Faculty of Engineering & Technology
P.K.University
Shivpuri (MP)

Evaluation Scheme & Syllabus for
Department Of Electrical Engineering.

M. Tech (Power System)
(I to IV Semester)

(Effective from session 2019-20)

EVALUATION SCHEME

M.Tech- Power System

Semester-I

SUBJECT CODE	SUBJECT NAME	THEORY		PRACTICAL		TOTAL
		SESS. (30)	EXT. (70)	SESS. (25)	EXT. (25)	
MTPS-101	Advance power System Analysis	30	70	NA	NA	100
MTPS-102	Power system operation & control	30	70	NA	NA	100
MTPS-103	Adv. Control System	30	70	NA	NA	100
MTPS-104	Adv. Microprocessor & its App.	30	70	NA	NA	100
MTPS-105	Research Process & Methodology	30	70	NA	NA	100
MTPS-106	CAD of power System Lab	NA	NA	25	25	50
MTPS-107	High Voltage Lab	NA	NA	25	25	50

Semester-II

SUBJECT CODE	SUBJECT NAME	THEORY		PRACTICAL		TOTAL
		SESS. (30)	EXT. (70)	SESS. (25)	EXT. (25)	
MTPS-201	Adv. Power system stability	30	70	NA	NA	100
MTPS-202	Adv. Protective Relaying	30	70	NA	NA	100
MTPS-203	Distributed generation	30	70	NA	NA	100
MTPS-204	Power system planning	30	70	NA	NA	100
MTPS-205	Power system restructuring	30	70	NA	NA	100
MTPS-206	Power quality	NA	NA	25	25	50
MTPS-207	Seminar-I	NA	NA	25	25	50

Semester-III

SUBJECT CODE	SUBJECT NAME	THEORY		PRACTICAL		TOTAL
		SESS. (30)	EXT. (70)	SESS. (25)	EXT. (25)	
MTPS-301	Dissertation phase-I	NA	NA	200	200	400
MTPS-302	Seminar-II	NA	NA	25	25	50

Semester-IV

SUBJECT CODE	SUBJECT NAME	THEORY		PRACTICAL		TOTAL
		SESS. (30)	EXT. (70)	SESS. (25)	EXT. (25)	
MTPS-401	Dissertation phase-II	NA	NA	300	300	600

Department of Electrical Engg.
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I Year I Semester

MTPS-101 ADVANCE POWER SYSTEM ANALYSIS

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Objective & Outcome of learning

To emphasize the fundamentals of Power System analysis while employing a Computer for computational purposes. This course will handle three basic problems of short circuit studies, flow studies and the transient stabilities which are computationally intensive. At the end the student will be in a position to develop his own program for such purposes and feel more confident while using various software available in the field.

I. Network Matrices Evaluation of Bus Admittance matrix (YBUS), Bus impedance matrix (ZBUS), Branch, Impedancematrix(ZBT),andLoopImpedancematrix(ZLOOP)bysingularandnonsingulartransformations.

II. ShortCircuitStudiesFormulationofZBUSforsinglephaseandthreephasenetworks, transformation of net work matricesusingsymmetricalcomponents;shortcircuitstudiesusingcomputers,sparsstyorientedstudies.

III. Load Flow Studies Representation of off-loadandon-load tap changing and phase shifting transformers and d.c. link;decoupledandfastdecoupledmethods,sparsitytechnique;introductiontoloadflowofintegratedac/dcsystem.

IV. Stability Studies Network formulation for stability studies for different types of loads, (constant impedance, constant current and constant power loads), digital computer solution of swing equation for single and multi- machine cases using Runge-Kutta and predictor-corrector methods, effects of exciter and governor on transient stability Fast Transient StabilitySolution.

References :

1. G.W.StaggandA.H.El-Abiad,computerMethodsinPowersystemAnalysisMcGrawHill,1971
2. G.L. Kusic, Computer Sided Power system Analysis Prentice Hall International,1986
3. L.P. Singh, Advanced Power System Analysis and Dynamics, WileyEastern,
4. J. Arrillage and C.P. Arnold "Computer Analyzing Power Sysem" john Wiley Singapore1990.
5. P. Kundur "Power System Stability and Control" McGraw Hill, New York1993.
6. A.R.BergenandV.Vittal,"PowerSystemAnalysis"Englewood,Cliff,N.J.PrenticeHall,2000.

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I Year I Semester

MTEE-102 POWER SYSTEM OPERATION AND CONTROL

L T P 3 0 0

Objective &Out come of learnin

To impart knowledge about the structure and control aspect of the power system operation. This includes SCADA, optimal economic operations, AGC control, excitation and reactive power control, system security and the elements of FACTS control.

1. **Introduction:**

Large scale power systems-their interconnections and operation ; load dispatch centre and control centre, introduction to centralized and decentralized controls ; various operational stages of power system ; power systemsecurity.

2. **EconomicOperation:**

Problem of unit commitment, system constraints, incremental fuel cost, economic load scheduling with and without transmission losses, penalty factor, loss coefficient, incremental transmission loss ; optimal power flow problem ; optimal operation of hydro-thermalsystem.

3. **Load Frequency Control:**

Concept of load frequency control, speed governing systems and its representation, automatic control, modeling of single area and multiarea systems, tie line control, supervisory control ; automatic generation control including excitation system; optimum load frequency controller, PIDcontroller.

4. **Voltage Reactive PowerControl**

Concept of voltage control, methods of voltage control, reactive power injection, control by tap changing transformer, series compensation, static VAR compensation, Excitation system & stabilizer, rate feedback controller, PIDcontroller.

5. **StateEstimation:**

State estimation, linear and nonlinear models, detection and identification of measurement errors.

6. **Flexible AC Transmission System:**

Concept and objectives, basic FACTS controllers:

TCR,FC-TCR, TSC, SVC, STATCOM, TCSC, SSSC, PAR and UP FC

References:

1. O.I. Elgerd, "Electric Energy System Theory", McGraw Hill,1971
2. Leon K. Kirchmayer, "Economic operation of Power Systems" WileyEastern Ltd.,
3. A. Chakrabarti, D.P. Kothari and A.K. Mukhopadhyay, "Performance Operation and Control of EHV Power Transmission Systems", Wheeler PublishingCo.
4. K.R. Padiyar "FACTS Controllers in Power Transmission and distribution" New Age Delhi,2007.

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I Year I Semester

MTEE-103 ADVANCEDCONTROLSYSTEM

L T P 3 0 0

1. States Space Analysis:

Review of the state space representation of continuous linear time invariant system, conversion of state variable models to transfer functions and vie-versa, transformation of state variable, solution of state equations, state and output controllability and observability.

2. Analysis of Nonlinear Systems:

Common physical non linarites , singular points, phase plane analysis, limit cycle, describing functionmethodandstabilityanalysis,jumpresonance,linearizationofnonlinearsystem.Lyapunovstability , methods for generating lyapunov function , statement of lure problem, circle criterion, popov criterion.

3. Analysis of Discrete System:

Discrete time signals and systems, z-transformation, modeling of sample hold circuit, pulse transfer function, solution of difference equation by z-transform method , stability analysis in z-plane.

4. Basic concepts of optimal control, adaptive control and robust control system.

References:

1. K.Ogata, "Modern Control Engineering", Prentice Hall of India ,1999
2. Norman S.Nise, "Control System Engineering", John Wiley & Sons,2001
3. Kuo B.C., "Digital Control System", Saunders College publishing,1992
4. M.Gopal , "Digital Control and state variable methods", Tata Mcgraw Hill,1997
5. M.Gopal , "Modern Control System Theory", Wiley Eastern,1993
6. K.Ogata, " Discrete Time Control System", Prentice Hall International,1987.

Related Journals and Booksfor applications and advanced works.

(i) IEEE Transactions on ControlSystemTechnology
(ii) IET Research Journal on ControlTheory&Applications
(iii) NPTEL Courses on ElectricalEngineering

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I Year I Semester

MTEE-104 Adv. Microprocessor & its App.

Introduction:

Review of basic microprocessor, architecture and instruction set of typical 8 bit microprocessor

Advanced Microprocessor:

Overview of 16 bit and 32 bit microprocessors, arithmetic and I/O coprocessors, architecture, register details, operation addressing models and instruction set of a 16 bit 8086 microprocessor, assembly language programming, introduction to multi-processing, multi-user, multi-tasking operating system concepts ,Pentium I,II,III,IV processors, Motorola 68000processor

Input-Output Interfacing:

Parallel an series I/O, programmed I/O, Interrupt driven I/O, single and multi- interrupt levels, use of software polling and interrupt controlling for multiplying interrupt levels, programmable interrupt controller, DMA controller programmabletimer/counter,programmablecommunicationandprincipalinterface,synchronous andasynchronous data transfers, standard serial interfaces likeRS.232.

Programmable Support Chips:

Functional schematic, operating modes, programming and interfacing of 8255, 8251, 8259 and 8253 with microprocessor.

Memory Interfacing:

Types of Memory: RAM and ROM, interfacing with timing consideration DRAM interfacing

Analog Input & Output:

MicroprocessorcompatibleADCandDACchips,interfacingofADCandDACwithmicroprocesso r,useofsample and hold circuit and multiplexer with ADC.

Micro-controller and Micro-Computer:

Concepts of microcontroller and microcomputer micro controller (8051/8759) based design. Application of microcomputer in online real time control

Microprocessor Development System (MDS):

Single user, times hard and networked MOS, hardware facilities and software supporting MDS, development of hardware and application software and hardware software integration in MDS.

Microprocessor Application: Design methodology, examples of microprocessor applications**.**

Reference:

1. R.S.Gaonkar,"MicroprocessorArchitecture,ProgrammingandAp plication," Wiley EasternLimited.
2. B.Ram, "Fundamentals Of Microprocessors and Micro computers," DhanpatRai andSons.
3. Liu&Gibson,"Micro-ComputerSystemthe8086/8088familyarchitecture,"PrenticsHallofIndia.
4. D.V. Hall, "Microprocessors and Interfacing Programming and Software," McGrawHill

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I Year I Semester
MTEE105: Research Process and Methodology

UNIT 1:

Introduction to Research and Problem Definition-Meaning, Objective and importance of research, Types of research, steps involved in research, defining research problem

UNIT 2:

Research Design-Research design, Methods of research design, research process and steps involved, Literature Survey

UNIT 3:

Data Collection-Classification of Data, Methods of Data Collection, Sampling, Sampling techniques procedure and methods, Ethical considerations in research

UNIT 4:

Data Analysis and interpretation-Data analysis, Statistical techniques and choosing an appropriate statistical technique, Hypothesis, Hypothesis testing, Data processing software (e.g. SPSS etc.), statistical inference, Interpretation of results

UNIT 5:

Technical Writing and reporting of research-Types of research report: Dissertation and Thesis, research paper, review article, short communication, conference presentation etc., Referencing and referencing styles, Research Journals, Indexing and citation of Journals, Intellectual property, Plagiarism

Text Books:

1. C. R. Kothari, Gaurav Garg, Research Methodology Methods and Techniques , New Age International publishers, Third Edition.
2. Ranjit Kumar, Research Methodology: A Step-by-Step Guide for Beginners, 2nd Edition, SAGE, 2005
3. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition
4. Creswell, John W. Research design: Qualitative, quantitative, and mixed methods approaches.
Sage publications, 2013.

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I Year I Semester

MTEE-106 CAD of power System Lab

LIST OF EXPERIMENTS

1. Solution of simultaneous Algebraic equations by Gauss-Elimination,
2. Crout'smethodandCholeskymethodSolutionofSimultaneousdifferentialequationsbyRK-4 and Modified Euler's method
3. Formation of Ybus using two dimensional arrays by inspection method
4. Formation of Ybus using Sparsity Technique
5. LoadflowbyGaussSeidel,NewtonRaphsonandFastDecoupledmethodsusingtwo-dimenentin

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I Year I Semester

MTEE-107 High Voltage Lab

LIST OF EXPERIMENTS:

1. TestingoftransformeroilaccordingtoIS:6792
2. Testing of solidin sulation with tape electrodes
3. Generation High D.C. Voltages and measurement through spheregaps
4. Generation High A.C.voltages and measurement through spheregaps
5. Generation of High A. C. voltages through cascaded transformers
6. Impulse voltage generation through Marx generator
7. Impulse voltage generation though simulation
8. Trace the field through electrolytic tank
9. Generation and visualization of corona in coronac age
10. Capacitance and loss factor measurement
11. A report on visit to high voltage laboratory

Note: At least eight practical's shall be performed depending on availability of the equipment

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I Year II Semester

MTEE-201 Adv. Power system stability

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Objective &Out come of learning.

To impart detailed knowledge about the stability of power system-this happens to be largest control structure in the world. The problem is subdivided into synchronous machine turbine modeling followed by methodologies of dynamic & transient stability studies of large system & methods to improve them. Stability problems of the combined operation of EHV AC and HVDC system are also to be investigated. This will enable a student to plan for large power system studies in a design office.

1. Modeling:

Detailed synchronous machine modeling, modeling of turbine-generator and associated systems, modeling of induction motor and static loads, sub-synchronous resonance (SSR) and system modeling for SSR studies.

2. Dynamic Stability:

Review of stability of single machine connected to infinite bus system, multi machine system stability, role of prime mover, governor and excitation system, design concept of machine and power system stabilizers based on modern control techniques, self-excited oscillations and theirremedies.

3. Transient Stability:

Single machine and multimachine transient stability considering voltage regulators, governors and supplementary controls, methods of improving transient stability, stability of long lines.

4. VoltageStability

P-V and Q-V curves, static analysis, sensitivity and continuation method.

5. Stability of AC-DCsystem

References:

1. E.W. Kimbark, "Power System Stability Vol, I,II III", John Wiley sons,1956
2. P.M. Anderson and A.A. Fouad, "Power system Control and Stability" IEEEPress,1993
3. E.W. Kimbark, "Stability of Large Electric Power System", IEEE Press,1974
4. C.W. Taylor, Voltage stability IEEEPress.
5. V.A. Vanikov, "Transient Phenomena in Electric Power system" PergamonPress
6. P. Kundur "Power System Stability and Control" McGraw Hill, New York1993.

Related e-Journals and books for advanced work.

(i) IEEE Transactions on PowerSystems
(ii) IET Research Journal on Generation, Trans &Distributed
(iii)MATLAB TOOL BOX on Control and PowerSystem

Department of Electrical Engg.
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I Year II Semester

MTEE-202 Advance Protective Relaying

I . Introduction Essential qualities of protection, zones of protection, classification of relays, basic protective schemes.

II. **Comparators Transfer impedance**, mixing circuits, amplitude and phase comparators and their duality, static realization of amplitude and phase comparators, multi-input comparators.

III. **Static Relays Basic construction**, input-output devices, merits and demerits of static relays, application of solid state devices.

IV. **Static Protection Over current** relaying schemes, differential relaying schemes, distance relaying schemes, power swing, carrier protection of long lines, protection of multi terminal lines, new type of relaying criteria, quadrilateral relay, elliptical relay, restricted distance relays.

V. **Digital Protection Concept** of digital protection, microprocessor based over current and distance relay schemes, generalized interface for distance relays.

References :

1.A.R. Van C. Warrington, "Protective Relays- Their theory and practice Vol.I II", John Wiley Sons, 1977.

2. B.D.RusselandM.E.Council,"PowerSystemControlandProtection"AcademicPress,1982,

3. T.S.M. Rao, "Power System Protection with Microprocessor Applications" Tata Mc. Graw Hill, 1989

4. B.RavindranathandM.Chander,"PowerSystemProtectionandSwitchgear"WileyEastern,19775.

5. S.S.Rao, "Switchgear and Protection" Khanna Publishers,1986

6. B.Ram and D.N. Vishwakarma, "Power system Protection and Switchgear" Tata McGraw Hill,

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I Year II Semester

MTEE-203 Distributed generation

UNIT I

Need for Integration of Renewable Energy Schemes: Planning, constraints and economics. Grid Integration of Renewable Energy Systems: Wind, biomass gasification and solar systems: Effects on the grid, Renewable energy systems; Interfacing techniques; Innovations required in technology and policy.

UNIT II

Hybrid Energy Systems: Principles and applications; Comparison of schemes; System design concepts; Techno- economic performance; Energy storage schemes and estimation. Interconnection: Distributed power generation schemes using renewable energy sources.

UNIT III

Decentralized Generation Systems : Decentralized generation technologies; Costs and choice of technology, Demandandbenefitsforecastingandprogramdevelopment,Principlesofcost-benefitcalculations,Economicand financial analysis of stand-alone electrification projects, Decentralized versus central station generation, Traditional power systems, Load curves and load curveanalysis.

UNIT IV

Grid Interconnection Options : The power grid; DG-grid interconnection issues; Case studies of DG-grid interconnections, Case studies of JNNSM grid connected solar power plants of roof top systems and Megawatt systems, Case studies of wind-grid connected power plants.

References:

1. John D. Mc Donald (Editor), "Electrical Power Substation Engineering" CRC Press2003.
2. W.H. Kersting, "Distribution System Modeling and Analysis" CRC Press2002.
3. J. Northcote Green, R.G.Wilson," Control and Automation of Electric Power distribution system", Taylor and Francis,2007.
4. R.E. Brown, "Electric Distribution Reliability" CRC Press2009.

Related e-Journals and books for advanced work.

(i) IEEE Transactions on PowerSystem
(ii) IEEE Transactions on PowerDelivery
(iii) IET Research Journal on Generation, Trans andDistribution

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I Year II Semester

MTEE-204 Power system planning

Objective & Outcome of learning

To emphasize the basic principles and advanced methodologies to evaluate the reliability of a large power system. The problem is to be broken down into the reliability of Generation system, transmission system and composite reliability of them..

I. Basic Probability Theory Probability concepts, rules for combining probability, probability distributions, random variables,densityanddistributionfunctions,mathematicalexpectations,varianceandstandarddeviation.

II. Basic Reliability Evaluation General reliability functions, probability distributions in reliability evaluation, network modeling and evaluation of series, parallel series-parallel, network modeling and evaluation of complex systems, cut-set method, tie-set method, discrete Markov chains, continuous Markov process.

III. Generation System Reliability Generation system models, capacity outage table, recursive algorithm, loss of load indices, inclusion of scheduled outage, load forecast uncertainty, loss of energy indices, expected energy generation, energy limited systems, Gram-Charlier series and its application to generation system reliability evaluation, generating capacity-frequency and duration method.

IV. Interconnected System Probability array method in two inter-connected system, effect of tie capacity, tie reliability and number of tie lines, equivalent assistance unit method for reliability evaluation of inter-connected system, elementary concepts for reliability evaluation of multi-connected systems.

V. Composite Generation and Transmission System Reliability Radial configurations, conditional probability approach, network configurations, conditional probability approach, network configuration, state selection, system and load point indices.

VI. Distribution System Reliability Basic technique and application to radial systems, customer-oriented indices, load and energy indices, effect of lateral distributor protection, effect of disconnects effect of protection failures, effect of load transfer, meshed and parallel networks, approximate methods, failure modes and effects analysis.

References :

1. Billinton R. and Ronald N.A. “Reliability Evaluation of Power Systems”, Pitman Advanced Publishing Program, 1984.
2. Billinton R. and Ronald N.A. “Reliability Evaluation of Engineering Sysems Concepts and Techniques”, Pitman Advanced Publishing Program,1983.
3. Endrenyi J. “Reliability Modeling in Electric Power Systems”, John Wiley and Sons.1978

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I Year II Semester

MTEE-205 Power system restructuring

Objective & Outcome of learning

Tofamiliarizethestudentswiththeimportantproblemsofderegulationandopenaccesssystemwhichhavebecome implemented in most of the advanced countries. This also includes ISO and pricing & market bidding strategies, congestion Management and auxiliary services. At the end student should feel confident in handling such problems at an ISOcentre.

I. FundamentalsofDeregulationPrivatizationandDeregulation,MotivationsforRestructuringthePowerIndustry

II. Restructuring Models and Trading Arrangements Components of restructured Systems, Independent System Operator (ISO) Functions and Responsibilities, Trading Arrangements (Pool, Bilateral Multilateral), Open Access TransmissionSystems

III. Differential Models of Deregulation UK model, California Model, Australian and New Zeeland Models, Deregulation in Asia includingIndia.

IV. Operational and Control Bidding strategies, Forward and future market, Market Power, Available Transfer Capability, Congestion Management, Ancillaryservices.

V. Wheeling charges and pricing Wheeling methodologies, pricingstrategies.

References :

1. F.C. Sscweppe, M.C. Carmanis, R.D. Tabor, and RE Robin "Spot Pricing of Electricity" Norwell, M.A., Kluwer 1998.
2. M. Shahidehpour, H. Yamin and Z Li "Market Operations in Electrical Power System" New york, IEEE/ Wiley Inter science,2002.
3. D.KrischenandG.Strabac"FundamentsofPowerSystemEconomics"NewYork,Wiley2004.
4. S. Stoft "Power System Economics" New York, John Wiley2002.

Related e-Journals and books for advanced work.

1. IEEE Transactions on Power System
2. IET Research Journal on Generation, Trans and Distribution
3. NPTEL Course on Electrical Engg