M.TECH. IN ELECTRICAL ENGINEERING
(POWER ELECTRONICS AND POWER SYSTEMS)

NETAJI SUBHAS UNIVERSITY, JAMSHEDPUR

Established Under Jharkhand State Private University Act, 2018
Approved by AICTE, PCI, BCI, NCTE, INC & JNRC

EVALUATION SCHEME & SYLLABUS
FOR
MASTER OF TECHNOLOGY
IN
ELECTRICAL ENGINEERING
(POWER ELECTRONICS
AND
POWER SYSTEMS)
(M.TECH-EE (PE & PS))

On
Choice Based Credit System
(Effective from the Session : 2025-26)

Netaji Subhas University
Pokhari, Near Bhilai Pahadi, Jamshedpur, Jharkhand

M.TECH. IN ELECTRICAL ENGINEERING
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VISION

We aim to be a center of excellence in Electrical Engineering education and research, fostering innovation and sustainability. We aim to empower graduates with advanced technical knowledge, leadership qualities and a commitment to the development of the society through cutting-edge technologies and ethical practices.

MISSION

- To deliver in-depth knowledge in electrical engineering through rigorous coursework, laboratory experience, and project-based learning.
- To foster a research-oriented environment to encourage innovation in emerging areas such as power electronics, smart grids, renewable energy, automation, and embedded systems.
- To encourage continuous learning, entrepreneurial thinking, and leadership qualities to adapt to the evolving technological landscapes.

PROGRAMME EDUCATION OBJECTIVES (PEOs)

PEO1: Post graduates will show expertise in the core areas of electrical engineering that will help them to design and analyze complex engineering problems.
PEO2: Postgraduates will engage in research and development activities, contributing to advancements in electrical engineering through original research, patents, publications, or higher academic pursuits.
PEO3: Post graduates will demonstrate professionalism, ethical responsibility, and leadership in academic, industrial, and research organizations.
PEO4: Post graduates will pursue lifelong learning through professional development, certifications, or further education to stay abreast of emerging technologies and industry trends.
PEO5: Post graduates will demonstrate leadership qualities, effectively work in interdisciplinary teams, and manage projects and teams in professional environments, both nationally and globally.

PROGRAMME OUTCOMES (POs)

PO1: Apply advanced knowledge of electrical engineering, including theoretical and practical aspects, to solve complex engineering problem.
PO2: Identify, formulate, review research literature, and analyze complex electrical engineering problems using principles of mathematics, science, and engineering
PO3: Design electrical systems, components, or processes that meet desired specifications with appropriate consideration for public health, safety, cultural, societal, and environmental aspects.
PO4: Communicate effectively on complex engineering activities with the engineering community and with society at large, through reports, documentation, presentations, and clear instructions.

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M.Tech in Electrical Engineering (Power Electronics & Power Systems) (EE-PEPS)

COURSE STRUCTURE

SEMESTER - I

Code No.	Name of the Subjects	Periods			Credits	Marks		
		L	T	P		IA	TE	TM
MTEE101	Renewable & Distributed Energy Sources	3	1	-	4	30	70	100
MTEE102	Power System Relaying	3	1	-	4	30	70	100
MTEE103	Power Electronics Converter & Machine Drives	3	1	-	4	30	70	100
MTEE104	Power System Operation & Control	3	1	-	4	30	70	100
MTEE1XX	Elective - I	3	1	-	4	30	70	100
MTEE112L	Simulation Lab - I	-	-	4	2	15	35	50
MTEE113	Seminar - I	-	-	-	2	-	50	50
	Total	**18**	**2**	**8**	**24**	**165**	**435**	**600**

	Name of the Subject	L	T	P	Credits
Elective-I	Instrumentation in Electric Drives	3	1	-	4
	Micro & Smart Grid	3	1	-	4
	Generalize Theory of Electrical Machines	3	1	-	4

SEMESTER - II

Code No.	Name of the Subjects	Periods			Credits	Marks		
		L	T	P		IA	TE	TM
MTEE201	HVDC & FACTS	4	-	-	4	30	70	100
MTEE202	Special Electrical Machines	3	1	-	4	30	70	100
MTEE203	Advanced Power Electronic Converter	3	1	-	4	30	70	100
MTEE204	Advanced Control System	4	0	-	4	30	70	100
MTEE2XX	Elective - II	4	0	-	4	30	70	100
MTEE212L	Simulation Lab - II	-	-	4	2	15	35	50
MTEE213	Seminar - II	-	-	-	2	-	50	50
	Total	**18**	**2**	**8**	**24**	**165**	**435**	**600**

	Name of the Subject	L	T	P	Credits
Elective-II	Power System Dynamics	3	1	-	4
	Electrical Energy System	3	1	-	4
	EHVAC Transmission Systems	3	1	-	4

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SEMESTER - III

Code No.	Name of the Subject	Periods			Credits
		L	T	P	
MTEE301	Dissertation-I	-	-	-	16
MTEE302	Project Seminar-I	-	-	-	4
	Total	**-**	**-**	**-**	**20**

SEMESTER - IV

Code No.	Name of the Subject	Periods			Credits
		L	T	P	
MTEE401	Dissertation-II	-	-	-	16
MTEE402	Project Seminar-II	-	-	-	4
	Total	**-**	**-**	**-**	**20**

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RENEWABLE AND DISTRIBUTED ENERGY SOURCES (MTEE101)

Subject Code:-	**MTEE101**	**IA Marks:-**	**30**
Number of Lecture Hours/Week:-	**04**	**Term End Exam Marks:-**	**70**
Total Number of Lecture Hours:-	**60**	**Credit:-**	**04**

Topics Covered:

Unit -1

Over view of conventional & renewable energy sources, need, environmental consequences of fossil fuel use, potential & development of renewable energy sources, types of renewable energy systems, Future of Energy Use, Global and Indian Energy scenario, Energy for sustainable development, renewable electricity and key elements, Global climate change. [12hours]

Unit-2

Solar energy system, Solar Radiation, Availability, Measurement and Estimation, Solar-Electrical Power Generation, Solar Photo Voltaic (SVP) system, Different configurations, SPV system components and their characteristics, maximum power point tracking, Stand-Alone and Grid Connected SPV systems, other Miscellaneous Applications of Solar Energy. [12 hours]

Unit-3

Wind Energy Conversion, Potential, Site selection, Types of Wind Power Plants (WPPs), Components of WPPs, Working of WPPs, Characteristics, Betz limit Grid integration issues of WPPs. Basic working principle of hydal energy, Site selection, Classification of hydal systems: Large, small, micro-measurement of head and flow. [12 hours]

Unit-4

Geothermal Energy: Methods of harnessing the energy, potential in India. Ocean Energy: OTEC, Principle‘s utilization, setting of OTEC plants. Tidal power: Conventional and latest design of tidal power system. [12 hours]

Unit-5

Bio-mass Energy: Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, Fuel cell energy: Description, properties and operation of fuel cells, Major components & general characteristics of fuel cells, Indirect methanol fuel cell systems. [12 hours]

Course Outcomes:-

On completion of the course the learner shall be able to:

Course Outcome No.	Statement	Knowledge Level(KL)
CO1	Explain the principles and technologies of various renewable energy sources.	K2
CO2	Analyze the performance of distributed generation systems using simulation tools.	K4
CO3	Design and evaluate hybrid renewable energy systems for specific applications	K5

KL-Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2-Understand, K_3-Apply, K_4-Analyze, K_5-Evaluate, K_6-Create

Text Books:

1. S.P. Sukhatme, Solar Energy Principle of thermal Collection and Storage, Tata McGraw Hill, 1990.
2. G.L. Johnson , Wind Energy Systems, Prentice Hall Inc. New Jersey.
3. J.M. Kriender, Principles of solar Engineering , McGraw Hill, 1987

Reference Books:

1. V.S. Mangal, Solar Engineering, Tata McGraw Hill, 1992.
2. N.K. Bansal, Renewable Energy Source and Conversion Technology, Tata McGraw Hill, 1989.
3. P.J. Lunde., Solar Thermal Engineering, Jhon Willey & Sons, New York,1988.
4. J.A. Duffie, And W.A. Beckman, Solar Engineering Of Termal Processes, Wiley &Sons, 1990.

Mapping of CO (Course Outcome) and PO (Programme Outcome)

	PO1	PO2	PO3	PO4
CO1	**3**	**2**		
CO2		**3**	**3**	**2**
CO3			**3**	**2**
CO (Average)	**1**	**1.6**	**2**	**1.3**

M.TECH. IN ELECTRICAL ENGINEERING
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POWER SYSTEM RELAYING (MTEE102)

Subject Code:-	**MTEE102**	**IA Marks:-**	**30**
Number of Lecture Hours/Week:-	**04**	**Term End Exam Marks:-**	**70**
Total Number of Lecture Hours:-	**60**	**Credit:-**	**04**

Topics Covered:

Unit -1

Review of electromagnetic relays, their characteristics and applications. Introduction to static relays – amplitude and phasor comparators and their application in realization of various relay characteristics. [12hours]

Unit-2

Microprocessor based relays – Microprocessor based over-current relay, distance, directional relays. [12 hours]

Unit-3

Computer based relays – application of ANN, Wavelet transform, Fuzzy logic etc. in power system relaying. [12 hours]

Unit-4

Evolution of digital relays from electromechanical relays, Performance and operational characteristics of digital protection. [12 hours]

Unit-5

Digital protection of generators, Digital Differential Protection of Transformers, Digital protection of transmission lines. [12 hours]

Course Outcomes:-

On completion of the course the learner shall be able to:

Course Outcome No.	Statement	Knowledge Level (KL)
CO1	Explain the principles and operation of various protective relays used in power systems.	K2
CO2	Analyze fault scenarios and determine appropriate relay coordination for system protection.	K4
CO3	Design and evaluate a protection scheme using numerical relays for a given power network.	K3

KL-Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2-Understand, K_3-Apply, K_4-Analyze, K_5-Evaluate, K_6-Create

Text Books:

1. B. Ravindranath and M. Chander, Power System Protection and Switchgear, First Edition, New Age International (P) Limited.
2. B. Ram and D.N. Vishwakarma, Power System Protection and Switchgear, Ninth Reprint, Tata McGraw-Hill Publishing Company.
3. A.R. Van C. Warrington, Protective Relays their Theories and Practice, Volume II, Third Edition, John Willey & Sons, Inc, New York.
4. Computer Relaying for Power Systems by Arun G Phadke, James S Thorp , Wiley Publishers.

Reference Books:

1. Digital/Numerical Relays by T S Madhava Rao
2. R. T. Lythall, The J&P Switchgear Book, Seventh Edition, Newnes-Butterworth Stan Stewart, Distribution Switchgear, The Institute of Electrical Engineers, London.
3. Singh R. P., ―Digital power system protection‖, PHI Ltd., New Delhi 2007

Mapping of CO (Course Outcome) and PO (Programme Outcome)

	PO1	PO2	PO3	PO4
CO1	**3**	**2**		
CO2	**2**	**3**	**3**	
CO3			**3**	**2**
CO (Average)	**1.6**	**1.6**	**2**	**.6**

POWER ELECTRONICS CONVERTERS & MACHINE DRIVES (MTEE103)

Subject Code:-	**MTEE103**	**IA Marks:-**	**30**
Number of Lecture Hours/Week:-	**04**	**Term End Exam Marks:-**	**70**
Total Number of Lecture Hours:-	**60**	**Credit:-**	**04**

Topics Covered:

Unit -1

Power semi-conductor Devices, Characteristics and rating of thyristor, Power Diodes, Power Transistors, TRIAC, MOSFETs, GTOs, IGBT, MCT Firing circuit, protection scheme and Commutation techniques. [12hours]

Unit-2

Line-commutated rectifiers, single and three-phase rectifiers (controlled/uncontrolled), performance analysis, harmonics, Ripple reduction techniques, Introduction to multi-pulse converters, Dual Converter [12 hours]

Unit-3

DC to DC Converters: Study of single and multi-quadrant Chopper, Switch-mode DC-DC Converters, pulse width modulation, Non isolated and isolated Topologies, continuous and discontinuous modes of operations, steady-state analysis, energy storage elements design, higher-order topologies. [12 hours]

Unit-4

Inverters: Inverters, single and three-phase inverter configurations, voltage and current source inverters and their operating modes, voltage control in inverters and harmonic reduction using PWM strategies, Introduction to Multi-level Inverters, Rotary Inverter and their applications. [12 hours]

Unit-5

Variable frequency operation of three phase induction motors: Steady state analysis, Torque-speed , current-speed and slip frequency -speed characteristics and operating limits with constant volts/Hz and constant air gap flux operation, Slip power recover schemes. [12 hours]

Course Outcomes:-

On completion of the course the learner shall be able to:

Course Outcome No.	Statement	Knowledge Level (KL)
CO1	Explain the working principles of power electronic converters and electric drives.	K2
CO2	Analyze the performance of different converters and machine drives for industrial applications.	K4
CO3	Design control strategies for power electronic converters integrated with motor drives.	K3

KL-Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2-Understand, K_3-Apply, K_4-Analyze, K_5-Evaluate, K_6-Create

Text Books:

1. P.C. Sen, ―Power Electronics‖, McGraw Hill, 1st Ed., 2001
2. P.S. Bimbhra, ―Power Electronics‖, Khanna Publishers, 5th ed., 2012
3. G. K. Dubey, Fundamentals of Electrical Drives, Narosa Publishing House, 2002.

Reference Books:

1. Cyril W. Lander, ―Power Electronics‖, McGraw-Hill; 2nd edition,1987
2. Joseph Vidyathil, ―Power Electronics Principles and Applications‖, TMH,2010.

Mapping of CO (Course Outcome) and PO (Programme Outcome)

	PO1	PO2	PO3	PO4
CO1	**3**	**2**		
CO2	**2**	**3**	**3**	**1**
CO3			**3**	**1**
CO (Average)	**1.6**	**1.6**	**3**	**.6**

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POWER SYSTEM OPERATION AND CONTROL (MTEE104)

Subject Code:-	**MTEE104**	**IA Marks:-**	**30**
Number of Lecture Hours/Week:-	**04**	**Term End Exam Marks:-**	**70**
Total Number of Lecture Hours:-	**60**	**Credit:-**	**04**

Topics Covered:

Unit -1

Primary Control of Frequency : Governors, Secondary Control of Frequency: AGC. [12hours]

Unit-2

Voltage control: Automatic Voltage Regulators (generators), Shunt Compensation, SVC [12 hours]

Unit-3

Introduction to Power Flow Control : HVDC, FACTS, Load Curves, Unit Commitment. [12 hours]

Unit-4

Introduction to the use of Optimization Methods [12 hours]

Unit-5

Load Dispatch Centre Functions, Contingency Analysis Preventive, Emergency and Restorative Control [12 hours]

Course Outcomes:-

On completion of the course the learner shall be able to:

Course Outcome No.	Statement	Knowledge Level (KL)
CO1	Describe the functions and structure of modern power system operation and control centers.	K1
CO2	Analyze load frequency and voltage control techniques in interconnected power systems.	K4
CO3	Design and evaluate economic dispatch and unit commitment strategies for optimal system control.	K3

KL-Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2-Understand, K_3-Apply, K_4-Analyze, K_5-Evaluate, K_6-Create

Text Books:

1. "Power system stability and control", P. Kundur, Tata-McGraw Hill.2001
2. D.P. Kothari and I.J. Nagrath, ―Modern Power system Analysis, Tata McGraw Hill Publishing Company Limited.

Reference Books:

1. M. Shahideh Pourand Y. Wang, Communication and Control in Electric Power Systems Applications of parallel and Distributed Processing, Willey, 2003.

Mapping of CO (Course Outcome) and PO (Programme Outcome)

	PO1	PO2	PO3	PO4
CO1	**3**	**2**		
CO2	**2**	**3**	**3**	
CO3		1	**3**	**2**
CO (Average)	**1.6**	**1.6**	**2**	**.6**

INSTRUMENTATION IN ELECTRIC DRIVES (MTEE109)

Subject Code:-	**MTEE109**	**IA Marks:-**	**30**
Number of Lecture Hours/Week:-	**04**	**Term End Exam Marks:-**	**70**
Total Number of Lecture Hours:-	**60**	**Credit:-**	**04**

Topics Covered:

Unit -1

Transducers and sensors, definitions, classification of errors. Review of characteristics and parameters of transducers: tachometers, shaft-encoders, torque sensors, Hall-effect sensors and magnetic pick-ups.. [12hours]

Unit-2

Devices for instrumentation, design characteristics and typical applications of instrumentation, operational trans-conductance, isolation amplifiers, analog multipliers and dividers, function generators, timers, analog multiplexers [12 hours]

Unit-3

Sample and hold, optical and magnetic isolators; Frequency to voltage converters, temperature to current converters. [12 hours]

Unit-4

Review of A/D and D/A converters, specifications, multiplexed ADC, multiplying ADC; Data acquisition system. Instrumentation and signal processing. [12 hours]

Unit-5

Basic concept of PLL system, definitions of lock-in-range, capture range, loop gain, design aspects of phase detector, loop filter, PLL based motor speed control. [12 hours]

Course Outcomes:-

On completion of the course the learner shall be able to:

Course Outcome No.	Statement	Knowledge Level (KL)
CO1	Explain the types and functions of sensors and transducers used in electric drive systems.	K1
CO2	Analyze signals and measurement systems for monitoring speed, torque, and position in drives.	K4
CO3	Design and integrate instrumentation systems with control units for efficient drive operation.	K3

KL-Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2-Understand, K_3-Apply, K_4-Analyze, K_5-Evaluate, K_6-Create

Text Books:

1. Cerni, R. H. and Foster L. E., "Instrumentation for Engineering Measurement", John Wiley and Sons. 1966
2. Coughlin R. F. and Driscoll F. F., "Operational Amplifier and Linear Integrated Circuits", Prentice Hall of India Private Limited. 2008

Reference Books:

1. Norton N., "Handbook of Transducers", Prentice Hall International Edition. 2004
2. Hamilton T. D. S., "Handbook of Linear Integrated Electronics", McGraw-Hill International Book Company. 1977

Mapping of CO (Course Outcome) and PO (Programme Outcome)

	PO1	PO2	PO3	PO4
CO1	**3**			
CO2	**2**	**3**		**3**
CO3		3	**3**	**1**
CO (Average)	**1.6**	**2**	**1**	**1.3**

MICRO AND SMART GRIDS (MTEE110)

Subject Code:-	**MTEE110**	**IA Marks:-**	**30**
Number of Lecture Hours/Week:-	**04**	**Term End Exam Marks:-**	**70**
Total Number of Lecture Hours:-	**60**	**Credit:-**	**04**

Topics Covered:

Unit -1

Introduction to Smart Grid: 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 [12hours]

Unit-2

Concept of Resilient & Self-Healing Grid, Present development & International policies in Smart Grid. Case study of Smart Grid ,CDM opportunities in Smart Grid [12 hours]

Unit-3

Electri Net SM, Local Energy Networks, Electric Transportation, Low-Carbon Central Generation. [12 hours]

Unit-4

Smart Substations: Substation Automation equipment, Current transformers. Voltage transformers, Intelligent electronic devices, Bay controller, Remote terminal units, Faults in the distribution system, Components for fault isolation and restoration, Fault location, isolation and restoration, Voltage regulation. Feeder Automation, Geographic Information System (GIS). [12 hours]

Unit-5

Micro Grids: Concept of micro grid, need & applications of micro grid, formation of micro grid, issues of interconnection, protection & control of micro grid. Islanding, need and benefits, different methods of islanding detection. [12 hours]

Course Outcomes:-

On completion of the course the learner shall be able to:

Course Outcome No.	Statement	Knowledge Level (KL)
CO1	Describe the architecture, components, and communication technologies of micro and smart grids.	K1
CO2	Analyze the integration of distributed energy resources and control strategies in smart grids.	K4
CO3	Design and evaluate microgrid systems with renewable integration, demand response, and storage.	K3

KL-Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2-Understand, K_3-Apply, K_4-Analyze, K_5-Evaluate, K_6-Create

Text Books:

1. Stuart Borlase, 'Smart Grid: Infrastructure, Technology and Solutions', CRC Press 2012.
2. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, Smart Grid: Technology and Applications',Wiley, 2012.

Reference Books:

1. Lars.T. Berger, K. Iniewski, ―Smart Grid: Applications, Communications & Security‖ Wiley India Pvt. Ltd, Reprint 2015

Mapping of CO (Course Outcome) and PO (Programme Outcome)

	PO1	PO2	PO3	PO4
CO1	**3**			**3**
CO2	**2**	**3**	**3**	**1**
CO3	**3**	3	**3**	**2**
CO (Average)	**2.6**	**2**	**2**	**2**

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GENERALISED THEORY OF ELECTRICAL MACHINES (MTEE111)

Subject Code:-	**MTEE111**	**IA Marks:-**	**30**
Number of Lecture Hours/Week:-	**04**	**Term End Exam Marks:-**	**70**
Total Number of Lecture Hours:-	**60**	**Credit:-**	**04**

Topics Covered:

Unit -1

Basics of magnetic circuits, Analysis of magnetic circuits with air gap and permanent magnets, Analysis of singly excited electromechanical system with linear magnetics, Nonlinear magnetics using energy and co-energy principles. [12hours]

Unit-2

Inductances of distributed windings - salient pole, Cylindrical rotor. Analysis of the doubly excited two-phase rotational system, References frames power invariance and non-power invariance [12 hours]

Unit-3

Derivation of dc machine systems from the generalized machine [12 hours]

Unit-4

Analysis of induction machine – synchronous references frame with currents as variables - with rotor flux as variables, Basis for vector control - small signal modeling of induction machine [12 hours]

Unit-5

Analysis of the alternator - synchronous references frame, Derivation of salient and cylindrical rotor machine phasor diagrams, Three phase short circuit of alternator and various time constants. [12 hours]

Course Outcomes:-

On completion of the course the learner shall be able to:

Course Outcome No.	Statement	Knowledge Level (KL)
CO1	Explain the fundamental concepts and transformation techniques used in the generalized theory.	K1
CO2	Analyze the dynamic behavior of AC and DC machines using d-q and other reference frame models.	K4
CO3	Apply generalized machine models to simulate and evaluate machine performance in modern systems.	K3

KL-Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2-Understand, K_3-Apply, K_4-Analyze, K_5-Evaluate, K_6-Create

Text Books:
1. Fitzgerald and Kingsley, "Electric Machinery".2001
2. O'Simmons and Kelly, "Introduction to Generalized Machine Theory".

Reference Books:
1. Hancock, "Matrix Analysis of Electric Machinery".
2. N. Biranchi, Electrical Machines Analysis using Finite Elements, CRC Press, 2005.

Mapping of CO (Course Outcome) and PO (Programme Outcome)

	PO1	PO2	PO3	PO4
CO1	**3**			
CO2	**2**	**3**	**3**	
CO3		3	**3**	**2**
CO (Average)	**1.6**	**2**	**2**	**.6**

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HVDC AND FACTS (MTEE201)

Subject Code:-	**MTEE201**	**IA Marks:-**	**30**
Number of Lecture Hours/Week:-	**04**	**Term End Exam Marks:-**	**70**
Total Number of Lecture Hours:-	**60**	**Credit:-**	**04**

Topics Covered:

Unit -1

Reactive power control in electrical power transmission, principles of conventional reactive power compensators .Introduction to FACTS, flow of power in AC parallel paths, meshed systems, basic types of FACTS controllers, definitions of FACTS controllers, brief description of FACTS controllers. [12hours]

Unit-2

Shunt compensation – objectives of shunt compensation, methods of controllable VAR generation, static VAR compensators–SVC, STATCOM, SVC and STATCOM comparison. Series compensation–objectives of series compensation, thyristor switched series capacitors(TCSC), static series synchronous compensator(SSSC), power angle characteristics, and basic operating control schemes. [12 hours]

Unit-3

Unified power flow controller (UPFC) – Introduction, operating principle, independent real and reactive power flow controller and control structure. Interline power flow controller (IPFC), Introduction to Active power filtering, Concepts relating to Reactive power compensation and harmonic current compensation using Active power filters. 12 hours]

Unit-4

HVDC Transmission system: Introduction, comparison of AC and DC systems, applications of DC transmission, types of DC links, Layout of HVDC Converter station and various equipment‘s. HVDC Converters, analysis of bridge converters with and without overlap, inverter operation, equivalent circuit representation of rectifier and inverter configurations [12 hours]

Unit-5

Principles of control, desired features of control, converter control characteristics, power reversal, Ignition angle control, current and extinction angle control. Harmonics introduction, generation, ac filters and dc filters. Introduction to multi terminal DC systems and applications, comparison of series and parallel MTDC systems, Voltage Source Converter based HVDC systems

[12 hours]

Course Outcomes:-

On completion of the course the learner shall be able to:

Course Outcome No.	Statement	Knowledge Level (KL)
CO1	Explain the principles, types, and components of HVDC and FACTS systems.	K1
CO2	Analyze the performance of HVDC converters and FACTS devices for power flow and stability.	K4
CO3	Design and evaluate control strategies for integrating HVDC and FACTS in modern power systems.	K3

KL-Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2-Understand, K_3-Apply, K_4-Analyze, K_5-Evaluate, K_6-Create

Text Books:

1. Hingorani , L.Gyugyi, _Concepts and Technology of Flexible AC Transmission System', IEEE Press New York, 2000 ISBN –078033 4588. G.L. Johnson , Wind Energy Systems, Prentice Hall Inc. New Jersey.
2. Padiyar K.R., FACTS controllers for Transmission and Distribution systems' New Age International Publishers, 1st Edition, 2007.

Reference Books:

1. HVDC Transmission, S. Kamakshaiah, V. Kamaraju, The Mc — Graw Hill Companies. N.K.Bansal, Renewable Energy Source and Conversion Technology, Tata McGraw Hill, 1989.

Mapping of CO (Course Outcome) and PO (Programme Outcome)

	PO1	PO2	PO3	PO4
CO1	**3**			
CO2	**2**	**3**	**3**	**1**
CO3		3	**3**	**2**
CO (Average)	**1.6**	**2**	**2**	**1**

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SPECIAL ELECTRICAL MACHINES (MTEE202)

Subject Code:-	**MTEE202**	**IA Marks:-**	**30**
Number of Lecture Hours/Week:-	**04**	**Term End Exam Marks:-**	**70**
Total Number of Lecture Hours:-	**60**	**Credit:-**	**04**

Topics Covered:

Unit -1

Permanent Magnet Brushless D.C. Motors: Fundamental equations, EMF and Torque equations, Torque speed characteristics, Rotor position sensing, Sensor less motors, Motion control.

[12hours]

Unit-2

Permanent Magnet Synchronous Motors**:** Construction, Principle of operation, EMF and torque equations, Starting Rotor configurations, Dynamic model. [12 hours]

Unit-3

Synchronous Reluctance Motors: Constructional features, axial and radial flux motors, operating principle, characteristics. [12 hours]

Unit-4

Switched Reluctance Motors: Constructional features, principle of operation, torque production, characteristics and power controllers. [12 hours]

Unit-5

Stepping Motors: Features, fundamental equations, PM stepping motors, Reluctance stepping motors, Hybrid stepping motors, Torque and voltage equations, characteristics. [12 hours]

Course Outcomes:-

On completion of the course the learner shall be able to:

Course Outcome No.	Statement	Knowledge Level (KL)
CO1	Explain the construction, working, and characteristics of special electrical machines such as stepper, BLDC, and SRM.	K1
CO2	Analyze the performance and control strategies of special machines under various operating conditions.	K4
CO3	Design and simulate control systems for special machines using modern engineering tools.	K3

KL-Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2-Understand, K_3-Apply, K_4-Analyze, K_5-Evaluate, K_6-Create

Text Books:

1. Miller, T. J. E., Brushless Permanent Magnet and Reluctance Motor Drives, Oxford Science Publications, 1989.
2. Venkataratnam K., Special Electrical Machines, CRC Press, 2009.

Reference Books:

1. Krishnan. R, "Permanent Magnet and BLDC Motor Drives", CRC Press, 2009.

Mapping of CO (Course Outcome) and PO (Programme Outcome)

	PO1	PO2	PO3	PO4
CO1	**3**			
CO2	**2**	**3**	**3**	**1**
CO3		3	**3**	**2**
CO (Average)	**1.6**	**2**	**2**	**1**

M.TECH. IN ELECTRICAL ENGINEERING
(POWER ELECTRONICS AND POWER SYSTEMS)

ADVANCED POWER ELECTRONICS CONVERTERS (MTEE203)

Subject Code:-	**MTEE203**	**IA Marks:-**	**30**
Number of Lecture Hours/Week:-	**04**	**Term End Exam Marks:-**	**70**
Total Number of Lecture Hours:-	**60**	**Credit:-**	**04**

Topics Covered:

Unit -1 Switched Mode Rectifier-Operation of single/three phase bridges in Rectifier mode, Control principles-control of the DC side voltage, voltage control loop, the inner current control loop. Introduction to active power factor control.. [12hours]

Unit-2 Switched Mode Power Supply: Forward and flyback converter circuit, operation, waveforms and design, transformer design for power supplies, small signal analysis of DC-DC converters and closed loop control. [12 hours]

Unit-3

Multilevel Inverter; Diode clamped type, Flying Capacitor type and cascaded type; Basic topology and waveforms, Improvement in Harmonics, suitable modulation techniques, Space vector modulation. Current regulated inverter; Current regulated PWM voltage source inverters, Method of current control, Hysteresis control, Variable band Hysteresis control, Fixed frequency current control methods. [12 hours]

Unit-4

Resonant converters: Classification and operating principle, Zero voltage switching and Zero current switching techniques in DC-DC converters. [12 hours]

Unit-5

Introduction to Matrix converter and Z-source inverter: principle and control strategy. [12 hours]

Course Outcomes:-

On completion of the course the learner shall be able to:

Course Outcome No.	Statement	Knowledge Level (KL)
CO1	Explain the operating principles and classifications of advanced DC-DC, AC-DC, and multilevel converters.	K1
CO2	Analyze switching techniques, control strategies, and performance of advanced converters.	K4
CO3	Design and simulate advanced converter topologies for renewable and industrial applications.	K3

KL-Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2-Understand, K_3-Apply, K_4-Analyze, K_5-Evaluate, K_6-Create

Text Books:

1. N. Mohan, T. M. Underland & W.P. Robbing, Power Electronics: Converter, Applications & Design, John Wiley & Sons, New York, 2003.

Reference Books:

1. M. H. Rashid, Power Electronics Circuits, Devices, and Applications, Pearson, 2003.

Mapping of CO (Course Outcome) and PO (Programme Outcome)

	PO1	PO2	PO3	PO4
CO1	**3**			
CO2	**2**	**3**	**3**	**1**
CO3		2	**3**	**3**
CO (Average)	**1.6**	**1.6**	**2**	**1.3**

ADVANCED CONTROLSYSTEMS(MTEE204)

Subject Code:-	**MTEE204**	**IA Marks:-**	**30**
Number of Lecture Hours/Week:-	**04**	**Term End Exam Marks:-**	**70**
Total Number of Lecture Hours:-	**60**	**Credit:-**	**04**

Topics Covered:

Unit -1

Introduction, Control structures and performance measures, Time and frequency domain performance measures, Design of controller, Design of controller for SISO system, Controller design for TITO processes, Limitations of PID controllers, PI-PD controller for SISO system, PID-P controller for Two Input Two Output system. [12 hours]

Unit-2

Introduction to Nonlinear systems and their properties, Common Non-linearities, Describing functions, Phase plane method, Lyapounov's method for stability study, concept of Limit Cycle. [12 hours]

Unit-3

Stability Analysis: Stability of linear systems, stability types and their definitions for any general system, controllability theorem and its proof, Observability theorem and its proof, Controllable and observable subspaces. Conversion of model to controllable, canonical form and its use for pole placement. [12 hours]

Unit-4

Introduction to the philosophy of optimal control, formulation of optimal control problem, different performance criterion, [12 hours]

Unit-5

Linear quadratic regulator (LQR) and optimum gain matrix, Riccati equations, conceptual models and statistical models for random processes. [12 hours]

Course Outcomes:-

On completion of the course the learner shall be able to:

Course Outcome No.	Statement	Knowledge Level (KL)
CO1	Explain state-space analysis, modern control theory, and system stability concepts.	K1
CO2	Analyze controllability, observability, and design state feedback and observer systems.	K4
CO3	Design and simulate advanced control strategies for real-time and digital control applications.	K3

KL-Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2-Understand, K_3-Apply, K_4-Analyze, K_5-Evaluate, K_6-Create

Text Books:

1. Bandyopadhyay, M.N., Control Engineering: Theory and Practice, Prentice-Hall of India Private Limited
2. Ogata, K., Discrete-time Control Systems, Pearson Education (2005)

Reference Books:

1. B. C. Kuo. Automatic Control Systems, Prentice – Hall of India, Seventh Edition 1997.

Mapping of CO (Course Outcome) and PO (Programme Outcome)

	PO1	PO2	PO3	PO4
CO1	**3**			
CO2	**3**	**3**	**3**	**2**
CO3		2	**3**	**1**
CO (Average)	**2**	**1.6**	**2**	**1**

POWER SYSTEM DYNAMICS(MTEE207)

Subject Code:-	**MTEE207**	**IA Marks:-**	**30**
Number of Lecture Hours/Week:-	**04**	**Term End Exam Marks:-**	**70**
Total Number of Lecture Hours:-	**60**	**Credit:-**	**04**

Topics Covered:

Unit -1

Stability phenomena, Basic concepts and definitions, Rotor angle stability, Classification of stability, Synchronous machine characteristics, Power versus angle, relationship

[12 hours]

Unit-2

Small Signal Stability: State space concepts, Eigen properties of state matrix, small signal stability of a single machine infinite bus system, PSS, small signal stability of multi-machine systems, small signal stability enhancement [12 hours]

Unit-3

Transient stability, numerical integration methods, synchronous machine representation, excitation system representation, direct method of transient stability analysis, methods of improving transient stability [12 hours]

Unit-4

Voltage stability, characteristics: transmission system, generator & load. [12 hours]

Unit-5

Voltage collapse, classification of voltage stability, analysis, and prevention of voltage collapse [12 hours]

Course Outcomes:-

On completion of the course the learner shall be able to:

Course Outcome No.	Statement	Knowledge Level (KL)
CO1	Explain the fundamentals of state-space representation and modern control theory concepts.	K1
CO2	Analyze system controllability, observability, and pole placement techniques.	K4
CO3	Design and simulate advanced control strategies for real-time and digital control systems.	K3

KL-Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2-Understand, K_3-Apply, K_4-Analyze, K_5-Evaluate, K_6-Create

Text Books:

1. Padiyar K R, ―Power System Dynamics, Stability and Control", BS Publications

Reference Books:

1. P. Sauer and M. Pai, ―Power system dynamics and stability‖, Prentice Hall, 1998

Mapping of CO (Course Outcome) and PO (Programme Outcome)

	PO1	PO2	PO3	PO4
CO1	**3**			
CO2	**2**	**3**	**3**	
CO3		3	**3**	**2**
CO (Average)	**1.6**	**2**	**2**	**.6**

ELECTRICAL ENERGY SYSTEMS(MTEE208)

Subject Code:-	**MTEE208**	**IA Marks:-**	**30**
Number of Lecture Hours/Week:-	**04**	**Term End Exam Marks:-**	**70**
Total Number of Lecture Hours:-	**60**	**Credit:-**	**04**

Topics Covered:

Unit -1

Solar Radiation, Solar Radiation measurement, estimation of average solar radiation. Solar energy storage, well mixed storage, comparison, photo-voltaic system, design of cells, modules, array and all photo-voltaic system for measurement of electrical energy.

[12 hours]

Unit-2

Wind Energy: The nature of wind, Wind energy resources and modeling. [12 hours]

Unit-3

Geothermal Energy: Origin and types of geothermal energy and utilization. [12 hours]

Unit-4

OTEC: Ocean temperature differences. OTEC systems. Recent OTEC developments. Wave Energy: Fundamentals, Availability Wave energy conversion systems. [12 hours]

Unit-5

Tidal Energy: Fundamentals, Availability Tidal-energy conversion systems. Biomass Energy: Photosynthesis; Biomass resource; utilization of biomass. [12 hours]

Course Outcomes:-

On completion of the course the learner shall be able to:

Course Outcome No.	Statement	Knowledge Level (KL)
CO1	Describe the structure, components, and operation of modern electrical energy systems.	K1
CO2	Analyze the performance of generation, transmission, and distribution systems under various operating conditions.	K4
CO3	Design and evaluate efficient and reliable electrical energy systems using modern tools.	K3

KL-Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2-Understand, K_3-Apply, K_4-Analyze, K_5-Evaluate, K_6-Create

Text Books:

1. S.P. Sukhatme, Solar Energy Principle of thermal Collection and Storage, Tata McGraw Hill, 1990.
2. G.L. Johnson , Wind Energy Systems, Prentice Hall Inc. New Jersey.

Reference Books:

1. N.K.Bansal, Renewable Energy Source and Conversion Technology, Tata McGrawHill, 1989.

Mapping of CO (Course Outcome) and PO (Programme Outcome)

	PO1	PO2	PO3	PO4
CO1	**3**	**2**	**3**	
CO2	**2**	**3**		**3**
CO3		3	**3**	**2**
CO (Average)	**1.6**	**1.6**	**2**	**1.6**

EHVAC TRANSMISSION SYSTEMS (MTEE209)

Subject Code:-	**MTEE209**	**IA Marks:-**	**30**
Number of Lecture Hours/Week:-	**04**	**Term End Exam Marks:-**	**70**
Total Number of Lecture Hours:-	**60**	**Credit:-**	**04**

Topics Covered:

Unit -1

Overview of Electrical power transmission at high voltages. Overhead transmission lines, Bundled conductors, Resistance, Inductance and capacitance calculations of EHV line configurations [12hours]

Unit-2

Computation of surface voltage gradient on conductors. Corona: Power loss due to corona, Radio noise and Audible noise and their measurement as well as computation. Electric Field under transmission lines and its computation. [12 hours]

Unit-3

Overhead line insulators: Ceramic and non-ceramic types, Insulator performance in polluted environments, mitigation of pollution induced flashover. HV cable transmission -Underground cables and Gas insulated transmission lines [12 hours]

Unit-4

HV substations - AIS and GIS. Over voltages in power systems, Temporary, lightning and Switching over voltages, overvoltage computation. Design of line insulation for power frequency voltage, lightning and switching over voltages, Insulation characteristics of long air gaps [12 hours]

Unit-5

Protection of station apparatus and transmission lines against over voltages, Surge arresters, Shielding of transmission lines against lightning using ground wires. Insulation Co-ordination. Grounding of transmission towers and substations. Use of FACTS devices in EHV transmission. [12 hours]

Course Outcomes:-

On completion of the course the learner shall be able to:

Course Outcome No.	Statement	Knowledge Level (KL)
CO1	Explain the fundamentals, configurations, and advantages of EHVAC transmission systems.	K1
CO2	Analyze the effects of electrostatic and electromagnetic fields, corona loss, and voltage gradients.	K4
CO3	Design insulation coordination, reactive power compensation, and evaluate system performance using modern tools.	K3

KL-Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2-Understand, K_3-Apply, K_4-Analyze, K_5-Evaluate, K_6-Create

Text Books:
1. Extra High Voltage A.C. Transmission Engineering by R.D. Begamudre
2. EHV AC/DC Transmission by Deepak Gupta, Shobhit Gupta

Reference Books:
1. Transmission Line References Book 345 kV and Above, Electrical Power Research Institute(EPRI) 1982 USA.N. Biranchi.

Mapping of CO (Course Outcome) and PO (Programme Outcome)

	PO1	PO2	PO3	PO4
CO1	**3**	**2**		
CO2		**3**	**3**	**2**
CO3		3	**3**	**1**
CO (Average)	**1**	**2.6**	**2**	**1**