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Duration of Exam:-03 hours	3	1	60	40

MTEE-101
Advanced Power System

Note: The theory question paper will have 5 sections containing a total of 9 questions. Section-1 will have one compulsory question from whole syllabus. The remaining 8 questions will be divided into 4 sections (2 questions per unit per section) and the student will have to attempt 5 questions i.e. exactly one question from each of the sections.

Unit 1

Network Modelling: System graph, loop, cut set and Incidence matrices, Primitive network and matrix, Formation of various network matrices by singular transformation and their interrelations. Building algorithm & modification for bus impedance matrix, Formation of bus admittance matrix and modification.

Unit 2

Fault Studies: Representation of three phase network elements, Treatment under balanced and unbalanced excitation, Transformation matrices and unbalanced elements.
Network short circuit studies using Z bus, Short circuit calculations for various types of faults.
Load flow studies using Gauss-Seidel and Newton-Raphson methods, Decoupled and fast decoupled method, Representation of regulating and off nominal ration transformers, Tie-line control, Comparison of methods.

Unit 3

Power System Security: Factors affecting security, contingency analysis using network sensitivity method and AC power flow method.
State estimation in power systems: Method of least-squares, State estimation of AC network, Detection and identification of bad measurements, Network observability and pseudo measurements, Application of power system state estimation.

Unit 4

Stability Studies: Transient stability analysis, swing equation, stability of multimachine system using modified Euler method and Runge-Kutta method.

Text/Reference:

1. G.W. Stagg & A.H El-Abaid, “Computer methods in Power system analysis”, McGraw Hill, New York.
2. L. P. Singh, “Advanced Power System Analysis and Dynamics”, New Age, International Publishers, New Delhi.
3. M. A. Pai, “Computer Techniques in Power System Analysis”, Tata McGraw Hill Publishing Co. Ltd.
4. John J.Grainger and W.D.Stevenson, “Power System Analysis”, McGraw Hill, New York, 1994.
5. D. P. Kothari and I. J. Nagrath, “ Modern Power System Analysis”, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1994.
6. Hadi Saadat, “ Power System Analysis”, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2002.

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	L	T	Ext.	Int.
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MTEE-103E
Power Apparatus and Electric Drives

Note: The theory question paper will have 5 sections containing a total of 9 questions. Section-1 will have one compulsory question from whole syllabus. The remaining 8 questions will be divided into 4 sections (2 questions per unit per section) and the student will have to attempt 5 questions i.e. exactly one question from each of the sections.

Unit 1

Generalized Theory of Electrical Machines: Introduction, primitive model, transformation, voltage equations for induction machine.

Induction Machines: Introduction, effect of space harmonics, slip power control, capacitor self-excitation of induction machines and its applications.

Unit 2

Transformers: Transformer as a mutually coupled circuit, equivalent circuit from coupled circuit approach.

Multi circuit Transformers: Advantage, theory, equivalent circuit, regulation, three circuit transformers.

Three phase autotransformers: Connections and Analysis Parallel operation of dissimilar transformers, Harmonics, Inrush current phenomenon, Effect of load and three phase connections.

Unit 3

Electric drives: Basic concept characteristics and operating mode of drive motors. Starting, braking and speed control of motors (AC & DC), Four Quadrant drives, Types of loads.

Unit 4

Duty cycle, Heating/cooling and insulation in motors, Choice of motors and rating, Modern trend in industrial drives, Studies relating to steel mills, paper mills, textile mill, machine tools etc. A.C. motor drives in transportation system and traction.

Special Machines: Servomotors, Stepper motors, Synchros, BLDC motors.

Text/Reference:

1. MIT Staff, 'Magnetic Circuits and Transformers', MIT Press Cambridge.
2. Fitzgerald & Kingsley, 'Electric Machinery' McGraw Hill Co. New Delhi.
3. PS Bimbhra 'Generalized Theory of Electrical Machines' Khanna Publishers, New Delhi.
4. Dubey, G.K. Fundamentals of Electrical Drives, Narosa Publishing House, New Delhi.
5. Bose B.K., Modern Power Electronics and AC Drives, Pearson Educational, Delhi, 2002.
6. S. K. Pillai, A first course on electrical drives, New Age International (P) Ltd., New Delhi.
7. Krishan R. Electric Motor Drives: Modeling Analysis and Control: PHI Pvt Ltd. New Delhi-2001.

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Duration of Exam:-03 hours	3	1	60	40

MTEE-105
Digital Control System

Note: The theory question paper will have 5 sections containing a total of 9 questions. Section-1 will have one compulsory question from whole syllabus. The remaining 8 questions will be divided into 4 sections (2 questions per unit per section) and the student will have to attempt 5 questions i.e. exactly one question from each of the sections.

Unit-1

Signal Processing in Digital Control: Basicdigital control scheme,principle of signal conversion, basic discrete-time signal, time-domain model for discrete-time systems,z-transform, transfer function models, jury stabilitycriterion, sample and hold systems,sample spectra and aliasing

Unit-2

Models of Digital Control Devices and Systems: Introduction, z-domain description of sampled continuous-time plants,z-domain description of systems with dead-time, implementation of digital controllers, digital PID controllers, digital temperature control system,stepping motors and their control,PLC

Unit-3

Analysisusing State Variable Methods: Statevariable representation-concepts, modeling, transformation, state diagrams, Jordan canonical form, Eigen values and Eigenvectors,
Solution of state equations, concepts of controllability and Observability,

Unit-4

Digital Observers: State regulator design-full order and reduced order state observer, design of state observers, compensator design by separation principle, state feedback with integral control ,deadbeat control by state feedback and deadbeat observers

Text/References:

1. Discrete time Control Systems by K. Ogata, “Prentice Hall International”.
2. Control System Engineering by Nagrath and Gopal, “New Age International”.
3. Digital Control Systems by B.C. Kuo “Oxford University Press

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MTEE-107
OPTIMAL CONTROL SYSTEM

Note: The theory question paper will have 5 sections containing a total of 9 questions. Section-1 will have one compulsory question from whole syllabus. The remaining 8 questions will be divided into 4 sections (2 questions per unit per section) and the student will have to attempt 5 questions i.e. exactly one question from each of the sections.

Unit-I

Problem formulation – Mathematical model – Physical constraints – Performance measure, Optimal control problem. Form of optimal control. Performance measures for optimal control problem. Selection a performance measure.

Unit-2

Calculus of variations – Fundamental concepts. Minimization of Functionals. Functionals involving in independent Function, Constrained Minimization,Formulation of Variational Calculus Using Hamiltion Method, Minimum Principle- Pontryagin's minimum principle and state inequality constraints.

Unit-3

Dynamic Programming – Optimal control law – Principle of Causality, invariant imbedding, optimality,

Multistage Decision in Continuous time-Hamiltion Jacobi Equation, Methods of steepest decent, Variation of extremals.

Unit-4

Discrete-Time Linear State Regulator, Continuous-Time Linear State Regulator, Time-Invariant Linear State Regulator for Continuous-Time Systems and Discrete-Time Systems, Numerical Solution of Riccati Equation- Direct Integration, Negative Exponential Method, An Iterative Method

Text/Reference:

1. Donald E. Kirk, Optimal Control Theory: An Introduction, Prentice-Hall networks series, 1970.
2. Anderson .B. D. O, Moore .J. B, Optimal control linear Quadratic methods, Prentice Hall of India, New Delhi, 1991.
3. Sage A. P, White .C. C, Optimum Systems Control, Second Edition.

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Duration of Exam:-03 hours	3	40	60

MTEE-109
Advanced Control System Lab

Note: During the semester, at least 9 experiments are to be conducted selecting at least 6 from the above mentioned.

1. Introduction to MATLAB.
2. Different toolboxes in MATLAB, Introduction to Control Systems Toolbox.
3. Determine tr5anspose, inverse values of given matrix.
4. To study polynomial representation by vector.
5. Plot the pole-zero configuration in s-plane for the given transfer function.
6. Determine the transfer function for given closed loop system in block diagram representation.
7. Plot unit step response of given transfer function and find peak overshoot, peak time.
8. Plot unit step response and to find rise time and delay time.
9. Determine the discrete transfer function for open loop and closed loop system in block diagram representation.
10. To study discrete pole location and transient response.
11. To study state space realizations.
12. To study digital DC motor speed control with PID control using MATLAB.

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Duration of Exam:-03 hours	3	40	60

MTEE-111
Advanced Power System Lab-I

Note: During the semester, at least 9 experiments are to be conducted selecting at least 6 from the above mentioned.

1. Formulation of Y-bus with matrix A and using direct approach/Formulation of Jacobian matrix.
2. Formulation of Bus Incidence matrices A, B, C using MATLAB.
3. Power flow analysis by Newton-Raphson method.
4. Power flow analysis by Fast decoupled method.
5. Formulation of Z-Bus using Z-Bus building algorithm.
6. Short circuit studies using Z-Bus.
7. Load frequency control for multi-area system using SIMULINK.
8. Contingency analysis: Generator shift factors and line outage distribution factors.
9. Economic dispatch using lambda-iteration method.
10. Unit commitment: Priority-list schemes and dynamic programming.

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Duration of Exam:-03 hours	3	1	60	40

MTEE-102
Power System Protection & Relaying

Note: The theory question paper will have 5 sections containing a total of 9 questions. Section-1 will have one compulsory question from whole syllabus. The remaining 8 questions will be divided into 4 sections (2 questions per unit per section) and the student will have to attempt 5 questions i.e. exactly one question from each of the sections.

Unit 1

Introduction: Need for protective systems, Zones of protection, classification or protective relays and protective schemes, Current transformers and potential transformers, Advantages of static relays.
Comparators: general equation of comparators, Analysis for amplitude comparator, analysis for phase comparator, duality between amplitude and phase comparators, different types of amplitude and phase comparators.

Unit 2

Over current relays: Instantaneous over current relays, definite time overcorrect relays, directional overcorrect relay, comparison with conventional relays, differential relays, operating and restraining characteristics, types of differential relays, comparison with conventional relays, distance relays, impedance relays, reactance relays, mho relay quadrilateral relays, elliptical relays, comparison with conventional relays.

Unit 3

Distance protection: Principle of distance relaying, time grading of distance relays, schemes of distance protection, distance protection by impedance, reactance and mho relays, Effect of power swings on the performance of distance relays.
Pilot relaying schemes: Pilot wire protection, carrier current protection.

Unit 4

Protection of Generators and Motors: Types of faults, Stator and rotor protection against various types of faults.
Protection of Transformers: Types of faults, differential protection schemes, harmonic restraint relay, over flux protection, earthing transformer protection.
Bus Zone Protection: Types of Bus-bar faults, differential current protection frame leakage protection.
Microprocessor based protective relays: Over current relay, impedance relay, reactance relay, mho relay, microprocessor based distance relaying.

Text/Reference:

1. TSM Rao, “Power System Protection – Static Relays”, Tata McGraw Hill.
2. S.P Patra, S.K Basu and S. Choudhary, “Power System Protection”, Oxford IBH Pub.
3. B.Ravindernath and M. Chander, “Power System Protection and Switchgear”, Wiley Eastern Ltd.

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Duration of Exam:-03 hours	3	1	60	40

MTEE -104
Virtual Instrumentation

Note: The theory question paper will have 5 sections containing a total of 9 questions. Section-1 will have one compulsory question from whole syllabus. The remaining 8 questions will be divided into 4 sections (2 questions per unit per section) and the student will have to attempt 5 questions i.e. exactly one question from each of the sections.

Unit-1

Introduction, History of Instrumentation Systems, Evolution of Virtual Instrumentation,Premature Challenges, Virtual Instrumentation, Architecture of Virtual Instrumentation,Presentation and Control, Functional Integration, Programming Requirements,Drawbacks of Recent Approaches,Conventional Virtual Instrumentation.Distributed Virtual Instrumentation, Virtual Instruments versus Traditional Instruments, Creating Virtual Instruments Using LabVIEW, Advantages of LabVIEW,Virtual Instrumentation in the Engineering Process.

Unit-2

Control Structures, Selection Structures, Case Structures , Sequence Structures(Flat and Stacked Structures),The Formula Node, Array, Single and Multidimensional Arrays, Autoindexing, Functions for Manipulating Arrays, Polymorphism ,Clusters, Creating Cluster Controls and Indicators,Cluster Functions ,Error Handling,Waveform Charts ,Chart Components , Mechanical Action of Boolean Switches , Waveform Graphs ,Single-Plot Waveform Graphs , Multiple-Plot Waveform Graphs , XY Graphs , Strings, Creating String Controls and Indicators , String Functions.

Unit-3

Components of Measuring System, Origin of Signals, Transducers and Sensors, Acquiring the Signal, Sampling Theorem, Filtering and Averaging, Triggering, Throughput, Selecting a Transducer, Electrical Transducer.
Sensors and Biosensors: Definitions, Differences between Chemical Sensors, Physical Sensors and Biosensors, Thermocouples, RTD, Strain Gauges.

Unit-4

Data Acquisition VIs, Data Acquisition Hardware ,Analog Input Modes ,Range and Resolution, Sampling Frequency and the Aliasing Effect ,Measurement & Automation Explorer (MAX) , Simple Analog Input Operation on a DC Voltage ,Digital Oscilloscope Analog Output , DC Voltage Source , Software-Timed Sine-Wave Generator, Hardware-Timed Waveform Generator ,Placing a Custom-Made VI on a Block Diagram ,Voltage-Controlled Bi-Directional Current Driver for , Thermoelectric Device , PID,Temperature Control Algorithm , PID Temperature Control System

Text/ References:

1. Gary Johnson, LabVIEW Graphical Programming, Second edition, McGraw Hill, 1997.
2. Lisa K. wells & Jeffrey Travis, LabVIEW for everyone, Prentice Hall, New Jersey, 1997.
3. Kevin James, PC Interfacing and Data Acquisition: Techniques for Measurement.

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Duration of Exam:-03 hours	3	1	60	40

MTEE-106
HVDC Transmission & Distribution

Note: The theory question paper will have 5 sections containing a total of 9 questions. Section-1 will have one compulsory question from whole syllabus. The remaining 8 questions will be divided into 4 sections (2 questions per unit per section) and the student will have to attempt 5 questions i.e. exactly one question from each of the sections.

Unit 1

Introduction: Role of EHV AC Transmission, standard transmission voltages, average value of line parameters, power handling capacity.

Line parameters, Properties of bundled conductors, resistance, induction and capacitance of bundled conductor lines, temperature rise of conductors and current carrying capacity. Voltage gradients on conductors: Charge potential relations for multi-conductor lines, surface voltage gradient on conductors, distribution of voltage gradient on sub conductors of bundle.

Unit 2

Corona Effects: Corona loss, attenuation of traveling waves, audible noise, limits for audible noise, AN measurement and meters, Day night equivalent noise level, limits for radio interference fields, RI excitation function, measurements of RI, RIV, Excitation function.

Switching Over voltages: Origin of over voltages and their types, over voltages due to interruption of low inductive current and interruption of capacitive currents, Reduction of switching surges on EHV systems.

Unit 3

Power frequency over voltages: Problems at power frequency, no-load voltage conditions and charging current, voltage control using synchronous condensers, sub synchronous resonance in series-capacitor compensated lines, state reactive compensating schemes.

Operational aspects of Power flow: Line loadability, effects of over load, reactive power limitations and over voltage problem.

Unit 4

H V D C Transmission: Introduction, Comparison of AC and DC transmission, Application of DC transmission, Planning of HVDC transmission, Parallel operation of AC and DC systems, Methods of control of power.

Text/Reference:

1. Begamudre, “EHV AC Transmission engineering”, Wiley Easter Ltd. 2nd Ed.
2. Edison Electric Institute, “EHV transmission reference book”, GE Co.
3. EPRI, Palo Alto, “Transmission line reference book 345 KV”.
4. Rudenberg, “Transient performance of electric power systems” McGraw Hill.
5. EW Kimbark, ‘Direct current Transmission’, Vol. I, Wiley Interscience.
6. J. Arrillaga, ‘High Voltage Direct Current Transmission’, Peter Peregrines.

KR Padiyar, ' HVDC Power Transmission Systems', New Age International (P) Ltd.,Publishers, 3rd Edition.

	L	T	Ext.	Int.
Duration of Exam:-03 hours	3	1	60	40

MTEE-108
System Engineering

Note: The theory question paper will have 5 sections containing a total of 9 questions. Section-1 will have one compulsory question from whole syllabus. The remaining 8 questions will be divided into 4 sections (2 questions per unit per section) and the student will have to attempt 5 questions i.e. exactly one question from each of the sections.

Unit 1

Optimization Theory: Introduction to optimization theory, Importance in solving system engineering problems, convex sets & Functions; affine and convex sets, supporting and separating hyper planes, dual cones and generalized inequalities.

Unit 2

Linear Programming problem; Formulation, Simplex Method, Dual Simplex method, sensitivity analysis, duality in programming. Introduction to nonlinear programming.

Unit 3

Unconstrained Optimization-formulation of quadratic optimization problems, gradient descent and steepest descent methods, Newton's method, self-concordance.
Constrained optimization – direct optimization, Cutting plane methods, methods of feasible direction, analytic center cutting plane methods.Multi-objective optimization.
Application to approximation and filling problems.

Unit 4

System Modeling: Introduction, types of modeling, modeling of time-varying, distributed, stochastic, nonlinear, discrete event and hybrid systems.
Conventional tools for linear system modeling, Introduction to non-conventional modeling tools, Neural models, and fuzzy models.
Model simulation languages and tools.

Text/References:

1. SS Rao, "Optimization theory and applications" Wiley Eastern Ltd.
2. KV Mittal, "Optimization methods", Wiley Eastern Ltd.
3. NA Kheir, "System modeling and computer simulation" Marcel Decker, New York.
4. Korn G.A., "Interactive Dynamic System Simulation", McGraw Hill, N.Y.

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Duration of Exam:-03 hours	3	40	60

MTEE-110
Virtual Instrumentation Lab

I. Introdunction LabVIEW Programming Techniques:-
   - I. Create and use sub VI
   - II. Create VI for studying loops
   - III. Create VI for studying case structures
   - IV. Create VI for studying array functions
   - V. Create VI for studying sequence structure
   - VI. Create VI for studying properties and options of graphs/charts
   - VII. Create VI to read and write to file

II. Creating Models, Simulation and Analysis
   - I. Creating s-transfer functions, Simulation frequency response
   - II. Creating discrete-time(z) transfer functions
   - III. Creating continuous-time state-space models
   - IV. Creating discrete-time state-space models
   - V. Standard transfer functions
   - VI. PID controllers

III. Data Acquisition:-
   - I. BASIC CONCEPTS OF DATA ACQUISITION & TECHNOLOGY
   - II. Analog input, Analog Output, and Digital I/O based Data Acquisition
   - III. Measurement of Temperature using Virtual Instrumentation
   - IV. Implementation of Strain using Virtual Instrumentation
   - V. Real Time Power measurement and analysis using Virtual Instrumentation

Products Required:

I. LabVIEW Departmental License
II. NI ELVIS II+
III. NI Compact RIO

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MTEE-112
Advanced Power System Lab-II

Note: During the semester at least 9 experiments are to be conducted selecting at least 6 from the above mentioned list.

1. Determination of the generalized constants A,B,C,D of a long transmission line.
2. Simulation of DC distribution by Network Analyzer.
3. Different parameter, calculation by power circle diagram.
4. Study on (i) On Load Time Delay Relay (ii) Off Load Time Delay Relay.
5. Testing on (i) Under Voltage Relay (ii) Earth Fault Relay.
6. Study on D.C. Load Flow.
7. Study of transformer protection by Simulation.
8. Study of generator protection by Simulation.
9. Study of Motor protection by Micom Relay.
10. Study of different characteristics of Over Current Relay.