M.TECH. IN ELECTRICAL ENGINEERING (CONTROL 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 (CONTROL SYSTEMS)

(M.TECH-EE(CS))

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 (CONTROL SYSTEMS)

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: Post graduates 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.

M.TECH. IN ELECTRICAL ENGINEERING (CONTROL SYSTEMS)

M.Tech in Electrical Engineering (Control Systems) (EE-CS)

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
MTEE103	Power Electronics Converter & Machine Drives	3	1	-	4	30	70	100
MTEE105	Non Linear Control System	3	1	-	4	30	70	100
MTEE106	Industrial Process Control	3	1	-	4	30	70	100
MTEE1XX	Elective - I	3	1	-	4	30	70	100
MTEE112	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
MTEE202	Special Electrical Machines	4	-	-	4	30	70	100
MTEE204	Advanced Control System	3	1	-	4	30	70	100
MTEE205	Optimal Control Theory	3	1	-	4	30	70	100
MTEE206	Sensor Based Control	4	0	-	4	30	70	100
MTEE2XX	Elective - II	4	0	-	4	30	70	100
MTEE212	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

M.TECH. IN ELECTRICAL ENGINEERING
(CONTROL SYSTEMS)

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**

M.TECH. IN ELECTRICAL ENGINEERING
(CONTROL SYSTEMS)

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]

CourseOutcomes:-

Oncompletion ofthe coursethelearner shallbeable 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

ReferenceBooks:

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 OfTermal Processes, Wiley &Sons, 1990.

	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
(CONTROL SYSTEMS)

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‖, McGrawHill, 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. JosephVidyathil, ―Power Electronics Principles and Applications‖, TMH,2010.

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

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

M.TECH. IN ELECTRICAL ENGINEERING (CONTROL SYSTEMS)

NON LINEAR CONTROL SYSTEM(MTEE105)

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 nonlinear systems, Fundamental properties: Existence &uniqueness, Dependence on initial conditions & parameters. [12hours]

Unit-2

Phase plane analysis. And describing function methods for analysis of nonlinear systems. [12 hours]

Unit-3

Limit cycles & oscillations. Examples of phenomena, models & derivation of system equations. [12 hours]

Unit-4

Linearization, nonlinear control systems design by feedback linearization, input output Linearization. [12 hours]

Unit-5

Lyapunov stability: autonomous systems invariance principle, linear systems and linearization, non-autonomous systems. Linear time varying systems. [12 hours]

Course Outcomes:-

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

Course Outcome No.	Statement	Knowledge Level (KL)
CO1	Analyze and classify different types of nonlinear systems and their behaviors	K4
CO2	Apply phase-plane and Lyapunov methods to assess stability of nonlinear system	K3
CO3	Design nonlinear controllers using feedback linearization and sliding mode control	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. M. Vidyasagar, ―Nonlinear Systems Analysis‖, Society for Industrial and Applied Mathematics, 2002
2. S. Strogatz, ―Nonlinear Dynamics and Chaos‖, West view Press, 2001
3. Alberto Isidori, ―Nonlinear Control System‖, Vol I and II, Springer, 1999

Reference Books:

1. H.K.Khalil,―Non linear systems", 3rd edition, Prentice Hall, 2001

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

	PO1	PO2	PO3	PO4
CO1	**3**	**2**		
CO2	**2**		**3**	**2**
CO3	**2**		**3**	**2**
CO (Average)	**2**	**.6**	**2**	**1.3**

M.TECH. IN ELECTRICAL ENGINEERING
(CONTROL SYSTEMS)

INDUSTRIAL PROCESS CONTROL (MTEE106)

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

Process control principles, Process control block, diagram, loop components—sensor and transmitter, controller, final control element. Process transfer functions - process lag and dead-time, Self-regulating and non-self-regulating processes. Process instrumentation diagram: Symbols and interconnections. [12hours]

Unit-2

Process control sensors and transmitter, thermal sensors, mechanical sensors, analog signal conditioning—instrumentation amplifier, signal isolation, and filter, Analog signal transmission systems, Analog process controller, P, PI, PD and PID modes of operation, controller-tuning methods, on-off controllers. [12 hours]

Unit-3

Digital process controllers— theory, Digital controller in a process control loop, analog-to digital and digital-to- analog converters, Realization of digital controller. Final control elements: Actuators, Positioners and control valves. Recorders: Analog, digital and data loggers. Control loop characteristics. Controllability and stability. [12 hours]

Unit-4

Ratio-control, cascade control, feed -forward control and multi-loop control-P1Dcontrol. Process loop tuning-process reaction method, Ziegler-Nichols method and frequency response methods. [12 hours]

Unit-5

Characteristics of chemical processes, Chemical reactors, pH and blending processes, delay time and its effect. Flow control, pressure control, level control, and temperature control. Computer control of processes, Direct digital control and supervisory 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 principles and architecture of process control systems and instruments	K1
CO2	Analyze and model first and second-order industrial processes using dynamic behavior	K4
CO3	Design PID controllers and implement tuning techniques for real-time process 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. Johnson D Curtis, —*Instrumentation Technology"*, (7th Edition) Prentice Hall India, 2002.
2. Shinskey, F.G., —*Process Control Systems: Applications, Design and Tuning"* (3rd Edition) McGraw Hill Book Co, 1988.

Reference Books:

1. Seborg, D.E., T.F. Edgar, and D.A. Mellichamp, —Process Dynamics and Control", John Wiley, 2004
2. B. Wayne Bequette, —Process control: modeling, design, and simulation", Prentice Hall PTR, 2003

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

	PO1	PO2	PO3	PO4
CO1	**3**	**2**		
CO2		**3**	**2**	**2**
CO3	**3**		**3**	
CO (Average)	**2**	**1.6**	**1.6**	**.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, analogmultipliers and dividers, function generators, timers, analog multiplexers [12 hours]

Unit-3

Sample and hold, optical and magnetic isolators; Frequency to voltage converters, temperature to currentconverters. [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 aspectsof 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 IntegratedCircuits", 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-HillInternational 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 ,CDMopportunities in Smart Grid [12 hours]

Unit-3

Electri Net SM, Local Energy Networks, Electric Transportation, Low-Carbon CentralGeneration. [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 InformationSystem(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 andbenefits, 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, KithsiriLiyanage, 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

M.TECH. IN ELECTRICAL ENGINEERING
(CONTROL SYSTEMS)

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 permanentmagnets, 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 rotationalsystem, References frames power invariance and non-power invariance [12 hours]

Unit-3

Derivation of dcmachine 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 vectorcontrol - small signal modelling of induction machine [12 hours]

Unit-5

Analysis of the alternator - synchronous references frame, Derivation of salient and cylindrical rotor machine phasordiagrams, 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 (ProgrammeOutcome)

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

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, torqueproduction, 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, OxfordScience 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
(CONTROL SYSTEMS)

ADVANCED CONTROL SYSTEMS (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 domainperformance measures, Design of controller, Design of controller for SISO system, Controllerdesign 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]

M.TECH. IN ELECTRICAL ENGINEERING
(CONTROL SYSTEMS)

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**

OPTIMAL CONTROL THEORY (MTEE205)

Subject Code:-	**MTEE205**	**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, static and dynamic optimization, parameter optimization, Necessary conditions for optimal control, Calculus of variations: problems of Lagrange, Mayer and Bolza, Euler- Lagrange equation and transversality conditions. [12hours]

Unit-2

Lagrange multipliers, Pontryagins maximum principle; theory; application to minimum time, energy and control effort problems, and terminal control problem. [12 hours]

Unit-3

Dynamic programming: Hamilton-Jacobi-Bellman Equation, Bellman‘s principle of optimality, multistage decision processes, application to optimal control. [12 hours]

Unit-4

Linear regulator problem: matrix Riccati equation and its solution, tracking problem, computational methods in optimal control. [12 hours]

Unit-5

Application of mathematical programming, singular perturbations. [12hours]

Course Outcomes:-

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

Course Outcome No.	Statement	Knowledge Level (KL)
CO1	Explain the basic principles of optimal control and formulate performance indices	K1
CO2	Apply Pontryagin's Maximum Principle and Dynamic Programming to solve optimal control problems	K3
CO3	Design optimal controllers for linear systems using Linear Quadratic Regulator (LQR) methods	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. Enid R. Pinch, ―Optimal Control and Calculus of variation‖, Oxford University Press.
2. M. Gopal ,Digital Control & State Variable Methods, TMH.

Reference Books:

1. F.L. Lewis , V.L. Symmos, Optimal Control‖, Second Edition, John Wiley, 1995.
2. A.P.Sage and C.C.White II, Optimum Systems Control, 2nd Ed., Prentice-Hall, 1977.

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

	PO1	PO2	PO3	PO4
CO1	**3**	**2**		
CO2	**2**	**3**		**2**
CO3	**3**		**3**	**1**
CO (Average)	**2.6**	**1.6**	**1**	**1**

SENSOR BASED CONTROL (MTEE206)

Subject Code:-	**MTEE206**	**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

Definition, Sensor Characteristics, Transfer function, Characteristics, principle of sensing & transduction, classification, Resistive (Potentiometric type). [12hours]

Unit-2

Forms, material, resolution, accuracy, sensitivity. Strain gauge: Theory, type, materials, design consideration, sensitivity, gauge factor, variation with temperature, adhesive, rosettes. [12 hours]

Unit-3

Introduction, Classification of Transducers, Advantages and Disadvantages of Electrical Transducers, Transducers Actuating Mechanisms, Resistance Transducers, Variable Inductance Transducers, Capacitive Transducers, Piezoelectric Transducers, Hall Effect Transducers, Thermoelectric Transducers, Photoelectric Transducers. [12 hours]

Unit-4

Introduction, Functions of Signal Conditioning Equipment, Amplification, Types of Amplifiers, Mechanical Amplifiers Fluid Amplifiers, Electrical and Electronic Amplifiers. Configuration of Data Acquisition System, Data Acquisition Systems, Data Conversion. [12 hours]

Unit-5

Component of smart sensor, General architecture of smart sensor, Industrial application of smart sensor, Chemical sensors, biosensors, fiber optic sensors, gas sensors. [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 various sensors and their roles in control applications	K2
CO2	Integrate sensor data to monitor and control dynamic systems in real-time	K3
CO3	Design sensor-based feedback systems for automation and smart control systems	K3

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

K_1-Remember, K2-Understand, K3-Apply, K4-Analyze, K5-Evaluate, K6-Create

Text Books:

1. D. Patranabis, —Sensor & transducers, 2nd edition, PHI.
2. H.K.P. Neubert, —Instrument transducers, Oxford University press.

Reference Books:

1. H S Kalsi, —Electronic Instrumentation, TMH 2nd Ed 2004.

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

	PO1	PO2	PO3	PO4
CO1	**3**	**2**		**3**
CO2	**2**	**3**		**2**
CO3	**3**		**3**	**1**
CO (Average)	**2.6**	**1.6**	**1**	**2**

POWER SYSTEM DYNAMICS (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

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**

M.TECH. IN ELECTRICAL ENGINEERING (CONTROL SYSTEMS)

ELECTRICAL ENERGY SYSTEMS (MTEE210)

Subject Code:-	**MTEE210**	**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 electricalenergy.

[12 hours]

Unit-2

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

Unit-3

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

Unit-4

OTEC: Oceantemperature 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; Biomassresource; 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**

M.TECH. IN ELECTRICAL ENGINEERING
(CONTROL SYSTEMS)

EHVAC TRANSMISSION SYSTEMS (MTEE211)

Subject Code:-	**MTEE211**	**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 lineconfigurations [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 andswitching 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. Groundingof 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 volt 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 (ProgrammeOutcome)

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