ESTD : 1946

2025

OBE & CBCS

CURRICULUM

POSTGRADUATE PROGRAMME ON POWER SYSTEMS AND POWER ELECTRONICS

Department of Electrical & Electronics Engineering (2025 -2027)

THE NATIONAL INSTITUTE OF ENGINEERING

(An Autonomous Institute under Visvesvaraya Technology University, Belagavi)

Recognised by AICTE, New Delhi

Manandavadi Road, Mysuru - 570 008

Phone: 0821 - 4004900, 2481220

Email: info@nie.ac.in; Website: http://www/nie.ac.in

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Department Vision

The department will be an internationally recognized centre of excellence imparting quality education in electrical engineering for the benefit of academia, industry, and society at large.

Department Mission

M1: Impart quality education in Electrical and Electronics Engineering through theory and its applications by dedicated and competent faculty.

M2: Nurture creative thinking and competence leading to innovation and technological growth in the overall ambit of Electrical Engineering

M3: Strengthen industry-institute interaction to inculcate best engineering practices for sustainable development of the society

Programme Educational Objectives

PEO1. Graduates will be competitive and have a successful career in the Electric Power industry and other organizations.

PEO2. Graduates will excel as academicians and contribute to research and development.

PEO3. Graduates will demonstrate leadership qualities with professional standards for sustainable development of society.

Programme Outcomes

Students graduating from M. Tech. - Power Systems of department of Electrical & Electronics Engineering shall have the ability to:

PO1: Independently carry out research/ investigation and development work to solve practical problems in the field of Power Systems and Power Electronics engineering.

PO2: Write and present a substantial technical report/document.

PO3: Demonstrate a degree of mastery in the field of Power Systems and Power Electronics engineering in a technologically changing scenario.

PO4: Demonstrate managerial and financial skills.

PO5: Demonstrate concern for the safety and environment for sustainable development of society

TABLE OF SCHEME AND EXAMINATION FOR I SEMESTER (2025-27 Batch)

Sl. No	Type of Course	Course Code	Course Title	Teaching Department (TD)	Question Paper seting Board (PSB)	Teaching Hrs/Week				Examination				Credits
						L	T	P	S	Duration in	CIE Marks	SEE Marks	Total Marks	
1	BSC	MEPP101	Advanced Engineering Mathematics	EEE	EEE	2	2	0	0	3	50	50	100	3
2	IPCC	MEPP102	Power Electronic Converters and Applications	EEE	EEE	3	0	2	0	3	50	50	100	4
3	PCC	MEPP103	Power System Analysis and Stability	EEE	EEE	3	0	0	0	3	50	50	100	3
4	PCC	MEPP104	Electric Vehicles	EEE	EEE	3	0	0	0	3	50	50	100	3
5	PEC	MEPP105	Professional Elective -I	EEE	EEE	3	0	0	0	3	50	50	100	3
6	PCCL	MEPPL106	Power System Simulation Laboratory	EEE	EEE	0	2	2	0	3	50	50	100	2
7	NCMC	MRMI107	Research Methodology and IPR	Online courses (online.vtu.ac.in)										PP
Total											**300**	**300**	**600**	**18**

Professional Elective -I			
MEPP105A	Smart Grid-Technology and Applications	MEPP105C	Soft Computing Techniques
MEPP105B	Switched Mode Power Conversion	MEPP105D	Battery Management Systems

Note: ***MRMI107-Research Methodology and IPR-*** *None Credit Mandatory Course (NCMC) if students have not studied this course in their undergraduate program then he /she has to take this course at* ***http://online.vtu.ac.in*** *and to qualify for this course is compulsory before completion of the minimum duration of the program (Two years), however, this course will not be considered for vertical progression.*

TABLE OF SCHEME AND EXAMINATION FOR II SEMESTER (2025-27 Batch)

Sl. No	Type of Course	Course Code	Course Title	Teaching Department (TD)	Question Paper setting Board (PSB)	Teaching Hrs/Week				Examination				Credits
						L	T	P	S	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
1	IPCC	MEPP201	Embedded Control Systems	EEE	EEE	3	0	2	0	3	50	50	100	4
2	PCC	MEPP202	Electrical Power Distribution Automation and Control	EEE	EEE	3	0	0	0	3	50	50	100	3
3	PCC	MEPP203	Control of Power Electronic Drives	EEE	EEE	3	0	0	0	3	50	50	100	3
4	PCC	MEPP204	Flexible AC Transmission Systems	EEE	EEE	3	0	0	0	3	50	50	100	3
5	PEC	MEPP205	Professional Elective -II	EEE	EEE	3	0	0	0	3	50	50	100	3
6	PEC	MEPP206	Professional Elective -III	EEE	EEE	3	0	0	0	3	50	50	100	3
7	PCCL	MEPPL207	Drives Laboratory	EEE	EEE	0	2	2	0	3	50	50	100	2
8	AEC/ SEC	PE258A	Ability/Skill Enhancement Course (Offline/Online)	EEE	EEE	0	0	2	0	2	50	50	100	1
Total											**400**	**400**	**800**	**22**

Professional Elective -II	
MEPP205A	Power Quality and Custom Power Devices
MEPP205B	Power Generation Operation and Control
MEPP205C	IoT in Smart Grid
Professional Elective -III	
MEPP206A	Electromagnetic Interference & Compatibility
MEPP206B	Wide Band Gap Devices in Power Electronics
MEPP206C	Control Techniques for Power Converters

Note:

Ability Enhancement Courses (AEC): *These courses are designed to help students enhance their skills in communication, language, and personality development. They also promote a deeper understanding of subjects like social sciences and ethics, culture and human behavior, human rights, and the law.* ***Skill Enhancement Course (SEC):*** *Skill Enhancement Course means a course designed to provide value-based or skill-based knowledge and should contain both theory and lab/hands-on/training/fieldwork. The main purpose of these courses is to provide Students with life skills in the hands-on mode to increase their employability.*
If AEC/SEC courses are ONLINE (MOOCs) courses *suggested by the board of studies concerned. These courses will be made available on* ***www. online.vtu.ac.in****, however online courses are not considered for vertical progression, but qualifying in online courses is mandatory for the award of the degree.*

TABLE OF SCHEME AND EXAMINATION FOR III SEMESTER (2025-27 Batch)

Sl. No	Type of Course	Course Code	Course Title	Teaching Department (TD)	Question Paper setting Board (PSB)	Teaching Hrs/Week				Examination				Credits
						L	T	P	S	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
1	PEC	MEPP311	Professional Elective – IV (MOOC)	EEE	EEE	3	0	0	0	3	100	-	100	3
2	PEC	MEPP312	Professional Elective – V (MOOC)	EEE	EEE	3	0	0	0	3	100	-	100	3
3	INT	MINT383	Research Internship /Industry-Internship leading to project work/ Startup	Two-semester duration, SEE in the IV semester which leads to project work /start-up						3	100	-	100	4
4	PROJ	MPRJ384	Project Phase-I							3	100	-	100	2
Total											**400**		**400**	**12**

TABLE OF SCHEME AND EXAMINATION FOR IV SEMESTER (2025-27 Batch)

Sl. No	Type of Course	Course Code	Course Title	Teaching Department (TD)	Question Paper setting Board (PSB)	Teaching Hrs/Week				Examination				Credits
						L	T	P	S	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
1	IPCC	MINT481	Research Internship /Industry-Internship leading to project work/ Startup	Two-semester duration, SEE in the IV semester which leads to project work /start-up						3	100	100	200	12
2	PCC	MPRJ482	Project Phase-II							3	100	100	200	16
Total											**200**	**200**	**400**	**28**

M.Tech in Power Systems and Power Electronics
(2025-2027)

Syllabus – I Semester

Department of Electrical and Electronics Engineering
The National Institute of Engineering
Mysuru-570 008

Course Code: MEPP101 **Course Name: Advanced Engineering Mathematics**
Credits: 3 **L: T:P:S - 2:0:2:0**
SEE: 50% Marks **CIE: 50% Marks**
SEE Hours: 3 **Max. Marks: 100**

Prerequisites if any	Nil
Learning objectives	1. To have an insight into solving Linear Algebraic Equations and the importance of Eigen values and Eigenvectors in singular value decompositions. 2. To develop proficiency in vector spaces and linear transformations 3. To enable learning concepts of probability theory and their implication in Electrical and Electrical Engineering

Course Outcomes:

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

COs		**Bloom's level**
CO1	Solve system of linear equations using direct and iterative methods.	Analyse
CO2	Understand the fundamentals of vector space and bases in reference totransformations.	Understand
CO3	Use the idea of Eigen values and Eigen vectors for the application of Singular value decomposition.	Apply
CO4	Describe the basic notions of discrete and continuous probability distributions.	Understand
CO5	Find out responses of linear systems using statistical and probability tools.	Analyse

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5
CO1	1	-	3	-	-
CO2	1	-	3	-	-
CO3	1	-	3	-	-
CO4	1	-	3	-	-

Mapping Strength: **Strong– 3** **Medium – 2** **Low – 1**

Course Structure

Module – 1: Linear Algebra		**No. of Lecture Hours**	**No. of Tutorial Hours**
1.1	Solution of Systems of Linear Equations: Direct Methods-Partition method, Croute's Triangularization method.	2	1
1.2	Iterative method- relaxation method	1	1
1.3	Eigen values and Eigen vectors. Bounds on Eigen Values. Jacobi method & Givens method for symmetric matrices.	2	Nil
Module – 2: Vector Space 1			
2.1	Introduction to vectors paces and sub-spaces, definitions column, Null spaces, spaces illustrative example.	2	1
2.2	Linearly independent and dependent vectors-Basis definition and problems.	2	Nil
2.3	Linear transformations definitions. Matrix form of linear Transformations-Illustrative examples	1	1
Module – 3: Vector Space 2			
3.1	Orthogonal vectors and orthogonal bases, Gram-Schmidt Orthogonalization process.	3	1
3.2	QR decomposition, Least square problems, Singular value decomposition. Applications	2	1
Module – 4: Probability distribution functions			
4.1	Review of basic probability theory. Random variables, Probability distributions: Binomial, Poisson, uniform, and Normal (Gaussian) and Erlang distributions	3	1
4.2	Joint probability distribution (discrete and continuous)-Illustrative examples. Independent random variables, covariance and correlation	2	1

Module – 5: Moments & Transformation of random variables			
5.1	Moments, Central moments, Transformation of random variables Characteristic functions, probability generating and moment generating functions-illustrations	3	1
5.2	Engineering applications: Entropy and Source coding.	2	1
	Total No. of Lecture Hours	25	
	Total No. of Tutorial Hours		10

Textbooks

1. David C.Lay et al, **“Linear Algebra and its Applications”,** Pearson, 5th Edition, 2015.
2. M. K. Jain et al**, “Numerical Methods for Scientific and Engineering Computation”,** New Age International, 9th Edition, 2014.
3. Scott L. Miller, Donald G.Childers, **“Probability and Random Processes”**, Elsevier 2004

Reference Books

1. Steven C Chapra andRaymond P Canale, **“Numerical methods for Engineers”,** McGrawHill,7th Edition, 2015.
2. B.S. Grewal, **“Higher Engineering Mathematics”,** Khanna Publishers, 44th Edition, 2017
3. E.Kreyszig, **“Advanced Engineering Mathematics”,** Wiley, 10thedition, 2015.

Web links and Video Lectures (e-Resources)

https://nptel.ac.in/
http://nptel.ac.in/courses.php?disciplineId=111
http://www.class-central.com/subject/math(MOOCs)
http://ocw.mit.edu/courses/mathematics/

Course Code: MEPP102 | **Course Name: Power Electronic Converters and Applications**
Credits: 4 | **L: T:P:S - 3:0:2:0**
SEE: 50% Marks | **CIE: 50% Marks**
SEE Hours: 3 | **Max. Marks: 100**

Prerequisites if any	Power Electronics
Learning objectives	1. To have insights on the performance characteristics of line-commutated converters and their applications. 2. To design and simulate DC-DC converters used in solar PV applications. 3. To discuss various inverter topologies and appropriate modulation techniques to optimize power conversion efficiency and minimize harmonic distortion in renewable energy systems. 4. To develop skills to design and simulate complete power conversion chains (AC/DC/AC and DC/AC/DC) for wind power applications. 5. To develop simulation competencies for various power electronic converters using industry-standard tools, and interpret results to validate theoretical concepts in practical applications.

Course Outcomes:

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

COs		**Bloom's level**
CO1	Analyse the performance of Line commutated Converters and DC- DC converters for solar PV	Analyse
CO2	Analyse the performance of Inverters and implement modulation techniques	Analyse
CO3	Describe the operations of AC/DC/AC and DC/AC/DC conversion technologies.	Understand
CO4	Simulate the power Electronics Converters for various applications	Apply

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5
CO1	2	-	3	-	1
CO2	2	-	3	-	1
CO3	2	-	3	-	1
CO4	3	-	3	-	1

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

Module – 1: Line Commutated Converter		**No. of Lecture Hours**	**No. of Tutorial Hours**
1.1	Functional circuit block of Line commutated converter	2	Nil
1.2	Direction of power flow-inverter operation, two quadrant phase-controlled converter for HVDC power link	2	Nil
1.3	Analysis of Midpoint configuration, Analysis of the bridge configuration- Voltage and current ripples on dc side, Commutation and overlap	2	Nil
1.4	Voltage regulation, power factor correction method-VIENNA rectifiers.	2	Nil
Module – 2: DC Converter for Solar PV			
2.1	Introduction to topologies: Unidirectional and Bidirectional Double-input pulse width modulation DC-DC converter.	3	Nil
2.2	Multiple-input buck-boost converter, modes of operation, mathematical Modelling and closed loop control	3	Nil
2.3	Interleaved boost converter, modes of operation and design	2	Nil
Module – 3: Inverters			
3.1	Classifications, Full bridge configuration, operation with PWM	2	Nil
3.2	Voltage and current harmonics in PWM and reduction techniques	3	Nil
3.3	Shaping of output voltage wave form- sinusoidal pulse width modulation (SPWM) and implementation.	3	Nil

Module – 4: Three phase inverter			
4.1	Inverter operation with reverse power flow, Space vector PWM Modulation Techniques	2	Nil
4.2	**Multilevel inverters -** Neutral-Point-Clamped (NPC), Capacitors-clamped (flying capacitors) multilevel inverters and Cascaded H Bridge type multilevel inverters operating principles, switching states.	6	Nil
Module – 5: AC/DC/AC Converters and DC/AC/DC Converters			
5.1	Introduction, AC/DC/AC converters used in wind turbine systems, New AC/DC/AC converters	1	Nil
5.2	AC/DC/AC boost-type converters, Two-level AC/DC/AC ZSI.	1	Nil
5.3	Three- level diode-clamped AC/DC/AC converter, linking a wind turbine system to a utility network.	2	Nil
5.4	DC/AC/DC Converters: Chopper type DC/AC/DC converters	2	Nil
5.5	Switched capacitor DC/AC/DC converters- single stage and three stage.	2	Nil
	Total No. of Lecture Hours	40	
	Total No. of Tutorial Hours		Nil

List of Experiments:

Sl. No.	Experiment	Hands on/ Virtual
1	Study and performance analysis of single phase fully controlled converter fed separately excited DC Motor for continuous current mode.	Hands on
2	Simulation study of buck, boost and buck-boost converter (basic topologies) and analysis of waveforms for continuous current mode (CCM).	Hands on
3	Simulation of closed loop DC -DC Boost Converter using PI controller	Hands on
4	Simulation of Bidirectional DC-DC Converter for Solar PV applications	Hands on
5	Simulation of Interleaved Boost Converter	Hands on
6	Simulation of Single-phase inverter with sinusoidal PWM controller.	Hands on
7	Simulation of Three phase inverter with PWM controller.	Hands on
8	Simulation of Capacitor clamped Multilevel inverters	Hands on
9	Simulation of H bridge multilevel inverters	Hands on
10	Simulation of AC-DC-AC Converter	Hands on

Textbooks

1. Joseph Vithayathil, **"Power Electronics Devices and Circuits",** 2nd edition, Tata- McGraw Hill, 2010.
2. L. Ashok Kumar, S. Albert Alexander, Madhuvanthani Rajendran, **"Power Electronic Converters for Solar Photovoltaic Systems"** Academic Press, Elsevier, 2021

Reference Books:

1. Fang Lin Luo Hong Ye, **"Power Electronics Advanced Conversion Technologies",** 1st edition, CRC Press Taylor & Francis Group, 2018.
2. M.H.Rashid, **"Power Electronics Circuits, Devices & Applications",** 3rd edition, P.H.I. Pearson, New Delhi, 2002.
3. Narayanaswamy P. R. Iyer**, "Power Electronic Converters Interactive Modelling Using Simulink",** CRC Press Taylor & Francis Group, 2018.

Course Code: MEPP103
Credits: 3
SEE: 50% Marks
SEE Hours: 3

Course Name: Power System Analysis and Stability
L: T:P:S - 3:0:0:0
CIE: 50% Marks
Max. Marks: 100

Prerequisites if any	Nil
Learning objectives	1. To apply advanced power system analysis techniques including AC-DC power flow studies to assess grid performance under normal operating conditions. 2. To conduct comprehensive system security assessments by evaluating sensitivity factors and analysing contingency scenarios to determine system security. 3. To analyze system stability through transient and voltage stability studies, identifying critical stability limits.

Course Outcomes:

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

COs		Bloom's level
CO1	Apply Power Flow Techniques on Power Systems.	Apply
CO2	Perform Security analysis on Power systems.	Analyse
CO3	Analyse Transient stability and Voltage stability of Power systems.	Analyse

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5
CO1	3	-	3	-	-
CO2	3	-	3	-	-
CO3	3	-	3	-	-

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

Module – 1: Power Flow Analysis		**No. of Lecture Hours**	**No. of Tutorial Hours**
1.1	DC power flow method, AC-DC power flow analysis	3	Nil
1.2	HVDC system model – governing equations of rectifier and inverter, simultaneous solution algorithm, sequential solution algorithm (numerical problem for calculation of HVDC system only)	3	Nil
1.3	AC-DC power flow analysis using E-Tap and Mi-Power Softwares (simulation exercise).	2	Nil
Module – 2: Power System Security Analysis			
2.1	Linear sensitivity factors, Calculation of GOSF and LOSF	3	Nil
2.2	Contingency analysis using DC model, ATC assessment	3	Nil
2.3	Contingency ranking and selection – MW and voltage security ranking methods.	2	Nil
Module – 3: Power System Stability Problem			
3.1	Rotor angle stability, Voltage stability and voltage collapse, Mid-term and long-term stability	2	Nil
3.2	Classification of stability problems, States of operation and system security, Review of classical methods, Swing equation, Some mathematical preliminaries	3	Nil
3.3	Analysis of steady state stability	3	Nil
Module – 4: Transient Stability			
4.1	Introduction to transient stability and equal-area criterion, Transient stability analysis using explicit integration methods - Euler method and Runge-Kutta method	2	Nil
4.2	Implicit integration method - trapezoidal method (numerical problem for a single generator connected to infinite bus case only)	3	Nil
4.3	Transient stability analysis using MATLAB programming (simulation exercise), Transient Stability Enhancement methods - High speed fault clearing, Reduction of transmission system reactance, Regulated shunt compensation.	3	Nil

Module – 5: Voltage Stability			
5.1	Definition and classification, Mechanism of voltage collapse, Analysis of voltage stability of a two-bus system using PV curve, Factors affecting voltage stability, Voltage security, Voltage security assessment using PV and QV curves	3	Nil
5.2	**Voltage Stability Indicators:** Introduction to voltage stability indicators, Fundamental indicators using PV and QV curves, dE/dV and dQ/dV criteria of voltage stability.	3	Nil
5.3	Load voltage indicator, Voltage stability index, Voltage stability analysis using E-Tap and Mi-Power Softwares (simulation exercise).	2	Nil
	Total No. of Lecture Hours	40	
	Total No. of Tutorial Hours		Nil

Textbooks:

1. Prabha Kundur, **"*Power System Stability and Control*",** Tata McGraw-Hill edition, 2011.
2. A.K. Mukhopadhyay, D.P. Kothari, A. Chakrabarti, **"*An Introduction to Reactive Power Control and Voltage Stability in Power Transmission Systems*",** PHI Publisher, 2010.

Reference Books:

1. K.R. Padiyar, **"*Power System Dynamics Control and Stability*",** 2nd edition, B S Publications, 2004.
2. K N Shubhanga, "***Power System Analysis: A Dynamic Perspective",*** Pearson publications, 2018

Course Code: MEPP104	**Course Name: Electric Vehicles**
Credits: 3	**L: T:P:S - 3:0:0:0**
SEE: 50% Marks	**CIE: 50% Marks**
SEE Hours: 3	**Max. Marks: 100**

Prerequisites if any	Nil
Learning objectives	1. To have an insight into EV architectures and dynamics 2. Developing proficiency in EV propulsion system design by understanding motor selection, power converter modeling and thermal management design. 3. To enable learning energy storage and charging solutions by battery/fuel cell/supercapacitor comparisons, understanding cell-balancing techniques, and charging circuit design.

Course Outcomes:

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

COs		**Bloom's level**
CO1	Design and model the dynamics of electric vehicles.	Analyze
CO2	Design and model Electric Motor and its drive system for EV applications	Analyze
CO3	Identify the suitable hybrid energy storage and charging system for EV application	Apply

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5
CO1	2	-	3	-	1
CO2	2	-	3	-	1
CO3	1	-	3	-	1

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

Module – 1: Introduction to Electric Vehicles		**No. of Lecture Hours**	**No. of Tutorial Hours**
1.1	Electromobility and the Environment, History of Electric Vehicle	2	Nil
1.2	Basic architecture of battery and fuel-cell electric vehicles	2	Nil
1.3	Vehicle load forces: aerodynamic drag, rolling resistance, grading resistance, Mathematical Model of vehicle to describe vehicle performance	2	Nil
1.4	Vehicle acceleration, Traction motor characteristics**,** Drive cycles	2	Nil
Module – 2: EV Motors			
2.1	Introduction to motors suitable for EV applications—Modeling of Induction motor and its characteristics	3	Nil
2.2	Modeling of BLDC Motor, Modeling of PMSM Motor, Modeling of switched Reluctance Motor	3	Nil
2.3	Modeling of Synchronous Reluctance Motor, Thermal modeling of Motors	2	Nil
Module – 2: Power Converters for EV Traction			
2.1	Converter design of High gain DC/DC Converter, design of Low voltage high current Inverter drive	3	Nil
2.2	Design of Multilevel Inverter Drive, Efficiency calculation, Harmonic Analysis	3	Nil
2.3	Thermal modeling of switches	2	Nil
Module – 3: Energy Storage for EV			
3.1	Storage requirements for Electric Vehicles, Battery energy storage, Fuel Cell based energy storage, Super Capacitor based energy storage and Super Magnetic Energy storage (SMES)	3	Nil
3.2	Power pack management systems, Active and passive Cell balancing techniques.	2	Nil
3.3	Hybridization of different energy storage devices, Flywheel based energy storage, compressed air storage systems, super magnetic storage systems.	3	Nil
Module – 5: Charging of EV			

5.1	Charger classifications and standards, selection of AC charging systems, DC charging systems	3	Nil
5.2	Power Electronics for Battery Charging Systems, charging architectures, low power charger circuit, Automotive standard charger circuit	2	Nil
5.3	Conductive battery charging circuit, inductive charging circuit	3	Nil
	Total No. of Lecture Hours	40	
	Total No. of Tutorial Hours		Nil

Textbooks:

1. Iqbal Husain, **"Electric and Hybrid Vehicles Design Fundamentals"**, 2nd Edition, CRC Press Taylor & Francis Group, 2011.
2. Ali Emadi, **"Advanced Electric Drive Vehicles",** CRC Press, 2015

Reference books:

1. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, ***"Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design"***, CRC Press, 2004.
2. K. T. Chau, ***"Electric Vehicle Machines and Drives - Design, Analysis and Application",*** Wiley 2015.
3. John G. Hayes, G. Abas Goodarzi, ***"Electric Powertrain - Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles",*** Wiley, 2018.

Course Code: MEPP105A **Course Name: Smart Grid Technology and Applications**
Credits: 3 **L: T:P:S - 3:0:0:0**
SEE: 50% Marks **CIE: 50% Marks**
SEE Hours: 3 **Max. Marks: 100**

Prerequisites if any	Nil
Learning objectives	1. To provide insight into Smart Grid fundamentals such as Smart Grid evolution, characteristics, and benefits, supplemented with real-world case studies 2. To develop proficiency in decentralized control models 3. To enable learning of smart metering and demand response 4. To foster expertise in Smart Grid security and communication

Course Outcomes:

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

COs		**Bloom's level**
CO1	Discuss the concepts of Smart grid along with Modelling, control and optimization.	Understand
CO2	Describe the aspects of Metering, communication and networking in Smart Grid.	Understand
CO3	Discuss the interaction of Smart Grid with Electric Vehicles.	Understand

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5
CO1	1	-	3	-	-
CO2	1	-	3	-	-
CO3	2	-	3	-	1

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

Module – 1: Introduction to Smart Grid		**No. of Lecture Hours**	**No. of Tutorial Hours**
1.1	Background and history of smart Grid evolution, Definition and characteristics of smart grid.	3	Nil
1.2	Benefits of smart grid, Smart Grid vision and its realisation, Motives behind developing the Smart Grid concept.	3	Nil
1.3	Examples of Smart Grid projects/initiatives, The Smart Grid basic infrastructure.	2	Nil
Module – 2: Smart Grid modelling, control, and optimization			
2.1	Decentralized models for real-time renewable integration in future grid - Introduction to future smart grid.	2	Nil
2.2	Hybrid model of centralized resource management and decentralized grid control, Graph Modelling, General decentralized approaches - Distributed Nodal Approach.	2	Nil
2.3	Distributed Clustering Approach - Tie Set Graph theory and its Application to Distribution Systems.	2	Nil
2.4	Case Study of decentralized Grid Control.	2	Nil
Module – 3: Smart Metering			
3.1	Smart price-based scheduling of flexible residential appliances - Introduction, Modelling operation and price response of flexible residential appliances.	3	Nil
3.2	Measures against demand response concentration, Case Studies - Scheduling of flexible residential appliances in electricity markets.	3	Nil
3.3	Scheduling of flexible residential appliances for management of local distribution networks.	3	Nil
Module – 4: Smart grid communications and networking			

4.1	Cyber Security of Smart Grid State Estimation - Power system state estimation and FDIAs, Stealth attack strategies.	3	Nil
4.2	Defense Mechanisms, Cellular Enabled D2D Communication for Smart Grid Neighbourhood area networks, IEC 61850 communication protocol for smart grid.	3	Nil
4.3	Compression Techniques for Smart Meter data, Hierarchical control of a microgrid.	2	Nil
Module – 5: Smart Grid Interaction with Electric Vehicles			
5.1	Types of electric drive vehicle, Characteristics of energy storage devices/systems, Types, characteristics and benefits of EES systems.	4	Nil
5.2	Types of EV charging systems, smart charging in smart grid, Load management of EVs using Smart-Grid technologies.	3	Nil
	Total No. of Lecture Hours	40	
		Total No. of Tutorial Hours	Nil

Textbooks:

1. Salman K. Salman, ***"Introduction to the Smart Grid Concepts, Technologies and Evolution",*** The Institution of Engineering and Technology, London, United Kingdom, 2017.

2. Hongjian Sun, Nikos Hatziargyriou, ***"Smarter Energy: From Smart Metering to the Smart Grid",*** IET Power and Energy Series, 2016.

Course Code: MEPP105B **Course Name: Switched Mode Power Conversion**
Credits: 3 **L: T:P:S - 3:0:0:0**
SEE: 50% Marks **CIE: 50% Marks**
SEE Hours: 3 **Max. Marks: 100**

Prerequisites if any	Nil
Learning objectives	1. To discuss the analysis and design of isolated DC-DC converters (forward, flyback, bridge topologies), demonstrating solutions to real-world challenges like flux imbalance and leakage inductance through waveform analysis and case studies 2. To train magnetic component design, including ferrite core selection, high-frequency transformer/inductor optimization, and loss calculation methods to mitigate high-frequency effects in SMPS applications 3. To demonstrate SMPS modeling and control techniques, covering state-space averaging, compensator design (Type I-III), and PWM IC implementation (UC3842/SG3525) through simulations and lab experiments

Course Outcomes:
On the successful completion of the course, the student will be able to

COs		**Bloom's level**
CO1	Analyze, compare, and design key isolated DC-DC topologies	Analyse
CO2	Design high-frequency transformers/inductors using ferrite cores, and evaluate the losses	Apply
CO3	Implement isolation techniques and protection mechanisms for SMPS	Apply
CO4	Derive the small-signal models for Buck/Boost converters and design compensators for voltage/current mode control using industry ICs	Analyse

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5
CO1	1	-	3	-	-
CO2	2	-	3	-	1
CO3	2	-	3	-	1
CO4	2	-	3	-	1

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

Module – 1: Isolated DC to DC Converter Topologies		**No. of Lecture Hours**	**No. of Tutorial Hours**
1.1	Need for & advantages of employing a high frequency isolation transformer in SMPS designs, Single-ended Forward Converter, need for tertiary winding, effect of leakage inductance on input-output relation of Forward Converter – Double ended Forward Converter	2	Nil
1.2	Push-Pull DC-DC Converter – Flux Walking Problem and Solution, Effect of leakage inductance on input-output relation	2	Nil
1.3	Half-Bridge DC-DC Converter – Waveforms, Relations, Component Stresses in CCM mode, Selection of Voltage Splitting Capacitors, Flux Walking problem and solution, Full-Bridge DC-DC Converter	2	Nil
1.4	Flyback Converter in CCM – Waveforms and Design Relations for CCM Designs, Effect of Leakage inductance, Passive Voltage Clamp Design	2	Nil
Module – 2: Converter Magnetic Design			
2.1	Ferrite material and its magnetic properties, Ferrite Cores – Ac , Aw , AL and area product of ferrite cores of various shapes	2	Nil
2.2	Design of Inductors with DC Current Bias using air-gapped Ferrite Cores, Output equation of various isolated converters	2	Nil
2.3	Design of high-frequency transformers using Ferrite cores, core selection – winding calculations, winding layout	2	Nil
2.4	Estimation of core loss in Inductor and Transformer designs, Copper loss in Inductors and transformers, Skin effect and Proximity effect	2	Nil

Module – 3: Isolation and Protection Circuits			
3.1	Isolation techniques of switching regulator systems, PWM systems, Optical coupler	2	Nil
3.2	Self-Bias technique used in primary side reference power supplies, Opto-couplers circuit design	3	Nil
3.3	Soft start in switching power supply design, current limit circuits, Overvoltage protection circuits.	3	Nil
Module – 4: Modeling of SMPS Units			
4.1	Small-signal Modeling of Converters for Control Design, the switching function, Switched model of a DC-DC Converter	2	Nil
4.2	Local Average of variables in a fixed-frequency Switched Mode Converter, the duty-ratio function versus duty-ratio	2	Nil
4.3	Local Average Model for a Switched Mode Converter, State Space Average Model	2	Nil
4.4	Solving for steady-state behavior from SSA Model – Linearised SSA Model and Small Signal Transfer Functions for Buck & Boost Converters – Effect of operating point and ESR of Capacitor on small signal transfer functions.	3	Nil
Module – 5: Control of SMPS Units			
5.1	Design of Type-I, Type-2 and Type-3 Compensators for Voltage Mode Control of SMPS based on small-signal transfer functions, Study of SG3525 VMC PWM Control IC	2	Nil
5.2	Current Mode Control - Advantages, Subharmonic Instability, Slope Compensation, Ideal Slope for Slope Compensation, Design of Outer Voltage Control Loop in Current Mode Controlled Converter, Study of UC3842 CMC PWM Control IC	3	Nil
5.3	Principles of One Cycle Control as applied to DC-DC Converters	2	Nil
	Total No. of Lecture Hours	40	
		Total No. of Tutorial Hours	Nil

Textbooks

1. Abraham I Pressman, **"Switching Power Supply Design",** McGraw Hill Publishing Company, 2001
2. George chryssis,**"*High-Freequency Switching Power Supplies: Theory and Design*"** 2nd edition, McGraw-Hill.

Reference Books

1. Robert W. Erickson and Dragan Maksimovic, Fundamentals of Power Electronics, Springer, 2001
2. Keith Billings, Taylor Morey, **"*Switch Mode Power Supply Handbook*",** 3rdedition, McGrawHill, 2011.
3. Umanand L and Bhatt S R, "***Design of Magnetic Components for Switched Mode Power Converters***", New Age International, New Delhi, 2001
4. Mohan, Undeland and Robbins**, "*Power Electronics Converters, Applications and Design*",** 2nd edition, John Wiley**,** 2002.

Course Code: MEPP105C **Course Name: Soft Computing Techniques**
Credits: 3 **L: T:P:S - 3:0:0:0**
SEE: 50% Marks **CIE: 50% Marks**
SEE Hours: 3 **Max. Marks: 100**

Prerequisites if any	Nil
Learning objectives	1. To apply fuzzy logic principles to design membership functions, construct rule bases, and implement Mamdani/Sugeno inference systems for control applications. 2. To develop artificial neural networks using perceptron models and backpropagation algorithms to solve pattern recognition and forecasting problems. 3. To design neuro-fuzzy controllers by integrating neural networks to optimize fuzzy membership functions and scaling parameters through supervised learning methods. 4. To evaluate system performance through computer simulations of fuzzy logic systems, neural networks, and hybrid neuro-fuzzy controllers for engineering applications.

Course Outcomes:
On the successful completion of the course, the student will be able to

COs		**Bloom's level**
CO1	Analyze fuzzy logic systems by constructing membership functions, rule bases, and inference mechanisms to solve engineering problems.	Analyse
CO2	Design neural network architectures using perceptrons, backpropagation, and RBF networks for pattern recognition and forecasting applications.	Apply
CO3	Develop hybrid neuro-fuzzy controllers by integrating neural networks for tuning fuzzy parameters using supervised learning.	Apply
CO4	Validate models through simulations by implementing fuzzy inference systems and ANN training algorithms in computational tools.	Analyse

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5
CO1	2	-	3	-	-
CO2	2	-	3	-	-
CO3	2	-	3	-	-
CO4	2	-	3	-	-

Mapping Strength: **Strong– 3** **Medium – 2** **Low – 1**

Course Structure

Module – 1: Fuzzy Control		**No. of Lecture Hours**	**No. of Tutorial Hours**
1.1	Fuzzy Logic, Fuzzy Sets, Membership Functions - Piecewise Linear MF,	2	Nil
1.2	Nonlinear Smooth MF, Sigmoidal MF, Polynomial or Spline-Based Functions, Irregular Shaped MF, Linguistic Variables,	2	Nil
1.3	Fuzzy If–then Rules, Fuzzy Proposition,	2	Nil
1.4	Methods for Construction of Rule-Base	2	Nil
Module – 2: Fuzzification and Defuzzification:			
2.1	Fuzzification - Inference Mechanism Mamdani Fuzzy Inference,	3	Nil
2.2	Sugeno Fuzzy Inference, Tsukamoto Fuzzy Inference, Defuzzification,	3	Nil
2.3	Defuzzification Methods, Properties of Defuzzification	2	Nil
Module – 3: Artificial Neural Networks			
3.1	Introduction Neural Networks, Biological Neuron, Biological and Artificial Neuron Models, types of Neuron Activation function.	2	Nil
3.2	ANN Architectures, supervised, and unsupervised learning, Perceptron Models, training Algorithms,	2	Nil

3.3	Limitations of the Perceptron Model and Applications,	2	Nil
3.4	Computer based simulation.	2	Nil
Module – 4: ANN Paradigms			
4.1	Multilayer Feed forward Neural Networks - Back propagation Algorithm, Limitations of Back propagation Algorithm, Radial Basis	3	Nil
4.2	Function network structure - covers theorem and the separability of patterns - RBF learning strategies.	3	Nil
4.3	Applications in forecasting and pattern recognition and other engineering problems, Computer based simulation	2	Nil
Module – 5: Neuro-Fuzzy Control			
5.1	Combinations of Neural Networks and Fuzzy Controllers - NN for Correcting FLC, NN for Learning Rules, NN for Determining MFs, NN for Learning/Tuning Scaling Parameters.	3	Nil
5.2	Scaling Parameters of PD-PI Fuzzy Controller, Reducing the Number of Scaling Parameters,	2	Nil
5.3	Neural Network for Tuning Scaling Factors, Backpropagation Learning with Linear Activation Function, Learning with Non-Linear Activation Function.	3	Nil
	Total No. of Tutorial Hours	40	
		Total No. of Tutorial Hours	Nil

Textbooks:

1. Nazmul Siddique, **"Intelligent Control A Hybrid Approach Based on Fuzzy Logic, Neural Networks and Genetic Algorithms",** Springer International Publishing Switzerland, 2014
2. S.Rajasekaran and G.A.V.Pai,"**Neural Networks, Fuzzy Logic & Genetic Algorithms"**, PHI, New Delhi, 2003.

Reference Book*:*

1. Robert J. Schalkoff, "**Artificial Neural Networks"**, Tata McGraw Hill Edition, 2011.

Course Code: MEPP105D **Course Name: Battery Management Systems**
Credits: 3 **L: T:P:S - 3:0:0:0**
SEE: 50% Marks **CIE: 50% Marks**
SEE Hours: 3 **Max. Marks: 100**

Prerequisites if any	Nil
Learning objectives	1. To have insights on the battery fundamentals by modeling Li-ion cells using equivalent-circuit components. 2. To develop skills to implement BMS hardware/software architectures for real-world battery-pack management. 3. To apply model-based algorithms to predict battery states accurately. 4. To understand the power imbalance issues in battery packs and study the implementation of balancing circuits. 5. To understand the power limit estimation techniques of a battery pack

Course Outcomes:
On the successful completion of the course, the student will be able to

COs		**Bloom's level**
CO1	Explain battery terminologies, cell working principles, and equivalent-circuit modeling approaches.	Understand
CO2	Design sensing and control circuits of a BMS for SOC, SOH, and power estimation	Apply
CO3	Apply voltage or current-based methods and Kalman filter for the estimation of state of Charge (SOC) and State of Health (SOH) of a battery pack.	Apply
CO4	Evaluate cell-balancing techniques and power-limit estimation methods	Apply

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5
CO1	-	-	3	-	-
CO2	2	-	3	-	3
CO3	2	-	3	-	3
CO4	1	-	3	-	3

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

Module – 1: Introduction to Battery Technology:		**No. of Lecture Hours**	**No. of Tutorial Hours**
1.1	Introduction to battery terminologies, Working of a cell, Li-ion cells, Equivalent-Circuit Models:	2	Nil
1.2	Open-circuit voltage (OCV), State-of-charge dependence, Equivalent series resistance.	2	Nil
1.3	Diffusion voltages, Warburg impedance, Hysteresis voltages, Enhanced self-correcting cell model.	2	Nil
1.4	Battery testing - Lab tests to determine OCV relationship, Lab tests to determine dynamic relationship.	2	Nil
Module – 2: Battery Management System Design Requirements:			
2.1	Purposes of a battery-management system, Battery-pack sensing of Voltage, Temperature and Current,	3	Nil
2.2	High-voltage contactor control, Isolation sensing, Thermal control, Protection, Charger control, Communication via CAN bus, Log book function,	3	Nil
2.3	State of charge estimation, Energy estimation, Power estimation, SOH estimation.	2	Nil
Module – 3: Battery State of Charge Estimation:			
3.1	Definition of State of Charge, SOC estimation:	3	Nil
3.2	Voltage-based methods to estimate SOC, Current-based method to estimate SOC, Model-based SOC estimation,	3	Nil
3.3	SOC estimation using Linear Kalman Filter.	2	Nil
3.4	Benefits of accurate SOC estimates	Nil	Nil

Module – 4: Battery State of Health Estimation:			
4.1	Effect of ageing on Total capacity and Equivalent Series Resistance,	2	Nil
4.2	Negative-electrode aging, Positive electrode aging,	2	Nil
4.3	Sensitivity of voltage to Equivalent Series Resistance,	2	Nil
4.4	Sensitivity of voltage to total capacity, Estimating SOH parameters via Kalman filters.	2	Nil
Module – 5: Cell Balancing:			
5.1	Causes of imbalance, Balancer design choices, Circuits for balancing: Fixed shunt resistor, Switched shunt resistor.	2	Nil
5.2	Multiple switched capacitors, One switched capacitor, Switched transformer, Shared transformer, Shared bus.	2	Nil
5.3	**Power Limit estimation:** Terminal-voltage-based power limits, Voltage-based power limits, using a simple cell model, Rate limits based on SOC.	2	Nil
5.4	maximum current, and power, Voltage-based power limits, using a full cell model.	2	Nil
	Total No. of Tutorial Hours	40	
		Total No. of Tutorial Hours	

Textbooks:

1. Gregory L. Plett, **“Battery Management Systems, Vol. 1, Battery Modelling”**, Artech House, 2015.
2. Gregory L. Plett, **“Battery Management Systems, Volume II, Equivalent-Circuit Methods”,** Artech House, 2016.

Reference Book:

1. Rui Xiong, **“Battery Management Algorithm for Electric Vehicles”**, Springer publications 2020.

Course Code: MEPPL106 **Course Name: Power System Simulation Laboratory**
Credits: 2 **L: T:P:S - 0:2:2:0**
SEE: 50% Marks **CIE: 50% Marks**
SEE Hours: 3 **Max. Marks: 100**

Prerequisites if any	Nil
Learning objectives	1. To develop skills in power system analysis using ETAP software for AC/DC power flow, short circuit studies, and transient stability assessment. 2. To demonstrate renewable energy integration through hands-on simulation of solar PV systems, energy storage, and wind turbines in modern power grids. 3. To demonstrate feeder/motor/generator protection schemes using laboratory prototypes 4. To develop competencies in modeling of load frequency control and power system stabilizer using hands-on simulation using MATLAB/Simulink.

Course Outcomes:
On the successful completion of the course, the student will be able to

COs		**Bloom's level**
CO1	Perform steady state and transient analysis on Power Systems.	Analyse
CO2	Test and Analyse Relaying algorithms and Power System protection schemes	Analyse
CO3	Analyse Power Electronic Converter for Renewable Energy applications	Understand
CO4	Analyse load frequency control and power system stabilizer in a power system	Apply

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	-	-
CO2	3	2	3	-	1
CO3	2	2	3	-	1
CO4	3	2	3	-	1

Mapping Strength: Strong– 3 Medium – 2 Low – 1

List of Experiments:

Sl. No.	**Experiment**	**Hands on/ Virtual**
1	AC-DC Power flow analysis on 5 Bus system with HVDC transmission line in E-TAP	Hands on
2	Short Circuit studies on a given Power System in E-TAP	Hands on
3	Transient analysis on a Power System in E-TAP	Hands on
4	Simulation and analysis of performance of Solar PV system	Hands on
5	Simulation and analysis of performance of Energy Storage system	Hands on
6	Simulation and analysis of performance of DFIG and PMSG wind energy systems	Hands on
7	Modeling and analysis of automatic load frequency control of single-area power systems using MATLAB	Hands on
8	Modeling and analysis of automatic load frequency control of two-area power systems using MATLAB	Hands on
9	Modeling and analysis of Synchronous Machine with PSS using MATLAB.	Hands on
10	Performance evaluation of Power System stabilizer in a closed loop system.	Hands on
11	Feeder protection schemes using a laboratory prototype of a transmission feeder.	Hands on
12	Motor protection schemes using a laboratory prototype.	Hands on
13	Generator protection schemes using a laboratory prototype.	Hands on

M.Tech in Power Systems and Power Electronics
(2025-2027)

Syllabus – II Semester

Department of Electrical and Electronics Engineering
The National Institute of Engineering
Mysuru-570 008

Course Code: MEPP201 **Course Name: Embedded Control Systems**
Credits: 4 **L:T:P:S - 3:0:2:0**
CIE: 50% Marks **SEE: 50% Marks**
SEE Hours: 3 **Max. Marks: 100**

Prerequisites if any	Nil
Learning objectives	1. To develop proficiency in DSC architectures by teaching the computational building blocks, memory organization, and programming models of TMS320 and NXP platforms, enabling students to configure system registers and implement efficient memory addressing techniques. 2. To enable mastery of DSC peripherals through hands-on training in GPIO, interrupt handling, timer modules, and ADC operations, ensuring students can program control registers and implement real-time I/O management. 3. To cultivate expertise in motor control applications by demonstrating PWM generation, quadrature encoder interfacing, and field-oriented control transformations, guiding students in implementing BLDC/stepper motor drives and space vector PWM techniques using DSCs.

Course Outcomes:
On the successful completion of the course, the student will be able to

COs		**Bloom's level**
CO1	Explain the architectural features, peripherals and interrupt mechanisms of Digital Signal Processor.	Understand
CO2	Describe the capability of event managers of Digital Signal Controller.	Understand
CO3	Derive the mathematical modeling of motors by transformations.	Apply
CO4	Write the C program code for PWM generation, processing of various signals required for power converter control.	Apply

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5
CO1	3	-	3	-	-
CO2	3	-	3	-	-
CO3	3	-	3	-	-
CO4	3	-	3	-	-

Mapping Strength: **Strong– 3** **Medium – 2** **Low – 1**

Course Structure

Module – 1: Architecture of Digital Signal Controller		**No. of Lecture Hours**	**No. of Tutorial Hours**
1.1	Basic Architectural Features, DSP computational Building Blocks, Bus architecture, and memory, Data addressing capabilities, Address generation Module, Programmability and program execution, Speed issues, Features for external interfacing	3	Nil
1.2	Introduction to DSC TMSLF2407/TMS320F28379D/NXP56F8367, Brief introduction to peripherals.	3	Nil
1.3	Introduction to the C2xx DSP core and code generation, components of C2xx DSC core, Mapping external devices to C2xx core and peripheral interface, system configuration register memory, memory addressing modes, programming using C2xx DSC.	2	Nil
Module – 2: I/O, Interrupts, Timers and ADC			
2.1	General purpose I/O overview, multiplexing and general purpose I/O control register, using general purpose I/O ports.	2	Nil
2.2	Introduction to interrupts, Interrupt Hierarchy, Interrupt control registers.	2	Nil
2.3	Over-view of general-purpose timers, Timer control registers and its operation	2	Nil
2.4	ADC overview, operation of ADC.	2	Nil

Module – 3: PWM, Compare & Capture, Quadrature Encoders			
3.1	Overview of the PWM module, PWM Control registers and initializing the PWM Control registers for PWM generation	4	Nil
3.2	Operating principle of Capture and Quadrature modules. Control registers associated with these modules and their initialization and control.	4	Nil
Module – 4: Applications of DSC			
4.1	Interfacing the DSC to Buck-Boost converter	2	Nil
4.2	Principle of operation of stepper motors, stepper motor drive system, Implementation of stepper motor control system using DSC	2	Nil
4.3	Principles of operation of BLDC motor, Implementation of BLDC motor control system using DSC.	3	Nil
Module – 5: Transformations using DSC			
5.1	Clarke's Transformation, Park's transformation, Inverse Clarke's Transformation	2	Nil
5.2	Park's transformation, Transformation between reference frames	2	Nil
5.3	Field oriented control transformations	2	Nil
5.4	Space Vector Pulse Width Modulation, space vector PWM Technique, DSC implementation.	3	Nil
	Total No. of Lecture Hours	40	
		Total No. of Tutorial Hours	Nil

List of Experiments:

Sl. No.	Experiment	Hands on/ Virtual
1	Introduction to DSP kit and interfacing circuits	Hands on
2	PWM Square wave generation for single phase induction motor	Hands on
3	SPWM wave generation for three phase Induction motor	Hands on
4	Initialization of ADC Module for converting analog signal to digital signal	Hands on
5	Initialization of DAC Module for converting digital signal to analog signal	Hands on
6	Generation of Control pulse for stepper motor	Hands on
7	Generation of control pulse for boost and buck converter	Hands on
8	Controlling the traffic light	Hands on
9	Controlling the Elevator movement using GPIO	Hands on
10	Introduction to DSP kit and interfacing circuits	Hands on

Textbooks:

1. Hamid T Toliyat and Steven G Campbell, **"DSP – based Electromechanical motion control",** 1st edition, CRC PRESS, Newyork, Washington D.C
2. Avtar Singh and S. Srinivasan, **"Digital Signal Processing",** Thomson Publications,2004.

Reference Books:

1. TMS320F2837xD Dual-Core Delfino Microcontrollers, Technical Reference Manual (Source: http://ti.com/products (spruhm8h-28379D-Tech Reference Manual))
2. TMS320F2837xD Dual-Core Delfino Microcontrollers, Data sheet (Source: http://ti.com/products (sprs880k-28379D Datasheet))

Course Code: MEPP202 **Course Name: Electrical Power Distribution Automation and Control**
Credits: 3 **L:T:P - 3:0:0**
SEE: 100 Marks **CIE: 50 Marks**
SEE Hours: 3 Hrs **Total Marks: 100**

Prerequisites if any	Nil
Learning objectives	1. To discuss the fundamental control strategies and communication technologies used in Distribution Automation. 2. To develop skills to model key distribution system components such as feeders, reclosers, distributed generators 3. To evaluate challenges in Feeder and Substation Automation and propose solution methodologies 4. To compare the performance of automated versus conventional distribution systems

Course Outcomes:

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

COs		**Bloom's level**
CO1	Discuss the basic control strategies and communication technologies in the Distribution Automation.	Understand
CO2	Model the Distribution system components	Analyse
CO3	Describe the problems and solution methodologies for Feeder and Substation Automation	Understand
CO4	Analyse the performance of distribution system with and without Automation.	Analyse

Mapping with POs

COs	PO1	PO2	PO3	PO4	PO5
CO1	1		3		
CO2	2		3		1
CO3	2		3		
CO4	2		3		

S – Strong (3) M – Medium (2) L – Low (1)

Course Contents and Lecture Schedule

Module – 1: Power delivery system control and Automation		**No. of Lecture Hours**	**No. of Tutorial Hours**
1.1	Introduction, Control hierarchy, Distribution Automation concepts,	2	Nil
1.2	Basic architectures and implementation strategies for distribution automation. Operations environment of distribution networks,	2	Nil
1.3	Basics of real time control system (SCADA)	2	Nil
1.4	Outage management, Decision support applications	2	Nil
Module – 2: Computational Techniques for Distribution System			
2.1	Introduction, Equipment Modelling: Distribution transformer, Photovoltaic systems.	2	Nil
2.2	Component Modelling: Line model	2	Nil
2.3	Shunt capacitor model, Switch model and load models	2	Nil
2.4	Distribution power flow methods, Problems.	2	Nil
Module – 3: Distribution Automation and Control Function			
3.1	State and trends substation automation, Demand side management, Feeder automation -Voltage/Var control, Fault detection,	3	Nil
3.2	Trouble calls, Restoration functions	3	Nil
3.3	Reconfiguration, Power quality assessments -Problem formulation and solution methods.	2	Nil
Module – 4: Intelligent Systems in Distribution Automation			

4.1	Introduction, Artificial Intelligence Methods- Artificial Intelligence Neural Networks, Fuzzy logic systems (FL)	2	Nil
4.2	Neural network-based method	2	Nil
4.3	Genetic algorithms (GA) for Reconfiguration	2	Nil
4.4	Voltage/Var control and Fault Detection control functions, Applications of SSSC, Simulation exercise using MATLAB.	2	Nil
Module – 5: Performance of Distribution system			
5.1	Faults on distribution networks, Performance and basic reliability calculations, Improving the performance without automation	2	Nil
5.2	Improving the reliability of underground and overhead network –design methods,	2	Nil
5.3	Improving the performance with automation, Performance as function of network complexity factor.	2	Nil
5.4	**Communication system for control and automation**: Wire communication, Wireless communications, Distribution automation communications- protocols, Architecture, User interface, Requirements of dimensioning the communication channel.	2	Nil
	Total No. of Lecture Hours	40	
	Total No. of Tutorial Hours		Nil

Textbooks:

1. James Northcote-green and Robert wilson, "***Control and automation of Electrical Power Distribution Systems***", 1st edition, CRC Press Taylor and Francis group, 2013.
2. James A. Momoh, "***Electrical Power Distribution, automation, protection and control***", 1st edition, CRC Press Taylor and Francis group, 2009.

Reference Book:

1. William H. Kersting, "***Distribution System Modelling and Analysis***", 3rd edition, CRC Press, 2001.
2. Biswarup Das, "***Power Distribution Automation***", 1st edition, IET, Power and Energy Series, 2016.

Course Code: MEPP203 **Course Name: Control of Power Electronic Drives**
Credits: 3 **L:T:P:S – 3:0:0:0**
CIE: 50% Marks **SEE: 50% Marks**
SEE Hours: 3 **Max. Marks: 100**

Prerequisites if any	Nil
Learning objectives	1. To analyze and model electric drive systems, including induction/synchronous machines and power electronic converters, using dynamic modeling techniques and reference frame theory for control applications. 2. To analyse advanced control strategies for various electric machines (induction, PMSM, SRM) using modern estimation techniques and converter topologies

Course Outcomes:
On the successful completion of the course, the student will be able to

COs		Bloom's level
CO1	Discuss fundamental principles of Electric Drive systems.	Understand
CO2	Explain principles of modelling for control of electrical machines.	Understand
CO3	Analyze various drive control methods.	Apply

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	-	-	-	-
CO2	3	-	-	-	-	2
CO3	3	-	-	-	-	2

Mapping Strength: **Strong– 3** **Medium – 2** **Low – 1**

Course Structure

Module – 1: Introduction to Electric Drives and Modelling of Induction Machines		**No. of Lecture Hours**	**No. of Tutorial Hours**
1.1	Introduction to Electric Drives, Electric Motors	2	Nil
1.2	Power Electronic Converters, Controllers, Load, Load Dynamics and Stability,	2	Nil
1.3	Multi-quadrant Operation, Duty Cycle and Motor Rating. Induction Machine Theory, Equivalent Circuit of Induction Motor	4	Nil
1.4	Dynamic Model of a Two-Phase Induction Machine.	2	Nil
Module – 2: Modeling of Induction Machines			
2.1	Selection of Reference Frame, Models in Other Reference Frames, Space Phasor Model	3	Nil
2.2	Speed Control of Induction Motor,Synchronous Machine, Production of Torque in Cylindrical Rotor Machine,	3	Nil
2.3	Salient Pole Synchronous Machine, Dynamic Modelling of Synchronous Machine, Space Phasor Model	4	Nil
Module – 3: Direct Torque Control and Sensor-Less Control of Induction Machine			
3.1	Introduction, Direct Torque Control Basics, DTC Control Strategy, Switching Table Based DTC Scheme, Sensorless Control of Induction Motor	3	Nil
3.2	Slip frequency calculation method Speed estimation using state equations, Flux estimation method, Model reference adaptive systems (MRAS)	3	Nil
3.3	Observer (Kalman, Luenberger) based methods, Artificial intelligence methods for speed estimation	2	Nil
Module – 4: Control of Permanent Magnet Machine (PM)			
4.1	Introduction, Design Considerations, Modelling of PMSM	3	Nil
4.2	Modelling of Brushless DC Motor, Drive Operation with Inverter, Operating Modes, Direct Torque Control of PM Motor	3	Nil

4.3	Sensorless Control of PM Motor, Sensorless Control of BLDC Motor	2	Nil
Module – 5: Switched Reluctance Motor Drives			
5.1	Introduction, Construction, Basic Principle of Operation, Converters for SR Machine	3	Nil
5.2	Asymmetric Bridge Converter, Six Switch Converter, Buck-Boost Converter, Control of SR Motor Drive	3	Nil
5.3	General Purpose SRM Drive with Speed/Position Sensor, Direct Torque Control of SRM Drive.	2	Nil
	Total No. of Lecture Hours	40	
	Total No. of Tutorial Hours		Nil

Textbooks

1. M. Ahmad, "***High Performance AC Drives- Modelling Analysis and Control***", Springer Verlag Limited, London, 2010.

Reference Books

1. Krause, P.C., "***Analysis of Electrical Machinery***", McGraw Hill Book Company, New York (1986)
2. Krishnan, R.: "***Electric Motor Drives, Modeling Analysis and Control***", Prentice Hall, Englewood Cliffs (2001)
3. Vithyathil J., "***Power Electronics***", McGraw Hill Inc., New York (1995)
4. Bose, B.K, "***Modern Power Electronics and AC Drives***", Pearson Education Inc., London (2002)

Course Code: MEPP204 **Course Name: Flexible AC Transmission Systems**
Credits: 3 **L:T:P:S - 3:0:0:0**
CIE: 50% Marks **SEE: 50% Marks**
SEE Hours: 3 **Max. Marks: 100**

Prerequisites if any	Nil
Learning objectives	1. To analyze the fundamental principles of reactive power compensation in AC transmission systems, including series/shunt compensation methods and their impact on power flow control. 2. To evaluate the operation and applications of key FACTS controllers (SVC, STATCOM, TCSC, SSSC) through theoretical analysis and MATLAB-based simulations. 3. To study and compare combined compensation systems (UPFC, IPFC) by examining their control strategies and implementation in power transmission networks.

Course Outcomes:

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

COs		**Bloom's level**
CO1	Analyse the behaviour of uncompensated AC transmission system	Analyse
CO2	Analyse series and shunt compensated systems with fixed compensators and FACTS controllers	Analyse
CO3	Explain the structure and functions of combined compensators	Understand

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5
CO1	1	-	3	-	-
CO2	1	-	3	-	1
CO3	1	-	3	-	1

Mapping Strength: **Strong– 3** **Medium – 2** **Low – 1**

Course Structure

Module – 1: Basic types of reactive power compensation		**No. of Lecture Hours**	**No. of Tutorial Hours**
1.1	Fundamental requirements in AC power transmission, Control of power flow in AC transmission line	2	Nil
1.2	Concept and objectives of series and shunt capacitive compensation, Virtual surge impedance loading compensation	2	Nil
1.3	Line length compensation and compensation by sectioning, Uniformly distributed compensation and discrete compensation	2	Nil
1.4	Compensation by a series capacitor connected at the midpoint of the line, Shunt compensation connected at the midpoint of the line.	2	Nil
Module – 2: Introduction to FACTS controllers			
2.1	Relative importance of different types of controllers, Brief description and definitions of FACTS controllers	3	Nil
2.2	Benefits from FACTS technology, A General Equivalent circuit for FACTS controllers	2	Nil
2.3	Basic concept of Voltage-Sourced Converters, Operation of Single-Phase and three-phase full-wave bridge converters.	2	Nil
Module – 3: Static Shunt Compensators			
3.1	Introduction, Analysis of SVC, Configuration of SVC, SVC Controller, Susceptance Regulator, Supplementary modulation controller	3	Nil
3.2	Protective functions of SVC control, SVC modelling of SVC, Application of SVC.	2	Nil
3.3	**Static Synchronous Compensator (STATCOM):** Introduction, Principle of operation of STATCOM	2	Nil
3.4	Analysis of a three phase six pulse STATCOM, Applications of STATCOM. Simulation exercise using MATLAB	2	Nil

Module – 4: Static Series Compensators: Thyristor Controlled Series Capacitor (TCSC)			
4.1	Basic concepts of controlled series compensation	2	Nil
4.2	Operation of TCSC, Analysis of TCSC, Control of TCSC, Applications of TCSC.	2	Nil
4.3	**Static Synchronous Series Compensator (SSSC):** Introduction, Operation of SSSC and the Control of power flow, Comparison between variable series compensation and SSSC,	2	Nil
4.4	Power flow control Characteristics, Modelling of SSSC, Internal control, External Control for series reactive compensators, SSSC with an energy Source, Applications of SSSC, Simulation exercise using MATLAB.	2	Nil
Module – 5: Combined Compensators			
5.1	**Unified Power Flow Controller (UPFC):** Introduction to UPFC, Operation of UPFC connected at sending end, midpoint and receiving end	2	Nil
5.2	Control of UPFC, Interline power flow controller, Applications of UPFC	2	Nil
5.3	**Interline Power Flow Controller (IPFC):** Basic operating principles and characteristics, Control Structure, Applications.	4	Nil
	Total No. of Lecture Hours	40	
	Total No. of Tutorial Hours		Nil

Textbooks:

1. Narain. G. Hingorani & Laszlo Gyugyi, "***Understanding FACTS*** ", IEEE Press, 2000.
2. K. R. Padiyar, "***FACTS Controllers in Power Transmission & Distribution***", New Age International Publishers, 1st edition, 2007.

Reference Books:

1. T.J.E. Miller, "***Reactive Power Control in Electric Systems***", A Wiley Interscience Publication,1982.
2. R. Mohan Mathur & Rajiv K. Varma , ***"Thyristor-based FACTS controllers for electrical transmission systems"***, A John Wiley & Sons, Inc. Publication, 2002

Course Code: MEPP205A **Course Name: Power Quality and Custom Power Devices**
Credits: 3 **L:T:P:S - 3:0:0:0**
CIE: 50% Marks **SEE: 50% Marks**
SEE Hours: 3 **Max. Marks: 100**

Prerequisites if any	Nil
Learning objectives	1. To analyze power quality disturbances using IEEE standards and develop conventional mitigation strategies for unbalanced and distorted systems. 2. To evaluate custom power devices and design compensation systems for voltage regulation and current control in distribution networks. 3. To compare UPQC configurations and suggest appropriate control strategies for unified power quality conditioning in different network conditions.

Course Outcomes:
On the successful completion of the course, the student will be able to

COs		**Bloom's level**
CO1	Discuss different standards of Power quality and Custom power devices	Understand
CO2	Analyse the power quality problems and conventional mitigation techniques.	Analyse
CO3	Analyse the principles of shunt and series compensation for power quality enhancement.	Analyse
CO4	Describe different structures and control of UPQC.	Understand

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5
CO1	1	-	3	-	-
CO2	2	-	3	-	-
CO3	2	-	3	-	-
CO4	2	-	3	-	-

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

Module – 1: Analysis and Conventional Mitigation Methods		**No. of Lecture Hours**	**No. of Tutorial Hours**
1.1	Power quality terms and definitions, Overview on IEEE Standards of Power Quality - IEEE 519, IEEE 1159, IEEE 141, IEEE 142, IEEE 493,	2	Nil
1.2	Analysis of power outages, Analysis of unbalance, Analysis of distortion	2	Nil
1.3	Analysis of voltage sag, Analysis of voltage flicker,	2	Nil
1.4	Reduced duration and customer impact of outages, Classical load balancing problem and harmonic reduction.	3	Nil
Module – 2: Custom Power Devices			
2.1	Utility-customer interface, Custom power devices, Network reconfiguring devices,	3	Nil
2.2	Solid state current limiter, Solid state breaker, Issues in limiting and switching operations,	3	Nil
2.3	Solid state transfer switch, Sag/swell detection algorithms.	2	Nil
Module – 3: Realization and Control of DSTATCOM			
3.1	DSTATCOM structure, Control of DSTATCOM connected to a stiff source,	3	Nil
3.2	DSTATCOM connected to weak supply point, DSTATCOM current control through phasors when both load and source are unbalanced,	3	Nil
3.3	DSTATCOM in voltage control mode.	2	Nil
Module – 4: Series Compensation of Power Distribution System			
4.1	Rectifier supported DVR, DC capacitor supported DVR	2	Nil
4.2	DVR structure	2	Nil
4.3	Voltage restoration, Series active filter.	4	Nil

Module – 5: Unified Power Quality Conditioner			
5.1	UPQC configurations,	1	Nil
5.2	Right-shunt UPQC characteristics,	1	Nil
5.3	Left-shunt UPQC characteristics,	1	Nil
5.4	Structure and control of right-shunt UPQC	2	Nil
5.5	Structure of left-shunt UPQC.	2	Nil
	Total No. of lecture Hours	40	Nil
	Total No. of Tutorial Hours	***Nil***	

Textbooks:

1. ArindamGhosh, Gerard Ledwich, Kluwer, “***Power Quality Enhancement Using Custom Power Devices***”, 1st edition, Academic Publishers, 2002.
2. Math H J Bollen, “***Understanding Power Quality Problems - Voltage Sags and Interruptions***”, 1st edition, Wiley India, 2011.

Course Code: MEPP205B **Course Name: Power Generation Operation and Control**
Credits: 3 **L:T:P:S - 3:0:0:0**
CIE: 50% Marks **SEE: 50% Marks**
SEE Hours: 3 **Max. Marks: 100**

Prerequisites if any	Nil
Learning objectives	1. To formulate and solve economic dispatch problems for thermal units considering generation limits and transmission losses, and apply unit commitment techniques for optimal generation scheduling. 2. To develop hydrothermal coordination models for both short-term and long-term scheduling, including pumped-storage plants, using gradient methods and dynamic programming approaches. 3. To analyze power system control and optimization through load frequency control mechanisms, optimal power flow solutions, and evaluate power interchange strategies between interconnected utilities.

Course Outcomes:
On the successful completion of the course, the student will be able to

COs		**Bloom's level**
CO1	Formulate and evaluate Economic dispatch and Unit Commitment problem in Power system	Apply
CO2	Analyse single area and two area load frequency control of power system	Analyse
CO3	Apply optimization techniques to solve optimal power flow problem.	Apply
CO4	Discuss the concept of interchange of power and energy.	Understand

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5
CO1	1	-	3	2	-
CO2	1	-	3	-	-
CO3	1	-	3	2	-
CO4	1	-	3	1	-

Mapping Strength: **Strong– 3** **Medium – 2** **Low – 1**

Course Structure

Module – 1: Economic Dispatch and Optimal Unit Commitment (OUC) of Thermal Units		**No. of Lecture Hours**	**No. of Tutorial Hours**
1.1	Introduction to economic load dispatch	2	Nil
1.2	Characteristics of hydro and thermal units, Economic load dispatch problem neglecting transmission losses and generation limits	2	Nil
1.3	Economic load dispatch problem with generation limits, Derivation of transmission line loss expressions	2	Nil
1.4	Economic load dispatch with transmission network losses, Introduction to OUC, Constraints in OUC	2	Nil
1.5	Priority list method and dynamic programming for UC, Problems.	2	Nil
Module – 2: Hydrothermal Coordination			
2.1	Introduction, Hydroelectric plant models, Composite generation production cost function	2	Nil
2.2	Long-range hydro-scheduling, Short- range hydro-scheduling, Short-term hydro-scheduling: a gradient approach	1	Nil
2.3	Hydro- units in series (hydraulically coupled), Pumped-storage hydro plants	2	Nil
2.4	Dynamic- programming solution to the hydrothermal scheduling problems.	2	Nil
Module – 3: Load Frequency Control			
3.1	Single area block diagram representation, Single area – steady state and dynamic analysis	3	Nil
3.2	Static load frequency curves, Integral control, Response of a two – area system for	3	Nil

	uncontrolled and controlled case with block diagram		
3.3	Dynamic state variable model.	2	Nil
Module – 4: Optimal Power Flow			
4.1	Introduction, Solution of the optimal power flow – Gradient method, Newton's method	3	Nil
4.2	Linear sensitivity analysis, Linear programming methods	2	Nil
4.3	security-constrained optimal power flow.	3	Nil
Module – 5: Interchange of Power and Energy			
5.1	Introduction, Economy interchange between interconnected utilities, Inter utility economy energy evaluation,	2	Nil
5.2	interchange evaluation with unit commitment, Multiple-utility interchange transactions, Other types of interchange- capacity interchange,	1	Nil
5.3	Diversity interchange, Energy banking, Emergency power interchange, Inadvertent power exchange	2	Nil
5.4	Power pools - the energy-broker system, Allocating pool savings, Transmission effects and issues-transfer limitations, Wheeling, Rates for transmission services in multiparty utility transactions, Some observations.	2	Nil
	Total No. of Lecture Hours	40	
		Total No. of Tutorial Hours	Nil

Textbooks:

1. Allen J. Wood and Bruce F. Woollenberg, "***Power Generation, Operation, and Control***", 2nd edition, John Wiley and Sons, INC**,** 2013.
2. S. Sivanagaraju, G. Sreenivasan, "***Power System Operation and Control*** ", Pearson Publisher, 2009.

Course Code: MEPP205C
Course Name: IoT in Smart Grid
Credits: 3
L:T:P:S - 3:0:0:0
CIE: 50% Marks
SEE: 50% Marks
SEE Hours: 3
Max. Marks: 100

Prerequisites if any	Nil
Learning objectives	1. To study IoT architectures and enabling technologies for smart grid applications, evaluating implementation challenges in organizational and technical contexts. 2. To have insights on the design of IoT-based smart grid solutions using appropriate communication protocols, edge computing models, and security frameworks for energy management systems. 3. To develop proficiency in IoT-enabled forecasting and control systems for renewable energy integration and distribution network optimization in smart city environments.

Course Outcomes:

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

COs		**Bloom's level**
CO1	Discuss the concepts, organizational implementation and challenges of Internet of Things.	Understand
CO2	Explain the fundamental components for realizing IoT platforms targeting the smart-grid domain.	Understand
CO3	Explain various applications of IoT in Smart grid and Smart cities.	Understand

Mapping with POs

COs	PO1	PO2	PO3	PO4	PO5
CO1	1	-	3	-	-
CO2	1	-	3	-	1
CO3	1	-	3	-	1

S – Strong (3) M – Medium (2) L – Low (1)

Course Structure

Module – 1: Introduction to IoT		**No. of Lecture Hours**	**No. of Tutorials Hours**
1.1	Introduction, Definition of IoT	2	Nil
1.2	Proposed architecture and Reference Models, Enabling technologies, challenges	2	Nil
1.3	Organizational Implementation and Management Challenges in the Internet of things: Introduction	2	Nil
1.4	IoT in Organizations, Managing IoT Systems.	1	Nil
Module – 2: Custom Power Devices			
2.1	**The Smart-Grid Concept:** Introduction**,** Actors in the Smart-grid Environment: Grid operator, Grid users, Energy marketplace, Technology providers,	2	Nil
2.2	Influencers. Challenges of Smart grid: Inadequacies in Grid Infra Structure, Cyber Security, Storage Concern, Data Management, Communication Issues.	2	Nil
2.3	**Edge Computing for Smart Grid: An Overview on Architectures and Solutions:** Introduction, IoT Applications, Requirement and Architecture,	2	Nil
2.4	Information processing in Smart-Grid, Edge Computing in Internet of Things, Edge Computing Model for Smart Grid, A Use-Case for Home Appliance Management.	2	Nil
Module – 3: Communication Protocols for the IoT-Based Smart Grid			
3.1	Introduction, IoT Application types, IoT based Smart-Grid review, Current IoT Based Smart Grid Technology Enablers.	3	Nil
3.2	**Smart Grid Hardware Security:** Introduction, Smart Grid Architecture Patterns, Hardware Device Authentication,	3	Nil
3.3	Confidentiality of Power Usage, Integrity of Data, Software and Hardware.	2	Nil

Module – 4: Solar Energy Forecasting in the Era of IoT Enabled Smart Grids			
4.1	Introduction, The Future Role of Forecasting, Summary of Solar Forecasting Methods, Example of a Detailed, Short-Term Forecasting Method.	3	Nil
4.2	**Intelligence in IoT-enabled Smart Cities:** Energy Consumption monitoring in IoT based smart cities, Smart homes in the crowd of IoT based cities,	3	Nil
4.3	Smart meters for the smart city's grid, Intelligent parking solutions in IoT based smart cities.	3	Nil
Module – 5: The Internet of Things in Electric Distribution Networks:			
5.1	Introduction, Current Control and Communication Provision in DNOs	2	Nil
5.2	AuRA-NMS-Based Electric IoT Architecture, Communication Standards, Protocols, and Requirements of Electric IoT.	2	Nil
5.3	Satellite-Based Internet of Things Infrastructure for Management of Large-Scale Electric Distribution Networks: Introduction	2	Nil
5.4	Distributed Control Approach for Smart Distribution Grid, LEO Network Characteristics and Modelling, Communication Performance Assessment.	2	Nil
	Total No. of lecture Hours	40	Nil
	Total No. of Tutorial Hours		Nil

Textbooks:

1. Qusay F. Hassan, Atta ur Rehman Khan, Sajjad A. Madani, ***"Internet of Things: Challenges, Advances, and Applications"***, 1st edition, CRC Press, Taylor and Francis group, 2019.
2. Kostas Siozios, Dimitrios Anagnostos, Dimitrios Soudris, Elias Kosmatopoulos, ***"IoT for Smart Grids: Design Challenges and Paradigms",*** Springer, 2019

Reference book:

1. Fadi Al-Turjman, ***"Intelligence in IoT-enabled Smart Cities",*** 1st edition, CRC, Press , 2018

Course Code: MEPP206A **Course Name: Electromagnetic Interference & Compatibility**
Credits: 3 **L:T:P – 3:0:0:0**
CIE: 50% Marks **SEE: 50% Marks**
SEE Hours: 3 **Total Marks: 100**

Prerequisites if any	Nil
Learning objectives	1. To study EMI sources and propagation mechanisms in power electronic systems, including conducted/radiated emissions from semiconductor circuits and relay systems, while applying EMC standards and measurement techniques. 2. To design effective EMI suppression solutions through proper component selection and circuit layout optimization for both conducted and radiated noise reduction. 3. To develop EMI mitigation strategies for switch-mode power supplies and transformers, incorporating Faraday screening techniques and compliant filter designs that meet safety regulations and IEC standards.

Course Outcomes:
On the successful completion of the course, the student will be able to

COs		**Bloom's level**
CO1	Recognize the sources of Conducted and radiated EMI in Power Electronic Converters and consumer appliances and suggest remedial measures to mitigate the problems	Understand
CO2	Assess the insertion loss and design EMI filters to reduce the loss	Analyse
CO3	Design EMI filters, common-mode chokes and RC-snubber circuits measures to keep the interference within tolerable limits	Apply
CO4	Develop suitable techniques to mitigate EMI/EMC issues in power converters	Apply

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5
CO1	1	-	3	-	1
CO2	1	-	3	-	2
CO3	2	-	3	-	2
CO4	2	-	3	-	2

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

Module – 1: Introduction to Electromagnetic Interference		**No. of Lecture Hours**	**No. of Tutorial Hours**
1.1	Sources of conducted and radiated EMI, EMC standardization and description measuring instruments, conducted EMI references,	4	Nil
1.2	EMI in power electronic equipment: EMI from power semiconductors circuits.	4	Nil
Module – 2: Noise suppression in relay systems			
2.1	AC switching relays, shielded transformers, capacitor filters	4	Nil
2.2	EMI generation and reduction at source, influence of layout and control of parasites.	4	Nil
Module – 3: EMI filter design			
3.1	Capacitors, choke coils, resistors, EMI filter circuits, Ferrite breeds, feed through filters, bifilar wound choke filter	2	Nil
3.2	EMI filters at source, EMI filter at output.	2	Nil
3.3	Worst case insertion loss, design method for mismatched impedance condition	2	Nil
3.4	EMI filters with common mode choke-coils, IEC standards on EMI	2	Nil
Module – 4: EMI in Switch Mode Power Supplies			
4.1	EMI propagation modes, power line conducted-mode inference, safety	3	Nil

	regulations (ground return currents)		
4.2	Power line filters, suppressing EMI at sources, Line impedance stabilization network (LISN), line filter design	3	Nil
4.3	Common-mode line filter inductors- design& example, series –mode inductors and problems, EMI measurements.	2	Nil
Module – 5: Faraday Screens for EMI prevention			
5.1	As applied to switching devices, transformers faraday screen and safety screens	3	Nil
5.2	Faraday screens on output components	2	Nil
5.3	Reducing radiated EMI on gapped transformer cores, metal screens, electrostatic screens in transformers	3	Nil
	Total No. of Lecture Hours	**40**	
	Total No. of Tutorial Hours		**Nil**

Textbooks:

1. Ficchi, F. Rocco, **“Practical Design for Electromagnetic Compatibility”,** Hayden Book Co.,1981.
2. Laszlo Tihanyi, **“Electromagnetic Compatibility in Power Electronics”,** IEEE Press, 1995, 1st Edition.
3. Andrzej M. Trzynadlowski, **“EMI Effects of Power Converters”,** in Power Electronics Handbook (Fifth Edition), 2024.

Reference Books:

1. Paolo Stefano Crovetti, **“Electromagnetic Interference and Compatibility”,** MDPI, 2021. 2.
2. Keith H Billings, Taylor Morey, “**Handbook on Switch-Mode power supplies**”, McGraw-Hill Publisher, 2011, 3rd Edition.
3. Abraham I. Pressman, Keith Billings, Taylor Morey, **“Switching Power Supply Design”,** McGraw Hill International, 2009, 3rd Edition.

Course Code: MEPP206B **Course Name: Wide Band Gap Devices in Power Electronics**
Credits: 3 **L:T:P – 3:0:0:0**
CIE: 50% Marks **SEE: 50% Marks**
SEE Hours: 3 **Total Marks: 100**

Prerequisites if any	Nil
Learning objectives	1. To discuss the fundamental principles of GaN power devices, including their structural characteristics, switching behavior, and thermal properties, comparing them to conventional power semiconductors. 2. To have insight on how to design driver circuits and protection systems for GaN transistors, with emphasis on gate driving requirements, switching loss optimization, and managing dv/dt and di/dt challenges in power converter applications. 3. To discuss techniques for implementing GaN devices in high-frequency power conversion systems, covering parasitic management, EMI mitigation, and thermal design considerations for electric vehicle and renewable energy applications.

Course Outcomes:
On the successful completion of the course, the student will be able to

COs		**Bloom's level**
CO1	Explain the basic operation of wide band gap devices and their characteristics	Understand
CO2	Derive the electrical and thermal modeling of wideband devices, as well as EMI filter design for high-frequency power converters	Apply
CO3	Explain the compact single-layer and multilayer PCB designs according to industrial needs	Understand
CO4	Utilize wide band gap devices for real-time applications through simulation and experimental studies	Apply

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5
CO1	1	-	3	-	1
CO2	1	-	3	-	2
CO3	2	-	3	-	2
CO4	2	-	3	-	2

Mapping Strength: **Strong– 3** **Medium – 2** **Low – 1**

Course Structure

Module – 1: Wide Band Gap Devices		**No. of Lecture Hours**	**No. of Tutorial Hours**
1.1	Introduction to basic power devices, Need of GaN device, Basic GaN Transistor structure, GaN Vertical Power HEFTs and Horizontal Power HEFTs,	4	Nil
1.2	Different types of wide band gap devices, advantages and challenges in designing converters with wide band gap devices.	4	Nil
Module – 2: GaN Transistor Characteristics & Driver Circuits			
2.1	Turn ON and Turn OFF switching characteristics of GaN devices, Hard switching loss analysis	4	Nil
2.2	Gate driver design, Impact of gate resistance, dv/dt and di/dt immunity, etc., Protection design for double pulse test set-up.	4	Nil
Module – 3: Modeling and Measurement of GaN Transistors			
3.1	Electrical and thermal modeling of GaN transistors	4	Nil
3.2	Thermal management, and Reliability.	4	Nil
Module – 4: High-frequency design complexity			

4.1	The impact of parasitic inductance and capacitance	2	Nil
4.2	EMI filter design for high-frequency power converters	3	Nil
4.3	Heat sink design	3	Nil
Module – 5: Applications			
5.1	GaN in AC/DC & DC/AC Power Converters	3	Nil
5.2	GaN in Switched Mode Power Amplifiers	3	Nil
5.3	GaN in Electric Vehicle and Renewable Applications and problems	2	Nil
	Total No. of Lecture Hours	**40**	
		Total No. of Tutorial Hours	**Nil**

Textbooks:

1. Lidow, J. Strydom, M. D. Rooij, D. Reusch, **"GaN Transistors for Efficient Power Conversion",** Wiley, 2014.
2. G. Meneghesso, M. Meneghini, E. Zanoni, **"Gallium Nitride-enabled High Frequency and HighEfficiency Power Conversion",** Springer International Publishing, 2018.
3. Maurizio Di Polo Emilio**, "GaN and SiC Power Devices",** Springer, 2024

Reference Books:

1. B.J.Baliga, **"Gallium Nitride and Silicon Carbide Power Devices",** World Scientific Publishing Company, 2017.
2. F. Wang, Z. Zhang and E. A. Jones**, "Characterization of Wide Bandgap Power Semiconductor Devices",** IET, 2018.

Course Code: MEPP206C **Course Name: Control Techniques for Power Converters**
Credits: 3 **L:T:P – 3:0:0:0**
CIE: 50% Marks **SEE: 50% Marks**
SEE Hours: 3 **Total Marks: 100**

Prerequisites if any	Nil
Learning objectives	1. To discuss how to model power converters using linearized averaged models, switched models, and small-signal analysis, and demonstrate their application in control system design for converter operation. 2. To explain advanced control techniques, including PID tuning methods, fractional-order control, and resonant controllers, and mentor designing these controllers for DC-DC converters through case studies. 3. To demonstrate robust control design methods such as loop shaping (H∞, QFT) and sliding mode control (SMC), showing their application in power converters to handle uncertainties and improve dynamic performance.

Course Outcomes:
On the successful completion of the course, the student will be able to

COs		**Bloom's level**
CO1	Understand and analyze the different types of converter model and its usage	Analyse
CO2	Design the advanced PID controller with its fractional version and resonant controller for converters	Apply
CO3	Design the robust controller for converter using the loop-shaping method	Apply
CO4	Design the robust controller for converter using Sliding mode control	Apply

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5
CO1	1	-	3	-	1
CO2	2	-	3	-	2
CO3	2	-	3	-	2
CO4	2	-	3	-	2

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

Module – 1: Modeling of Power converters		**No. of Lecture Hours**	**No. of Tutorial Hours**
1.1	Types of Models, Linearized Averaged models, Large signal and Small signal models	4	Nil
1.2	Switched models, Relation between various model types, Control goals in converter operation, Review of classical control methods	4	Nil
Module – 2: Advanced PID controller			
2.1	PID controller-Tuning methods of PID controller, Set point weighting, Integrator Windup	2	Nil
2.2	Controller degrees of freedom, Model based Design methods: Direct Synthesis (DS) method, Internal Model Control (IMC) method	2	Nil
2.3	Fractional Control System (FOS), Design of Fractional PID controller	2	Nil
2.4	Case Study: PID controller design for DC-DC boost converter	2	Nil
Module – 3: Resonant Controller:			
3.1	Necessity of resonant controller, Principle of Proportional Resonant (PR) control	4	Nil
3.2	Design methods of PR controller, Example of PR controller design for DC-DC boost converter	4	Nil

Module – 4: Loop-shaping design			
4.1	Concept of Loop shaping, Robust controller design using the loop shaping methods: H∞ Control, Quantitative feedback theory (QFT)	5	Nil
4.2	Case Study: Loop shaping methods to design the robust controller for DC-DC converter.	3	Nil
Module – 5: Sliding mode controller (SMC)			
5.1	Nonlinear control preliminaries, Types of Uncertainty, Sliding surface design	3	Nil
5.2	Stability of SMC, Equivalent control concept- Integral Sliding Mode Control (ISMC) design	3	Nil
5.3	Case study: Application of SMC to design the robust controller for DC-DC converter	2	Nil
	Total No. of Lecture Hours	**40**	
	Total No. of Tutorial Hours		**Nil**

Textbooks:

1. S. Bacha, I. Munteanu, A.I. Bratcu, **"Power Electronic Converters Modeling and Control with Case Studies",** Springer- Verlag London, 2014, 1st Edition.
2. L. Wang, S. Chai, D. Yoo, L. Gan, K. Ng, **"PID and Predictive Control of Electrical Drives and Power Converters using MATLAB/Simulink"** Wiley Press, 2015, 1st Edition.
3. A. Mehta, B. Naik, **"Sliding Mode Controllers for Power Electronic Converters",** Springer Nature, 2019

Reference Books:

1. C. Olalla, Ramon Leyva, I. Queinnec, "**Robust Linear Control of DC-DC Converters: A Practical Approach to the Synthesis of Robust Controllers"**, VDM Verlag- Dr. Muller, 2010, 1st Edition.
2. S-C. Tan, Y-M. Lai, C.K. Tse, **"Sliding Mode Control of Switching Power Converters: Techniques and Implementation"**, CRC Press, 2012, 1st Edition.
3. Freede Blaabjerg, **"Control of Power Electronic Converters and Systems",** Academic Press, 2018. 1 st Edition.
4. Q- C. Zhong,T. Hornik, **"Control of Power Inverters in Renewable Energy and Smart Grid Integration"**, Wiley Press, 2013, 1st Edition

Course Code: MEPPL207 **Course Name: Drives Laboratory**
Credits: 2 **L: T:P:S - 0:2:2:0**
SEE: 50% Marks **CIE: 50% Marks**
SEE Hours: 3 **Max. Marks: 100**

Prerequisites if any	Nil
Learning objectives	1. To demonstrate DSP interfacing with power converters, DC motor, Stepper motor, Induction motor, BLDC, PMSM, Traffic Lights Module, Elevator Module

Course Outcomes:
On the successful completion of the course, the student will be able to

COs		**Bloom's level**
CO1	Digital Signal Processor Interfacing with power converters	Analyse
CO2	Digital Signal Processor Interfacing with DC motor, Stepper motor, Induction motor, BLDC and PMSM	Apply
CO3	Digital Signal Processor Interfacing with Traffic Lights Module, Elevator Module	Apply

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5
CO1	3	-	-	-	-
CO2	3	3	2	-	-
CO3	3	3	2	-	2

Mapping Strength: Strong– 3 Medium – 2 Low – 1

List of Experiments:

Sl. No.	**Experiment**	**Hands on/ Virtual**
1	DSP Interfacing with Buck Converter and performance evaluation.	Hands on
2	DSP Interfacing with Boost Converter and performance evaluation.	Hands on
3	DSP Interfacing with Buck-Boost Converter and performance evaluation.	Hands on
4	DSP Interfacing with DC Motor and performance evaluation	Hands on
5	DSP Interfacing with Stepper motor and performance evaluation.	Hands on
6	DSP Interfacing with Traffic lights module	Hands on
7	DSP Interfacing with Elevator module	Hands on
8	DSP Interfacing with Induction Motor and performance evaluation.	Hands on
9	DSP Interfacing with BLDC motor and performance evaluation.	Hands on
10	DSP Interfacing with PMSM and performance evaluation	Hands on
11	DSP Interfacing with Buck Converter and performance evaluation.	Hands on
12	DSP Interfacing with Boost Converter and performance evaluation.	Hands on
13	DSP Interfacing with Buck-Boost Converter and performance evaluation.	Hands on

M.Tech in Power Systems and Power Electronics

(2025-2027)

Syllabus – III Semester

Department of Electrical and Electronics Engineering

The National Institute of Engineering

Mysuru-570 008

5. .

Course Code: MEPP311
Credits: 3
CIEE: 100% Marks
SEE Hours: -

Course Name: Professional Elective IV (Online Course)
L:T:P:S : 3:0:0:0
SEE: -
Max. Marks: 100

Prerequisites if any	Nil
Learning objectives	1. To be provided by the course instructor – NPTEL

Course Outcomes:
On the successful completion of the course, the student will be able to

COs		**Bloom's level**
CO1	Apply the knowledge of Power Systems and Power Electronics to solve real world problems and design solutions.	Apply

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5
CO1	2	-	3	-	-

Mapping Strength: Strong– 3 Medium – 2 Low – 1

MOOC courses of 12 weeks duration are the courses suggested by the Board of Studies of the University and will be displayed on **www.online.vtu.ac.in**. The online courses selected should not be the same as those studied in the first and second semesters of the program. The student will not be eligible to get their degree if they unintentionally select online courses that match previously finished courses. These courses are not considered for vertical progression; however, qualifying for these courses and earning the credits is a must for the award of the degree. It is permitted to complete these online MOOC courses either in 3rd semester or in 4th semester.

Course Code: MEPP312
Credits: 3
SEE: 100% Marks
SEE Hours: -

Course Name: Professional Elective V (Online Course)
L:T:P:S:0:0:0:3
CIE: -
Max. Marks: 100

Prerequisites if any	Nil
Learning objectives	1. To be provided by the course instructor – NPTEL

Course Outcomes:
On the successful completion of the course, the student will be able to

COs		**Bloom's level**
CO1	Apply the knowledge of Power Systems and Power Electronics to solve real world problems and design solutions.	Apply

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5
CO1	2	-	3	-	-

Mapping Strength: Strong– 3 Medium – 2 Low – 1

MOOC courses of 12 weeks duration are the courses suggested by the Board of Studies of the University and will be displayed on **www.online.vtu.ac.in**. The online courses selected should not be the same as those studied in the first and second semesters of the program. The student will not be eligible to get their degree if they unintentionally select online courses that match previously finished courses. These courses are not considered for vertical progression; however, qualifying for these courses and earning the credits is a must for the award of the degree. It is permitted to complete these online MOOC courses either in 3rd semester or in 4th semester.

Course Code: MINT383
Credits: 4
SEE: -
SEE Hours: -

Course Name: Research Internship /Industry-Internship leading to project work/ Startup
L:T:P:S : -
CIE: 100% Marks
Max. Marks: 100

Prerequisites if any	Nil
Learning objectives	1. Gain field experience in the relevant discipline. 2. Connect the theory with practice. 3. Present and document the training experience. 4. Acquire knowledge by introspection.

Course Outcomes:

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

COs		Bloom's level
CO1	Gain field experience in the relevant discipline	Apply
CO2	Present and document the training experience	Apply
CO3	Apply modern tools for Engineering Applications	Apply
CO4	Understand the ethical practices adapted for sustainable development	Understand

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5
CO1	1	-	3	-	1
CO2	2	3	3	-	1
CO3	1	-	3	-	1
CO4	2	3	3	-	1

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Instructions:

- **Industry Internship:** The main objective of the industry internship is to ensure that the intern is exposed to a real-world environment and gain practical experience. Often, it may be a practical exposure to the theory that has been learned during the academic period.
- **Research Internship:** These internships can take place in academic institutions, research organizations, government agencies, or private companies
- **Internship Leading to Start-up:** An internship that leads to a startup is an exciting pathway, blending real-world experience with entrepreneurial ambition. Here's a comprehensive guide to transitioning an internship experience into launching your startup: 1) Maximize your internship experience, 2) Identifying Viable Business Ideas, 3) Research and Validation 4) Building a Business Plan 5) Networking and Mentorship 6) Securing Funding 7) Establishing Startup 8) Launching and Marketing. By following these steps, you can effectively transition from an internship to launching a successful startup. This journey requires dedication, resilience, and a willingness to learn and adapt.

Evaluation:

The continuous internal evaluation will be done in two phases using appropriate rubrics, the final evaluation will be done at the end of the IV semester with industry experts and the internship supervisor.

Course Code: MPRJ384
Course Name: Project Phase - I
Credits: 4
L:T:P:S : -
SEE: -
CIE: 100% Marks
SEE Hours: -
Max. Marks: 100

Prerequisites if any	Nil
Learning objectives	1. Identify the topic of relevance within the discipline 2.Carry out literature survey 3. Formulate the problem, Identify the objectives and develop solution methodology 4. Inculcate ethical practices. 5. Present and document the preliminary project work. 6. Acquire knowledge by introspection.

Course Outcomes:
On the successful completion of the course, the student will be able to

COs		**Bloom's level**
CO1	Identify the topic of relevance and carry out literature review inculcating ethical practice	Apply
CO2	Formulate the problem, identify the objectives and develop solution methodology	Analyse
CO3	Present and document the project work	Analyse

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5
CO1	3	-	3	-	1
CO2	3	-	3	-	1
CO3	-	3	3	-	1

Mapping Strength: **Strong– 3** **Medium – 2** **Low – 1**

M.Tech in Power Systems and Power Electronics

(2025-2027)

Syllabus – IV Semester

Department of Electrical and Electronics Engineering

The National Institute of Engineering

Mysuru-570 008

Course Code: MINT481
Credits: 12
SEE: 100 Marks
SEE Hours: 3

Course Name: Research Internship /Industry-Internship leading to project work/ Startup
L:T:P:S : -
CIE: 100 Marks
Max. Marks: 100

Prerequisites if any	Nil
Learning objectives	1. Gain field experience in the relevant discipline. 2. Connect the theory with practice. 3. Present and document the training experience. 4. Acquire knowledge by introspection.

Course Outcomes:
On the successful completion of the course, the student will be able to

COs		Bloom's level
CO1	Gain field experience in the relevant discipline	Apply
CO2	Present and document the training experience	Apply
CO3	Apply modern tools for Engineering Applications	Apply
CO4	Understand the ethical practices adapted for sustainable development	Understand

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5
CO1	1	-	3	-	1
CO2	2	3	3	-	1
CO3	1	-	3	-	1
CO4	2	3	3	-	1

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Instructions:

- **Industry Internship:** The main objective of the industry internship is to ensure that the intern is exposed to a real-world environment and gain practical experience. Often, it may be a practical exposure to the theory that has been learned during the academic period.
- **Research Internship:** These internships can take place in academic institutions, research organizations, government agencies, or private companies
- **Internship Leading to Start-up:** An internship that leads to a startup is an exciting pathway, blending real-world experience with entrepreneurial ambition. Here's a comprehensive guide to transitioning an internship experience into launching your startup: 1) Maximize your internship experience, 2) Identifying Viable Business Ideas, 3) Research and Validation 4) Building a Business Plan 5) Networking and Mentorship 6) Securing Funding 7) Establishing Startup 8) Launching and Marketing. By following these steps, you can effectively transition from an internship to launching a successful startup. This journey requires dedication, resilience, and a willingness to learn and adapt.

Evaluation:

The continuous internal evaluation will be done in two phases using appropriate rubrics, the final evaluation will be done at the end of the IV semester with industry experts and the internship supervisor.

Course Code: MPRJ482
Credits: 16
SEE: 100 Marks
SEE Hours: 3

Course Name: Project Phase - II
L:T:P:S : -
CIE: 100 Marks
Max. Marks: 200

Prerequisites if any	Nil
Learning objectives	1. Implement solution methodology. 2. Harness the modern tools. 3. Analyse the economic feasibility of projects of social relevance. 4. Analyse, interpret the results and establish the scope for future work. 5. Present and document the project work. Acquire knowledge by introspection.

Course Outcomes:
On the successful completion of the course, the student will be able to

COs		**Bloom's level**
CO1	Implement solution methodology by utilising modern tools.	Create
CO2	Analyse the economic feasibility of the project and interpret the results.	Analyse
CO3	Present and document the project work.	Apply

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5
CO1	3	-	3	-	1
CO2	3	-	3	3	1
CO3	3	3	3	-	1

Mapping Strength: **Strong– 3** **Medium – 2** **Low – 1**