation.

UNIT- 5

WBG Device Applications: - WBG in based AC/DC & DC/AC Power Converters, Automotive Traction Inverters, Boost PFC Converters, Switched Mode Power Amplifiers, Data Centres, Electric Vehicle Applications, and Renewable Applications.	**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

CO1	Apply the knowledge of semiconductor devices into wide band gap devices
CO2	Analyse power electronics systems using wide band gap devices
CO3	Design gate driver circuits, magnetic components and circuit using wide band gap devices

Choice:

Textbooks:

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	GaN Transistors for Efficient Power Conversion	A. Lidow, J. Strydom, M. D. Rooij, D. Reusch	Wiley,	2014, ISBN-13: 978-1118844762

2	Characterization of Wide Bandgap Power Semiconductor Devices	F. Wang, Z. Zhang and E. A. Jones	IET,	ISBN-13: 978-1785614910.
3	Gallium Nitride-enabled High Frequency and High Efficiency Power Conversion	G. Meneghesso, M. Meneghini, E. Zanoni	Springer International Publishing, ISBN: 978-3-319-77993-5.1	
4	Power Electronics	Ned Mohan, Tore M. Undeland, William P. Robbins	John Wiley & Sons, 2003	
5	Gallium Nitride and Silicon Carbide Power Devices	B.J.Baliga	World Scientific Publishing Company (3 Feb. 2017)	
Reference Books				
1	Design of Magnetic Components for Switched Mode Power Converters	. L. Umanand and S. R. Bhat	John Wiley & Sons Australia, Limited, 1992	
2	Digital Control of High-Frequency Switched-Mode Power Converters	L. Corradini, D. Maksimovic, P. Mattavelli, R.Zane	Wiley, ISBN-13: 978-1118935101..	

Electrical & Electronics Engineering

Course Title:	**Advanced Control Techniques to Power Electronics**		
Course Code:	MPE312A	**CIE MARKS**	**50**
L:T:P :	**(3:0:0)**	**SEE MARKS**	**100**
Credits:	**03**	**EXAM HOURS**	**03**
UNIT - 1			
Introduction to state space modeling, modeling of physical systems. Solution to vector differential equations and state transition matrix.			**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.		
UNIT - 2			
Stability analysis of linear systems. Controllability and Observability definitions and Kalman rank conditions. Detectability and Stabilizability, Kalman decomposition State feedback controller design using pole placement.			**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.		
UNIT - 3			
Control of rectifiers. State space modeling of single phase and three phase rectifiers. State feedback controllers and observer design for output voltage regulation for nonlinear loads. Analysis of continuous and discontinuous mode of operation			**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.		
UNIT –4			
Vector control of three-phase AC/DC front-end converter, design of inner and outer control loop, Hysteresis control, control of three phase motor with single phase inverter			**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.		
UNIT- 5			
Overview of control techniques for grid connected converters under unbalanced grid voltage			

conditions, control of grid converters under grid faults, control structures for unbalanced current injection, power control under unbalanced grid condition, flexible power control with current limitation.	**08Hrs**

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

CO1	Demonstrate various control topologies for power electronic converters.
CO2	Analyze and evaluate the performance of intelligent control topologies converters
CO3	Design the control circuit for power electronic converters using intelligent topologies.

Choice:

Textbooks:

Sl No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Modern Control Engineering,	Ogata, K.	Prentice Hall of India	2010
2	Power Electronics – Circuits, Devices and Applications	Rashid M.H	Pearson	3rd Edition, 2011
3	DC-DC Switching Regulator Analysis	D M Mitchel	McGraw-Hill Ltd	1988

Reference Books

1	Power Electronics Converters, Applications, and Design	Ned Mohan, Tore M. Undeland, William P. Robbins	Wiley India Pvt. Ltd	3rd Edition, 2010

Electrical & Electronics Engineering

Subject	DSP APPLICATIONS TO DRIVES	Sub-code	MPE312B
Credits	**04**	**L-T-P**	**3-0-0**

Course outcomes:

CO1: Identify the functionality of TMS320F28335 DSP Controller.

CO2: Analyze various DSP based DC-DC Converters**.**

CO3: Design and develop DSP based control for various motors.

Unit 1: Introduction To Digital Controller: Digital Signal Controller (A micro-controller with a DSP engine): Comparison of microprocessor and digital signal controller (Block diagram approach), TMS320F2x family,

Architecture of TMS320F28335, Functional Units, pipelining processing of instructions, memory map and code security modules

Unit 2: Numbering Systems: Fixed and Floating point Formats,

Digital Input/Output: GPIO input qualifications and Registers. Clock Modules, System Control and Status Register

Interrupt: Interrupt Sources, Core Interrupt Lines, Maskable Interrupts, Peripheral Interrupt Expansion Unit, Hardware Interrupt Response, CPU Timers

PWM, Capture and Encoder Units: Block Diagram, PWM Time base units, Timer Operating Modes, Time Base Registers, PWM Compare Units, PWM Action Qualification Unit, Dead Band Module, Capture Module, Enhanced QEP Module

Unit 3: ADC Module: ADC Module Overview, Operating Modes, ADC Conversion Time, ADC Register Block

Communication Modules: SCI, SPI, I2C and CAN Modules: Data Formats, Register Sets and Data Transfer

Unit 4: Multi Channel Buffered Serial Port (McBSP): Block Diagram, Data Frame Diagram, Companding Data. Clocking, Transmission and Receiving, Module Registers

Flash Programming: Flash Memory Sectors, Configuration Registers, Flash Programming Procedure

BOOT-ROM and BOOT Loader: Memory Map, Timeline, Boot Loader data stream, Init Boot Assembly Function

Flash Application Program Interface (API): API Fundamentals, General Guidelines, FLASH-API checklist

Unit 5:

Digital Motor Control: Motor Control Principles, Field Oriented Control (FOC), F28335 features for motor control, Example of control of PMSM Motor

Digital Power Supply: Introduction to digital power supply design, driving power stages with PWM waveforms, Controlling power stage with feedback, Tuning the loop for good transient response

REFERENCE BOOKS:

1. Hamid Toliyat and Steven Campbell, "DSP-Based Electromechanical Motion Control", CRC Press, 2011.
2. P.C. Krause, Oleg Wasynczuk, Scott D. Sudhoff, "Analysis of Electrical Machinery and Drive Systems", 2nd Edition, Wiley India,2010
3. Chee-Mun Ong, "Dynamic Simulation of Electric Machinery using MATLAB / Simulink", Prentice Hall, 1998.
4. Technical Reference Manual for TMS320F28335, Texas Instruments, Web link: https://www.ti.com/product/TMS320F28335

Electrical & Electronics Engineering

Subject	Subject	POWER ELCTRONICS IN SMART GRID *	Sub-code	MPE312C
Credits	Credits	03	L-T-P-S	3-0-0-0

Course outcomes:

CO1: Acquire in-depth knowledge about smart grid, power quality problems, high frequency AC power distribution platforms, distributed generation and their integration with existing grid and importance of energy storage system in smart grid.

CO2: Analyze the process of installation and operation of different active power controllers in smart grid network.

CO3: Learn and explain in the form of presentation and report about different components and recent advancement in smart grid.

Introduction: Introduction to smart grid, electricity network, attributes of the smart grid, alternate views of a smart grid. Smart grid components: Smart infrastructure, smart communication, smart management, smart protection, Power quality and EMC, power quality issues, power quality monitoring, legal and organizational regulations, mitigation methods.

High frequency AC Power Distribution Platforms: High frequency in space application, high frequency in telecommunications, high frequency in automotive and motor drives, high frequency in micro grids, future prospects.

Integration of Distributed Generation with hosting grid: Distributed generation past and future, interconnection with a hosting grid, Design of grid integrated solar PV system , Different topologies for single phase and three phase grid integration, integration and interconnection concerns, DC architecture of micro grid, AC Architecture of micro grid, AC-DC architecture of micro grid, Demand side management.

Active Power Controllers: Power injection principle, Static VAR Compensators, Advanced Static Devices, Dynamic static synchronous compensators (D – STATCOMs), Dynamic static synchronous series compensators (D-SSSCs), Dynamic voltage restorer (DVR), AC/AC voltage regulators.

Energy Storage Systems: Introduction, structure of power storage devices, pumped – storage hydroelectricity, compressed air energy storage system, flywheels, battery storage, hydrogen storage, super conducting magnet energy storage, super capacitors, applications of energy storage devices.

REFERENCE BOOKS:

1. Strzelecki Benysek, "Power Electronics in Smart Electrical Energy Networks", Springer, 2008.
2. Clark W Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Side Response", CRC Press, 2009.

Electrical & Electronics Engineering

REFERENCE MATERIAL: NPTEL Lectures on "Introduction to Smart Grid".

*** Option is also provided for Online course of this course from VTU online portal – Syllabus as defined by VTU is followed.**

Electrical & Electronics Engineering

CourseTitle:	**INTERNSHIP 1**		
Course Code:	**MINT384**	**CIE MARKS**	**50**
L:T:P :	**(0:0:3)**	**SEE MARKS**	**100**
Credits:	**03**	**EXAM HOURS**	**03**

Course outcomes:

CO1: Get an insight into the company profile and understand the organizational structure.

CO2: Apply and correlate theory and practice.

CO3: Communicate effectively regarding complex Engineering activities.

CO4: Prepare and present a technical report for the Internship carried out.

Electrical & Electronics Engineering

CourseTitle:	Project phase 1		
Course Code:	MPRJ385	CIE MARKS	50
L:T:P :	(0:0:3)	SEE MARKS	100
Credits:	03	EXAM HOURS	03

Course outcomes:

CO1: Carry out literature survey from reputed journal/conference publications, and formulate a complex engineering problem.

CO2: Apply the fundamental knowledge of mathematics, engineering and Power Electronics principles in design of solutions or system components.

CO3: Identify, Select, and apply a suitable engineering/IT tool in modeling/data interpretation /analytical studies, conduct experiments leading to a logical solution.

CO4: Design a system/system component, simulate and test its functioning as a solution to a complex engineering problem.

CO5: Prepare a technical report and present the work carried out before the expert committee.

CO6: Communicate effectively the results of publication in a reputed journal/conference.

Course Title:	**Soft Switching Techniques for Converters**		
Course Code:	MPE411A	**CIE MARKS**	**50**
L:T:P :	**(3:0:0)**	**SEE MARKS**	**100**
Credits:	**03**	**EXAM HOURS**	**03**
UNIT - 1			
Theoretical Basis of Soft Switching for PWM Full-Bridge Converters: Introduction to soft switching, PWM Strategies for Full-Bridge Converters, PWM strategies, Classification of Soft-Switching PWM Full-Bridge Converters,			**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.		
UNIT - 2			
Zero-Voltage-Switching PWM Full-Bridge Converters: Topologies and Modulation Strategies of ZVS PWM Full-Bridge Converters, Operating Principle of ZVS PWM Full-Bridge Converter, ZVS Achievement of Leading and Lagging Legs, Commutation of the Rectifier Diodes, Simplified Design Procedure and Example			**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.		
UNIT - 3			
Zero-Voltage-Switching PWM Full-Bridge Converters with Auxiliary-Current-Source Networks, Current-Enhancement Principle, Auxiliary Current-Source Network, Operating Principle, Conditions for Achieving ZVS in the Lagging Leg, Parameter Design, Secondary Duty Cycle Loss and Selection of Dead Time for the Drive Signals of the Lagging Leg			**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.		
UNIT – 4			

Zero-Voltage-and-Zero-Current-Switching PWM Full-Bridge Converters: Modulation Strategies and Topologies of a ZVZCS PWM Full-Bridge Converter, Operating Principle, Theoretical Analysis, Simplified Design Procedure and Example	**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.
UNIT- 5	
Zero-Voltage-Switching PWM Full-Bridge Converters with Clamping Diodes, Causes of Voltage Oscillation in the Output Rectifier Diode in ZVS PWM Full-Bridge Converters, Zero-Voltage-Switching PWM Full-Bridge Converters with Current Transformers to Reset the Clamping Diode Currents, Zero-Voltage-Switching PWM Full-Bridge Converters with Current-Doubler Rectifiers	**08Hrs**
Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

CO1	Demonstrate the working of different topologies of soft switching converters.
CO2	Analyze and evaluate the performance of different topologies of soft switching converters
CO3	Design the components for different topologies of soft switching converters.

Choice:

Textbooks:

Sl No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Soft-Switching PWM Full-Bridge Converters: Topologies, Control, and Design	Xinbo Ruan	Science Press, Wiley	
2	Power Electronics – Circuits, Devices and Applications	Rashid M.H	Pearson	3rd Edition, 2011

3	DC-DC Switching Regulator Analysis	D M Mitchel	McGraw-Hill Ltd	1988
Reference Books				
1	Power Electronics Converters, Applications, and Design	Ned Mohan, Tore M. Undeland, William P. Robbins	Wiley India Pvt. Ltd	3rd Edition, 2010
2	Design of Magnetic Components for Switched Mode Power Converters	Umanand L and Bhatt S R	New Age International, New Delhi,	2001

Course Title	ELECTROMAGNETIC COMPATIBILITY		
Course Code	MPE411B	CIE MARKS	50
Credits	03	SEE MARKS	100
L–T-P	(3:0:0)	EXAM HOURS	03

Teaching - Learning Process	Chalk and Talk/PPT Presentation, Problem based learning.

UNIT - 1

Review of EMI Theory: Introduction to EMI, Sources of EMI, noise pick up modes, , EMI Measurements. **08 Hrs**

UNIT - 2

Emissions and Reduction Techniques: EMI reduction techniques in analog circuits, use of co-axial cables and shielding of signal lines, conducted and radiated noise emission in power electronic equipment and reduction techniques. **08 Hrs**

UNIT - 3

EMI in Power Electronics, CM and DM noise, EMI induced failure mechanisms for power electronic equipment, EMC in design of digital circuits **08 Hrs**

UNIT - 4

Electrostatic Discharge: ESD and switching interference reduction, susceptibility aspects of power electronic and digital equipment. **08 Hrs**

UNIT - 5

Design strategies for EMI mitigation, Shielding of electronic equipment **08 Hrs**

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

CO1 Analyze the fundamentals and reasons for noise in Analog electronics, Power electronics and Digital electronics circuit

CO2 Design and develop filters for Analog electronics, Power electronics and Digital circuits for reduction of noise.

CO3 Design the various types of grounding systems and get familiarized with handling electro static discharge systems, testing standards and Regulations.

CO4 Acquire knowledge about testing standards and regulations.

Textbooks:

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Noise Reduction Techniques in Electronic Systems	Otto H. W	John Wiley and Sons	2nd Edition, 1988.
2	Introduction to Electromagnetic Compatibility	Paul Clayton	Wiley Inter science	2nd Edition, 1988.
3	Electrostatic Damage in Electronics Devices and Systems	William B. Greason	John Wiley and Sons	1986
4	Digital Bus Hand Book	Joseph Di Giacomo	McGraw Hill Publishing Company	1990

Reference Books

1	Handbook Series of Electromagnetic Interference and Compatibility	White, R. J	Don White consultants Inc	1981

Electrical & Electronics Engineering

Subject	Battery Storage Systems	Sub-code	MPE 411C
Credits	03	L-T-P-S	3-0-0-0

Course outcomes:

CO1: Acquire in-depth knowledge about the energy storage systems

CO2: Analyze the structure, working and characteristics of various types of energy storage devices.

CO3: Design a particular battery system suitable to a given application.

UNIT 1

Energy storage systems overview - Scope of energy storage, needs and opportunities in energy storage, Technology overview and key disciplines, comparison of time scale of storages and applications, Energy storage in the power and transportation sectors. Importance of energy storage systems in electric vehicles, Current electric vehicle market. **08 Hours**

UNIT 2

Thermal storage system-heat pumps, hot water storage tank, solar thermal collector**, Chemical storage system-** hydrogen, methane etc., concept of chemical storage of solar energy, application of chemical energy storage system, advantages and limitations of chemical energy storage, challenges, and future prospects of chemical storage systems. **08 Hours**

UNIT 3

Electromagnetic storage systems - double layer capacitors with electrostatically charge storage, superconducting magnetic energy storage (SMES), concepts, advantages and limitations of electromagnetic energy storage systems, and future prospects of electrochemical storage systems. **08 Hours**

UNIT 4

Electrochemical storage system

(a) Batteries-Working principle of battery, primary and secondary (flow) batteries, battery performance evaluation methods, major battery chemistries and their voltages- Li-ion battery& Metal hydride battery vs lead-acid battery.

(b) Supercapacitors- Working principle of supercapacitor, types of supercapacitors, cycling and performance characteristics, difference between battery and supercapacitors, Introduction to Hybrid electrochemical supercapacitors

(c) Fuel cell: Operational principle of a fuel cell, types of fuel cells, hybrid fuel cell-battery systems, hybrid fuel cell-supercapacitor systems. **08 Hours**

UNIT 5

Battery design for transportation, Mechanical Design and Packaging of Battery Packs for Electric Vehicles, Advanced Battery-Assisted Quick Charger for Electric Vehicles, Charging Optimization Methods for Lithium-Ion Batteries, Thermal run-away for battery systems, Thermal management of battery systems, State of Charge and State of Health Estimation Over the Battery Lifespan, Recycling of Batteries from Electric Vehicles. **08 Hours**

REFERRENCE BOOKS:

3. Frank S. Barnes and Jonah G. Levine, Large Energy Storage Systems Handbook CRC press (2011).
4. Ralph Zito, Energy storage: A new approach, Wiley (2010)

Electrical & Electronics Engineering

CourseTitle:	**Internship 2**		
Course Code:	**MINT481**	**CIE MARKS**	**50**
L:T:P :	**(0:0:12)**	**SEE MARKS**	**100**
Credits:	**12**	**EXAM HOURS**	**03**

Course outcomes:

CO1: Demonstrate knowledge and understanding of Engineering & Management principles of the company.

CO2: Engage in life-long learning with a commitment to improve knowledge and competence continuously.

CO3: Acquire professional & intellectual integrity and its impact on the society.

CO4: Develop a greater understanding about career options while more clearly defining personal career goals.

CO5: Develop and refine oral and written communication skills.

CO6: Prepare and present a technical report for the Internship carried out.

CO7: Identify areas for future knowledge and skill development

Electrical & Electronics Engineering

CourseTitle:	PROJECT PHASE 2		
Course Code:	MPRJ482	CIE MARKS	50
L:T:P :	(0:0:13)	SEE MARKS	100
Credits:	13	EXAM HOURS	03

Course outcomes:

CO1: Apply the fundamental knowledge of mathematics, engineering and Power Electronics principles in design of solutions or system components.

CO2: Identify, Select, and apply a suitable engineering/IT tool in modeling/data interpretation/analytical studies, conduct experiments leading to a logical solution.

CO3: Design a system/system component, simulate and test its functioning as a solution to a complex engineering problem.

CO4: Develop a prototype model for the simulated work.

CO5: Communicate effectively the work carried out before the expert committee.

CO6: Develop good technical report.

CO7: Publish the results in a reputed International IEEE conference/journal.