VIVEKANANDA GLOBAL UNIVERSITY, JAIPUR

(Established by Rajasthan State Legislature vide Act. No. 11/2012 and covered u/s 2(f) of UGC Act 1956)

FACULTY OF ENGINEERING & TECHNOLOGY

SCHEME & SYLLABUS

FOR

Master of Technology

(Effective from the Session 2016-17)

(Power System)

Department of Electrical Engineering

SESSION: 2016-17

Sector – 36, NRI Road, Sisyawas, Jagatpura, Jaipur (Raj.) – 303012
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Semester-I

Course Code	Course	Hrs/Week			Credits
		L	T	P	C
MBM 204	Research Methodology	3	-	-	3
MEE101	Computer Aided Analysis of Power System	3	1	-	3.5
MEE102	Power System Operation and Control	3	1	-	3.5
MEE 103	Restructuring of Power System Network	3	-	-	3
	Elective- I	3	-	-	3
MEE 104	Computer Aided Analysis of Power System lab	-	-	4	2
MEE 105	Seminar-I (Review of Literature)	-	-	4	2
	Total	**15**	**2**	**8**	**20**

Semester-II

Course Code	Course	Hrs/Week			Credits
		L	T	P	C
MGT 103	Project Formulation and Appraisal Techniques	3		-	3
MEE 201	Distributed Generation & Control	3	1	-	3.5
MAT 156	Advance Mathematics	3	1	-	3.5
	Elective -II	3		-	3
	Elective - III	3	-	-	3
MEE 202	Power System Simulation Lab	-	-	4	2
MEE 203	Seminar-II (Review of Literature)			4	2
	Total	**15**	**2**	**8**	**20**

Semester-III

Course Code	Course	Hrs./Week			Credits
		L	T	P	C
MEE 301	Internship			-	4
MEE 302	Dissertation part - I	-	-	-	8
MEE 303	Seminar-III (Review of Literature)	-	-	-	2
	Total			-	**14**

Semester-IV

Course Code	Course	Hrs/Week			Credits
		L	T	P	C
MEE 401	Dissertation Part –II	-	-	-	16
	Total				**16**

ELECTIVE I

MEE 106 Modern Protection Methods
MEE 107 Reactive Power Control and Facts
MEE 108 AI Application to Power Systems
MEE 109 Renewable Energy System

ELECTIVE II

MEE 204 Power Quality Monitoring
MEE 205 Power System Planning Reliability & Economic Operations
MEE 206 Soft Computing Techniques
MEE 207 Power System- Networks and Utility

ELECTIVE III

MEE 208 Modern Control Theory
MEE 209 Power System Monitoring and Scada System
MEE 210 Modeling and Analysis of Electrical Machines

1	Total Subjects	10
	Total Labs	2
2	Total Credits	70

Subject Code

MEE101	Computer Aided Analysis of Power System
MEE102	Power System Operation and Control
MEE 103	Restructuring of Power System Network
MEE 104	Computer Aided Analysis of Power System lab
MEE 105	Seminar-I (Review of Literature)
MEE 106	Modern Protection Methods
MEE 107	Reactive Power Control and Facts
MEE 108	AI Application to Power Systems
MEE 109	Renewable Energy System
MEE 201	Distributed Generation & Control
MEE 202	Power System Simulation Lab
MEE 203	Seminar-II (Review of Literature)
MEE 204	Power Quality Monitoring
MEE 205	Power System Planning Reliability & Economic Operations
MEE 206	Soft Computing Techniques
MEE 207	Power System- Networks and Utility
MEE 208	Modern Control Theory
MEE 209	Power System Monitoring and Scada System
MEE 210	Modeling and Analysis of Electrical Machines
MEE 301	Internship
MEE 302	Dissertation part - I
MEE 303	Seminar-III(Review of Literature)
MEE 401	Dissertation part - II

Semester I **M.Tech in Power System**

MBA 204: RESEARCH METHODS IN MANAGEMENT

3L+0T+0P+3C **MM 100**

MODULE – I: MEANING AND IMPORTANCE OF RESEARCH –Review of Literature, Objectives of the research, Types of Research- Exploratory Research – Descriptive Research – Casual Research - Research Approaches- Research Process ––Defining Research Problem- Selection and necessity of defining the problem.

MODULE – II: RESEARCH DESIGN –meaning, need and features of good research design- Important concepts related to research design. Experimental research designs: Before and After without control design, After only with control design, Before and after with control design, Completely randomized design (C.R Design).
Sampling and Sampling Design – Sampling Methods – Simple Random Sampling – Stratified Sampling – Systematic Sampling – Cluster Sampling – Multistage Sampling, Non–Probability Sampling – Convenience Sampling – Judgment Sampling – Quota Sampling- Snowball sampling.

MODULE – III: **DATA COLLECTION** – Primary and Secondary Data – Designing of Questionnaire –**Measurement and Scaling** – Nominal Scale – Ordinal Scale – Interval Scale – Ratio Scale –Guttman Scale – Likert Scale – Schematic Differential Scale. Descriptive statistics- Measures of central tendency- Dispersion- Skewness -Correlation and Regression Analysis.

MODULE – IV: **EDITING** – Coding – Classification of Data – Tables and Graphic Presentation –Basics of inferential statistics- Types of Errors- **Hypothesis testing** -Parametric test - T-test, Z test, Chi Square test- ANOVA Test. Introduction of SPSS.

MODULE – V: **NON PARAMETRIC TESTS** – Kolmogorov – Smirnov Test – Runs Test for Randomness. Sign Test – Median Test –Factor Analysis.
Preparation and Presentation of Research Report- Types of reports- Layout of Research Report- Bibliography-References writing- Precautions for writing Research Report.

Teaxt/Reference Books:

1. Research Methods for Business Students, Mark Saunders, Philip Lewis, Adrian Thornbill, Pearson,ND
2. Marketing Research: A South Asian Perspective, Churchill, Iacobucci & Israel, Cengage, New Delhi
3. Research Methodology, C.R. Kothari, New Age International.
4. Data Analysis with SPSS, Carver & Nash, Cengage, New Delhi
5. Business Research Methods, Alan Bryman & Emma Bell, Oxford University Press.
6. Business Research Methods, Donald R. Cooper & Pamela S. Schindler, 8th Edition, Tata McGraw Hill.
7. Statistics made sample, do it yourself on PC, K.V.S. Sarma, Prentice Hall.
8. Research Methodology in Management, V P Michael, Himalaya, Mumbai

Semester I **M.Tech in Power System**

MEE 101 : COMPUTER AIDED ANALYSIS OF POWER SYSTEM

3L+1T+0P+3.5C **MM 100**

MODULE 1: BUS IMPEDANCE ALGORITHM: Partial network, building algorithm for bus impedance matrix, Addition of links, addition of branches, (considering tual coupling) removal of links, modification of bus impedance matrix for network changes, Formation of bus admittance matrix and modification, Gauss elimination, Node elimination (Kron reduction), LU factorization, Schemes of Ordering, Sparsity, Calculation of Z bus elements for Y bus, Numerical examples

MODULE II: BALANCED AND UNBALANCED NETWORK ELEMENTS: Representation of three phase network elements, representation under balanced and unbalanced excitation, transformation matrices, symmetrical components, sequence impedances, unbalanced elements, three phase power invariance.

MODULE III FAULT ANALYSIS: Positive. Negative and Zero Sequence equivalent circuits of lines, two and three winding transformers, induction machines and synchronous machines. Analysis of shunt and series faults, effect of neutral grounding.

MODULE IV: LOAD FLOW STUDIES: Formulation of load flow problem. Various types of buses. Gause-Siedel, Newton-Raphson and Fast Decoupled Algorithms. Calculation of reactive power at voltage controlled buses in the Gauses-Seidel iterative method using Y-bus, Representation of transformers - Fixed tap setting transformer, Tap changing under load transformers, Phase shifting transformers, Tie line control, Comparison of methods for load flow.

MODULE V: POWER SYSTEM SECURITY: Introduction to Power system security, Adding removing multiple lines, piece-wise solution of interconnected systems, analysis of single and multiple contingencies, analysis with sensitivity factors, system reduction for contingency and fault analysis.

Teaxt/Reference Books:

1. Computer methods in Power system analysis, G.W. Stagg & A.H EI-Abaid, McGraw Hill, New York.
2. Computer Techniques in Power System Analysis, M. A. Pai, 2nd Edi., TMH-New Delhi.
3. Computer-Aided Power System Analysis, Kusic., Prentice Hall of India, New Delhi.
4. Power System Analy , John J.Grainger and W.D.Stevenson, McGraw Hill, New York, 1994.
5. Power Generation, Operation, and Control, A.J.Wood & W.F.Wollenberg, 2nd Ed., John Wiley & Sons, New York, 1996.
6. Electric Energy Systems Theory: An Introduction, O.I. Elgerd, McGraw Hill, New York, 1982.
7. Computer Modeling Electrical Power Systems, J. Arrillaga, C.P Arnold & Harker, John Wiley & Sons.
8. FACTS: Modeling and Simulation in Power Networks, Enrique Acha et al., John Wiley and Sons Ltd.
9. Power Systems Optimization, Kothari and Dhillon, PHI, 2004

Semester I **M.Tech in Power System**

MEE 102 : POWER SYSTEM OPERATION AND CONTROL

3L+1T+0P+3.5C **MM 100**

MODULE I: **ECONOMIC OPERATION**- Load forecasting - Unit commitment – Economic dispatch problem of thermal units – Gradient method- Newton's method –Base point and participation factor method.

MODULE II: HYDRO-THERMAL CO-ORDINATION-Hydroelectric plant models – short term hydrothermal scheduling problem - gradient approach – Hydro units in series - pumped storage hydro plants-hydro-scheduling using Dynamic programming and linear programming.

MODULE III: AUTOMATIC GENERATION CONTROL -Review of LFC and Economic Dispatch control (EDC) using the three modes of control viz. Flat frequency – tie-line control and tie-line bias control – AGC

MODULE IV: IMPLEMENTATION – AGC features - static and dynamic response of controlled two area system. MVAR control - Application of voltage regulator – synchronous condenser – transformer taps – static VAR compensators

MODULE V: INTRODUCTION TO STATE ESTIMATION IN POWER SYSTEMS- Introduction, Power system state estimation, Maximum Likelihood Weighted Least Squares Estimation, Introduction, , Maximum Likelihood Concepts, Matrix Formulation, State Estimation of an AC network , Development of Method, State Estimation by Orthogonal Decomposition, An Introduction to Advanced topics in state estimation, Detection and Identification of Bad measurements, Estimation of quantities not being

Teaxt/Reference Books:

1. Power Generation Operation and control, Allen J.Wood and Wollenberg B.F., John Wiley & Sons, Second Edition, 1996.
2. Economic Control of Interconnected Systems, Kirchmayer L.K., John Wiley & Sons, 1959.
3. Modern Power System Analysis, Nagrath, I.J. and Kothari D.P., TMH, New Delhi, 2006.
4. Power Generation Operation and Control, Allen Wood and Woolenberg, John Wiley & Sons

Semester I **M.Tech in Power System**

MEE 103 : RESTRUCTURING OF POWER SYSTEM NETWORK

3L+0T+0P+3C **MM 100**

MODULE I: DEREGULATION OF ELECTRICITY SUPPLY INDUSTRIES- Introduction to deregulation, different entities in deregulated electricity markets, background of deregulation around the world, benefits from competitive electricity markets, different key issues competitive electricity markets, market Clearing Price(MCP), Power System Restructuring and electricity reforms in India, key features of electricity act 2003

MODULE II: MARKET MODELS- Market Models based on energy trading, contractual agreement: Pool & Bilateral models, different independent models, role of ISO, power Bidding and auction mechanisms, market models in Indian market context, and power trading in India.

MODULE III: TRANSMISSION OPEN ACCESS AND PRICING ISSUES- Power wheeling, transmission open access, cost component in transmission pricing, basic objectives, different methods of transmission pricing, Short run and long run marginal transmission price structure, development in international transmission pricing, reactive power pricing structure.

MODULE IV: TRANSMISSION CONGESTION MANAGEMENT- Transmission congestion, impact of transmission congestion, different methods of congestion management, financial transmission right, market power and congestion issues, international experiences of transmission congestion management.

MODULE V: AVAILABLE TRANSFER CAPABILITY DETERMINATION- Definitions, principles of ATC determination, factors affecting ATC, static and dynamic ATC, static ATC determination using DC power transfer distribution factors, AC power transfer distribution factors, ATC with line outage contingencies, LODFs with DC and AC, dynamic ATC and its determination, numerical examples.

Text/Reference Books:

1. Power System restructuring and deregulation, Lio Lee Lai, John Wiley and Sons, UK. 2001.
2. Operation of Restructured Power Systems, K. Bhattacharya, MHT Bollen and J.C Doolder, Kluwer Academic Publishers, USA, 2001.
3. Market Operations in Electric Power Systems, M. Shahidehpour et al., John Wiley and Sons,
4. Restructured Electric Power Systems, M. Shahedehpor, Operation, trading and volatility', Marcel Dekker, Inc.
5. Power Systems Restructuring-Engineering and Economics, M. Ilic, Kluwer Int. Series, 2000.
6. Power System Operation and Control, A.J Wood and B.F Wollenberg, John Wiley and Sons

Semester I **M.Tech in Power System**

PROGRAM ELECTIVE: I

MEE 106 : MODERN PROTECTION METHODS

3L+0T+0P+3C **MM 100**

MODULE I: PROTECTIVE RELAYS: Relaying review, characteristics and operating equations of relays. CTs and PTs differential relay, over current relay, reverse power relay, distance relays, applications of relays.

MODULE II: STATIC RELAYS: Principles of static relay comparators (Amplitude & phase comparator), Types of amplitude and phase comparators. Summation transformers, over current, differential relays, techniques in development of static relays.

MODULE III: GENERATOR AND TRANSFORMER PROTECTION: Protective devices for system. Protective devices for stator, rotor, and prime mover of generator, percentage differential relays protection, three winding transformer protection, earth fault protection, generator transformer unit protection.
Carrier Current Protection: Phase Comparison scheme, carrier aided distance protection. Distance Protection: Effect of are resistances, power swings, line length and source impedance on the performance of distance protection. Out of step tripping and blocking relays. Mho relay with blinders. Quadrilateral and elliptical relays. Selection of distance relays.

MODULE IV: BUSBAR AND TRANSMISSION LINE PROTECTION: Distance protective schemes, directional wave detection relay. Phase compensation carrier protection. High impedance differential scheme, supervisory and check relay, some features of 500 KV relaying protection.

MODULE V: MODERN TRENDS IN POWER SYSTEM PROTECTION: Different types of digital and computer aided relays; Microprocessor based relays, autoreclosing, frequency relays, under and over frequency relays, di/dt relays.
Digital Protection: Introduction to digital protection, block diagram of digital relay, sampling theorem, correlation with a reference wave, Fourier analysis of analogue and discrete signals, least error squared tech nique, digital filtering – low pass, high pass, finite impulse response and infinite impulse response fillers. Introduction to digital over-current, transformer differential and transmission line distance protection.
Teaxt/Reference Books:

1. Power System Protection and Switchgear, B.Ram – Tata Mc-Graw Hill Pub.
2. Switchgear and Protection, M.V.Deshpande - Tata Mc-Graw Hill Pub.
3. Power System Protection and Switchgear, R.Ravindra Nath and M.Chander – Willy Eastern Ltd.

Semester I **M. Tech in Power System**

PROGRAM ELECTIVE: I

MEE 107 : REACTIVE POWER CONTROL AND FACTS

3L+0T+0P+3C **MM 100**

MODULE I: INTRODUCTION OF FACTS:- Introduction to FACTS- Basic Types of FACTS controllers, Description and definition of FACTS controllers – Benefits from FACTS technology- Static Var Compensator(SVC): Principle of operation, configuration and control, Thyristor Controlled Series compensator(TCSC): Principle of operation, configuration and control, Application of TCSC for damping electromechanical Oscillations, Application of TCSC for mitigation of SSR – Static

MODULE II: COMPENSATOR:- Compensator(STATCOM): Principle of operation, configuration and control – Static Synchronous Series Compensator(SSSC): Principle of operation, configuration and control, Thyristor Controlled Phase Angle Regulator(TCPAR): Principle of operation, configuration and control, Unified Power Flow Controller(UPFC): Principle of operation, configuration and control, Simulation of UPFC, Steady state model of UPFC, Interline Power Flow Controller(IPFC) - Principle of operation, configuration and control

MODULE III: OSCILLATION STABILITY ANALYSIS AND CONTROL:- Oscillation Stability Analysis and Control: Introduction – Linearized model of power systems installed with FACTS based Stabilizers – Heffron-Phillips model of a SMIB system installed with SVC, TCSC and TCPS – Heffron-Phillips model of a SMIB system with UPFC – Heffron-Phillips model of a Multimachine system installed with SVC, TCSC and TCPS

MODULE IV: ANALYSIS AND DESIGN OF FACTS BASED STABILIZERS: - Analysis and Design of FACTS based stabilizers: Analysis of damping torque contribution by FACTS based stabilizers installed in SMIB systems, Design of robust FACTS based stabilizers installed in SMIB systems by phase compensation method - Selection of installing locations and feedback signal for FACTS based stabilizers

MODULE V: TRANSIENT STABILITY CONTROL WITH FACTS:- Transient Stability control with FACTS: Introduction – Analysis of Power systems installed with FACTS devices: Power transmission control using Controllable Series Compensation(CSC), Power Transmission Control using SSSC, Power Transmission Control using UPFC, Power Transmission Control using Phase Shifting Transformer(PST), Power Transmission Control using UPFC, Control of FACTS devices for transient stability improvement – General considerations of FACTS control strategy: CSC,SSSC, SVC, STATCOM and UPFC control strategy – General Structure of the FACTS devices control.

Teaxt/Reference Books:

1. Reactive Power Control in Power Systems – T J E Miller, John Wiley, 1982
2. Computer modeling of Electrical Power Systems – J Arriliga and N R Watson, Wiley, 2001
3. Understanding FACTS, N G Hingorani and L Gyugyi, IEEE Press, 2000
4. Flexible AC Transmission Systems (FACTS) –Y.H. Song and A.T. Johns – IEE Press, 1999

Semester I **M.Tech in Power System**

PROGRAM ELECTIVE: I

MEE 108 : AI APPLICATIONS TO POWER SYSTEMS

3L+0T+0P+3C **MM 100**

MODULE I: INTRODUCTION TO AI: Definition, Applications, Components of an AI program; production system, Problem characteristics, Overview of searching techniques.

MODULE II: KNOWLEDGE REPRESENTATION: Turning test, AI agents and architecture, Predicate and propositional logic, Procedural versus declarative knowledge, forward versus backward reasoning.

MODULE III: STATISTICAL REASONING: Probability and Baye's theorem, Certainty factor and rule based systems, Baysian Networks, Dampster Shafer theorem, Examples of knowledge based systems.

MODULE IV: ARTIFICIAL NEURAL NETWORKS: Biological Neuron, Neural Net, Use of neural nets, Applications, Perceptron Model, Idea of single layer and multiplayer neural nets, Back propagation, Hopfield nets, Supervised and unsupervised learning.

MODULE V: EXPERT SYSTEMS: Introduction, Study of some popular expert systems, Expert system building tools and shells, Components of expert systems, Applications to power systems.
Fuzzy Logic: Fuzzy logic concepts, Fuzzy relation and membership functions, Defuzzufication, Fuzzy controllers **Genetic algorithm**: concepts, coding, reproduction, crossover, mutation, scaling and fitness

Teaxt/Reference Books:

1. Artificial Intelligence Techniques in Power Systems by K. Warwick, Arthur Ekwue, Raj Aggarwal – IEE
2. Artificial Intelligence in Power System Optimization by Weerakorn Ongsakul, Vo Ngoc Dieu – CRC Press
3. Introduction to Artificial Intelligence and Expert Systems, D.W.Patterson, Prentice-Hall of India, 1992.
4. Introduction to AI, Charniak E. and Mcdermott D., Addison-Wesley, 1985.
5. Artificial Intelligence, Elaine Rich, Kevin Knight, Tata McGraw-Hill, 1991.
6. Problem Solving Methods in AI, Nils J.Nilson, McGraw-Hill, 1971.
7. Principles of AI, Nils J.Nilson, Berlin Springer-Verlag", 1980.

Semester I **M.Tech in Power System**

PROGRAM ELECTIVE: I

MEE 109 : RENEWABLE ENERGY SYSTEMS

3L+0T+0P+3C **MM 100**

MODULE I: INTRODUCTION TO RENEWABLE ENERGY SYSTEMS: Wind power, Hydropower, Solar energy-Biomass, Bio-fuel, Geothermal Heat energy, Solar-thermal plants, Applications.

MODULE II: SOLAR ENERGY: Introduction to PV-Cells, Array, Solar power extraction using PV-Cells, I-V Characteristics, PV-Inverters without D.C. to D.C. converters,Grid interfacing-with isolation, without isolation, Maximum power point tracking-Methods, PV-Inverters with D.C. to D.C. converters-on low frequency side and high frequencyside with isolation, without isolation.

MODULE III: WIND ENERGY: Sources and potentials, Evaluation of Wind Intensity, Topography, General Classification of Wind Turbines-Rotor Turbines, Multiple-Blade Turbines, Drag Turbines, Lifting Turbines, System TARP–WARP, Generators and speed control used in wind power energy.

MODULE IV: WIND POWER CONTROL: Fixed speed with capacitor bank, Rotor resistance control, DFIG, Synchronous Generator externalmagnetized, SynchronousGeneratorpermanent magnets.

MODULE V: **FUEL CELLS**: FUEL cells, Commercial Technologies for Generation of Electricity, Constructional Features of Solid Oxide Fuel Cells, Constructional Features of Proton Exchange Membrane Fuel Cells, Load Curve Peak Sharing with Fuel Cells, Advantages and Disadvantages of Fuel Cells, voltage step-up using D.C.-D.C. converter-with andwithout battery storage, Voltage controller for Fuel cell using D.C. – D.C. converter, Inverterinteraction with fuel cell for A.C. loads, A.C. Voltage build-up and controller for fuel cells- using power converters and transformers (isolation).

Teaxt/Reference Books:

1. Non-Conventional Energy Sources, G.D. Rai, PHI,
2. Renewable Energy Technologies , Ramesh & Kumar , Narosa
3. Integration of alternative sources of energy, FelixA. Farret, M. Godoy simoes
4. Wind power plants and projects developments, JoshuaEarnest and T Wizelius, PHI, New Delhi, 2011.
5. Handbook of renewable energy technology, World Scientific, Singapore, 2011.

Semester I **M.Tech in Power System**

MEE 104 : COMPUTER AIDED ANALYSIS OF POWER SYSTEM LAB

0L+0T+4P+2C **MM 100**

1. Formation of Bus Impedance Matrix and its modification using MATLAB

2. Formation of Jacobian matrix for a power system not exceeding 4 buses (with & without PV Buses) in polar co-ordinates using MATLAB

3. Sequence Components of Power System Network with Single Line to Ground Fault using MATLAB SIMULINK

4. Z bus building algorithm for fault analysis of power system.

5. Modeling of Single Machine Infinite bus Power System using SIMULINK

6. Load flow analysis of Power System using Fast De-coupled method.

7. DC Load flow analysis of Power System using MATLAB.

8. Modeling of Automatic Generation Control for frequency control of two area network.

9. To determine a) Swing curve b) Critical clearing time for a single machine connected to infinite bus through a pair of identical transmission lines, three phase fault on one of the lines using MATLAB.

Semester - I **M.Tech in Power System**

MEE 105 : SEMINAR-I (REVIEW OF LITERATURE)

0L+0T+4P+2C **MM 100**

Student will present a seminar individually; download research papers from IEEE, Elsevier, Springer or any referred journal. This activity may also require visiting Learning Resources Centre of other institute of national importance.

Summarizing paper–Reading abstracts and finding ideas, conclusion, highlight of their approach, the drawbacks of the papers. Generalize results from a research paper to related research problems.

Comparing the approach -identify weaknesses and strengths in recent research articles in the subject. Practice sessions on how to read, analyze and summarize research papers. Students in group will have to deliver *presentation,* prepare a report and a review paper based on analysis.

Internal continuous assessment marks are awarded based on the relevance of the topic, presentation skill, quality of the report and participation.

Semester II **M.Tech in Power System**

MGT 103 : PROJECT FORMULATION AND APPRAISAL TECHNIQUES

3L+0T+0P+3C **MM 100**

MODULE 1 INTRODUCTION – project attributes; project life cycle; role of managers; Management – scheduling; Gantt charts; CPM; PERT; crashing; Generation of project ideas – resource allocation; environment analysis – PEST analysis, porter's model; analysis of strategic capabilities – value chain, BCG matrix, flexibility

MODULE 2 APPRAISAL METHODS IN PROJECT SCANNING AND SELECTION – market appraisal; technical appraisal; environmental appraisal; evaluating intangibles, social appraisal – SCBA, UNIDO, LM, CSR.

MODULE 3 TOTAL QUALITY MANAGEMENT: INTRODUCTION - Need for quality - Evolution of quality - Definition of quality -Basic concepts of TQM - Definition of TQM – TQM Framework -Contributions of Deming, TQM principles , The seven traditional tools of quality – New management tools – Six-sigma.

MODULE 4 FINANCIAL APPRAISAL: Time value of money; cost of capital – equity, debt, preference; weighted average cost; marginal and average cost; Capital budgeting – investment appraisal techniques; NPY; IRR; Payback period; replacement decisions; selection of exact discount factor – problems, inflation, taxation;

MODULE 5: RISK ANALYSIS models – single probability analysis; sensitivity analysis; break even analysis; certainty equivalent; uncertainty analysis, simulation; decision tree model; risk and utility.

Recommended Books

- Khatua Sitangshu. *Project Management and Appraisal*, Oxford University Press
- Pandey, I.M. *Financial Management*. Vikas Publishing House
- Prasanna, Chandra. *Financial Management*. Tata McGraw-Hill
- Maheshwari, S .N. & Maheshwari, S. K. *Advanced Management Accounting Vol.1 & Vol.2*. Vikas Publishing House
- Paresh Shah. *Management Accounting*. Oxford University Press

Semester II **M.Tech in Power System**

MEE 201 : DISTRIBUTED GENERATION & CONTROL

3L+1T+0P+3.5C **MM 100**

MODULE I: INTRODUCTION: Need, Advantages & features of distributed generators, Overview of energy sources relevant to Distributed generation, Distributed Generations in India. Power Quality Problems with Distributed generation.

MODULE II: ISOLATED GENERATION AND ENERGY STORAGE FOR DISTRIBUTED GENERATION: Wind- diesel systems- fuel savings- permanent magnet alternators- modeling- steady state equivalent circuit- self excited induction generators- integrated wind- solar systems, battery energy storage, SMES, capacitor and other energy storage systems.

MODULE III: GAS TURBINE POWERED DISTRIBUTED GENERATORS AND OTHER REWABLE SOURCES: Gas turbine types, mini and micro gas turbine generators, cro-hydel electric systems- power potential- scheme layout- generation efficiency and turbine power flow, isolated and parallel operation of generators- tidal and other sources and applications

MODULE IV: MICROGRID INTEGRATE WITH DISTRIBUTED GENERATION: Clarification of the Microgrid Concept, Market Models for Microgrids, Operation and Control of Microgrids- Centralized Control, Decentralized Control, Coordinated Voltage/var Support, Coordinated Frequency Control.

MODULE V: POWER ELECTRONICS INTERFACE: Power electronics circuits and components for DGs applications, Single phase inverters, Inverter vs. Non-Inverter Technologies, AC inductor design and need for LCL filter, LCL filter design.

Teaxt/Reference Books:

1. Distributed Power Generation, H. Lee Willis and W.G. Scott, Marcel Dekker, c. 2000.
2. Wind Energy Technology, John F. Walker & Jenkins, N., John Wiley and sons, Chichester, U.K., 1997.
3. Solar energy- Principles of Thermal Collection and Storage, Sukhatme, S.P. Tata McGraw-Hill, New Delhi.
4. Direct Energy Conversion, S.L Soo, Prentice Hall Publication.
5. FUEL Cell Systems, James Larminie, Andrew Dicks, John Wiley and Sons Ltd.

Semester II **M.Tech in Power System**

MAT 156 : ADVANCE MATHEMATICS

3L+1T+0P+3.5C **MM 100**

MODULE I: DIGITAL REPRESENTATIONS Signals and Systems, Linear Time Invariant Systems, Arithmetic: Fixed and Floating point representation, IEEE 754 Floating point standards, Floating point arithmetic operations

MODULE II: LAPLACE AND FOURIER TRANSFORMS The Laplace Transform, Properties, The Fourier Transform, Properties of Fourier Transform, FourierTransform of Sequence (Fourier series) and its properties, Fourier analysis for Continuous and Discrete Time Signals.Digital

MODULE III: MULTIDIMENSIONAL AND DISCRETE TRANSFORMS Introduction, 2D orthogonal & unitary transforms, Properties of unitary transforms,1D and 2D- DFT, DCT, Z Transform and its properties.

MODULE IV: WAVELET TRANSFORM Wavelet Transform: Continuous: introduction, C-T wavelets, properties, inverse CWT. Discrete wavelet transform and orthogonal wavelet decomposition using Harr Wavelets.

MODULE V: LINEAR ALGEBRA Linear Equations and Matrix Algebra: Fields; system of linear equations, and its solution sets; elementary row operations and echelon forms; matrix operations; invertible matrices, LU-factorization Vector Spaces: Vector spaces; subspaces; bases; dimension; coordinates

Teaxt/Reference Books:

1. Linear Algebra and its Applications, David C. Lay, 3rd edition, Pearson Education (Asia) Pte. Ltd, 2005
2. Digital Arithmetic, Milos D. Ercegovac, Tomas Lang, Elsevier
3. Fundamentals of Digital Image Processing, Anil K. Jain, PHI, New Delhi
4. Digital Signal Processing: a practical approach, Emmanuel C Ifeachor, W Barrie Jervis, Pearson Education (Singapore) Pte. Ltd., Delhi
5. Wavelet transforms-Introduction to theory and applications, Raghuveer M.Rao and Ajit S. Bapardikar, Person Education
6. Schaum's Outline for Advanced Engineering Mathematics for Engineers and Scientists, Murray R. Spiegel, MGH Book Co., New York
7. Advanced Engineering Mathematics, Erwin Kreyszing, John Wiley & Sons, NEW YORK
8. Advanced Engineering Mathematics, JAIN, R K, IYENGAR, S R K, Narosa, NEW YORK
9. Signal processing with fractals: a Wavelet - based approach, Wornell, Gregory, PH, PTR, NEW JERSEY
10. Wavelet a primer, Christian Blatter, Universities press (India) limited, Hyderabad

Semester II **M.Tech in Power System**

PROGRAM ELECTIVE: II

MEE 204 : POWER QUALITY MONITORING

3L+0T+0P+3C **MM 100**

MODULE 1: INTRODUCTION OF THE POWER QUALITY: Understanding Power quality, types of power quality disturbances, power quality indices, Causes and effects of power quality disturbances.

MODULE 2: EFFECTS OF HARMONICS: Causes and effects of harmonics, converter configuration and their contribution to supply harmonics, other sources of harmonics.

MODULE 3: SOLUTION OF HARMONICS-I: Radio interference, supply standards, elimination/ suppression of harmonics, classical solutions & their drawbacks, passive input filters, high power factor pre-regulator, switching control circuit, transformer connections.

MODULE 4: SOLUTION OF HARMONICS-II: Elimination/suppression of harmonics using active power filters – topologies, and their control methods, PWM converter as a voltage source active filter, current source active filter.

MODULE 5: FREQUENCY CONTROL: Electro-magnetic compatibility, constant frequency control, constant tolerance band control, variable tolerance band control, discontinuous current control.

Teaxt/Reference Books:

1. Heydt, G.T., Electric Power Quality, Stars in a Circle Publications, Indiana, 2nd edition 1994.
2. Bollen, M.H.J., Understanding Power Quality Problems: Voltage sags and interruptions, IEEE Press, New York, 2000.
3. Arrillaga, J. Watson, N.R., Chen, S., Power System Quality Assessment, Wiley, New York, 2000.
4. K.R.Padiyar, "Power System Dynamics, Stability & Control ", Interline Publishing

Semester II **M.Tech in Power System**

PROGRAM ELECTIVE: II

MEE 205 : POWER SYSTEM PLANNING RELIABILITY & ECONOMIC OPERATIONS

3L+0T+0P+3C **MM 100**

MODULE 1: SYSTEM PLANNING: Objectives of system planning: Long term and short term planning-stages in planning -Policy studies -Planning standardization studies- System and Network Reinforcement studies

Load forecasting: Classification of loads-Forecast methodology, Non weather sensitive forecast-Weather sensitive forecast- Total forecast-Annual and monthly peak load forecast

MODULE 2: GENERATION SYSTEM: Reliability analysis-Reliability Concepts- Exponential Distribution mean time to failure-Series and Parallel system – Markov Process- Recursive technique-Generator System reliability analysis-Probability Models for generator unit and loads-Reliability Analysis of isolated and inter connected system – Generator system cost analysis

MODULE 3: TRANSMISSION SYSTEM PLANNING AND RELAIBILITY: Tellegen's theorem-Network sensitivity-Network Decision-Problem formulator solution using DC load flow An overview of distribution system planning. Transmission system reliability model analysis, Capacity state classification-Average –Interruption rate method – LOLP method

MODULE 4: ECONOMICAL OPERATIONS OF THERMAL POWER PLANTS: Generator operating cost, input, output curves, heat rate and incremental rate curves of generating units, system constraints, economic dispatch problem, economic dispatch using Newton Raphson method, classical method, Calculation of loss coefficient using Y_{bus}, using Sensitivity Factors: Generation Shift Distribution (GSD) factors, Generalised Generation shift Distribution (GGSD) Factors. Effects of transmission losses, transmission loss coefficients, formula, function of generation and loads, economic dispatch using exact loss formula which is function of real and reactive power, economic dispatch for active and reactive power balance, evaluation of incremental transmission loss, economic dispatch based on penalty factors.

MODULE 5: ECONOMICAL OPERATIONS OF HYDROTHERMAL POWER PLANTS: Classification of hydro plants, long-range problem, short-range problem. Hydro Plant performance Model, Glimn-Kirchmayer Model, Hamilton-Lamonts Model, thermal and hydro model for short range fixed head hydrothermal scheduling, equality and inequality constraints, transmission losses, advantages of combined operation, base load, peak load operation requirement, Newton Raphson method for short range fixed head hydrothermal scheduling, reservoir dynamics, equality and inequality constraints, idea of multi objective generation scheduling.

Teaxt/Reference Books:

1. Reliability modeling in electric power system, Endreni.J., John Wiley 1980
2. Reliability evaluation of power systems, Roy Billington and Ronald .N. Allan Plenum Press 1984
3. Power system planning, Sullivan.R.L, McGraw Hill New York 1977
4. Electric power distribution system engineering, Turen Gonen, McGraw Hill New York 1986
5. Reliability modelling in Electric Power System, Eodrenyi, J., John Wiley, 1980.
6. Economic Market Design and Planning for Electric Power Systems, James Momoh & Lamine Mili, John Wiley
7. Economic operation of power systems, Leon K. Kirchmayer, John Wiley

Semester II **M.Tech in Power System**

PROGRAM ELECTIVE: II

MEE 206 : SOFT COMPUTING TECHNIQUES

3L+0T+0P+3C **MM 100**

MODULE 1: INTRODUCTION TO FUZZY LOGIC: Fuzzy sets- Fuzzy set operations-Fuzzy relations-Cardinality of Fuzzy relations-Operations on Fuzzy relations-Properties of Fuzzy relations-Membership Functions-Features of Membership functions-Fuzzification-Methods of Membership value Assignments- Fuzzy Rule Base-Defuzzification-Deffuzzification methods- Fuzzy logic controller(Block Diagram)

MODULE 2: ARTIFICIAL NEURAL NETWORKS: Basic concepts-Neural network Architectures-Single layer feed forward network-Multilayer feed forward network-Recurrent Networks-Characteristics of Neural Networks-Learning methods. Perceptron networks-Back Propagation networks-Radial base function network-Hopfield network-Kohonen Self organizing maps-ART

MODULE 3: FUNDAMENTALS OF GENETIC ALGORITHMS: Basic concepts-working principle – encoding – different methods – fitness function – reproduction-different methods. Genetic modelling-inheritance- Crossover mutation-convergence of genetic algorithm.

MODULE 4: HYBRID SYSTEMS-I: Neural network, fuzzy logic and genetic algorithm hybrids – Neuro fuzzy hybrids- neuro

MODULE 5: HYBRID SYSTEMS-II: genetic hybrids-Fuzzy genetic hybrids-Genetic algorithm based back propogation network- Fuzzy back propagation networks -fuzzy logic controlled genetic algorithms.

Teaxt/Reference Books:

1. Neural Network, Fuzzy Logic and Genetic Algorithms Synthesis and Applications, S.Rajasekharan, G.A.Vijayalakshmi Pai, Prentice Hall India.
2. Principles of Soft Computing, S.N.Sivanandam, S.N.Deepa, Wiley India.
3. Fuzzy logic with Engineering Applications, Timothy J Ross, Mc Graw Hill, New York. 4. S.Haykins, Neural Networks a Comprehensive foundation, Pearson Education.
4. Genetic Algorithms in Search Optimisation and Machine Learning, D.E.Goldberg, Pearson Education.

Semester II **M.Tech in Power System**

PROGRAM ELECTIVE: II

MEE 207 : POWER SYSTEM- NETWORKS AND UTILITY

3L+0T+0P+3C **MM 100**

MODULE I: STABILITY OF DYNAMIC Stability of Dynamic systems, Synchronous machine theory and modelling:- armature and field structure, parks transformation, machine with multiple pole pairs-mathematical description, d-q transformation, per unit representation, equivalent circuit for d-q axes, steady state analysis- voltage-current and flux linkage, phasor representation, rotor angle – steady state equivalent circuit.

MODULE II: PROBLEM FORMULATIONS State space representation concept, Eigen properties of the state vectors, analysis of stability- small signal stability of a single machine connected to infinite bus system, classical representation of generator, small signal stability of a multi machine connected to infinite bus system. Characteristics of small - signal stability problems

MODULE III: TRANSIENT STABILITY Transient stability:- Concept of transient stability, response to a step change in mechanical power input, Swing equation- multimachine analysis, factors influencing transient stability, numerical integration method – Euler method – R-K method (4rth order), critical clearing time and angle- methods for improving transient stability

MODULE IV: VOLTAGE STABILITY Basic concept, transmission system characteristics, generator characteristics, load characteristics, PV curve, QV curve and PQ curve, characteristics of reactive power compensating devices. Voltage collapse and prevention of voltage collapse.

MODULE V: UTILITY APPLICATIONS OF POWER ELECTRONICS: Static excitation systems: converters as used in SES, control and the IEEE types, enhancement of stability. HVDC transmission: configurations of line-commutated converters, constant current and Constant extinction angle control at device terminal level, individual phase and equidistant pulse firing control at device level, active and reactive power considerations. FACTS: impedance type and inverter type FACTS devices, the static var compensator, the thyristor controlled series reactor, the STATCOM and its developments in the form of UPFC and SSSC. Active filters: the power quality problems at distribution level, inverter control by transient p-q theory, configuration of active filters and their control, exist bottlenecks.

Teaxt/Reference Books:

1. Power System Stability and Control: –P. Kundur – McGraw Hill publications
2. Power System Dynamics: Stability and Control: – K.R.PADIYAR, II Edition, B.S.Publications.
3. Power system control and stability P.M. Anderson and A.A. Fouad, John Wiley & sons
4. Computer modelling of Electric Power Systems, J. Arrillaga and N. R. Watson, John Wiley & sons, 2001.

Semester II **M.Tech in Power System**

PROGRAM ELECTIVE: III

MEE 208 : MODERN CONTROL THEORY

3L+0T+0P+3C **MM 100**

MODULE 1: MATHEMATICAL PRELIMINARIES Fields, Vectors and Vector Spaces – Linear combinations and Bases – Linear Transformations and Matrices – Scalar Product and Norms – Eigenvalues, Eigen Vectors and a Canonical form representation of Linear operators – The concept of state – State Equations for Dynamic systems – Time invariance and Linearity – Nonuniqueness of state model – State diagrams for Continuous-Time State models .

MODULE 2: STATE VARIABLE ANALYSIS Linear Continuous time models for Physical systems– Existence and Uniqueness of Solutions to Continuous-Time State Equations – Solutions of Linear Time Invariant Continuous-Time State Equations – State transition matrix and it's properties.

MODULE 3: CONTROLLABILITY AND OBSERVABILITY General conceptofcontrollability – General concept of Observability – Controllability tests for Continuous-Time Invariant Systems – Observability tests for Continuous-Time Invariant Systems – Controllability and Observability of State Model in Jordan Canonical form – Controllability and Observability Canonical forms of State model.

MODULE 4: NON LINEAR SYSTEMS -I Introduction – Non Linear Systems - Types of Non-Linearities – Saturation – Dead-Zone - Backlash – Jump Phenomenon etc;– Singular Points – Introduction to Linearization of nonlinear systems, Properties of Non-Linear systems – Describing function–describing function analysis of nonlinear systems – Stability analysis of Non-Linear systems through describing functions.

MODULE 5: STABILITY ANALYSIS Stability in the sense of Lyapunov, Lyapunov's stability and Lypanov's instability theorems - Stability Analysis of the Linear continuous time invariant systems by Lyapunov second method – Generation of Lyapunov functions – Variable gradient method – Krasooviski's method.

Teaxt/Reference Books:

1. Digital Control and State variable Methods, M.Gopal, Tata Mc Graw Hill
2. Introduction to Control Engineering: Modeling, Analysis and Design, Ajit K.Madal, New Age International.
3. Adaptive Control, D.Landau, Marcel Dekker Inc.
4. Neural Networks,Fuzzy Logic and Genetic Alogorithms: Synthesis and Applications, S.Rajasekaran & G.A.Vjayalakshmi Pai, Prentice Hall of India.
5. Optimal Control Theory: An Introduction, Donald E. Kiv,Prentice Hall
6. Digital Control Systems, B.C. Kuo, Sounders College Publishing

Semester II **M.Tech in Power System**

PROGRAM ELECTIVE: III

MEE 209: POWER SYSTEM MONITORING AND SCADA SYSTEM

3L+0T+0P+3C **MM 100**

MODULE 1: INTRODUCTION TO SCADA: Data acquisition Systems- Evolution of SCADA - Communication Technologies-Monitoring and Supervisory Functions-SCADA Applications in Utility Automation-Industries.

MODULE 2: SCADA SYSTEMS COMPONENTS: Schemes – Remote Terminal Unit(RTU)-Intelligent Electronic Devices(IED)-Programmable Logic Controller(PLC)-Communication Network-SCADA server, SCADA/ HMI Systems

MODULE 3: SCADA ARCHITECTURE: Various SCADA Architectures- Advantages and Disadvantages of each system-single unified standard architecture- IEC 61850
SCADA Communication: Various industrial communication technologies- wired and wireless methods and fibre optics

MODULE 4: SCADA APPLICATIONS: Utility Applications- Transmission and distribution sector-Operations-Monitoring -Analysis and improvement- Substation automation structure- substation automation architecture.

MODULE 5: INTRODUCTION TO ROLE OF WIDE AREA PROTECTION- power system phenomenon with possible WAPS solution- Implementation of wide area protection- interaction of WAPS with SCADA System

Teaxt/Reference Books:

1. SCADA – Supervisory Control and Data Acquisition, Stuart.A. Boyer, Instrument So-ciety of America Publication, USA, 1999.
2. Practical Modern SCADA Protocol:DNP3, 60870.5 and Related Systems, Gordon Clarke, Deon Reynders, Newnes Publications, Oxford UK,2004
3. ABB –Substation automation handbook

Semester II **M.Tech in Power System**

PROGRAM ELECTIVE: III

MEE 210: MODELING AND ANALYSIS OF ELECTRICAL MACHINES

3L+0T+0P+3C **MM 100**

MODULE 1: ENERGY CONVERSION Principles of Electromagnetic Energy Conversion: General expression of stored magnetic energy, co-energy and force/torque, example using single and doubly excited system.

MODULE 2: BASIC CONCEPTS OF ROTATING MACHINES: Calculation of air gap mmf and per phase machine inductance using physical machine data; Voltage and torque equation of dc machine.

MODULE 3: THREE PHASE MACHINE-I: Three phase symmetrical induction machine and salient pole synchronous machines in phase variable form; Application of reference frame theory to three phases symmetrical, Induction and synchronous machines, dynamic direct and quadrature axis model in arbitrarily rotating reference frames

MODULE 4: THREE PHASE MACHINE-II Determination of Synchronous Machine Dynamic Equivalent Circuit Parameters, Analysis and dynamic modeling of two phase asymmetrical induction machine and single phase induction machine.

MODULE 5: SPECIAL MACHINES - Permanent magnet synchronous machine: Surface permanent magnet (square and sinusoidal back emf type) and interior permanent magnet machines. Construction and operating principle, dynamic modeling and self controlled operation; Analysis of Switch Reluctance Motors.

Teaxt/Reference Books:

1. Electric Machinery, Charles Kingsley, Jr., A.E. Fitzgerald, Stephen D.Umans, Tata Mcgraw Hill,6ht Edition, 2003.
2. Electric Motor & Drives: Modeling, Analysis and Control, R. Krishnan, Prentice Hall of India, 2001.
3. Brushless permanent magnet and reluctance motor drives, Miller, T.J.E,. Clarendon Press, Oxford, 1989.

Semester II **M.Tech in Power System**

MEE 202: POWER SYSTEM SIMULATION LAB

0L+0T+4P+2C **MM 100**

Software: - MATLAB / ETAP/GAMES will be used.

1. Economic Load Dispatch with thermal power plants.
2. Economic Load Dispatch with Hydro thermal power plants.
3. Simulation of frequency control of multi area system.
4. Simulate Swing Equation in Simulink (MATLAB)
5. Receiving end voltage control of infinite bus by Series compensation scheme.
6. Receiving end voltage control of infinite bus by mid-point compensation scheme.
7. Transient Stability Analysis and formation of Swing Curves using MATLAB/SIMULINK
8. Analysis of voltage stability of a SLIB (Single Load Infinite Bus) system while delivering maximum power using MATLAB.
9. Continuation Power Flow (CPF) analysis using MATLAB

Semester - II **M.Tech in Power System**

MEE 203: SEMINAR-II (REVIEW OF LITERATURE)

0L+0T+4P+2C **MM 100**

Each student will separately now continue to download further the research papers in the area, analyze, and allocate individually, the set of papers.

Literature survey Overview -What is literature survey, Functions of literature survey, maintaining a notebook, developing a Bibliography.

Methods of data collection –Observation, survey, contact methods, experimental, determining sample design Searching for publications –Publication databases, search engines and patent databases, Find some/all of the references for a given paper, including those that are not on the web.

Internal continuous assessment marks are awarded based on the relevance of the topic, presentation skill, quality of the report and participation.

Semester - II **M.Tech in Power System**

MEE 301: INTERNSHIP

0L-0T- (6Month)P+4C **MM 100**

As a part of the curriculum, the internship program forms an important component of education.. It is an attempt to bridge the gap between an academic institution and the corporate world. The Program, which would be a simulation of real work environment, requires the students to undergo the rigor of professional environment for 180 days internship in relevant industry or recognized research organization. In the process, it provides an opportunity for the students to satisfy their inquisitiveness about the corporate world provides exposure to practicing professional skills as well as in research area and also helps them acquire social skills by being in constant interaction with the professionals of an organization. During internship, some of the students may be offered stipend and/or job offer by the company. This program benefits the student to understand what he/she has studied in the class room and what is being practiced in the industry.

Every student is required to undertake On-the-Job-Training (OJIT) in his/her domain area along with day-to-day functions of the company and may conduct his research work, both at the assistance and the execution level. This will help the student to gain a deeper understanding of the professional work, culture, organizational targets, delivering results, work pressure, etc. of an organization.

Semester III **M. Tech in Power System**

MEE 302 DISSERTATION PART- I

0L+0T+0P+8C **MM 100**

The project work can be a design project/experimental project and/or computer simulation project on any of the topics in Software ETAP/ MiPOWER / MATLAB / LABVIEW will be used. The project work is allotted individually on different topics. The students shall be encouraged to do their project work in the parent institute itself. If found essential, they may be permitted to continue their project outside the parent institute.Department will constitute an Evaluation Committee to review the project work. The Evaluation committee consists of at least three faculty members of which internal guide and another expert in the specified area of the project shall be two essential members.The student is required to undertake the master research project phase 1 during the third semester and the same is continued in the 4thsemester (Phase 2). Phase 1 consist of preliminary thesis work, two reviews of the work and the submission of preliminary report. First review would highlight the topic, objectives, methodology and expected results. Second review evaluates the progress of the work, preliminary report and scope of the work which is to be completed in the 4th semester. The Evaluation committee consists of at least three faculty members of which internal guide and another expert in the specified area of the project shall be two essential members. The technical paper is to be submitted along with the thesis. The final evaluation of the project will be external evaluation.

Internal and external Continuous assessment:

	Guide	Evaluation Committee	
First Review	**30**	**20**	**Total**
Second Review	**30**	**20**	
Total	**60**	**40**	100

Semester III **M.Tech in Power System**

MEE 303: SEMINAR-III (REVIEW OF LITERATURE)

0L+0T+4P+2C **MM 100**

Objective: To assess the debating capability of the student to present a technical topic. Also, to impart training to students to face audience and present their ideas and thus creating in them self-esteem and courage that are essential for engineers.

Individual students are required to choose a topic of their interest from Digital Communication Systems related topics preferably from outside the M.Tech syllabus and give a seminar on that topic about 30 minutes. A committee consisting of at least three faculty members (preferably specialized in Digital Communication Systems) shall assess the presentation of the seminar and award marks to the students. Each student shall submit two copies of a write up of his/her seminar topic. One copy shall be returned to the student after duly certifying it by the chairman of the assessing committee and the other will be kept in the departmental library. Internal continuous assessment marks are awarded based on the relevance of the topic, presentation skill, quality of the report and participation.

Semester IV **M. Tech in Power System**

MEE 401 DISSERTATION PART- II

0L+0T+P+16C **MM 100**

Objective: To improve the professional competency and research aptitude by touching the areas which otherwise not covered by theory or laboratory classes. The project work aims to develop the work practice in students to apply theoretical and practical tools/techniques to solve real life problems related to industry and current research.

Master Research project phase II is a continuation of project phase I started in the third semester. There would be two reviews in the fourth semester, first in the middle of the semester and the second at the end of the semester. First review is to evaluate the progress of the work, presentation and discussion. Second review would be a pre-submission presentation before the evaluation committee to assess the quality and quantum of the work done. This would be a pre qualifying exercise for the students for getting approval by the departmental committee for the submission of the thesis. At least one technical paper is to be prepared for possible publication in journal or conferences. The technical paper is to be submitted along with the thesis. The final evaluation of the project will be external evaluation.