Course Structure
&
Detailed Syllabus

M. Tech.
Power Electronics

Academic Regulations - R24

Applicable for the Batches Admitted from 2024 - 2025

AVANTHI
INSTITUTE OF ENGINEERING AND TECHNOLOGY
(Autonomous)

(Approved by AICTE., New Delhi, & Permanently Affiliated to JNTU-GV, Vizianagaram)

NAAC "A+" Accredited Institute

Cherukupally (Village), Near Tagarapuvalasa Bridge, Vizianagaram (Dist)-531162

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

AVANTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY
(Autonomous)

Vision and Mission of the Institute

Vision: To develop highly skilled professionals with ethics and human values.

Mission:

- To impart quality education with industrial exposure and professional training
- To produce competent and highly knowledgeable engineers with positive approach
- To induce self confidence among students which is an imperative pre-requisite to face the challenges of life

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

AVANTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY
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Vision and Mission of the Department

Vision:

To emerge as a Center of Excellence for disseminating knowledge and research in the area of Electrical and Electronics Engineering.

Mission:

The Mission of the Department of Electrical & Electronics Engineering is to:

M1:

Impart quality education for addressing the needs of present & emerging technological world.

M2:

Interact with industry and research organizations to provide a unique set of well- rounded learning skills.

M3:

To enable graduates to take on the mantle of higher responsibilities in the domain of Electrical Engineering.

M4:

To produce competent and highly knowledgeable engineers with positive approach and self-confidence to face the challenges of life.

Program Educational Objectives (PEOs)

PEO1:

Ability to identify, analyses, design and solve complex and emerging problems of Power Electronics and drives.

PEO2:

Attain industry leadership skills to cater to the changing needs of Power Electronics industry, academia, society and environment.

PEO3:

Solve the real world problems in the emerging fields like smart grid, renewable energy interfaces and electric vehicles and to develop innovative technologies relevant to social, ethical, economic and environmental issues.

Program Outcomes (POs)

PO1: Demonstrate knowledge with ability to select, learn and apply appropriate techniques, skills and modern engineering tools to solve engineering problems appropriate to the relevant discipline.

PO2: Analyze engineering problems critically, conceptualize, design, implement and evaluate potential solutions to contribute to the development of scientific/technological solutions in the context of relevant discipline.

PO3: Independently carry out research /investigation and development work to solve practical problems.

PO4: Function effectively as an individual and in a team to possess knowledge and recognize opportunities for career progression and research.

PO5: Communicate effectively in professional practice through verbal and written formats.

PO6: Recognize the need for self-motivated pursuit of knowledge to show commitment and competence in the broadest context of technological change.

Program Specific Outcomes (PSOs)

PSO 1:

Apply technical knowledge, skill and analytical ability to design, develop and test power electronic converters and drives using modern tools and technologies.

PSO 2:

Solve the real world problems in the emerging fields like smart grid, renewable energy interfaces, and electric vehicles and to develop innovative technologies relevant to social, ethical, economic and environmental issues.

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Course Structure **Program: M.Tech-Power Electronics**

(Applicable from the academic year 2024-25 onwards)

I Year I Semester- Course Structure **Regulation: R24**

S.No	Category	Course Code	Course Name	L	T	P	C
1	PC	MTPE1101	**PC1: Professional Core 1** Electrical Machine Modeling and Analysis	3	0	0	3
2	PC	MTPE1102	**PC2: Professional Core 2** Advanced Power Electronic Converters - I	3	0	0	3
3	PE	MTPE11031 MTPE11032 MTPE11033	**Professional Elective-1** 1. Modern Control Theory 2. Power Quality Improvement Techniques **3.** Programmable Logic Controllers & Applications	3	0	0	3
4	PE	MTPE11041 MTPE11042 MTPE11043	**Professional Elective-2** 1. Artificial Intelligence Techniques 2. Renewable Energy Technologies 3. Reactive Power Compensation and Management	3	0	0	3
5	CC	MTCC1105	Research Methodology and IPR	2	0	0	2
6	LB	MTPE1106	**Laboratory-1** Power Electronics Simulation Laboratory	0	0	4	2
7	LB	MTPE1107	**Laboratory-2** Power Converters Laboratory	0	0	4	2
8	AC	MTAC1108 MTAC1109	**Audit Course – 1** 1. English for Research Paper Writing 2. Disaster Management	2	0	0	0
			Total	16	0	8	18

Category	Courses	Credits
PC-Professional Core Course	2	6
PE-Professional Elective Course	2	6
CC- Compulsory Course	1	2
LB-Laboratory Course	2	4
AC- Audit Courses	1	0
Total	8	18

Department of ELECTRICAL AND ELECTRONICS ENGINEERING

Course Structure **Program: M.Tech-Power Electronics**

(Applicable from the academic year 2024-25 onwards)

I Year II Semester- Course Structure **Regulation: R24**

S.No	Category	Course Code	Course Name	L	T	P	C
1	PC	MTPE1201	**PC3:Professional Core 3** Advanced Power Electronic Converters - II	3	0	0	3
2	PC	MTPE1202	**PC4: Professional Core 4** Power Electronic Control of Electrical Drives	3	0	0	3
3	PE	MTPE12031 MTPE12032 MTPE12033	**Professional Elective-3** 1. Power Electronics for Renewable Energy Systems 2. Electric Vehicles and Design 3. Digital Control Systems	3	0	0	3
4	PE	MTPE12041 MTPE12042 MTPE12043	**Professional Elective-4** 1. Advanced Digital Signal Processing 2. Applications of Power Converters 3. Microcontroller Applications to Power Electronics	3	0	0	3
5	LB	MTPE1205	**Laboratory-3** Electric Drives Simulation Laboratory	0	0	4	2
6	LB	MTPE1206	**Laboratory-4** Electric Drives Laboratory	0	0	4	2
7	PR	MTPE1207	Technical Seminar/Mini Project	0	0	4	2
8	AC	MTAC1208 MTAC1209	**Audit Course – 2** 1. Constitution of India 2. Pedagogy Studies	2	0	0	0
			Total	14	0	12	18

Category	Courses	Credits
PCC-Professional Core Courses	4	10
PEC-Professional Elective Courses	2	6
PR-Seminar	1	2
AC Audit Course	1	0
Total	8	18

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Course Structure-Program: M.Tech-Power Electronics

(Applicable from the academic year 2024-25 onwards)

II Year I Semester- Course Structure **Regulation: R24**

S.No	Category	Course Code	Course Name	L	T	P	C
1	PE	MTPE21051 MTPE21052 MTPE21053	**Professional Elective-5** 1. Digital Signal Processing Controlled Drives 2. Smart Grid Technologies 3. Modeling & Simulation of Power Electronic Systems	3	0	0	3
2	OE	MTPE2104	**Open Elective** 1. MOOCs-2 (NPTEL/SWAYAM)-Any 12 Week Course on Engineering/ Management/ Mathematics offered by other than parent department) 2. Course offered by other departments in the college	3	0	0	3
3	PJ	MTPE2105	**Dissertation-I / Industrial Project #**	0	0	20	10
			Total	**6**	**0**	**20**	**16**

Category	Courses	Credits
PC-Professional Core Course	1	3
OE-Open Elective Course	1	3
PJ- Project	1	10
Total	3	16

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Course Structure - Program: M.Tech-Power Electronics

(Applicable from the academic year 2024-25 onwards)

II Year II Semester- Course Structure **Regulation: R24**

S.No	Category	Course Code	Course Name	L	T	P	C
1	PJ	MTPE2201	Dissertation-II	0	0	32	16
			Total	0	0	32	16

Category	Courses	Credits
PR-Project	1	16
Total	**1**	**16**

Open Electives offered by the Department of EEE

1. Renewable Energy Sources
2. Fundamentals of Electric Vehicles
3. Concepts of Power System Engineering
4. Applications of Power Converters

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MTPE1101 ELECTRICAL MACHINE MODELING AND ANALYSIS 3 0 0 3

Course Objectives:

1. To know the concepts of generalized theory of electrical machines.
2. To represent the DC and AC machines as Basic Two Pole machine.
3. To model the electrical machines with voltage, current, torque and speed equations
4. To investigate the steady state and transient behaviour of the electrical machines.
5. To understand the dynamic behaviour of the AC machines

Course Code	Course Outcomes	Mapping with POs and PSOs						Dok
		PO1	PO2	PO3	PO4	PSO1	PSO2	
MTPE1101.1	Identify the methods and assumptions in modeling of machines.	2	-	2	3	1	1	L2,L3
MTPE1101.2	Analyze the characteristics of different types of DC motors to design suitable controllers for different applications.	2	3	-	1	2	1	L1, L2
MTPE1101.3	Apply the knowledge of reference frame theory for AC machines to model the induction and Synchronous machines	-	3	2	1	1	2	L2, L4,L6
MTPE1101.4	Evaluate the steady state and transient behaviour of induction and synchronous machines to propose the suitability of drives for different industrial applications	3	2	1	-	2	1	L3,,L5
MTPE1101.5	Analyze the behaviour of induction machines using voltage and torque equations.	2	-	3	1	2	3	L3, L4, L5

SYLLABUS

UNIT- I: Basic Concepts of Modelling **10 Hours**

Basic two-pole machine representation of Commutator machines, representations of 3-phase synchronous Machine with and without damper bars and 3-phase induction machine, Kron"s primitive Machine Voltage, current and torque equations. **COs – CO1**

Self-Learning Topics: Basics of DC & AC Machines

UNIT-II: DC Machine Modelling **10 Hours**

Mathematical model of separately excited D.C motor – Steady state analysis-transient State analysis sudden Application of inertia load-transfer function of separately excited D.C motor-Mathematical model Of D.C Series motor, shunt motor-Linearization techniques for small perturbations. **COs – CO2**

Self-Learning Topics: DC Motors

UNIT- III: Reference Frame Theory & Modelling Of Single Phase Induction Machines

12 Hours

Linear transformation-Phase transformation - three phase to two phase transformation (abc to αβ0) and Vice-versa, transformation to rotating reference frame, (αβ0 to dqo) and vice versa -Power equivalence-Mathematical modelling of single phase induction machines **COs– CO3**

Self-Learning Topics: Single Phase induction Motors

UNIT– IV: Modelling Of Three Phase Induction Machine **10 Hours**

Generalized model in arbitrary reference frame-Derivation of commonly used induction machine models-Synchronously rotating reference frame model, Stator reference frame model-Rotor reference frame Model--power equation, electromagnetic torque equation, and state space model in induction motor with flux Linkages as variables. **COs– CO4**

Self-Learning Topics: Three Phase Induction motors

UNIT– V: Modelling Of Synchronous Machine **10Hours**

Synchronous machine inductances –derivation of voltage equations in the roto's dq0 reference frame Electromagnetic torque-current in terms of flux linkages-three phase synchronous motor. State space Models with flux linkages as variables. **COs– CO5**

Self-Learning Topics: Special Machines

Board of Studies	: Electrical and Electronics Engineering
Approved in BoS No	: 01, 1st August, 2024
Approved in ACM No	: 01

Text Books

1. Analysis of Electric Machinery and Drive Systems, 3rd Edition-Wiley-IEEE Press- Paul Krause, Oleg Wasynczuk, Scott D. Sudhoff, Steven Pekarek, Junr 2013.
2. Electric Motor Drives - Modeling, Analysis& control -R.Krishnan- Pearson Publications

Reference Books:

1. Generalized theory of Electrical Machines -Fifth edition, Khanna Publishers P. S. Bimbhra, 1985.
2. Dynamic simulation of Electric machinery using MATLAB / Simulink –CheeMunOng-Prentice Hall, 2003.
3. Magneto electric devices transducers, transformers and machines-G. R. Slemon- Wiley in New York, London, 1966.

Web References:

1. **https://onlinecourses.nptel.ac.in/noc21_ee20/preview**
2. **https://onlinecourses.nptel.ac.in/noc24_ee76/preview**

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1(%)	Internal Assessment #2(%)
L1 L2	20	20
L3 L4	40	40

L5 L6	40	40
Total (%)	100	100

Sample Short and Long Answers questions of Various Cognitive Levels

1. Obtain the Primitive machine representations of amplifying and ac induction motor?
2. Describe the modelling of three phase synchronous machine with damper bars
3. Prove that rotational inductance and transformer mutual inductance appears in the Modelling of Kron's Primitive machine?
4. Why damper bars are used? Explain its significance
5. Derive the first order transfer functions of separately excited D.C motor by suitable assumptions?
6. Explain the basic modelling of three phase induction machine
7. Derive the torque equation of a three phase induction machine
8. Deduce the mathematical model of separately excited d.c. motor in the matrix form?
9. Explain the transfer function analysis of a separately excited DC motor
10. Deduce the speed equation of dc motor which is used to obtain steady state and Transient analysis?
11. Obtain transient state speed characteristics of D.C motor under sudden decrease in Supply voltage by an amount ΔVt?
12. Derive the mathematical model of single phase capacitor start induction motor?
13. Obtain the mathematical model 3-phase induction motor in synchronous reference frame in the state variable form assuming flux linkages as state variables?
14. Deduce the synchronous motor voltage equations in the rotor's dq0 reference frame?
15. Deduce the torque equation of the synchronous motor in terms current flux Variables?

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MTPE1102 ADVANCED POWER ELECTRONIC CONVERTERS-I 3 0 0 3

Course Objectives:

1. To understand various advanced power electronic devices.
2. To comprehend the design of rectifiers
3. To comprehend the PWM inverters.
4. To understand the operation of three faze inverters
5. To understand the operation of multi-level inverters with switching strategies for high power applications.

Course Code	Course Outcomes	Mapping with POs and PSOs						Dok
		PO1	PO2	PO3	PO5	PSO1	PSO2	
MTPE1102.1	Analyze the performance of controlled rectifiers	2	2	3	-	1	3	L3,L4
MTPE1102.2	Capability in designing isolated converters	3	2	2	1	2	1	L3,L5
MTPE1102.3	Ability to dynamic analysis of power Converters.	2	-	3	2	1	2	L2,L4
MTPE1102.4	Competency in operation of resonant converter.	3	1	-	2	1	2	L2,L3
MTPE1102.5	Know-how of multilevel converter	3	2	2	-	2	1	L3,L5

SYLLABUS

UNIT- I: Modern Power Semiconductor Devices **12 Hours**

Modern power semiconductor devices: Symbol, Structure and equivalent circuit of Insulated Gate Bipolar Transistor (IGBT), MOSFET, MOS Turn off Thyristor (MTO), Emitter Turn off Thyristor (ETO), Integrated Gate-Commutated Thyristor (IGCTs), MOS-controlled thyristors (MCTs), Power Integrated Circuits (PICs). Comparison of their features. **COs – CO1**

Self-Learning Topics: Power Electronics

UNIT-II: Single Phase & Three Phase Converters **14 Hours**

Single phase converters: Half controlled and Fully controlled converters, Evaluation of input power factor and harmonic factor, continuous and Discontinuous load current, Single phase dual converters, Power factor Improvements Techniques, Extinction angle control, Symmetrical angle control, Single phase sinusoidal PWM, Single phase series converters, Overlap analysis, Applications & Problems.

Three phase converters: Half controlled and fully controlled converters, Evaluation of input power factor and harmonic factor, Continuous and Discontinuous load current, Three phase dual converters, Power factor Improvements Techniques, Three phase PWM, Twelve pulse converters, Applications &Problems. **COs – CO2**

Self-Learning Topics: Power Electronics

UNIT- III: Pulse Width Modulated Inverters **12 Hours**

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

COs– CO3

Self-Learning Topics: Single Phase Inverters

UNIT– IV: Three Phase Inverters **10 Hours**

Generalized model in arbitrary reference frame-Derivation of commonly used induction machine models-Synchronously rotating reference frame model, Stator reference frame model-Rotor reference frame Model--power equation, electromagnetic torque equation, and state space model in induction motor with flux Linkages as variables. **COs– CO4**

Self-Learning Topics: Inverters

UNIT– V: Multilevel Inverters **10 Hours**

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

COs– CO5

Self-Learning Topics: Basics of Multi Level Inverters

Board of Studies: Electrical and Electronics Engineering

Approved in BOS No: 01, 1st August 2024

Approved in ACM No: 01

Textbooks:

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

References:

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

Web References:

https://onlinecourses.nptel.ac.in/noc21_ee20/preview

https://onlinecourses.nptel.ac.in/noc24_ee76/preview

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1(%)	Internal Assessment #2(%)
L1 L2	20	20
L3 L4	40	40
L5 L6	40	40

Total (%)	100	100

Sample Short and Long Answers questions of Various Cognitive Levels

1. Explain the difference between MOSFET, BJT and IGBT
2. Explain the working of MOS Turn off Thyristor
3. Explain in detail about Series Resonant Inverters with unidirectional switches
4. Explain in detail about M type ZCS resonant converter with waveforms and circuit diagram
5. List out the applications of Multilevel inverters
6. What is the need of Resonant converter
7. Explain Brief about DC side voltage control in rectifier
8. Explain in detail about L type ZCS resonant converter
9. Explain the operation of ZVS resonant converter with neat diagram and output waveforms
10. Explain the Principle of operation of Flying Capacitor multilevel inverter with neat diagram and output waveform
11. Discuss the principle, operation and features of 3-level diode clamped multilevel Inverter
12. Deduce the torque equation of the synchronous motor in terms current flux variables?
13. Derive the mathematical model of the switched reluctance motor?
14. Explain in detail about Class E Resonant rectifier with neat diagram and output waveforms
15. Give the advantages and disadvantages with comparing multilevel inverter, diode clamped multilevel inverter, Fining Capacitor multilevel inverter and Cascade H bridge multilevel inverter
16. The series resonant inverter has L1 = L2 = L = 50μH, C = 6μF, R= 2Ω, Vs = 220V, frequency of output voltage is of fo = 7KHz. Turn off time of thyristor is tq=10mS.Find i) the available circuit turn off time(toff), ii) Maximum permissible frequency (fmax) iii) Vpp (peak to peak capacitor voltage iv)The peak load current (Ip) 7 4 2 2 U

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MTPE11031 **MODERN CONTROL THEORY** **3 0 0 3**

Course Objectives:

1. To facilitate the evolution of state variable approach for the analysis of control systems.
2. To explain the concepts of state variables analysis
3. To examine the importance of controllability and observability in modern control engineering.
4. To enable students to analyze various types of nonlinearities & construction of trajectories using describing functions and phase plane analysis.
5. To study the analysis of stability and instability of continuous time invariant system

Course Code	Course Outcomes	Mapping with POs and PSOs						Dok
		PO1	PO2	PO3	PO4	PSO1	PSO2	
MTPE11031.1	Formulate and solve the state equations of dynamic systems, analyze controllability and observability	3	-	2	2	1	2	L2,L4
MTPE11031.2	Design state feedback controller; design an observer.	2	3	-	1	2	1	L3,L5
MTPE11031.3	Linearize a nonlinear system model; analyze non-linear systems through describing functions	2	3	2	-	1	2	L4,L5
MTPE11031.4	Determine the stability of a given system; generate a Lyapunov function	1	-	2	2	3	1	L2,L3
MTPE11031.5	Minimize a given functional, design an optimal feedback gain matrix	2	3	-	1	2	1	L3,L5

SYLLABUS

UNIT- I: State Variable Analysis **10 Hours**

The concept of state – State Equations for Dynamic systems– Solution of Linear Time Invariant Continuous-Time State Equations, State transition matrix and it"s properties. Controllability and Observability of state model in Jordan Canonical form - Controllability and Observability Canonical Forms of State model. **COs – CO1**

Self-Learning Topics: Basics of Control Systems

UNIT-II: Design Using State Variable Technique **8 Hours**

Design of state feedback controller through pole placement technique-Necessary and sufficient condition- Ackermann's formula. Concept of observer-Design of full order state observer-reduced order observer. **COs – CO2**

Self-Learning Topics: Control Systems

UNIT- III: Non Linear Systems **10 Hours**

Classification of Nonlinearities- common physical nonlinearities– Characteristics of nonlinear systems - Singular Points –Linearization of nonlinear systems– Describing function – describing

function analysis of nonlinear systems- Stability analysis of Nonlinear systems through describing functions. **COs– CO3**

Self-Learning Topics: Stability

UNIT– IV: Stability Analysis **12 Hours**

Generalized model in arbitrary reference frame-Derivation of commonly used induction machine models- Synchronously rotating reference frame model, Stator reference frame model-Rotor reference frame Model--power equation, electromagnetic torque equation, and state space model in induction motor with flux Linkages as variables. **COs– CO4**

Self-Learning Topics: Stability Analysis

UNIT– V: Introduction to Optimal Control **12 Hours**

Minimization of functional of single function – Constrained minimization – Minimum principle – Control Variable inequality constraints – Control and state variable inequality constraints – Euler Lagrangine Equation. Typical optimal control performance measures-optimal control based on Quadratic performance Measures- Quadratic optimal regulator systems- State regulator problems – Output regulator problems, Tracking problems; Riccati equation-Infinite time regulator problem-Reduce matrix Riccati equation determination of optimal feedback gain matrix. **COs– CO5**

Self-Learning Topics: Control Techniques

Board of Studies: Electrical and Electronics Engineering
Approved in BoS No: 01, 1st August, 2024
Approved in ACM No: 01

Textbooks:

1. Modern Control Engineering – by K. Ogata, Prentice Hall of India, 3rd edition, 1998.
2. Automatic Control Systems by B.C. Kuo, Prentice Hall Publication

References:

1. Modern Control System Theory – by M. Gopal, New Age International Publishers, 2nd edition,1996
2. Control Systems Engineering by I.J. Nagarath and M.Gopal, New Age International (P) Ltd.
3. Digital Control and State Variable Methods – by M. Gopal, Tata McGraw–Hill Companies, 1997.
4. Systems and Control by Stainslaw H. Zak , Oxford Press, 2003.

Web References:

https://onlinecourses.nptel.ac.in/noc21_ee20/preview
https://onlinecourses.nptel.ac.in/noc24_ee76/preview

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1(%)	Internal Assessment #2(%)
L1 L2	20	20
L3 L4	40	40
L5 L6	40	40
Total (%)	100	100

Sample Short and Long Answers questions of Various Cognitive Levels

1. Explain the concept of state?
2. Explain the physical significance of the concept of controllability and observability?
3. Discuss observability canonical forms of state model?
4. Describe the controllability tests for continuous time invariant systems
5. Explain the popular nonlinearities.
6. List out the properties of nonlinear systems.
7. Derive the describe function of relay with dead zone
8. Describe the stability analysis of Non-Linear systems through describing functions.
9. Explain the concept of singular point
10. What are the different types of stability? Define and explain each of them with examples.
11. Suppose you are given a linear continuous time autonomous system, how do you decide whether a system is globally asymptotically stable?
12. Explain the stability analysis of the linear continuous time invariant systems by Lyapunov second method.
13. Illustrate the generation of Lyapunov function by Krasooviski's method?
14. Define the state observer? Deduce the expression for reduced order observer?
15. Write a short note on the following
    a) Formulation using Hamiltonian method b) Linear quadratic regulator

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MTPE11032 POWER QUALITY IMPROVEMENT TECHNIQUES 3 0 0 3

Course Objectives:

1. To know different terms of power quality.
2. To illustrate power quality issues for short and long interruptions.
3. To study of characterization of voltage sag magnitude and three-phase unbalanced voltage sag.
4. To know the behaviour of power electronics loads, induction motors, synchronous motor etc. by the power quality issues
5. To know mitigation of power quality problems by using VSI converters.

Course Code	Course Outcomes	Mapping with POs and PSOs						Dok
		PO1	PO2	PO3	PO5	PSO 1	PSO 2	
MTPE11032.1	Know the severity of power quality problems in distribution system	3	2	-	3	2	1	L2,L5
MTPE11032.2	Understand the concept of voltage sag transformation from up-stream (higher voltages) to downstream (lower voltage)	1	3	2	-	1	2	L3,L4
MTPE11032.3	Compute the power quality improvement by using various mitigating custom power devices	3	1	2	-	2	1	L3,L5
MTPE11032.4	Understand power quality monitoring and Classification techniques.	2	2	-	2	3	2	L2,L3
MTPE11032.5	Understand power quality using UPQC and design	2	-	3	1	2	2	L4,L5

SYLLABUS

UNIT- I: Introduction and Power Quality Standards **12 Hours**

Introduction, Classification of Power Quality Problems, Causes, Effects and Mitigation Techniques of Power Quality Problems, Power Quality Terminology, Standards, Definitions, Monitoring and Numerical Problems. **COs – CO1**

Self-Learning Topics: Basics of Power Systems

UNIT-II: Causes Of Power Quality Problems **12 Hours**

Introduction to Non-Linear Loads, Power Quality Problems caused by Non-Linear Loads, Analysis of Non- Linear Loads, Numerical Problems. **COs – CO2**

Self-Learning Topics: Power Quality

UNIT- III: Passive Shunt And Series Compensation **12 Hours**

Introduction, Classification and Principle of operation of Passive Shunt and Series Compensators, Analysis and Design of Passive Shunt Compensators for Single-Phase System, Three-Phase Three Wire System and Three-Phase Four Wire System. **COs– CO3**

Self-Learning Topics: FACTS Devices

UNIT– IV: Active Shunt And Series Compensation **10Hours**

Introduction to Shunt compensators: Classification of DSTATCOM's, Principle of Operation of DSTATCOM.

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

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

Different Control Algorithms of DVR: Synchronous Reference Frame Theory-Based Control of DVR, Analysis and Design of Active Series Compensators, Numerical Problems **COs– CO4**

Self-Learning Topics: Control Algorithms

UNIT– V: Unified Power Quality Compensators **10Hours**

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

Control of UPQCs: Synchronous Reference Frame Theory-Based UPQC, Analysis and Design of UPQCs, Numerical Problems. **COs– CO5**

Self-Learning Topics: Facts Devices

Board of Studies: Electrical and Electronics Engineering

Approved in BoS No: 01, 1st August, 2024
Approved in ACM No: 01

Textbooks:

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

References:

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

Web References:

https://onlinecourses.nptel.ac.in/noc21_ee20/preview
https://onlinecourses.nptel.ac.in/noc24_ee76/preview

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1(%)	Internal Assessment #2(%)
L1 L2	20	20
L3 L4	40	40
L5 L6	40	40

Total (%)	100	100

Sample Short and Long Answers questions of Various Cognitive Levels

1. Explain how various modes of transformer connection reduces harmonics in a system?
2. Explain the principle of operation of power quality conditioners for flicker control.
3. Find the total harmonic distortion of a voltage waveform with the following harmonic frequency make up. Fundamental =114 V, 3rd harmonic = 4V, 5th harmonic=2V, 7th harmonic=1.5 V and 9th harmonic=1V.
4. Describe high power factor converter circuit and its application for improvement of power quality
5. Explain the use of capacitor for voltage regulation.
6. Define Ferro resonance? Explain the phenomena of Ferro resonance
7. A transformer rating 13.8kV, 50Hz, 20MVA star/star connected is solidly grounded. When fully loaded at rating, power factor=0.6. What is the value of capacitance C used to correct the power factor unity?
8. What is the need for integral cycle control? Explain a practical method of its application with the help of neat diagram
9. Explain the possible effects of harmonics on series and parallel resonance.
10. What is the effect of DC offset on power quality? What is the role of consumer equipments in maintenance of power quality?
11. Explain the unified power quality conditioner technique for improvement of power quality
12. What are filter design criteria? Explain principle of operation of single tuned high pass filter.
13. With a waveform sketch, explain the terms 'voltage sag' and 'voltage swell'. How do voltage sag and voltage swell affect power quality? Also explain the remedial measures for improvement of power quality.
14. Differentiate between active filters and passive filters. Also draw the input current waveforms and harmonic spectrum of 6-pulse and 12-pulse converters.
15. How do the harmonics affect the operation of transmission lines? Explain the role of capacitor banks in a power system. Also explain the role of arc furnace and battery chargers for harmonic production.
16. What are the effects of harmonic interference on control system equipments and protection equipments? Explain each with suitable diagram.

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MTPE11033 PROGRAMMABLE LOGIC CONTROLLERS & APPLICATIONS 3 0 0 3

Course Objectives:

1. To have knowledge on PLC.
2. To acquire the knowledge on programming of PLC.
3. To understand different PLC registers and their description.
4. To have knowledge on data handling functions of PLC.
5. To know how to handle analog signal and converting of A/D in PLC.

Course Code	Course Outcomes	Mapping with POs and PSOs						Dok
		PO1	PO2	PO3	PO4	PSO1	PSO2	
MTPE11033.1	Understand the PLCs and their I/O modules.	3	-	3	2	2	2	L2,L4
MTPE11033.2	Develop control algorithms to PLC using ladder logic etc.	1	2	2	-	2	3	L3,L5
MTPE11033.3	Manage PLC registers for effective utilization in different applications	2	1	2	-	2	3	L4,L5
MTPE11033.4	Handle data functions and control of two axis and their axis robots with PLC	-	2	1	1	3	2	L2,L3
MTPE11033.5	Design PID controller with PLC.	2	-	2	3	2	3	L3,L5

SYLLABUS

UNIT- I: PLC Basics **8 Hours**

PLC system, I/O modules and interfacing, CPU processor, programming equipment, programming formats, construction of PLC ladder diagrams, devices connected to I/O modules. **COs – CO1**

Self-Learning Topics: Basics in PLC

UNIT-II: PLC Programming: **10 Hours**

Input instructions, outputs, operational procedures, programming examples using contacts and coils. Drill press operation. Digital logic gates, programming in the Boolean algebra system, conversion examples.

Ladder diagrams for process control: Ladder diagrams and sequence listings, ladder diagram construction and flow chart for spray process system. **COs – CO2**

Self-Learning Topics: Programming

UNIT- III: PLC Registers **10 Hours**

Characteristics of Registers, module addressing, holding registers, input registers, output registers. PLC Functions: Timer functions and Industrial applications, counters, counter function industrial applications, Arithmetic functions, Number comparison functions, number conversion functions.

COs– CO3

Self-Learning Topics: Registers In PLC

UNIT– IV: Data Handling functions **10 Hours**

SKIP, Master control Relay, Jump, Move, FIFO, FAL, ONS, CLR and Sweep functions and their

applications. Bit Pattern and changing a bit shift register, sequence functions and applications, controlling of two axis and three axis Robots with PLC, Matrix functions. **COs– CO4**

Self-Learning Topics: Functions

UNIT– V: Analog PLC operation: **10Hours**

Analog modules and systems, Analog signal processing, multi bit data processing, analog output application examples, PID principles, position indicator with PID control, PID modules, PID tuning, PID functions. **COs– CO5**

Self-Learning Topics: Analog Operations

Board of Studies: Electrical and Electronics Engineering
Approved in BOS No: 01, 1st August, 2024
Approved in ACM No: 01

Textbooks:

1. Programmable Logic Controllers – Principle and Applications by John W. Webb and Ronald Reiss, Fifth Edition, PHI
2. Programmable Logic Controllers – Programming Method and Applications by JR., Hackworth and F.D Hackworth Jr. – Pearson, 2004.

References:

1. Introduction to Programmable Logic Controllers- Gary Dunning-Cengage Learning. Programmable Logic Controllers –W.Bolton-Elsevier publisher.

Web References:

https://onlinecourses.nptel.ac.in/noc21_ee20/preview
https://onlinecourses.nptel.ac.in/noc24_ee76/preview

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1(%)	Internal Assessment #2(%)
L1 L2	20	20
L3 L4	40	40
L5 L6	40	40
Total (%)	100	100

Sample Short and Long Answers questions of Various Cognitive Levels

1. What are the components of a PLC?
2. What are the functions of PLC CPU? Explain their operational sequence.
3. Explain a typical PLC output scheme
4. Design the operation of a drill press module and draw the necessary Ladder diagram.
5. Explain the following i) AND gate and relay and PLC equivalents ii) NOR gate and relay

and PLC equivalents

6. Discuss about ladder diagrams and sequence listings
7. What are the characteristics of PLC registers? Explain the function of any two types of PLC registers in detail.
8. How many configurations are there for PLC counter functions? Explain.
9. Discuss the application of a dual counter for parts to be counted on a conveyor belt. Assume required design considerations.
10. Explain the JUMP with NON-RETURN with an application.
11. Explain the FAL function of a PLC with a schematic of its operations.
12. How do you change the status of bit pattern of a register? Explain
13. Write short notes on the following a) Input output devices connected to PLC b) PLC analog signal processing c) PLC Master control Relay
14. Discuss in detail the coil (output) function of the PLC.
15. List and describe the major steps in creating a PLC program for an industrial situation.

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MTPE11041 ARTIFICIAL INTELLIGENCE TECHNIQUES 3 0 0 3

Course Objectives:

1. To have knowledge on concept of neural network.
2. To know different types of neural networks and training algorithms.
3. To understand the concept of genetic algorithm and its application in optimization.
4. To have the knowledge on fuzzy logic and design of fuzzy logic controllers.
5. To know the applications of AI Techniques in electrical engineering.

Course Code	Course Outcomes	Mapping with POs and PSOs						Dok
		PO1	PO2	PO3	PO4	PSO 1	PSO 2	
MTPE11041.1	Understand the PLCs and their I/O modules.	2	2	3	-	2	1	L3,L4
MTPE11041.2	Develop control algorithms to PLC using ladder logic etc.	1	-	2	2	-	2	L3,L5
MTPE11041.3	Manage PLC registers for effective utilization in different applications	3	2	-	1	2	1	L2,L4
MTPE11041.4	Handle data functions and control of two axis and their axis robots with PLC	1	3	2	-	2	-	L2,L3
MTPE11041.5	Design PID controller with PLC.	2	1	-	2	1	2	L3,L5

SYLLABUS

UNIT- I: Introduction **12 Hours**

Artificial Neural Networks (ANN) – definition and fundamental concepts – Biological neural networks – Artificial neuron – activation functions – setting of weights – typical architectures – biases and thresholds – learning/training laws and algorithms. Perceptron – architectures, ADALINE and MADLINE – linear separability- XOR function. **COs – CO1**

Self-Learning Topics: Fuzzy Basics

UNIT-II: ANN Paradigms **10 Hours**

ADALINE – feed forward networks – Back Propagation algorithm- number of hidden layers – gradient decent algorithm – Radial Basis Function (RBF) network. Kohonen"sself organizing map (SOM), Learning Vector Quantization (LVQ) and its types – Functional Link Networks (FLN) – Bidirectional Associative Memory (BAM) – Hopfield Neural Network. **COs – CO2**

Self-Learning Topics: ANN Techniques

UNIT- III: Classical and Fuzzy Sets **10 Hours**

Introduction to classical sets- properties, Operations and relations; Fuzzy sets, Membership, Operations, Properties, Fuzzy relations, Cardinalities, Membership functions. **COs– CO3**

Self-Learning Topics: Properties of Fuzzy

UNIT– IV: Fuzzy Logic Controller (FLC) **10 Hours**

Generalized model in arbitrary reference frame-Derivation of commonly used induction machine models- Synchronously rotating reference frame model, Stator reference frame model-Rotor

reference frame Model--power equation, electromagnetic torque equation, and state space model in induction motor with flux Linkages as variables. **COs– CO4**

Self-Learning Topics: FLC

UNIT– V: Application of AI Techniques **10Hours**

Speed control of DC motors using fuzzy logic –load flow studies using back propagation algorithm, single area and two area load frequency control using fuzzy logic. **COs– CO5**

Self-Learning Topics: AI Applications

Board of Studies: Electrical and Electronics Engineering
Approved in BOS No: 01, 1st August, 2024
Approved in ACM No: 01

Textbooks:

1. Introduction to Artificial Neural Systems - Jacek M. Zuarda, Jaico Publishing House, 1997.
2. Fuzzy logic with Fuzzy Applications – T.J Ross – McGraw Hill Inc, 1997.

References:

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

Web References:

1. **https://onlinecourses.nptel.ac.in/noc21_ee20/preview**
2. **https://onlinecourses.nptel.ac.in/noc24_ee76/preview**

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1(%)	Internal Assessment #2(%)
L1 L2	20	20
L3 L4	40	40
L5 L6	40	40
Total (%)	100	100

Sample Short and Long Answers questions of Various Cognitive Levels

1. Explain briefly about the concept of knowledge representation learning process and learning tasks?
2. Explain about the concepts of humans and computers in AI?
3. Describe neural network models and architecture?
4. Explain discrete, continuous and multi-category perception models?
5. Explain briefly about the concept of RBF algorithms?
6. Explain about reproduction operators concept in genetic algorithms?

7. Explain briefly about the concept of binary encoding?
8. Explain about the concept of mutation operator?
9. Explain about generational cycle?
10. Describe fuzzy set operations and relations?
11. Define uncertainty? What are the membership functions with schematic?
12. Explain briefly about the concept of membership value assignment?
13. Explain development of rule base and decision making system in fuzzy logic system?
14. How do you control the load frequency in power system by using fuzzy logic controller?
15. Explain the design of Fuzzy PI controller for speed control of DC motors.

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MTPE11042 RENEWABLE ENERGY TECHNOLOGIES 3 0 0 3

Course Objectives:

1. To learn technical challenges in renewable energy.
2. To learn basics of wind energy conversion & PV power generation.
3. To analyze the of fuel cell system.
4. To know the operation of AC-DC, DC-DC and AC-AC power converters used in renewable energy systems.
5. To know the principles of standalone, grid connected and hybrid operation in renewable energy systems.

Course Code	Course Outcomes	Mapping with POs and PSOs						Dok
		PO1	PO2	PO3	PO4	PSO1	PSO2	
MTPE11042.1	Understand various general aspects of renewable energy systems	2	2	3	-	2	3	L2,L4
MTPE11042.2	Analyze and design induction generator for power generation from wind.	2	-	2	3	-	2	L3,L5
MTPE11042.3	Design MPPT controller for solar power utilization.	1	2	-	2	2	1	L4,L5
MTPE11042.4	Utilize fuel cell systems for power generation.	2	1	2	-	2	-	L2,L3
MTPE11042.5	Interpret the stand alone, grid connected and hybrid renewable energy systems	3	2	-	2	1	2	L3,L5

SYLLABUS

UNIT- I: Introduction **10 Hours**

Renewable Sources of Energy; Distributed Generation; Renewable Energy Economics -Calculation of Electricity Generation Costs; Demand-Side Management Options; Supply-Side Management Options; Control of renewable energy based power Systems. **COs – CO1**

Self-Learning Topics: Basics of RES

UNIT-II: Induction Generators **10 Hours**

Principles of Operation; Representation of Steady-State Operation; Power and Losses Generated - Self-Excited Induction Generator; Magnetizing Curves and Self-Excitation – Mathematical Description of the Self-Excitation Process; Interconnected and Stand-alone operation - Speed and Voltage Control. **COs – CO2**

Self-Learning Topics: Power and Losses in Induction Generator

UNIT- III: Wind Power Plants **10 Hours**

Site Selection; Evaluation of Wind Intensity; Topography; Purpose of the Energy Generation-General Classification of Wind Turbines; Rotor Turbines; Multiple-Blade Turbines; Drag Turbines; Lifting Turbines - Generators and Speed Control Used in Wind Power Energy; Analysis of Small wind energy conversion system. **COs– CO3**

Self-Learning Topics: Energy Generation

UNIT– IV: Photovoltaic Power Plants: **12 Hours**

Solar Energy; Generation of Electricity by Photovoltaic Effect; Dependence of a PV Cell on Temperature and irradiance input-output Characteristics - Equivalent Models and Parameters for Photovoltaic Panels; MPPT schemes: P&O,INC, effect of partial shaded condition. Applications of Photovoltaic Solar Energy-Economical Analysis of Solar Energy. **COs– CO4**
Self-Learning Topics: Photovoltaic Effect

UNIT– V: Induction Generators **12 Hours**

The Fuel Cell; Low- and High-Temperature Fuel Cells; Commercial and Manufacturing Issues - Constructional Features of Proton Exchange-Membrane Fuel Cells; Reformers; Electrolyzer Systems; Advantages and Disadvantages of Fuel Cells - Fuel Cell Equivalent Circuit; Practical Determination of the Equivalent Model Parameters; Aspects of Hydrogen for storage. **COs– CO5**
Self-Learning Topics: Fuel Cells

Board of Studies: Electrical and Electronics Engineering
Approved in BOS No: 01, 1st Aug, 2024
Approved in ACM No: 01

Textbooks:

1. Felix A. Farret, M. Godoy Simo` es, Integration of Alternative Sources of Energy, John Wiley & Sons, 2006.
2. Remus Teodorescu, Marco Liserre, Pedro Rodríguez, Grid Converters for Photovoltaic and Wind, Power Systems, John Wiley & Sons, 2011.

References:

1. Gilbert M. Masters, Renewable and Efficient Electric Power Systems, John Wiley & Sons, 2004

Web References:

1. https://onlinecourses.nptel.ac.in/noc21_ee20/preview
2. https://onlinecourses.nptel.ac.in/noc24_ee76/preview

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1(%)	Internal Assessment #2(%)
L1 L2	20	20
L3 L4	40	40
L5 L6	40	40
Total (%)	100	100

Sample Short and Long Answers questions of Various Cognitive Levels

1. Write the construction and working of wind turbine
2. Give the construction and working of wind mill.
3. Describe working of grid connected wind turbine

4. Explain the applications of wind turbine for water pump.
5. Write the sources and application of solar energy
6. Explain the construction and working of solar water heating system
7. Describe the construction and working of solar photovoltaic system
8. Give brief idea regarding solar distillation and cooling in chemical industry.
9. Explain the construction and working of preparation of energy from wood
10. Describe the formation of energy from kitchen bio-mass
11. Write the demerits of bio- energy from solid bio-mass
12. Give the concepts of bio-energy from solid biomass. Illustrate it with suitable example
13. Write the merits of bio- energy from solid bio-mas
14. Explain concept and principle used in fuel cell
15. Write the construction working of fuel cell with labeled diagram giving its chemical reaction

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MTPE11043 REACTIVE POWER COMPENSATION AND MANAGEMENT 3 0 0 3

Course Objectives:

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

Course Code	Course Outcomes	Mapping with POs and PSOs						Dok
		PO1	PO2	PO3	PO5	PSO1	PSO2	
MTPE11043.1	Distinguish the importance of load compensation in symmetrical as well as unsymmetrical loads	2	3	-	2	2	3	L1,L2
MTPE11043.2	Work out on various compensation methods in transmission lines	-	1	3	2	1	2	L2,L3
MTPE11043.3	Construct models for reactive power coordination	3	-	2	1	2	1	L1,L5
MTPE11043.4	Analyse demand side reactive power management & user side reactive power management	2	2	1	-	3	2	L2,L4
MTPE11043.5	Analyze user side reactive power management	1	2	-	2	1	2	L1,L5

SYLLABUS

UNIT- I: Load Compensation **12 Hours**

Objectives and specifications, Reactive power characteristics, Inductive and capacitive approximate biasing, Load compensator as a voltage regulator, Phase balancing and power factor correction of unsymmetrical loads, Examples. **COs – CO1**

Self-Learning Topics: Fuzzy Basics

UNIT-II: Steady–State Reactive Power Compensation in Transmission Systems **12 Hours**

Uncompensated line, Types of compensation, Passive shunt and series and dynamic shunt compensation, Examples.

Transient State Reactive Power Compensation In Transmission Systems

Characteristic time periods, Passive shunt compensation, Static compensation, Series capacitor compensation, Compensation using synchronous condenser, Examples. **COs – CO2**

Self-Learning Topics: ANN Techniques

UNIT- III: Reactive Power Coordination **10 Hours**

Objective, Mathematical modelling, Operation planning, Transmission benefits, Basic concepts of quality of power supply, Disturbances, Steady–state variations, Effect of under-voltages, Frequency, Harmonics, Radio frequency and electromagnetic interference. **COs– CO3**

Self-Learning Topics: Properties of Fuzzy

UNIT– IV: Demand Side Management **12 Hours**

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

Distribution Side Reactive Power Management

System losses, Loss reduction methods, Examples, Reactive power planning, Objectives, economics Planning capacitor placement, Retrofitting of capacitor banks. **COs– CO4**

Self-Learning Topics: FLC

UNIT– V: User Side Reactive Power Management **10 Hours**

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

Reactive Power Management In Electric Traction Systems And Arc Furnaces

Typical layout of traction systems, Reactive power control requirements, Distribution transformers, Electric arc furnaces, Basic operation, Furnaces transformer, Filter requirements, Remedial measures, Power factor of an arc furnace. **COs– CO5**

Self-Learning Topics: AI Applications

Board of Studies:	Electrical and Electronics Engineering
Approved in BOS No:	01, 1st August, 2024
Approved in ACM No:	01

Textbooks:

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

References:

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

Web References:

1. https://onlinecourses.nptel.ac.in/noc21_ee20/preview
2. https://onlinecourses.nptel.ac.in/noc24_ee76/preview

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1(%)	Internal Assessment #2(%)
L1 L2	20	20
L3 L4	40	40
L5 L6	40	40
Total (%)	100	100

Sample Short and Long Answers questions of Various Cognitive Levels

1. What are reactive characteristics of ideal load compensator? Discuss its objectives.
2. Explain the method of phase balancing and power factor correction of unsymmetrical loads

3. Explain the reactive power biasing is obtained with inductive and capacitive systems
4. Explain the compensation in transmission lines using synchronous condensers
5. Discuss in detail about dynamic shunt compensation in transmission lines
6. Discuss about the four characteristic time periods of a transient state in a compensated transmission line.
7. Explain how shunt compensation is obtained by means of Mid-point shunt reactor or capacitor in transmission lines
8. Define reactive power management and explain the mathematical modeling of reactive power dispatching strategy.
9. Discuss the effects of under voltage on the performance of induction motor with necessary diagrams
10. What is electromagnetic interference? Explain sources of EMI and methods to minimize it.
11. Explain the various system losses and the loss reduction methods used in distribution side reactive power management
12. Explain kVAR requirements for domestic appliances in User side reactive power management.
13. Give the layout of electric traction system and discuss reactive power requirements of the same
14. Explain the power factor of an electric arc furnace
15. Explain how shunt compensation is obtained by means of Mid-point shunt reactor or capacitor in transmission lines.

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MTCS1105 **Research Methodology and IPR** **3 0 0 3**

Course Objectives:

1. To give an overview of the research methodology and explain the technique of defining a research problem.
2. To explain the functions of the literature review in research and guide the process of conducting a literature search, reviewing it, and writing a review.
3. To explain various research designs, their characteristics, and the details of sampling designs, measurement and scaling techniques, along with different methods of data collection.
4. To explain several parametric tests of hypotheses, including the Chi-square test, and their application in research.
5. To explain various forms of intellectual property, its relevance, business impact, and leading international instruments concerning Intellectual Property Rights in the global business environment.

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

Course Code	Course Outcomes	Mapping with POs			Dok
		PO1	PO2	PO12	
MTCS1105.1	Analyze the intensity variation of light due to interference, diffraction and classify various types of lasers.	3	2	1	L1,L4
MTCS1105.2	Identify various crystal systems and analyze the crystalline structure.	3	2	1	L1,L4
MTCS1105.3	Summarize various types of polarization of dielectrics and classify the magnetic materials.	2	2	1	L1,L3
MTCS1105.4	Explain fundamentals of quantum mechanics and apply to one dimensional motion of particles.	3	2	2	L1,L3
MTCS1105.5	Outline the properties of charge carriers in semiconductors	3	2	1	L1,L4

SYLLABUS

UNIT-I: Research Methodology **10 Hours**

Introduction, Meaning of Research, Objectives of Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India.

Technique Involved in Defining a Problem, an Illustration. **COS-CO1**

UNIT-II: Reviewing the literature **8 Hours**

Place of the literature review in research, Bringing clarity and focus to research problem, Improving research methodology, Broadening knowledge base in research area, Enabling contextual findings, Review of the literature, searching the existing literature, reviewing the selected Literature, Developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed.

Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs. **COS-CO2**

UNIT-III: Design of Sample Surveys **12 Hours**

Design of Sampling: Introduction, Sample Design, Sampling and Non-sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs.

Measurement and Scaling: Qualitative and Quantitative Data, Classifications of Measurement Scales, Goodness of Measurement Scales, Sources of Error in Measurement, Techniques of Developing Measurement Tools, · Scaling, Scale Classification Bases, Scaling Technics, Multidimensional Scaling, Deciding the Scale.

Data, Selection of Appropriate Method for Data Collection, Case Study Method. **COS-CO3**

UNIT-IV: Testing of Hypotheses **12 Hours**

Hypothesis, Basic Concepts Concerning Testing of Hypotheses, Testing of Hypothesis, Test Statistics and Critical Region, Critical Value and Decision Rule, Procedure for Hypothesis Testing, Hypothesis Testing for Mean, Proportion, Variance, for Difference of Two Mean, for Difference of Two Proportions, for Difference of Two Variances, P-Value approach, Power of Test, Limitations of the Tests of Hypothesis. Goodness of Fit, Cautions in Using ChiSquare Tests. Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports. **COS-CO4**

UNIT-V: Interpretation and Report Writing: **12 Hours**

Intellectual Property: The Concept, Intellectual Property System in India, Development of TRIPS Complied Regime in India, Patents Act, 1970, Trade Mark Act, 1999, The Designs Act, 2000, The Geographical Indications of Goods (Registration and Protection) Act 1999, Copyright Act, 1957, The Protection of Plant Varieties and Farmers' Rights Act, 2001, The Semi-Conductor Integrated Circuits Layout Design Act, 2000, Trade Secrets, Utility Models, IPR and Biodiversity, The Convention on Biological Diversity (CBD) 1992, Competing Rationales for Protection of IPRs, Leading International Instruments Concerning IPR, World Intellectual Property Organisation (WIPO), WIPO and WTO, Paris Convention for the Protection of Industrial Property, National Treatment, Right of Priority, Common Rules, Patents, Marks, Industrial Designs, Trade Names, Indications of Source, Unfair Competition, Patent Cooperation Treaty (PCT), Advantages of PCT Filing, Berne Convention for the Protection of Literary and Artistic Works, Basic Principles, Duration of Protection, Trade Related Aspects of Intellectual Property Rights (TRIPS) Agreement, Covered under TRIPS Agreement, Features of the Agreement, Protection of Intellectual Property under TRIPS, Copyright and Related Rights, Trademarks, Geographical indications, Industrial Designs, Patents, Patentable Subject Matter, Rights Conferred, Exceptions, Term of protection, Conditions on Patent Applicants, Process Patents, Other Use without Authorization of the Right Holder, Layout-Designs of Integrated Circuits, Protection of Undisclosed Information, Enforcement of Intellectual Property Rights, UNSECO. **COS-CO5**

Board of Studies : Management Science
Approved in BOS No: 05, August, 2024
Approved in ACM No: 01,

Textbooks:

1. Research Methodology: Methods and Techniques - C.R. Kothari, Gaurav Garg, New Age International, 4th Edition, 2018.
2. Research Methodology a step-by-step guide for beginners. (For the topic Reviewing the literature under module2)- Ranjit Kumar SAGE Publications Ltd, 3rdEdition, 2011
3. Study Material (For the topic Intellectual Property under module 5), Professional Programme Intellectual Property Rights, Law and Practice,The Institute of Company Secretaries of India, Statutory Body Under an Act of Parliament, September 2013.

Reference Books:

1. Research Methods: The concise knowledge base- Trochim, Atomic Dog Publishing, 2005
2. Conducting Research Literature Reviews: From the Internet to Paper–Fink, Sage Publications, 2009.

Web References:

1. https://www.ebooksdirectory.com/
2. http://www.sciencedirect.com/Science
3. https://onlinecourses.nptel.ac.in/
4. https://www.link.springer.com/physics/
5. https://www.loc.gov/rr/scitech/selected-internet/physics.html

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1(%)	Internal Assessment #2(%)
L1	30	30
L2	30	30
L3	20	20
L4	20	20
Total (%)	**100**	**100**

Sample Short and Long Answers questions of Various Cognitive Levels

Module-1: Research Methodology

1. What is the primary objective of research?
2. Describe the difference between basic and applied research.
3. Explain the significance of using the scientific method in research.
4. Differentiate between research methods and research methodology.
5. Outline the steps in the research process.
6. What are the criteria for good research?
7. Identify common problems encountered by researchers in India.
8. What are the main research approaches, and how do they differ from one another?
9. Discuss the significance of defining a research problem clearly.
10. Provide an example of how to define a research problem, including the steps involved.

Module-2: Reviewing the Literature & Research Design

1. What is the role of a literature review in a research study?
2. How does reviewing literature help in clarifying the research problem?
3. What is the difference between a theoretical framework and a conceptual framework?
4. List and describe the key features of a good research design.
5. Why is research design crucial for the validity of a study?

6. Explain the different types of research designs and their applications.
7. What are the basic principles of experimental designs?
8. How can a literature review improve research methodology?
9. Describe the process of searching and reviewing existing literature.
10. Illustrate how a well-developed theoretical framework can guide a research study.

Module-3: Design of Sample Surveys, Measurement, and Scaling

1. What is the difference between sampling errors and non-sampling errors?
2. Discuss the advantages and disadvantages of sample surveys compared to census surveys.
3. Explain the concept of sample design and its importance in research.
4. What are the classifications of measurement scales, and how are they used?
5. Describe the sources of error in measurement and techniques to minimize them.
6. Differentiate between qualitative and quantitative data.
7. What is multidimensional scaling, and how is it applied in research?
8. Explain the process of developing a measurement tool.
9. How does scaling affect data collection and analysis?
10. Discuss the role of the case study method in data collection.

Module-4: Testing of Hypotheses

1. Define hypothesis and its role in research.
2. What is the procedure for hypothesis testing?
3. Differentiate between Type I and Type II errors in hypothesis testing.
4. Explain the concept of the critical value and its role in decision-making.
5. How do you test hypotheses for differences between two means or proportions?
6. Describe the P-value approach and its significance in hypothesis testing.
7. What is the power of a test, and why is it important?
8. Discuss the limitations of hypothesis testing.
9. Explain how the chi-square test is used for goodness of fit and its cautions.
10. Describe the different test statistics used in hypothesis testing for variances.

Module-5: Interpretation, Report Writing, and Intellectual Property

1. What is the meaning of interpretation in research, and why is it important?
2. Discuss the techniques used for interpreting research data.
3. What are the key steps in writing a research report?
4. How should a research report be structured?
5. What precautions should be taken while writing a research report?
6. Explain the concept of intellectual property and its types.
7. Discuss the TRIPS Agreement and its impact on intellectual property laws.
8. What is the role of the World Intellectual Property Organisation (WIPO)?
9. How do national and international IP laws intersect?
10. Describe the protection mechanisms for patents and copyrights under Indian law.

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Board of Studies (MBA)

MTPE1106 POWER ELECTRONICS SIMULATION LABORATORY 0 0 4 2

Course Objectives:

1. To analyze the operation of DC-DC converters, AC-DC converters and DC-AC converters by simulation.
2. Use power electronic simulation packages& hardware to develop the power converters
3. Analyze and choose the appropriate converters for various applications.

Course Code	Course Outcomes	Mapping with POs and PSOs						DoK
		PO1	PO2	PO3	PO4	PS01	PS02	
MTPE1106.1	Describe the operation of power electronic devices and its applications.	2	-	3	2	2	3	L2
MTPE1106.2	power electronic simulation packages& hardware to develop the power converters	-	3	2	2	1	2	L3
MTPE1106.3	Analyze the I-V characteristics of SCR, DIAC and TRIAC.	3	3	2	-	2	1	L3

Board of Studies: Electrical and Electronics Engineering
Approved in BOS No: 01, 1st Aug, 2024
Approved in ACM No: 01

List of Experiments

1. Simulation of Buck converter using small signal model.
2. Simulation of Boost converter using small signal model.
3. Simulation of single phase half bridge inverter.
4. Simulation of single-phase full bridge inverter using Uni-polar & Bi-polar PWM techniques
5. Simulation of three phase inverter using sine-triangle PWM.
6. Simulation of three phase inverter using space vector PWM
7. Simulation of three level three phase NPC inverter.
8. Study of neutral point voltage floating in NPC three level inverter
9. Simulation of 3-level flying capacitor inverter & evaluation of capacitor Voltage balanced Methods
10. Simulation of single phase AC voltage regulator
11. Simulation of three phase AC voltage regulator.
12. Comparison of harmonic profile of two level& three level inverter
13. Simulation of 5-level inverter using carrier based PWM methods.
14. Simulation of three phase full converter with RL & RLE loads.
15. Simulation of three-phase dual converter.

Exercise Problems

1. Analysis of Buck Converter
2. Analysis of Boost Converter

3. I-Phase Bridge inverter
4. PWM Techniques.
5. 3-Phase Inverter using single triangle PWM
6. 5-Level Inverter using Carrier based PWM

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MTPE1107 POWER CONVERTERS LABORATORY 0 0 4 2

Course Objectives:

1. To expose students to operation and characteristics of power semiconductor devices and passive components, their practical application in power electronics.
2. To provide a practical exposure to operating principles, design and synthesis of different power electronic converters.
3. To introduce students to industrial control of power electronic circuits as well as safe electrical connection and measurement practices.

Course Code	Course Outcomes	Mapping with POs and PSOs						Dok
		PO1	PO2	PO3	PO 4	PS01	PS02	
MTPE1107.1	Analyze and test the power semiconductor devices and their applications.	2	3	-	2	2	3	L2
MTPE1107.2	Compare and contrast various power semiconductor devices according to their applications.	3	2	3	2	1	2	L3
MTPE1107.3	Analyze industrial control of power electronic circuits	2	-	3	2	2	1	L3

Board of Studies: Electrical and Electronics Engineering
Approved in BOS No: 01, 1st August, 2024
Approved in ACM No: 01

List of Experiments

1. Study of DC-DC non-isolated converters such as Buck & Boost converter
2. Study of DC-DC Buck-Boost and Cuk converters.
3. Study of 1-ϕ dual converter.
4. Determination of input p.f. and harmonic factor for 1-ϕsemi- converter and 1-ϕ full
5. converter (Inductive load)
6. Study of p.f. improvement in 1-ϕ full-converter with symmetric and extinction angle
7. Control.
8. Study of 1-ϕ square wave and sinusoidal PWM inverter
9. Study of 3-ϕ inverter with 120o and 180o mode of operation.
10. Study of 3-ϕ sinusoidal PWM inverter.
11. Study of 3-level NPC inverter
12. Study of 5-level cascaded H-bridge inverter.
13. Determination of input p.f. and harmonic factor for 3-ϕ full converter .
14. Determination of input p.f. and harmonic factor for 3-ϕ semi converter
15. Study the characteristics of IGBT, MOSFET & GTO"s.

16. Design of gate drive circuits for IGBT & MOSFET"s.

Exercise Problems

1. Study of DC – DC Converters
2. Study of 1-phase Dual converter
3. Study of 3-level NPC Inverter
4. Study of 5-level cascaded H-bridge Inverter

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MTPE1201 ADVANCED POWER ELECTRONIC CONVERTERS – II 3 0 0 3

Course Objectives:

1. To comprehend the concepts of different power converters and their applications
2. To analyze and design switched mode regulators for various industrial applications.
3. To develop resonant power converters with better performance.
4. To develop resonant Pulse Inverters with better performance.
5. To develop resonant Power Conditioners and advanced conditioners with better performance.

Course Code	Course Outcomes	Mapping with POs and PSOs						Dok
		PO1	PO2	PO3	PO5	PS01	PS02	
MTPE1201.1	Select an appropriate power semiconductor device and design a power converter for the required application	2	3	-	2	2	3	L1,L2
MTPE1201.2	Model existing and modified power converters based on real time applications	-	1	3	2	1	2	L2,L3
MTPE1201.3	Analyze and design power converters and feedback loops	3	-	2	1	2	1	L3,L4
MTPE1201.4	Analyse, apply and optimise the modulation schemes for single-phase and three phase switch-mode DC/DC and DC/AC power electronic converters.	2	3	1	-	3	2	L3,L4
MTPE1201.5	Model and simulate the electrical, thermal and electromagnetic performance of power electronic systems using advanced software tools.	3	2	-	2	1	2	L3,L5

SYLLABUS

UNIT– I

Non-Isolated D.C. to D.C. Converters **10 Hours**

Analysis of step-down and step-up dc to dc converters with Resistive and Resistive-Inductive loads, Switched mode regulators, Analysis of Buck Regulators, Boost regulators, Buck and boost regulators, Cuk regulators, Condition for continuous inductor current and capacitor voltage, Comparison of regulators,Multi output boost converters, Advantages, Applications, Problems, State space analysis of regulators. **COs – CO1**

Self-Learning Topics: Choppers

UNIT– II

Isolated D.C. to D.C. Converters **10 Hours**

Classification, switched mode dc power supplies, Fly back Converter, Forward converter, Push-pull

converter, Half bridge converter, Full bridge converter, Control circuits, Magnetic design considerations, Applications. **COs – CO2**

Self-Learning Topics: converters

UNIT – III:

Resonant Pulse Inverters **10 Hours**

Resonant pulse inverters, Series resonant inverters, Series resonant inverters with unidirectional switches, Series resonant inverters with bidirectional switches, Analysis of half bridge resonant inverter, Evaluation of currents and voltages of a simple resonant inverter, Analysis of half bridge and full bridge resonant inverter with bidirectional switches, Frequency response of Series resonant, Parallel resonant, Series loaded, Parallel loaded, Series and Parallel loaded inverters, Voltage control of resonant inverters, Class-E resonant inverter, Class-E resonant rectifier, Evaluation of values of 'C' and 'L' for Class-E inverter and Class-E rectifier, Numerical problems.

Self-Learning Topics: Inverters **COs – CO3**

UNIT- IV:

ZCS & ZVS Resonant Converters **8 Hours**

Resonant converters, zero current switching resonant converters, L-type and M-type ZCS resonant converter, zero voltage switching resonant converters, Comparison between ZCS and ZVS resonant converters, Two quadrant ZVS resonant converters, Resonant dc-link inverters, Evaluation of 'L' and 'C'for a zero current switching inverter, Numerical problems. **COs – CO4**

Self-Learning Topics: Resonance

UNIT-V:

POWER CONDITIONERS **6 Hours**

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

ADVANCED CONVERTERS

Principle of operation of SEPIC converter, Matrix Converter, Luo Converter, Interleaved Converter. **COs – CO5**

Self-Learning Topics: Converters

Board of Studies:	Electrical and Electronics Engineering
Approved in BOS No:	01, 1st Auguest-2024
Approved in ACM No:	01

Expert Talk (To be Delivered by SMEs from Industries)	**COs**	**POs / PSOs**
1. ZCS & ZVS RESONANT CONVERTER	CO1–CO5	PO1, PO2,PO3,PO5, PSO1, PSO2
2. RESONANT PULSE INVERTERS	CO1–CO5	PO1, PO2,PO3,PO5, PSO1, PSO2

Textbooks:

1. Mohammed H. Rashid, "Power Electronics", Pearson Education, 3rdEdition, 1stIndian reprint, 2004.

2. Ned Mohan Tore M. Undeland and William P. Robbins, "Power Electronics", John Wiley & Sons,2nd Edition.

References:

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

Electronics", Published by Academic Press, 2002.

Web References:

1. https://archive.nptel.ac.in/courses/108/107/108107128/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1(%)	Internal Assessment #2(%)
L1 L2	20	20
L3 L4	40	40
L5 L6	40	40
Total (%)	**100**	**100**

Sample Short and Long Answers questions of Various Cognitive Levels

1. Explain about series resonant inverter with unidirectional switches.
2. Explain about series resonant inverter with bidirectional switches.
3. Explain about parallel resonant inverter with neat circuit diagram and waveforms.
4. How to control the voltage in series resonant inverter.
5. With a neat circuit diagram and related waveforms explain the modes of operation of Class-E resonant inverter.
6. What is the necessity of resonant dc link inverters and explain the operation.
7. With a neat circuit diagram and related waveforms explain the operation of L-type ZCS resonant converter.
8. Explain about M-type ZCS resonant converter.
9. Explain about the modes of operation of zero voltage switching resonant converter.
10. Compare ZCS and ZVS.
11. What are the advantages and disadvantages of resonant power supplier?
1. 12.Explain the operation of flyback converter with continuous mode with neat circuit and Waveforms.
12. Explain the operation of flyback converter with dis continuous mode with neat circuit and waveforms.

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MTPE1202 **Power Electronic Control of Electrical Drives** **3 0 0 3**

Course Objectives:

1. To understand principle of operation of scalar control of AC motor and corresponding speed- torque characteristics
2. To understand principle of operation of scalar control of AC motor and corresponding speed- torque characteristics
3. To understand principle of operation of scalar control of Induction motor
4. To understand principle of operation of PMSM Drive
5. To understand principle of operation of SRM Drive

Course Code	Course Outcomes	Mapping with POs and PSOs						Dok
		PO1	PO2	PO3	PO4	PS01	PSO2	
MTPE1202.1	Understand the concepts of scalar and vector control methods for drive systems.	2	3	-	2	2	2	L1,L2
MTPE1202.2	Analyze and design controllers and converters for induction motor,	1	2	2	3	1	-	L2,L3
MTPE1202.3	Analyze and design controllers and converters for PMSM and BLDC drives.	3	-	2	2	2	2	L3, L4
MTPE1202.4	Select and implement proper control techniques for induction motor and PMSM for specific applications	3	2	1	2	2	3	L4, L5
MTPE1202.5	Analyze and design control techniques and converters for SRM drives.	1	3	2	2	1	1	L3, L5

SYLLABUS

UNIT–1 **12 Hours**

Vector Control of Induction Motor Drive: Principle of scalar and vector control, direct vector control, indirect vector control, rotor flux oriented control, stator flux oriented control, air gap flux oriented control, decoupling circuits. **COs–CO1**

Self-Learning Topics: ac machines, power electronics

UNIT–2 **12 Hours**

Sensor less Control of induction Motor Drive: Advantages of speed sensor less control, voltage current based speed sensor less control, MRAS-model reference adaptive systems, Extended Kalman filter observers. **COs–CO2**

Self-Learning Topics: power electronics

UNIT–3 **12 Hours**

Direct Torque Control of Induction Motor Drive: Principle of Direct torque control (DTC), concept of space vectors, DTC control strategy of induction motor, comparison between vector control and DTC, applications, space vector modulation based DTC of induction motors.

COs–CO3

Self-Learning Topics: induction motors

UNIT–4 **10 Hours**

Control of Permanent Magnet Synchronous Machines (PMSM) and Brushless DC (BLDC) Motor Drives: Advantages and limitations of Permanent magnet machines, operating principle of PMSM, modeling of PMSM, operating principle of BLDC, modeling of BLDC, similarities and difference between PMSM and BLDC, need for position sensing in BLDC motors, control strategies for PMSM and BLDC, methods of reducing torque ripples of BLDC motor.

COs–CO4

Self-Learning Topics: synchronous machines

UNIT–5 **10 Hours**

Control of Switched Reluctance Motor (SRM) Drive: SRM structure, Merits and limitations, stator excitation, converter topologies, SRM waveforms, Torque control schemes, speed control of SRM, torque ripple minimization, instantaneous -torque control using current controllers and flux controllers.

COs–CO5

Self-Learning Topics: reluctance motor

Board of Studies : Electrical and Electronics Engineering
Approved in BOS No: 01, 1st Aug-2024
Approved in ACM No: 01,

Expert Talk (To be Delivered by SMEs from Industries)	**COs**	**POs / PSOs**
Control of Permanent Magnet Synchronous Machines (PMSM) and Brushless DC (BLDC) Motor Drives	CO1–CO5	PO1,PO2,PO3,PO4,PSO1,PSO2
Control of Switched Reluctance Motor (SRM) Drive	CO1–CO5	PO1,PO2,PO3,PO4,PSO1,PSO2

Text Books:

1. Bose B. K., "Power Electronics and Variable Frequency Drives",IEEE Press, Standard Publisher Distributors. 2001
2. Krishnan R., "Electric Motor Drives – Modeling, Analysis and Control", Prentice Hall of India Private Limited.

Reference Books:

1. Switched Reluctance Motors and Their Control-T. J. E. Miller, Magna Physics, 1993.
2. Power electronic converters applications and design-Mohan, Undeland, Robbins-Wiley Publication

Web Resources:

1. Advance Power Electronics and Control - Course (nptel.ac.in)
2. Power Electronics Applications in Power Systems - Course (nptel.ac.in)
3. (PDF) Power Electronics and Motor Drives - Academia.edu

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1(%)	Internal Assessment #2(%)
L3	20	20
L4	40	40
L5	40	40
Total (%)	**100**	**100**

AIETTA |AR24| EEE| MTPE1202| Power Electronic Control of Electrical Drives

Sample Short and Long Answers questions of Various Cognitive Levels

1. Explain briefly about Fundamentals of torque equation?
2. What are the different types of torque that involved in drive system?
3. Derive the expression for torque equation in electrical drives.
4. Describe briefly about multi quadrant operation of drives.
5. Derive the expression for torque in multi-quadrant drive system.
6. Explain four quadrant operation of motor drive system with hoist load.
7. What are the classifications of load torques?
8. Explain briefly about steady state stability of motor load systems.
9. Explain the operation of closed loop speed control with inner current control loop.
10. What are the methods used in current sensing.
11. Derive the load equation of motor in electric drive system.
12. What is steady state stability of electric drives and explain it briefly.
13. How a phase does locked loop speed control schemes operate? Where do you use it?
14. State and explain different methods of speed sensing.
15. Explain the Dynamic simulation of speed controlled DC motor Drive?

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MTPE12031 POWER ELECTRONICS FOR RENEWABLE ENERGYSYSTEMS 3 0 0 3

Course Objectives:

1. To impart knowledge on different types of renewable energy systems.
2. To analyze the operation Solar cell characteristics and measurement
3. To analyze the operation of electrical generators used for the wind energy conversion Systems.
4. To know the operation of AC-DC, DC-DC and AC-AC power converters used in renewable energy systems.
5. To know the principles of standalone, grid connected and hybrid operation in renewable energy systems.

Course Code	Course Outcomes	Mapping with POs and PSOs						Dok
		PO1	PO2	PO3	P04	PSO1	PSO2	
MTPE12031.1	Demonstrate the various types of renewable energy technologies that are used to harness electrical power.	2	2	-	2	1	2	L1,L2
MTPE12031.2	Demonstrate the operating principle and analysis of various types of Wind generators.	3	-	1	1	2	1	L2,L3
MTPE12031.3	Identify a suitable converter such as AC-DC, DC-DC and AC-AC converters for renewable energy systems	2	3	3	-	1	3	L4,L5
MTPE12031.4	Demonstrate and analyze the various types of wind and PV systems	2	3	-	2	2	1	L3,L4
MTPE12031.5	Interpret the stand alone, grid connected and hybrid renewable energy systems	2	2	-	3	1	-	L4,L5

SYLLABUS

UNIT-I **10 Hours**

Solar cell characteristics and their measurement, PV Module, PV array, Partial shading of a solar cell and a module, The diode, Power conditioning unit, maximum power point tracker, Implementation of Perturb and Observe Method, Incremental Conductance Method, Battery charger/discharge controller. **COs – CO1**

Self-Learning Topics: Batteries and Cells

UNIT-II **12 Hours**

Centralized Inverters, String Inverters, Multi-string Inverters, Module Integrated Inverter/Micro-inverters, Inverter Topology, Model of Inverter, Sizing Batteries and Inverters for a Solar PV System. Types of PV Systems: Grid-Connected Solar PV System, Stand-Alone Solar PV System. **COs – CO2**

Self-Learning Topics: Inverter

UNIT-III **10 Hours**

Introduction to wind: Characteristics, Wind Turbine, Fixed and Variable-Speed Wind Turbines, Components of WECS, Description of Components, Types of Wind Turbine Generators, Economics of Wind Energy Conversion Systems, Linking Wind Turbines onto the Grid, Power Converter Topologies for Wind Turbine Generators. **COs – CO3**

Self-Learning Topics: Turbines

UNIT-IV **8 Hours**

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

COs – CO4

Self-Learning Topics: Synchronous and Induction Machines

UNIT-V **10 Hours**

Hybrid Energy Systems, Need for Hybrid Energy Systems, Range and types of Hybrid systems, Hybrid Solar PV/Wind Energy System, Architecture of Solar-Wind Hybrid System and Grid connected issues. **COs – CO5**

Self-Learning Topics: Hybrid Systems

Board of Studies: Electrical and Electronics Engineering
Approved in BOS No: 01, 1st Aug-2024
Approved in ACM No: 01

Expert Talk (To be Delivered by SMEs from Industries) **COs** **POs / PSOs**

1. Static Energy Conversion Technologies CO1–CO5 PO1,PO2,PO3, PO4,PSO1,PSO2
2. Integration of different Energy Conversion Technologies CO1–CO5 PO1,PO2, PO3,PO4,PSO1,PSO2

Textbooks:

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

Reference Books:

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

Web Resources:

1. (PDF) Control of Renewable Energy Systems (researchgate.net)

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1(%)	Internal Assessment #2(%)
L1L2	20	20
L3L4	40	40
L5L6	40	40

Total (%)	100	100

Sample Short and Long Answers questions of Various Cognitive Levels

1. Explain briefly Effects of renewable energy penetration into the grid,?
2. What are the different types Effects of renewable energy penetration into the grid
3. Describe briefly about multi Integration of different Energy Conversion
4. Explain Static Energy Conversion Technologies
5. Write about renewable energy resources in present world energy scenario.
6. How are cells normally connected in PV module?
7. What happen to V-I characteristics when PV cells are connected in parallel and series?
8. Explain the meaning of standalone PV system and write its configurations with neat sketch
9. Derive the relation between input and output voltage of buck boost type DC-DC converter with neat circuit diagram.
10. The relationship between the output voltage and current for a PV array is defined by the the data given in the table. The PV array is connected to resistive load R of 30 ohms through a buck boost type second order converter, operating in a continuous condition mode. Determine the duty cycle of the interfacing converter required to operate the PV array at a voltage of 28.08V.

Volts 27.86 27.91 27.97 28.02 28.08 28.13 28.18 28.98 28.35
Amps 1.76 1.73 1.71 1.69 1.67 1.64 1.62 1.59 1.57

11. Explain about the Bidirectional converters in solar PV system.
12. What are the advantages and disadvantages of Cuk converters compare with buck and boost converters?
13. Explain briefly about grid connection issues.
14. Explain about Grid connected 3-phase inverter with and without H6 type with neat diagram and waves.
15. Explain about Power extraction (MPP) and MPPT schemes in wind energy systems.
16. Explain about AC and DC microgrids with neat sketch.

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MTPE12032 **ELECTRIC VEHICLES AND DESIGN** **3 0 0 3**

Course Objectives:

1. To understand the fundamental concepts of hybrid and electric vehicles.
2. To understand the fundamental principles of hybrid and electric vehicles
3. To understand the fundamental analysis and design of hybrid and electric vehicles.
4. To know the various aspects of hybrid and electric drive train such as their configuration,
5. To know the types of electric machines that can be used energy storage devices, etc.

Course Code	Course Outcomes	Mapping with POs and PSOs						Dok
		PO1	PO2	PO3	PO4	PS0 1	PSO 2	
MTPE12032.1	Understand the fundamental concepts of hybrid and electric vehicles.	2	1	2	3	2	2	L1,L2
MTPE12032.2	Understand the models to describe hybrid vehicles and their performance	3	1	1	2	1	3	L3, L4
MTPE12032.3	Understand the different possible ways of energy storage.	2	3	2	-	2	1	L2, L4
MTPE12032.4	Understand the different strategies related to energy storage systems.	1	2	3	1	-	1	L3, L4
MTPE12032.5	Know different batteries and other energy storage systems	2	1	3	-	2	2	L3, L5

SYLLABUS

UNIT–I: Conventional Vehicles **10 Hours**

Basics of vehicle performance, Vehicle power source characterization,

Transmission characteristics, Mathematical models to describe vehicle performance. **COs – CO5**

Self-Learning Topics: vehicle performance

UNIT–II: Introduction to Hybrid Electric Vehicles **10 Hours**

History of hybrid and electric vehicles, Social and environmental importance of hybrid and electric vehicles, Impact of modern drive-trains on energy supplies.

Hybrid Electric Drive-Trains: Basic concept of hybrid traction, Introduction to various hybrid drive-train topologies, Power flow control in hybrid drive-train topologies, Fuel efficiency analysis

COs – CO5

Self-Learning Topics: electric vehicles

UNIT– III Electric Trains **10 Hours**

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

Electric Propulsion Unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor

drives, Configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, Drive system efficiency. **COs – CO5**

Self-Learning Topics: Power grid

UNIT–IV **10 Hours**

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

Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, Sizing the power electronics, selecting the energy storage technology, Communications, Supporting subsystems. **COs – CO5**

Self-Learning Topics: power electronics

UNIT–V **10 Hours**

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

Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV). **COs – CO5**

Self Learning Topics: power generation

Board of Studies:	Electrical and Electronics Engineering
Approved in BOS No:	01, 1st Aug-2024
Approved in ACM No:	01

Expert Talk (To be Delivered by SMEs from Industries)	**COs**	**POs / PSOs**
1. Battery and Storage Systems Energy Storage Parameters;	CO1–CO5	PO1,PO2,PO3,PSO1,PSO2
2. Plug-in Hybrid Electric Vehicle	CO1–CO5	PO1,PO2,PO4,PSO1,PSO2

Text Books:

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

Reference Books:

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

Web Resources:

1. (PDF) Control of Renewable Energy Systems (researchgate.net)

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1(%)	Internal Assessment #2(%)
L2L1	20	20
L3L4	40	40
L5L6	40	40
Total (%)	**100**	**100**

Sample Short and Long Answers questions of Various Cognitive Levels

1. Explain briefly Effects non-isolated bidirectional DC-DC converter,?
2. What are the different types Effects of renewable energy penetration into the grid
3. Describe briefly about Buck converter used in HEVs
4. Explain briefly about regenerative braking.
5. Explain about PWM rectifier in HEVs?
6. Explain Pumped Hydroelectric Energy Storage
7. Explain the term rolling resistance and aerodynamic drag in vehicles and derive the expression for vehicle translational speed from fundamentals.
8. Obtain the mathematical modeling of electric vehicle to describe its performance.
9. Explain the impact of different transportation technologies on environment and energy supply.
10. What are the basic techniques to improve Vehicle Fuel Economy? Explain.
11. Illustrate the power flow control in hybrid electric drive train.
12. Write short notes on fuel efficiency analysis in hybrid electric drive-trains.
13. Draw and explain the block diagram of switched reluctance motor drive system.
14. Discuss various electric drive train topologies.
15. Explain the super capacitor based energy storage and also state its limitations.
16. 16 Write a short note on sizing the power electronics to hybrid vehicles.
17. Explain the design of a Hybrid Electric Vehicle (HEV) as a case study

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MTPE12033 **DIGITAL CONTROL SYSTEMS** **3 0 0 3**

Course Objectives:

1. To understand fundamentals of digital circuits and devices using Z-transforms and Inverse Z-Transforms.
2. To understand the controllability and observability in digital domain.
3. To understand the stability and controller design in digital domain.
4. To understand the design an observer.
5. To understand the solving of a given optimal control problem.

Course Code	Course Outcomes	Mapping with POs and PSOs						Dok
		PO1	PO2	PO3	PO4	PS01	PSO2	
MTPE12033.1	Analyze digital control systems using Z-transforms and Inverse Z-Transforms.	3	-	2	3	2	1	L1,L2
MTPE12033.2	Evaluate the state transition matrix and solve state equation for discrete model for continuous time systems, investigate the controllability and observability.	2	3	1	-	3	2	L3,L4
MTPE12033.3	Determine the stability; design state feedback controller.	2	1	-	2	1	3	L3,L5
MTPE12033.4	Design an observer.	1	3	2	-	2	2	L2,L3
MTPE12033.5	Solve a given optimal control problem.	2	1	-	2	2	1	L4,L5

SYLLABUS

UNIT–I **10 Hours**

Introduction to analog and digital control systems – Advantages of digital systems – Typical examples– Sample and hold devices – Sampling theorem and data reconstruction-Transfer functions and frequency domain characteristics of zero order hold and first order hold. Review of Z–transforms and Inverse Z– transforms- solving differential equations. Mapping between the S–Plane and the Z–Plane – Primary strips and Complementary Strips. **COs – CO1**

Self-Learning Topics: Z Transforms

UNIT–2 **10 Hours**

State space analysis and the concepts of Controllability and observability State Space Representation of discrete time systems – State transition matrix properties and evaluation – Solution of state equations- Discretization of continuous-time state equations –controllability and observability – concepts, conditions and tests, Principle of duality. **COs – CO2**

Self-Learning Topics: Matrix

UNIT–3 **8 Hours**

Stability Analysis and Controller Design Stability criterion – Modified Routh"s stability criterion and Jury"s stability test, Lyapunov"s stability analysis. Design of state feedback controller through pole placement techniques, Necessary and sufficient conditions, Ackermann"s formula,

controller for deadbeat response, control system with reference input, Design of full order observer-reduced order observer. **COs – CO3**

Self-Learning Topics: control systems

UNIT–4 **10 Hours**

State Observer Necessary and sufficient condition for state observation-Full order state observer-error dynamics – design of prediction observers- Ackermann"s formula-effect of the addition of observer on closed loop system-Current observer- minimum order observer observed – state feedback control system with minimum order observer -control system with reference input.

COs – CO4

Self-Learning Topics: control systems

UNIT–5 **8 Hours**

Quadratic Optimal Control Systems Quadratic optimal control problems-Solution by minimization method using Lagrange multipliers Evolution of the minimum performance index – discretize quadratic optimal control –Steady state Riccati equations-Lyapunov approaches to the solution of the Steady state quadratic optimal regulator problem and optimal control problem - Quadratic optimal control of a servo system. **COs – CO5**

Self-Learning Topics: control systems

Board of Studies: Electrical and Electronics Engineering
Approved in BOS No: 01, 1st Aug-2024
Approved in ACM No: 01

Expert Talk (To be Delivered by SMEs from Industries) **COs** **POs / PSOs**

1. Quadratic Optimal Control Systems Quadratic optimal control problems
   CO1–CO5 PO1,PO2,PO3,PO4,PSO1,PSO2
2. Stability Analysis and Controller Design Stability criterion
   CO1–CO5 PO1,PO2,PO3,PO4,PSO1,PSO2

Text Book:

1. Discrete–Time Control systems – K. Ogata, Pearson Education/PHI, 2nd Edition.
2. B. C. Kuo, "Digital control systems"- Holt Saunder"s International Edition, 1991.

Reference Books:

1. M. Gopal: Digital control engineering, New Age Int. Ltd., India, 1998.
2. K. Ogata, "Modern control engineering"- PHI, 1991.

Web Resources:

NPTELECE4540/5540: Digital Control Systems (uccs.edu)

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1(%)	Internal Assessment #2(%)
L1L2	20	20
L3L4	40	40
L5L6	40	40
Total (%)	**100**	**100**

Sample Short and Long Answers questions of Various Cognitive Levels

1. With suitable diagram explain any method of digital to analog conversion.
2. What are the different types of sampling operations? Explain each of them.
3. Derive the transfer function of zero order hold device
4. What are the different types of sampling operations? Explain each of them.
5. What do you mean by the problem of aliasing? How to overcome these?
6. Explain the advantages and disadvantages of digital control systems.
7. Prove Initial Value and Final Value theorems with an example in digital control Systems.
8. Obtain the Inverse z-transform for the following using partial fraction method.
9. State and prove the following properties/theorems of z-transforms. i) Shifting theorem ii) Complex translation theorem iii) Complex differentiation and Partial differentiation theorem
10. Draw the block diagram and explain the function of each block of digital control system?
11. Explain the operation of equivalent circuit of sample and hold circuit?
12. Explain the detailed process of finding the Z-transform of a signal using the sampler switch?
13. Find the Z-transform of the signal $f(k) = (k+1)ak$; $k \geq 0$?
14. Write the differences between the classical control system and state space analysis?
15. Find the state space representation for the discrete time system $y(k+3)+6y(k+2)+11y(k+1)+8y(k)=10u(k)$ Also draw the state diagram.
16. Explain the necessary conditions and step wise procedure of Jury's stability test?
17. Describe the mapping between the s-Plane and the z-Plane with neat diagram.
18. Discuss in detail about the design and application of lag compensator with necessary equations?
19. Explain the design procedure of lead compensator with root locus technique in the z-Plane.
20. Explain the methods of finding the state feedback gain matrix with relevant equations?
21. Write about the Ackerman's formula and its role in the enhancement of stability

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MTPE12041 ADVANCED DIGITAL SIGNAL PROCESSING 3 0 0 3

Course Objectives:

1. To understand the various digital filter structures
2. To design the FIR and IIR Filters
3. To know the importance of FFT algorithm for computation of Discrete Fourier Transform
4. To analyze the finite word length effects on various filters
5. To learn the concepts of power spectrum estimation of periodic and non-periodic signals.

Course Code	Course Outcomes	Mapping with POs and PSOs						Dok
		PO1	PO2	PO3	PO5	PSO1	PSO2	
MTPE12041.1	Describe structure of digital filters	2	2	3	-	1	1	L1, L2
MTPE12041.2	To design the FIR and IIR Filters	1	-	2	2	-	2	L2,L3
MTPE12041.3	To know the importance of FFT algorithm for computation of Discrete Fourier Transform.	3	2	-	1	2	1	L3,L4
MTPE12041.4	To analyze the finite word length effects on various filters..	1	2	2	-	2	-	L3,L4
MTPE12041.5	To learn the concepts of power spectrum estimation of periodic and non-periodic signals	2	1	-	3	1	2	L4,L5

SYLLABUS

UNIT–I

Digital Filter Structure **10 Hours**

Block diagram representation-Equivalent Structures-FIR and IIR digital filter Structures All pass Filters-tunable IIR Digital Filters-IIR tapped cascaded Lattice Structures-FIR cascaded Lattice structures-Parallel-Digital Sine-cosine generator-Computational complexity of digital filter structures. **COs – CO1**

Self-Learning Topics: Filters

UNIT–II

Digital filter design **10 Hours**

Preliminary considerations-Bilinear transformation method of IIR filter design design of low-pass, high pass-band pass, and band stop- IIR digital filters-Spectral transformations of IIR filters, FIR filter design-based on windowed Fourier series- design of FIR digital filters with least –mean square-error-constrained least-square design of FIR digital filters. **COs – CO2**

Self-Learning Topics: Filters

UNIT–III

DSP algorithm implementation **8 Hours**

Computation of the discrete Fourier transform- number representation arithmetic operations handling of overflow-tunable digital filters-function approximation. **COs – CO3**

Self-Learning Topics: Fourier transforms

UNIT–IV

Analysis of finite Word length effects **8 Hours**

The quantization process and errors- quantization of fixed -point and floating -point Numbers-Analysis of coefficient quantization effects, Analysis of arithmetic round-off errors, dynamic range scaling-signal- to- noise ratio in low -order IIR filters-low-sensitivity digital filters Reduction of Product round-off errors using error feedback-Limit cycles in IIR digital filters, Round-off errors in FFT Algorithms. **COs – CO4**

Self-Learning Topics: Filters

UNIT–V

Power Spectrum Estimation **8 Hours**

Estimation of spectra from finite duration observations signals – Nonparametric methods for power spectrum estimation – parametric method for power spectrum estimation, estimation of spectral form-finite duration observation of signals-non-parametric methods for power spectrum estimation-Walsh methods-Blackman & torchy method. **COs – CO5**

Self-Learning Topics: Fundamentals of Signals and Systems

Board of Studies: Electrical and Electronics Engineering
Approved in BOS No: 01, 1st Aug-2024
Approved in ACM No: 01

Expert Talk (To be Delivered by SMEs from Industries)	**COs**	**POs / PSOs**
1. Power Spectrum Estimation	CO1–CO5	PO1,PO2,PO3, PO5 PSO1,PSO2
2. Analysis of finite Word length effects	CO1–CO5	PO1,PO2,PO3, PO5 PSO1,PSO2

Text Books

1. Digital signal processing-Sanjit K. Mitra-TMH second edition, 2002.
2. Discrete Time Signal Processing – Alan V.Oppenheim, Ronald W.Shafer - PHI-1996 1st edition 9th reprint

Reference Books:

1. Digital Signal Processing and principles, algorithms and Applications – John G.Proakis - PHI –3rd edition-2002.
2. Digital Signal Processing – S.Salivahanan, A.Vallavaraj, C. Gnanapriya – TMH - 2 nd reprint-2001
3. Theory and Applications of Digital Signal Proceesing-LourensR. Rebinar&Bernold.
4. Digital Filter Analysis and Design-Auntonian-TMH..

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc21_ee20/preview
2. https://onlinecourses.nptel.ac.in/noc24_ee76/preview

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1(%)	Internal Assessment #2(%)
L1L2	20	20
L3L4	40	40
L5L6	40	40
Total (%)	**100**	**100**

Sample Short and Long Answers questions of Various Cognitive Levels

1. What is multi rate signal processing?
2. Give a brief accnt of poly phase filter structures?
3. Explain in detail abt Tunable digital filters?
4. What are the quantization errors in FFT algorithm?
5. What is the basic principle of parametric methods in power spectral estimation?
6. Derive the frequency domain transfer function of a decimator.
7. Discuss clearly the process of sampling rate conversion of band pass signals.
8. Discuss abt the computation of the discrete Frier transform with an example?
9. Explain abt the errors result that from the truncation and rnding with an example
10. Derive the mean and variance of the power spectral estimate of the Blackman Tuckey method?
11. Draw and explain the lattice ladder structure for realization of pole zero system
12. Explain in detail Bilinear transformation method of IIR filter design
13. Discuss the procedure for the design of IIR filters and what are the constraints in the design of IIR filters using analog structures
14. What is the basic principle of parametric methods in power spectral estimation? Discuss varis techniques
15. Determine the mean and the auto correlation of the sequence x(n) generated by the MA(2) process described by the difference equation. $X(n) = w(n) - 2w(n-1) + w(n-2)$ Where w(n) is the white noise process with variance σ^2_w.

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MTPE12042 APPLICATIONS OF POWER CONVERTERS 3 0 0 3

Course Objectives:

1. To understand the inverters for induction heating applications
2. To understand the power converters for different industrial applications
3. To understand modeling of high voltage power supplies using the power converters for radar and space applications
4. To understand modeling of low voltage and high current power supplies using the power converters for microprocessors and computer loads
5. To understand the applications of DC-DC converters.

Course Code	Course Outcomes	Mapping with POs and PSOs						Dok
		PO1	PO2	PO3	PO4	PSO1	PSO2	
MTPE12042.1	Analyze power electronic application requirements.	2	-	1	2	3	2	L1,L2
MTPE12042.2	Identify suitable power converter from the available configurations	3	1	-	1	2	1	L2,L3
MTPE12042.3	Develop improved power converters for any stringent application requirements	1	3	2	-	1	3	L2,L3
MTPE12042.4	Improvise the existing control techniques to suit the application	-	2	3	2	3	2	L4,L5
MTPE12042.5	Design of Bi-directional converter for charge/discharge applications	3	-	2	3	2	1	L4,L5

SYLLABUS

UNIT–I

Inverters for Induction Heating: **5 Hours**

For induction cooking, induction hardening, melting, and welding applications. **COs – CO1**

Self-Learning Topics: Inverters

UNIT–II **7 Hours**

Power Converters for Lighting, pumping and refrigeration Systems

Electronic ballast, LED power drivers for indoor and outdoor applications. PFC based grid fed LED drivers, PV / battery fed LED drivers. PV fed power supplies for pumping/refrigeration applications. **COs – CO2**

Self-Learning Topics: Power Converters

UNIT–III **7 Hours**

High Voltage Power Supplies

Power supplies for X-ray applications - power supplies for radar applications - power supplies for space applications. **COs – CO1**

Self-Learning Topics: High Voltage Power Supplies

UNIT– IV

Low voltage high current power supplies: **5 Hours**

Power converters for modern microprocessor and computer loads. **COs – CO1**

Self-Learning Topics: microprocessor

UNIT– V **6 Hours**

Bi-directional DC-DC (BDC) converters

Electric traction, automotive Electronics and charge/discharge applications, Line Conditioners and Solar Charge Controllers. **COs – CO1**

Self-Learning Topics: Different types of converters

Board of Studies:	Electrical and Electronics Engineering
Approved in BOS No:	01, 1st Aug-2024
Approved in ACM No:	01

Expert Talk (To be Delivered by SMEs from Industries)	COs	POs / PSOs
1. Low voltage high current power supplies	CO1–CO5	PO1,PO2,PO3,PO4,PSO1,PSO2
2. Bi-directional DC-DC (BDC) converters	CO1–CO5	PO1,PO2,PO3,PO4,PSO1,PSO2

Text Books:

1. Ali Emadi, A. Nasiri, and S. B. Bekiarov: Uninterruptible Power Supplies and Active Filters, CRC Press, 2005.
2. M. Ehsani, Y. Gao, E. G. Sebastien and A. Emadi: Modern Electric, Hybrid Electric and Fuel Cell Vehicles, 1st Edition,CRC Press, 2004.

Reference Books:

1. William Ribbens: Understanding Automotive Electronics, Newnes, 2003.
2. Current literature

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc22_ee33/preview
2. https://onlinecourses.nptel.ac.in/noc24_ee130/preview

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1(%)	Internal Assessment #2(%)
L1	20	20
L2	40	40
L3	40	40
Total (%)	**100**	**100**

Sample Short and Long Answers questions of Various Cognitive Levels

1. Define Induction heating and Welding Processes?
2. What is the working principle of refrigeration system?
3. What is high voltage power supplies used for?
4. What is a low voltage high current power source?
5. How does a bidirectional DC-to-DC converter work?
6. What are the basics of induction heating?

7. What are the four main components of a refrigeration system?
8. What is the purpose of HV? What is the HV problem?
9. What happens when voltage is low and current is high?
10. What is the control strategy for the bidirectional DC-DC converter?
11. Explain with neat sketch induction cooking, induction hardening, melting with examples?
12. Explain the PV fed power supplies for pumping/refrigeration applications?
13. Explain the Power supplies of Different applications?
14. What are the Different Power converters for modern microprocessor?
15. Explain the operation of three-phase full-wave bidirectional controller applications?

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MTPE12043 MICROCONTROLLER APPLICATIONS TO POWER ELECTRONICS 3 0 0 3

Course Objectives:

1. To study the internal structure and operation of PIC 16F876 microcontroller and 8051 Microcontrollers
2. To know assembly language program for the generation of firing and control signals employing these microcontrollers..
3. Study the internal structure and operation of PIC 16F876 microcontroller and 8051 microcontroller; assembly language program for the generation of firing and control signals employing these microcontrollers
4. To know A/D Converter module
5. To know the MPLAB IDE and PICSTART plus hardware

Course Code	Course Outcomes	Mapping with POs and PSOs						Dok
		PO1	PO2	PO3	PO4	PSO1	PSO2	
MTPE12043.1	Understand the architecture of 8051 and 16F876 microcontrollers	2	3	-	3	2	1	L1,L2
MTPE12043.2	Develop assembly language programs employing 8051 & 16F876 microcontrollers.	3	2	2	-	-	2	L2,L3
MTPE12043.3	Analyze the microcontroller programming using MPLAB and develop typical programs for power converter applications	-	2	1	2	1	2	L3,L4
MTPE12043.4	Develop interfacing to real world devices.	3	2	-	2	3	2	L2,L5
MTPE12043.5	Learn use of hardware & software tools.	2	-	3	2	1	-	L3,L4

SYLLABUS

UNIT–I **8 Hours**

8051 microcontrollers: Architecture, Addressing modes, I/O ports, Instruction sets, Simple assembly language programming. **COs – CO1**

Self-Learning Topics: Architecture of 8051

UNIT–II **10 Hours**

Use of microcontrollers for pulse generation in power converters, Overview of Zero-Crossing Detectors, Typical firing/gate-drive circuits, Firing/gate pulses for typical single-phase and three-phase power converters. **COs – CO2**

Self-Learning Topics: Gate Drive Circuits

UNIT–III: **8 Hours**

PIC16F876 Micro-controller: Device overview, Pin diagrams, Memory organization, Special Function Registers, I/O ports, Timers, Capture/ Compare/ PWM modules (CCP). **COs– CO3**

Self-Learning Topics: Pin Diagram

UNIT-IV: **10 Hours**

Analog to Digital Converter module, Instruction set, Instruction description, Introduction to PIC Microcontroller programming, Oscillator selection, Reset, Interrupts, Watch dog timer. **COs– CO4**
Self-Learning Topics: A/D Converter Module

UNIT-V: **10 Hours**

Introduction to MPLAB IDE and PICSTART plus, Device Programming using MPLAB and PICSTART plus, Generation of firing / gating pulses for typical power converters. **COs – CO5**
Self-Learning Topics: Gating Pulses of Power Converters.

Board of Studies:	Electrical and Electronics Engineering
Approved in BOS No:	BOS 01, 1st Aug-2024
Approved in ACM No:	01, 1st Aug-2024

Expert Talk (To be Delivered by SMEs from Industries)	**COs**	**POs / PSOs**
1. ZCS & ZVS RESONANT CONVERTERS	CO1–CO5	PO1, PO2,PO3,PO4,PSO1,PSO2
2. RESONANT PULSE INVERTERS	CO1–CO5	PO1, PO2,PO3,PO4,PSO1,PSO2

Textbooks:

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

References:

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

Web References:

1. https://archive.nptel.ac.in/courses/108/107/108107128/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1(%)	Internal Assessment #2(%)
L1 L2	20	20
L3 L4	40	40
L5 L6	40	40
Total (%)	**100**	**100**

Sample Short and Long Answers questions of Various Cognitive Levels

1. Compare the Microprocessor and Microcontroller
2. Define assembler directives
3. Define different data types supported by 8051C Microcontroller
4. Explain the importance of TI and RI flags?
5. Explain the bit pattern of Program status word?
6. What are the Memory Organizations?

7. Explain with example the various addressing modes of 8051?
8. What is the purpose, peripherals and Peripheral Interface?
9. What is Operation of the ADC in the DSP
10. What are the Different Field Programmable Gate Arrays?
11. Draw the block diagram of 8051 microcontroller?
12. Differentiate JMP and CALL instructions. Explain with suitable diagram the jump and Call program range.
13. Explain the bit contents of IE and IP registers?
14. What are the Different Power converters for modern microprocessor?
15. Explain the Operation of the ADC in the DSP

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Bhogapuram (M), Vizianagaram (Dist) 5

MTPE1205 ELECTRIC DRIVES SIMULATION LABORATORY 0 0 4 2

Course Objectives:

1. The student should be able to understand the simulate different DC Shunt Machine.
2. The student should be able to understand the simulate Induction Machine.
3. The student should be able to understand the simulate PMSM.

Course Code	Course Outcomes	Mapping with POs and PSOs						Dok
		PO1	PO2	PO3	PO4	PS01	PS02	
MTPE1205.1	Should be able to simulate different DC shunt Machine	2	3	-	2	2	3	L2
MTPE1205.2	Should be able to understand the simulate Induction Motor	2	-	2	3	1	2	L3
MTPE1205.3	Should be able to understand the simulate PMSM drive	3	2	2	-	3	2	L3

Board of Studies: Electrical and Electronics Engineering
Approved in BOS No: 01, 1st August, 2024
Approved in ACM No: 01

List of Experiments

1. Simulation of DC shunt machine as motor & generator.
2. Simulate the speed control of DC motor using chopper converter.
3. Simulation of induction motor modes using d-q model.
4. Simulate the speed control of induction motor by using V/f control.
5. Simulate the BLDC motor and observe the speed transients.
6. Simulate speed control of induction motor by using vector control.
7. Compare the transient performance of induction motor controlled by v/f control & vector control methods.
8. Simulate PMSM motor by using d-q model.
9. Simulate the multi-level inverter fed induction motor drive.
10. Simulate the re-generative braking of inverter fed induction motor.
11. Study of PWM controlled inverter fed PMSM drive.
12. Evaluation of switching frequency effect on electric drive.

NOTE: Any 10 of the following experiments are to be conducted.

Exercise Problems

1. Explain briefly about Fundamentals of torque equation?
2. What are the different types of torque that involved in drive system?
3. Derive the expression for torque equation in electrical drives.
4. Describe briefly about multi quadrant operation of drives.
5. Derive the expression for torque in multi-quadrant drive system.

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Cherukupally (V), Near Tagarapuvalasa (
Bhogapuram (M), Vizianagaram (Dist)-53

MTPE1206 **ELECTRIC DRIVES LABORATORY** **0 0 4 2**

Course Objectives:

1. To study the speed control methods of DC Machine drives.
2. To study the speed control methods of AC Machine drives.
3. To study the speed control methods of PMSM and BLDC drives.

Course Code	Course Outcomes	Mapping with POs and PSOs						Dok
		PO1	PO2	PO3	PO4	PS01	PS02	
MTPE1206.1	Should be able to understand the dc Machine Drives	3	2	-	2	3	2	L2
MTPE1206.2	Should be able to understand the ac Machine Drives	2	-	3	2	2	2	L2,L3
MTPE1206.3	should be able to understand the PMSM and BLDC drive	2	3	2	-	2	3	L4, L5

Board of Studies: Electrical and Electronics Engineering
Approved in BOS No: 01, 1st August, 2024
Approved in ACM No: 01

List of Experiments

1. Study of armature controlled separately excited DC drive with 1-ϕ full converter.
2. Study of chopper controlled separately excited DC drive
3. Study of armature controlled separately excited DC drive with 3-ϕ full converter
4. Study of dynamic braking of DC drives.
5. Study of regenerative braking of DC drive.
6. Study of performance characteristics of a 3-ϕ induction motor using V/f control.
7. Vector control based speed control of induction motor.
8. Study of direct torque control of induction motor.
9. Speed control of PMSM drive with 3-ϕ inverter.
10. Speed control of BLDC drive with 3-ϕ inverter.
11. Speed control of switched reluctance motor drive.

NOTE: Any 10 of the following experiments are to be conducted.

Exercise Problems:

1. Explain briefly about Fundamentals of torque equation?
2. What are the different types of torque that involved in drive system
3. Derive the expression for torque equation in electrical drives.
4. Describe briefly about multi quadrant operation of drives.
5. Derive the expression for torque in multi-quadrant drive system.
6. Explain four quadrant operation of motor drive system with hoist load.

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MTPE21051 **Digital Signal Processors Controlled Drives** **3 0 0 3**

(Power Electronics)

Course Objectives:

The main objectives of the course is to

1. To study DSP controllers.
2. To learn coding in DSP's to control the electric drive speed.
3. To learn speed control methods for induction motor,
4. To learn speed control methods for PMSM,
5. To learn speed control methods for BLDC motors.

Course Code	Course Outcomes	Mapping with POs and PSOs							DoK
		PO1	PO2	PO3	PO5	PO6	PS01	PS02	
MTPE21051.1	Understand DSP architectures and their use in motor control	2	3	3	1	2	3	2	L2 L3
MTPE21051.2	Analyze the mathematical derivation and physical significance of Clarke's and Park's transformations in motor control.	-	3	2	1	3	2	2	L3, L4
MTPE21051.3	Develop control algorithms (PWM) for drive applications	-	2	3	1	1	3	2	L4, L5
MTPE21051.4	Apply the TMS320LF2407 DSP to control electric drives (DC, induction, BLDC) and power converters with real-time performance constraints.	-	-	2	3	2	3	3	L4, L5
MTPE21051.5	Understand, Construction, working principle, and characteristics of surface-mounted and interior PMSMs.	3	2	-	1	2	2	2	L5, L6

SYLLABUS

UNIT – I : Overview of TMS320LF2407 DSP controller **10 hours**

Review of Instruction Set, Interrupts, normalization and number formatting. **CO's: CO1**

Self-Learning Topics: Fundamentals of Digital Signal Processors

UNIT – II : Clarke's and Park's transformations **12 hours**

Review of Clarke's and Park's transformations, Implementation ofClarke's and Park's transformation using TMS320LF2407 DSP **CO's: CO2**

Self-Learning Topics: Fundamentals of AC Machine Representation

UNIT – III : Implementation of PWM Techniques for 3-Ph VSI **12 hours**

Implementation of Sine-triangle and SVPWM withTMS320LF2407 DSP using the concept of imaginary switching time. **CO's: CO3**

Self-Learning Topics: Basics of PWM Techniques

UNIT- IV: Control of BLDC Motor **10 hours**

Principle of operation with Drive control system, implementation of control system using TMS320LF2407 DSP.

CO's: CO4

Self-Learning Topics: Basics of BLDC Motor

UNIT- V: Control of PMSM and Induction Motor **10 hours**

Principle of operation with drive control system, implementation of vector control using TMS320 LF2407DSP.

Implementation of field-oriented control for the speed control of Induction Motor using TMS320LF2407DSP. **CO's: CO5**

Self-Learning Topics: Fundamentals of PMSM and Induction Motor

Board of Studies : Electrical and Electronics Engineering

Approved in BOS № : 02, 21st, May 2025

Approved in ACM № : 02

Text Books:

1. Hamid A.Toliyat: DSP Based Electromechanical Motion Control, 1st Edition, CRC Press, 2004
2. Ned Mohan, T.M. Undeland and William P. Robbins: Power Electronics: Converters, Applications, 3rd Edition, John Wiley & Sons, 2009

Reference Books:

1. Application Notes from the website of Texas Instruments.

Web References:

1. https://archive.nptel.ac.in/courses/108/104/108104052/
2. https://archive.nptel.ac.in/courses/108/101/108101040/#

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1(%)	Internal Assessment #2(%)
L1	---	---
L2	30	---
L3	40	---
L4	30	40
L5	---	40
L6	---	20
Total (%)	100	100

Sample Short and Long Answers questions of Various Cognitive Levels

L1: Remember

1. What is an instruction set in the context of a microprocessor or microcontroller?
2. Define the term “interrupt” in microprocessor systems.
3. What is normalization in floating-point number representation?

L2: Understand

1. Explain the basic principle behind Clarke's transformation and its role in converting three-phase quantities into two-phase quantities.
2. Describe Park’s transformation and its application in the analysis of rotating machines.

L3: Apply

1. Apply the concept of imaginary switching time to calculate the duty cycles for Sine-Triangle PWM in a three-phase inverter using the TMS320LF2407 DSP.
2. Illustrate the process of implementing Sine-Triangle PWM modulation using the TMS320LF2407’s PWM modules.
3. Apply Park’s transformation to generate the required voltage references for SVPWM implementation on the DSP.

L4: Analyzing

1. Analyze how the TMS320LF2407 DSP’s architecture supports real-time control in electric drive applications.
2. Compare the computational requirements for implementing PI control vs. PID control in a drive system on the TMS320LF2407.
3. Compare the implementation of scalar (V/f) control vs. vector control using the DSP in terms of performance and complexity.

L5: Evaluating

1. Evaluate the effectiveness of vector control over scalar control methods for induction motor speed regulation using TMS320LF2407 DSP.
2. Evaluate how well the TMS320LF2407 DSP’s hardware peripherals (ADC, PWM, timers) support the demands of vector control applications.
3. Analyze the trade-offs between computational load and control accuracy in FOC implementations on the TMS320LF2407.

L6: Create

1. Design a complete vector control system block diagram for an induction motor using the TMS320LF2407 DSP.
2. Develop an algorithm in pseudo-code for implementing field-oriented control on the TMS320LF2407 DSP for speed control of an induction motor.

3. Propose a method to integrate sensor less vector control with the TMS320LF2407 DSP for an induction motor drive.

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MTPE21052 **Smart Grid Technologies** **3 0 0 3**

(Power Electronics)

Course Objectives:

The main objectives of the course is to

1. To introduce the concept, architecture, and need for Smart Grids.
2. To familiarize students with enabling technologies
3. To provide knowledge on integration of renewable energy sources
4. To explore modern control techniques, power electronics, and energy management systems
5. To develop understanding of data management, big data analytics, and cyber security issues.

Course Code	Course Outcomes	Mapping with POs and PSOs							Dok
		PO1	PO2	PO3	PO5	PO6	PSO1	PSO2	
MTPS21052.1	Understand the Concept of Smart Grids and Analyze the Integration of Renewable Energy in Smart Grids	1	2	3	1	3	3	2	L2 L3
MTPS21052.2	Analyze the structure and design of a smart grid, including its components such as advanced metering infrastructure (AMI), communication networks, and control systems.	-	3	3	1	1	2	3	L3, L4
MTPS21052.3	Understand the principles of microgrids and distributed energy resources (DERs), and design their integration into larger smart grid systems.	2	1	-	1	1	2	3	L3, L4
MTPS21052.4	Design a microgrid for different environments (e.g., urban, rural, or off-grid settings) considering factors such as energy demand, renewable resource availability, and reliability.	1	2	3	1	1	3	2	L4, L5
MTPS21052.5	Understand and apply voltage and frequency control techniques, including voltage regulation and automatic frequency regulation, to maintain grid stability and quality.	1	-	1	1	-	3	3	L5, L6

SYLLABUS

UNIT – I: Introduction to Smart Grid **12 hours**

Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Functions of Smart Grid, Opportunities & Barriers of Smart Grid, Difference between conventional & smart grid, Concept of Resilient &Self-Healing Grid, Present development & International policies on Smart Grid. Case study of Smart Grid **CO's: CO1**

Self-Learning Topics: Basics of Electrical Grid

UNIT-II: Smart Grid Technologies Part 1 **12 hours**

Introduction to Smart Meters, Real Time Prizing, Smart Appliances, Automatic Meter Reading(AMR), Outage Management System(OMS), Plug in Hybrid Electric Vehicles(PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation, Phase Shifting Transformers.

Self-Learning Topics: Basics of Electric Vehicles, Smart Appliance **CO's: CO2**

UNIT-III: Smart Grid Technologies Part 2 **12 hours**

Smart Substations, Substation Automation, Feeder Automation. Geographic Information System(GIS), Intelligent Electronic Devices(IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System(WAMS), Phase Measurement Unit(PMU). **CO's: CO3**

Self-Learning Topics: Substation Layout, Feeder

UNIT- IV: Micro grids and Distributed Energy Resources **10 hours**

Concept of micro grid, need & applications of microgrid, formation of microgrid, Issues of interconnection, protection & control of microgrid. Plastic & Organic solar cells, Thin film solar cells, Variable speed wind generators, fuel cells, microturbines, Captive power plants, Integration of renewable energy sources. **CO's: CO4**

Self-Learning Topics: Variable Speed Generators, Fuel Cells

UNIT-V: Power Quality Management in Smart Grid **10 hours**

Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

Information and Communication Technology for Smart Grid: Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighbourhood Area Network (NAN), Wide Area Network (WAN). **CO's: CO5**

Self-Learning Topics: Power Quality

Board of Studies:	Electrical and Electronics Engineering
Approved in BOS No:	02, 21st, May 2025
Approved in ACM No:	02

Expert Talk (To be Delivered by SGs from Industries) CO's/ PO's / PSO's

1. Energy Storage Systems in Smart Grids CO1–CO6PO1, PO2,PO3,PO6,PSO1, PSO2
2. Cyber security Challenges in Smart Grids CO1–CO6PO1, PO2,PO3,PO6,PSO1, PSO2

Text Books:

1. Ali Keyhani, Mohammad N. Marwali, Min Dai "Integration of Green and Renewable Energy in Electric Power Systems", Wiley
2. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response", CRC Press

Reference Books:

1. JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, AkihikoYokoyama, "Smart Grid: Technology and Applications", Wiley
2. Jean Claude Sabonnadière, NouredineHadjsaïd, "Smart Grids", Wiley Blackwell 19
3. Peter S. Fox Penner, "Smart Power: Climate Changes, the Smart Grid, and the Future of Electric Utilities", Island Press; 1 edition 8 Jun 2010
4. S. Chowdhury, S. P. Chowdhury, P. Crossley, "Microgrids and Active Distribution Networks." Institution of Engineering and Technology, 30 Jun 2009
5. Stuart Borlase, "Smart Grids (Power Engineering)", CRC Press
6. Andres Carvallo, John Cooper, "The Advanced Smart Grid: Edge Power Driving Sustainability: 1", Artech House Publishers July 2011.

Web References:

1. https://archive.nptel.ac.in/courses/108/104/108104052/
2. https://archive.nptel.ac.in/courses/108/101/108101040/#

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1(%)	Internal Assessment #2(%)
L1	--	---
L2	40	---
L3	40	---
L4	20	40
L5	---	40
L6	---	20
Total (%)	100	100

Sample Short and Long Answers questions of Various Cognitive Levels

L1: Remember

1. Define the term Smart Grid
2. What is meant by the evolution of the electric grid?

3. List any three functions of a smart grid.

L2: Understand

1. Explain how smart meters differ from traditional energy meters
2. Describe the concept of real-time pricing and how it benefits consumers and utilities.
3. How do smart meters support demand-side management?

L3: Apply

1. Apply the concept of substation automation to design a basic automated protection scheme for a smart substation.
2. Apply GIS tools to map and analyze the layout of an urban power distribution network.
3. Demonstrate how GIS data can help improve outage response time in a smart grid.

L4: Analyzing

1. Analyze how micro grids contribute to grid stability during natural disasters and power outages.
2. Evaluate the potential challenges in integrating a microgrid into the main utility grid, considering factors like power quality and reliability.
3. Analyze the economic benefits and environmental impacts of deploying a micro grid in rural or off-grid areas.

L5: Evaluating

1. Evaluate the impact of electromagnetic compatibility (EMC) issues on the performance of smart grid systems, and propose strategies to mitigate these issues.
2. Assess the significance of power quality in a smart grid environment and how it affects the overall grid performance and end-user experience.
3. Evaluate how power quality management in a smart grid can address the challenges of voltage sags, harmonics, and flickers.

L6: Create

1. Design a power quality management strategy for a smart grid that addresses EMC issues arising from the integration of electric vehicles (EVs) and renewable energy sources issues.
2. Create a schematic diagram of a smart grid showing how power quality issues (voltage sags, harmonics, flickers) are managed using power quality conditioners and filters..
3. Propose a solution to mitigate electromagnetic interference (EMI) from smart meters in a smart grid environment, including a system for monitoring and controlling emissions.

Chairperson
Board of Studies (EEE)

MTPE21053 Modeling and Simulation of Power Electronic Systems 3 0 0 3

(Power Electronics)

Course Objectives:

The main objectives of the course is to

1. To introduce the principles of modeling power electronic devices and converters
2. To develop mathematical models for various power electronic systems
3. To enable the simulation of power electronic circuits using modern simulation tools.
4. To analyze the interaction of power electronic systems with electrical loads and the grid
5. To understand and apply different control strategies

Course Code	Course Outcomes	Mapping with POs and PSOs							DoK
		PO1	PO2	PO3	PO5	PO6	PSO1	PSO2	
MTPE21053.1	Explain the fundamental concepts of system modeling and simulation, and their applications in engineering problem-solving.	3	-	2	2	1	3	2	L2 L3
MTPE21053.2	Analyze and model different converter topologies using mathematical techniques	-	3	2	1	1	3	2	L3, L4
MTPE21053.3	Derive switching function models for basic converters like buck, boost, buck-boost, and full-bridge topologies.	-	3	1	1	-	2	3	L3, L4, L5
MTPE21053.4	Analyze steady-state and dynamic responses (e.g., transient, line/load regulation) using state-space averaged models.	-	3	2	1	2	3	2	L4, L5 L6
MTPE21053.5	Understand the principles of state-space averaging in converter modeling	1	1	-	1	-	3	2	L4, L5

SYLLABUS

UNIT – I: Introduction **12 hours**

Challenges in computer simulation - Simulation process - mechanics of simulation, Solution techniques for time domain analysis - Equation solvers, circuit-oriented simulators. **CO's: CO1**

Self-Learning Topics: Fundamentals of Simulation

UNIT – II: Simulation of power electronic converter –I **12 hours**

MNA and ST Approaches- Nodal Analysis, Modified Nodal Analysis, The Spare Tableau Approach, Nonlinear Circuits - The Newton-Raphson Method, Computation Time, Convergence Issues, Nonlinear Circuit Equations, Introduction to Transient Simulation - Introduction, Discretization of Time, Transient Analysis, Accuracy and Stability, Explicit and Implicit Schemes, Methods for Transient Simulation - FE, BE and TRZ, **CO's : CO2**

Self-Learning Topics: Nodal Analysis, Newton – Raphson Method

UNIT – III: Simulation of power electronic converter –II **12 hours**

Transient Analysis in Circuit Simulation, Equivalent Circuit Approach: RC Circuit, Buck Converter; Some Practical Aspects: Undamped Oscillations, Ringing, Global Error in Switching Circuits, Round-off Error, Assessment of Accuracy, Singular Matrix Problem, Trapezoidal integration, M & N method for simulating power electronic converters (with buck converter as a representative example). **COs – CO3**

Self-Learning Topics: Buck Converter, Undamped Oscillations

UNIT – IV: Switching Function **12 hours**

Introduction, Application of the switching function technique, Properties of the switching function, Voltage-Current relations in switched circuits - Single Switch, Parallel Switch, Pulse Width Modulation- Unipolar, PWM Signal of a composite function, bipolar square wave modulation, Mathematical Modeling of Buck Converter, Modeling using switching function-buck converter, Rectifier, 3-phase VSI inverter, matrix converter, m-phase rectifier. PWM rectifier topologies, Modeling of power electronic converters - PWM rectifier in different frames- abc, alpha-beta and d-q. **CO's: CO4**

Self-Learning Topics: Basics of Switching Function, Converter Operation & Switching Logic

UNIT- V: Modeling, Simulation of switching converters with state space averaging, hybrid model **10 hours**

State space approach, averaging method,State Space Averaging Technique – Modeling AND linearization of converter transfer functions- Hybrid Modeling for DC-DC converter. **CO's: CO5**

Self-Learning Topics: State-Space Averaging (SSA)

Board of Studies: Electrical and Electronics Engineering

Approved in BOS No: 02, 21st , May 2025

Approved in ACM No: 02

Text Books:

1. M. B. Patil, V. Ramnarayanan, V. T. Ranganathan**:** Simulation of Power Electronic Converters**,** 1st ed., Narosa Publishers, 2010

Reference Books:

1. Ned Mohan, Undeland and Robbins**, "**Power Electronics: Converters, Design and control**"**- 2nd ed., John Wiley.

Web References:

1. https://archive.nptel.ac.in/courses/108/104/108104052/
2. https://archive.nptel.ac.in/courses/108/101/108101040/#

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1(%)	Internal Assessment #2(%)
L1	---	---
L2	30	---
L3	40	30
L4	30	40
L5	---	20
L6	---	10
Total (%)	100	100

Sample Short and Long Answers questions of Various Cognitive Levels

L1: Remember

1. Define a power electronic converter.
2. List the types of DC-DC converters.
3. Name any four limitations of computer-based circuit simulation
4. What are the basic steps involved in the simulation process?

L2: Understand

1. Why is the Newton-Raphson method used for solving nonlinear circuit equations?
2. Describe how nonlinear circuit equations are formed and solved in simulation tools.
3. What do accuracy and stability mean in the context of transient simulation?

L3: Apply

1. Apply transient analysis techniques to determine the output voltage of an RC circuit when subjected to a step input.
2. Apply the M & N method to simulate a buck converter and compare the results with those obtained using the trapezoidal method.
3. Apply methods to estimate global error in switching circuit simulations.

L4: Analyzing

1. Analyze how the switching function affects voltage-current relationships in a single switch and parallel switch configurations.

2. Compare the behavior of circuits with single and parallel switches using switching function properties.

3. Examine how different PWM rectifier topologies manage input current shaping and power factor correction

4. Given a PWM rectifier modeled in the dq frame, analyze how the d and q components relate to active and reactive power control.

L5: Evaluating

1. Evaluate the advantages and limitations of using state-space averaging compared to time-domain simulation for modeling DC-DC converters.

2. Compare the hybrid model and state-space averaged model in terms of computational complexity and simulation time.

3. Compare the use of the averaging method versus full switching model in predicting converter behavior during transient event.

L6: Create

1. Evaluate the advantages and limitations of using state-space averaging compared to time-domain simulation for modeling DC-DC converters.

2. Compare the hybrid model and state-space averaged model in terms of computational complexity and simulation time.

3. Compare the use of the averaging method versus full switching model in predicting converte behavior during transient event

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MTPE2106 **Renewable Energy Sources** **3 0 0 3**
(Open Elective)

Course Objectives:

The main objectives of the course is to

1. To study the solar radiation data, equivalent circuit of PV cell and its I-V & P-V characteristics
2. To understand the concept of Wind Energy Conversion & its applications.
3. To study the principles of biomass and geothermal energy.
4. To understand the principles of Ocean Thermal Energy Conversion (OTEC), motion of waves and power associated with it.
5. To study the various chemical energy sources such as fuel cell and hydrogen energy along with their operation and equivalent circuit.

Course Code	Course Outcomes	Mapping with POs and PSOs							DoK
		PO1	PO2	PO3	PO4	PO5	PO6	PSO2	
MTPE2106.1	Analyze solar radiation data, extra-terrestrial radiation, radiation on earth's surface and solar Energy Storage.	-	3	2	1	1	3	1	L2,L3
MTPE2106.2	Illustrate the components of wind energy systems.	1	3	-	1	1	1	1	L3, L4
MTPE2106.3	Illustrate the working of biomass, digesters and Geothermal plants.	2	2	-	-	1	-	1	L3, L4
MTPE2106.4	Demonstrate the principle of Energy production from OTEC, Tidal and Waves.	3	1	-	2	1	1	1	L4,L5
MTPE2106.5	Evaluate the concept and working of Fuel cells & MHD power generation.	-	3	2	2	1	2	2	L5,L6

SYLLABUS

Unit –I: Solar Energy **14 Hours**

Introduction - Renewable Sources - prospects, Solar radiation at the Earth Surface - Equivalent circuit of a Photovoltaic (PV) Cell - I-V & P-V Characteristics - Solar Energy Collectors: Flat plate Collectors, concentrating collectors - Solar Energy storage systems and Applications: Solar Pond - Solar water heating - Solar Green house. **CO's: CO1**

Self-Learning Topics: Modeling and implementation of maximum-power-point-tracking (MPPT) algorithms for PV systems.

Unit –II: Wind Energy **10 Hours**

Introduction - basic Principles of Wind Energy Conversion, the nature of Wind - the power in the wind - Wind Energy Conversion - Site selection considerations - basic components of Wind Energy Conversion Systems (WECS) - Classification - Applications. **CO's: CO2**

Self-Learning Topics: wind farm control strategies for wake steering and power smoothing.

Unit –III: Biomass and Geothermal Energy **12 Hours**

Biomass: Introduction - Biomass conversion technologies - Photosynthesis, factors affecting Bio digestion - classification of biogas plants - Types of biogas plants - selection of site for a biogas plant.

Geothermal Energy: Introduction, Geothermal Sources – Applications - operational and Environmental problems. **CO's: CO3**

Self-Learning Topics: Advanced biomass pre treatment and enzymatic hydrolysis techniques for second-generation bio-fuels.

Unit –IV: Energy from Oceans, Waves & Tides **12 Hours**

Oceans: Introduction - Ocean Thermal Electric Conversion (OTEC) – methods - prospects of OTEC in India.

Waves: Introduction - Energy and Power from the waves - Wave Energy conversion devices.
Tides: Basic principle of Tide Energy -Components of Tidal Energy. **CO's: CO4**

Self-Learning Topics: Advanced fluid dynamics modeling of ocean currents for tidal-stream turbine optimization**.**

Unit –V: Chemical Energy Sources **12 Hours**

Fuel Cells: Introduction - Fuel Cell Equivalent Circuit - operation of Fuel cell - types of Fuel Cells - Applications.

Hydrogen Energy: Introduction - Methods of Hydrogen production - Storage and Applications
Magneto Hydro Dynamic (MHD) Power generation: Principle of Operation - Types.

Self-Learning Topics: Magneto hydro dynamic (MHD) channel design under different working fluids (liquid metal vs. plasma) and magnetic field configurations **CO's: CO5**

Board of Studies: Electrical & Electronics Engineering

Approved in BOS No: 02, 21st, May, 2025

Approved in ACM No: 02

Text Books:

1. G.D.Rai, Non-Conventional Energy Sources, Khanna Publications, 2011.
2. John Twidell & Tony Weir, Renewable Energy Sources, Taylor & Francis, 2013.

Reference Books:

1. S.P.Sukhatme & J.K.Nayak, Solar Energy-Principles of Thermal Collection and Storage, TMH, 2011.
2. John Andrews & Nick Jelly, Energy Science- principles, Technologies and Impacts, Oxford, 2nd edition, 2013.
3. Shoba Nath Singh, Non- Conventional Energy Resources, Pearson Publications, 2015.

Web References:

1. https://nptel.ac.in/courses/103103206
2. https://archive.nptel.ac.in/courses/103/103/103103206/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	---	---
L2	30	---
L3	50	20
L4	20	40
L5	---	30
L6	---	10
Total (%)	100	100

Sample Short and Long Answers questions of Various Cognitive Levels

L1: Remember

1. What is renewable energy
2. What are the different types of solar collectors?
3. Discuss the advantages and disadvantages of wind energy.
4. Describe the process of hydropower generation

L2: Understand

1. Discuss the environmental impacts of solar energy systems.
2. Explain the difference between renewable and non-renewable energy sources
3. What are the advantages and limitations of using wind energy?
4. Describe the process of energy generation in a wind turbine.

L3: Apply

1. Develop a Solar Water Pumping System for Irrigation
2. How can you apply the principles of wind energy to design a new type of turbine?.
3. How can renewable energy be used to power a home?

L4: Analyzing

1. Analyze the environmental benefits and drawbacks of using wind energy
2. Compare the efficiency and cost-effectiveness of different energy storage technologies in renewable energy systems
3. Analyze the impact of intermittency on the integration of solar and wind energy into the national grid.

L5: Evaluating

1. Evaluate the benefits of using a three-phase supply for residential versus industrial setups.
2. Briefly explain the environmental factors associated with wind energy.
3. Describe with a neat sketch the working of WECS with main components
4. Prioritize the advantage and limitations of Tidal power plant.

L6: Create

1. Compare open-cycle and closed-cycle MHD systems, discussing the working fluid, heat source, and typical thermal-to-electric conversion efficiencies for each.
2. Design a hybrid power plant combining solar thermal input with an open-cycle MHD generator, detailing the thermodynamic cycle and expected overall efficiency.

Chairperson
Board of Studies (EEE)

MTPE2107 **Fundamentals of Electric Vehicles** **3 0 0 3**
(Open Elective)

Course Objectives:

The main objectives of the course is to

1. To familiarize the students with the need and advantages of electric and hybrid electric vehicles.
2. To understand various power converters used in electric vehicles.
3. To know various architecture of hybrid electric vehicles.
4. To be familiar all the different types of motors suitable for electric vehicles.
5. To have knowledge on latest developments in strategies and other storage systems.

Course Code	Course Outcomes	Mapping with POs and PSOs							DoK
		PO1	PO2	PO3	PO4	PO5	PO6	PSO2	
MTPE2107.1	Illustrate different types of electric vehicles.	1	2	-	1	2	-	1	L2,L3
MTPE2107.2	Select suitable power converters for EV applications.	1	1	-	-	3	-	1	L3, L4
MTPE2107.3	Design HEV configuration for a specific application.	-	1	3	2	-	2	2	L3, L4
MTPE2107.4	Choose an effective method for EV and HEV applications.	-	2	-	2	2	-	1	L4,L5
MTPE2107.5	Analyse a battery management system for EV and HEV	-	3	2	1	1	2	1	L5,L6

SYLLABUS

Unit –I: **14 Hours**

Introduction Fundamentals of vehicles - Components of conventional vehicles - drawbacks of conventional vehicles – Need for electric vehicles - History of Electric Vehicles – Types of Electric Vehicles – Advantages and applications of Electric Vehicles. **CO's: CO1**

Self-Learning Topics: Regenerative braking strategies and energy recovery optimization

Unit –II: **12 Hours**

Components of Electric Vehicles: Main components of Electric Vehicles – Power Converters - Controller and Electric Traction Motor – Rectifiers used in EVs – Bidirectional DC–DC Converters – Voltage Source Inverters – PWM inverters used in EVs. **CO's: CO2**

Self-Learning Topics: Comparative analysis of different electric traction motors (BLDC, PMSM, SRM)

Unit –III: **12 Hours**

Hybrid Electric Vehicles: Evolution of Hybrid Electric Vehicles – Advantages and Applications of Hybrid Electric Vehicles – Architecture of HEVs - Series and Parallel HEVs – Complex HEVs – Range extended HEVs – Examples - Merits and Demerits. **CO's: CO3**

Self-Learning Topics: Energy flow control strategies in various hybrid configurations

Unit –IV: **10 Hours**

Motors for Electric Vehicles: Characteristics of traction drive - requirements of electric machines for EVs – Different motors suitable for Electric and Hybrid Vehicles – Induction Motors – Synchronous Motors – Permanent Magnetic Synchronous Motors – Brushless DC Motors – Switched Reluctance Motors (Construction details and working only). **CO's: CO4**

Self-Learning Topics: Comparison of torque-speed characteristics of various EV motors.

Unit –V: **10 Hours**

Energy Sources for Electric Vehicles: Batteries - Types of Batteries – Lithium-ion - Nickel-metal hydride - Lead-acid – Comparison of Batteries - Battery Management System – Ultra capacitors – Flywheels – Fuel Cell – it's working. **CO's: CO5**

Self-Learning Topics: Charge/discharge characteristics and degradation in Lithium-ion batteries

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Approved in BOS No: 02, 21st, May, 2025

Approved in ACM No: 02

Text Books:

1. Iqbal Hussein - Electric and Hybrid Vehicles: Design Fundamentals - CRC Press - 2021.
2. Denton - Tom. Electric and hybrid vehicles. Routledge - 2020.

Reference Books:

1. Kumar - L. Ashok - and S. Albert Alexander. Power Converters for Electric Vehicles. CRC Press - 2020.
2. Chau - Kwok Tong. Electric vehicle machines and drives: design - analysis and application. John Wiley & Sons - 2015.
3. Berg - Helena. Batteries for electric vehicles: materials and electrochemistry. Cambridge university press - 2015. NPTEL \ SWAYAM.

Web References:

1. https://archive.nptel.ac.in/courses/108/106/108106170/
2. https://onlinecourses.nptel.ac.in/noc20_ee99/preview

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	---	---
L2	20	---
L3	50	---
L4	30	50
L5	---	40
L6	---	10
Total (%)	100	100

Sample Short and Long Answers questions of Various Cognitive Levels

L1: Remember

1. Define an Electric Drive
2. List the Components of an Electric Drive System
3. What is the Role of a Control Unit in an Electric Drive?
4. Explain the Difference Between AC and DC Electric Drives.

L2: Understand

1. Explain the role of a power modulator in an electric drive system
2. Compare and contrast the characteristics of squirrel cage and wound rotor induction motors.
3. Analyze the impact of varying load conditions on the performance of an electric drive system..
4. What is the role of power converters in Electric Vehicles, and what types of power converters are commonly used?
5. What is the function of the controller in an Electric Vehicle, and how does it interact with other components?

L3: Apply

1. Discuss the benefits and challenges of implementing HEV technology in different applications
2. Compare and contrast the architectures of series and parallel HEVs. How do the different architectures impact the vehicle's performance, efficiency, and cost?
3. Analyze the impact of different power source and energy storage configurations on the overall efficiency, performance, and cost of a complex HEV.

L4: Analyzing

1. Analyze the impact of different battery management strategies on the performance, efficiency, and lifespan of electric vehicle batteries.

2. Analyze the advantages and disadvantages of using brushless DC motors versus switched reluctance motors in electric vehicles. Consider factors like torque ripple, efficiency, and reliability.
3. Compare and contrast the characteristics of lithium-ion, nickel-metal hydride, and lead-acid batteries for electric vehicle applications. Consider factors like energy density, power density, and lifespan.

L5: Evaluating

1. Evaluate the performance requirements for electric vehicle motors, including torque, power, and speed range, and how they impact motor design and selection.
2. Compare the efficiency, power density, and reliability of different motor types (e.g., induction, PMSM, BLDC, SRM) for electric vehicle applications.
3. Compare and contrast the characteristics of induction motors, synchronous motors, and permanent magnet synchronous motors for electric vehicle applications. Consider factors like efficiency, power density, and cost.

L6: Create

1. Design a hybrid energy storage system for an electric bus using batteries and ultra capacitors.
2. Propose an innovative energy source combination for EVs suitable for extreme temperature environments.

Chairperson
Board of Studies (EEE)

MTPE2108 **Concepts of Power System Engineering** **3 0 0 3**
(Open Elective)

Course Objectives:

The main objectives of the course is to

1. To understand the types of electric power plants and their working principles.
2. To understand the concepts of electric power transmission and distribution.
3. To gain the knowledge of protection and grounding of power system components.
4. To know the economic aspects of electrical energy.
5. To learn the importance of power factor improvement and voltage control.

Course Code	Course Outcomes	Mapping with POs and PSOs							DoK
		PO1	PO2	PO3	PO4	PO6	PSO1	PSO2	
MTPE2108.1	Know the concepts of power generation by various types of power plants.	3	1	-	1	-	2	1	L2,L3
MTPE2108.2	Learn about transmission line concepts and distribution systems schemes.	3	1	-	-	-	1	1	L3, L4
MTPE2108.3	Learn about protection equipments and grounding methods of power system.	3	1	-	-	-	1	2	L3, L4
MTPE2108.4	Know the economic aspects of electrical energy and their importance.	3	1	-	1	-	2	1	L4,L5
MTPE2108.5	Know the importance of power factor improvement and voltage control in power systems.	3	1	-	1	-	2	1	L5,L6

SYLLABUS

Unit –I: **14 Hours**

Power Generation Concepts & Types: Generation and sources of Energy – working principle and Schematic diagram approach of Thermal Power Plant – Hydro Power Plant - Nuclear Power Plant – Gas Power Plants – Comparison between Power Plants. **CO's: CO1**

Self-Learning Topics: Understand how daily and annual load curves influence plant efficiency and design.

Unit –II: **10 Hours**

Transmission and Distribution Concepts: Types of Conductors Materials – Constants of

Transmission Line – Classification of Overhead Transmission Lines – Performance of Short Transmission Lines – Simple Problems. Basic concept of Sub Station – Distribution Systems – Connection Schemes of Distribution Systems – Structure of Cables – Differences between Overhead & Underground systems. **CO's: CO2**

Self-Learning Topics: Understand how alternating current distribution affects conductor performance.

Unit –III: **12 Hours**

Protection and Grounding: List of Faults – Basic concepts of fuse – Circuit Breakers – Relays – SF6 Circuit Breakers – Vacuum Circuit Breakers – Operation of Lightning Arrester – Grounding and its advantages - Methods of Neutral Grounding: Resistance - Reactance and Resonant Grounding – Numerical Problems**.** **CO's: CO3**

Self-Learning Topics: Study the role of sulphur hexafluoride in arc quenching and insulation.

Unit –IV: **10 Hours**

Economic Aspects: Definitions of Load - Load & Load Duration Curves - Load Factor - Demand Factor – Utilization Factor – Types of tariff - Cost of Electrical Energy – Expression for Cost of Electrical Energy – Numerical Problems. **CO's: CO4**

Self-Learning Topics: Understand how to analyze load variation over time for system planning and optimization.

Unit –V: **10 Hours**

Power Factor Improvement and Voltage Control: Power Factor – Effects and Causes of low Power Factor- Shunt & Series Capacitor Compensation - Numerical Problems – Need of Voltage Control – Types of Voltage regulating Devices. **CO's: CO5**

Self-Learning Topics: Understand how low power factor increases system losses and reduces voltage levels.

Board of Studies: Electrical & Electronics Engineering

Approved in BOS No: 02, 21st, May, 2025

Approved in ACM No: 02

Text Books:

1. Power System Stability and Control by p. Kundur – Mc Graw Hill Publishers.
2. Power System Analysis John J. Grainger, William D. Stevenson- Mc Graw Hill Publishers.

Reference Books:

1. Electrical Power Systems by C.L.Wadwa - New Age International Publishers.

Web References:

1. https://archive.nptel.ac.in/courses/108/105/108105104/
2. https://onlinecourses.nptel.ac.in/noc22_ee17/preview

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	---	---
L2	30	---
L3	50	---
L4	30	50
L5	---	40
L6	---	10
Total (%)	100	100

Sample Short and Long Answers questions of Various Cognitive Levels

L1: Remember

1. What is a Transformer and its Role in Power Systems?
2. Explain the Purpose of Circuit Breakers in Power Systems.
3. List the Major Components of a Power System.

L2: Understand

1. Explain the significance of load curves in power system planning
2. Describe the purpose and operation of protective devices in T&D systems.
3. Describe the role and components of a substation in the power system.
4. Discuss the advantages and disadvantages of overhead versus underground transmission lines.

L3: Apply

1. Explain how power factor correction contributes to the overall efficiency of the power system.
2. Explain types of Traiff. Derive the expression for cost of Electrical energy.
3. Difference between Overhead line and underground cable.

L4: Analyzing

1. Explain the operation of SF_6 Circuit Breaker
2. Explain the operation of Lightning arrester.
3. Explain the effects and causes of Low power factor.

L5: Evaluating

1. Discuss the potential economic benefits of enhanced voltage stability, such as reduced

equipment wear and lower maintenance costs

2. Justify the use of hybrid parameters in transistor modeling.
3. Discuss the long-term economic benefits of maintaining a high power factor.

L6: Create

1. What is the role of reactive power compensation in voltage control, and how do capacitor banks assist in this process?
2. Describe the effects of inductive loads on power factor and how can capacitor compensation be used to counter these effects.

Chairperson
Board of Studies (EEE)

MTPE2109 **Applications of Power Converters** **3 0 0 3**
(Open Elective)

Course Objectives:

The main objectives of the course is to

1. To understand the inverters for induction heating applications.
2. To understand the power converters for different industrial applications.
3. To understand modeling of high voltage power supplies using the power converters for radar and space applications.
4. To understand modeling of low voltage and high current power supplies using the power converters for microprocessors and computer loads.
5. To understand the applications of DC-DC converters.

Course Code	Course Outcomes	Mapping with POs and PSOs							DoK
		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	
MTPE2109.1	Analyze power electronic application requirements.	-	3	2	1	1	2	1	L2,L3
MTPE2109.2	Identify suitable power converter from the available configurations.	-	3	-	1	-	2	2	L3, L4
MTPE2109.3	Develop improved power converters for any stringent application requirements.	-	1	3	2	1	3	2	L3, L4
MTPE2109.4	Improvise the existing control techniques to suit the application.	-	1	3	2	1	1	2	L4,L5
MTPE2109.5	Design of Bi-directional converters for charge/ discharge applications.	-	1	3	2	1	1	2	L5,L6

SYLLABUS

Unit –I: **14 Hours**

Inverters for Induction Heating: For induction cooking, induction hardening, melting, and welding applications **CO's: CO1**

Self-Learning Topics: Basic concepts of electromagnetic induction and its role in heating.

Unit –II: **10 Hours**

Power Converters for Lighting, pumping and refrigeration Systems: Electronic ballast, LED power drivers for indoor and outdoor applications. PFC based grid fed LED drivers, PV / battery fed LED drivers. PV fed power supplies for pumping/refrigeration applications. **CO's: CO2**

Self-Learning Topics: Overview of power conversion systems used in lighting, pumping, and refrigeration.

Unit –III: **12 Hours**

High Voltage Power Supplies - Power supplies for X-ray applications - power supplies for radar applications - power supplies for space applications**.**

Self-Learning Topics: Applications of Transients in Electrical Systems **CO's: CO3**

Unit –IV: **10 Hours**

Low voltage high current power supplies: Power converters for modern microprocessor and computer loads**.** **CO's: CO4**

Self-Learning Topics: Overview of low voltage high current power supplies

Unit –V: **10 Hours**

Bi-directional DC-DC (BDC) converters: Electric traction, automotive Electronics and charge/discharge applications, Line Conditioners and Solar Charge Controllers. **CO's: CO5**

Self-Learning Topics: Key components and operating principles of bi-directional DC-DC Converters.

Board of Studies: Electrical & Electronics Engineering

Approved in BOS No: 02, 21st, May, 2025

Approved in ACM No: 02

Text Books:

1. Ali Emadi, A. Nasiri, and S. B. Bekiarov: Uninterruptible Power Supplies and Active Filters, CRC Press, 2005.
2. M. Ehsani, Y. Gao, E. G. Sebastien and A. Emadi: Modern Electric, Hybrid Electric and Fuel Cell Vehicles, 1st Edition, CRC Press, 2004.

Reference Books:

1. William Ribbens: Understanding Automotive Electronics, Newnes, 2003.

Web References:

1. https://archive.nptel.ac.in/courses/117/103/117103148/
2. https://onlinecourses.nptel.ac.in/noc24_ee130/preview

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	---	---
L2	30	---
L3	50	20
L4	20	40

L5	---	30
L6	---	10
Total (%)	100	100

Sample Short and Long Answers questions of Various Cognitive Levels

L1: Remember

1. What is the principle of induction heating?
2. List common applications of induction heating.
3. What is the typical frequency range used in induction heating inverters?
4. Name two advantages of using inverters in induction heating systems.

L2: Understand

1. Explain how electronic ballasts differ from conventional magnetic ballasts in lighting systems.
2. Discuss the advantages of using LED power drivers in indoor vs. outdoor lighting applications
3. Explain why PFC-based LED drivers are important in grid-connected systems.
4. Describe how power converters enable PV-based pumping systems to operate efficiently throughout the day

L3: Apply

1. Calculate the output voltage needed for an X-ray power supply if the tube requires 80 kV and a current of 10 mA.
2. Design a basic block diagram of a high-voltage DC power supply suitable for radar transmitters.
3. Illustrate how voltage regulation can be achieved in a high-voltage power supply for X-ray applications.
4. Apply your knowledge of insulation and safety practices to propose suitable insulation methods for high-voltage supplies used in space applications.
5. Calculate the input power required by a high-voltage power supply delivering 100 kV at 1 mA with an overall efficiency of 80%.

L4: Analyzing

1. Analyze how load transients in modern microprocessors affect the performance of low-voltage high-current power supplies.
2. Compare the efficiency of different converter topologies (e.g., Buck, multiphase Buck) used for low-voltage high-current supplies in computing systems
3. Examine the impact of output voltage ripple on the performance of microprocessor loads

4. Analyze the need for high dynamic response in power supplies for modern computer loads.
5. Differentiate between single-phase and multiphase power converters in terms of current sharing and transient response.

L5: Evaluating

1. Evaluate the suitability of a bidirectional buck-boost converter for electric vehicle (EV) traction applications.
2. Evaluate the impact of different control strategies (e.g., current-mode vs. voltage-mode) on the stability and transient response of BDC converters in solar charge controllers
3. Evaluate the thermal management challenges in high-power bidirectional converters for electric traction applications.

L6: Create

1. Design a bidirectional DC-DC converter circuit for a solar charge controller that can charge and discharge a 48 V battery bank.
2. Develop a simulation model for a bidirectional buck-boost converter used in electric traction systems, including regenerative braking mode.
3. Create a block diagram for a BDC converter-based power management system in a hybrid electric vehicle.

Chairperson
Board of Studies (EEE)