INDIRA GANDHI UNIVERSITY, MEERPUR, REWARI

SCHEME OF STUDIES AND EXAMINATIONS

FOR

MASTER OF TECHNOLOGY

IN

ELECTRICAL ENGINEERING

w.e.f 2019-20

SCHEME OF STUDIES AND EXAMINATIONS FOR MASTER OF TECHNOLOGY IN ELECTRICAL ENGINEERING w.e.f. 2019-20

SEMESTER-I

S.No.	Course Code	Course Title	Teaching schedule			Credits	Class Work	Examination		Total
			L	T	P			Theory	Practical	
1.	MTEE101	ADVANCED COMPUTER POWER SYSTEM ANALYSIS	4	0	0	4	50	100	-	150
2.	MTEE102	ADVANCED DIGITAL SIGNAL PROCESSING	4	0	0	4	50	100	-	150
3.	MTEE103	REACTIVE POWER COMPENSATION & MANAGEMENT	4	0	0	4	50	100	-	150
4.	MTEE104	ADVANCED MICROPROCESSOR & MICROCONTROLLERS	4	0	0	4	50	100	-	150
5.	MTEE105	HIGH VOLTAGE ENGINEERING	4	0	0	4	50	100	-	150
6.	MTEE106	ADVANCE POWER SYSTEM LAB	0	0	2	2	50	-	50	100
7	MTEE107	Seminar				1				
8	MTEE108	Self Study Paper				1				
		GRAND TOTAL	15	5	2	24	300	500	50	850

SCHEME OF STUDIES AND EXAMINATIONS FOR MASTER OF TECHNOLOGY IN ELECTRICAL ENGINEERING

SEMESTER-II

S. No.	Course Code	Course Title	Teaching schedule			Credits	Class Work	Examination		Total
			L	T	P			Theory	Practical	
1.	MTE E201	ADVANCE SWITCHGEAR AND PROTECTION	4	0	0	4	50	100	-	150
2.	MTE E202	TRANSDUCERS AND MEASUREMENT TECHNIQUES	4	0	0	4	50	100	-	150
3.	MTE E203	FACTS AND HVDC	4	0	0	4	50	100	-	150
4.	MTE E204	POWER SYSTEM DYNAMICS AND STABILITY	4	0	0	4	50	100	-	150
5.	MTE E205	COMPUTER COMMUNICATION	4	0	0	4	50	100	-	150
6.	MTE E206	POWER SYSTEM SIMULATION LAB	0	0	2	2	50	-	50	100
7	MTE E207	#Foundation Elective (FEC)	0	0	2	2				
8	MTE E208	Seminar	-	-	-	1	-	-	-	25
9	MTE E209	Self Study Paper	-	-	-	1	-	-	-	25
		GRAND TOTAL	15	5	2	26				

#Note: A candidate has to select this paper from the pool of Foundation Electives provided by the University.

SCHEME OF STUDIES AND EXAMINATIONS FOR MASTER OF TECHNOLOGY IN ELECTRICAL ENGINEERING

SEMESTER-III

S.No.	Course Code	Course Title	Teaching schedule			Credits	Class Work	Examination		Total
			L	T	P			Theory	Practical	
1.	MTEE 301	ELECTIVE-I (DCEC)	3	1	0	4	50	100	-	150
2.	MTEE 302	ELECTIVE-II (DCEC)	3	1	0	4	50	100	-	150
3	MTEE 303	*Open Elective (OEC)	3	0	0	3				
4	MTEE 304	SEMINAR	0	0	0	1	--	-	-	25
5	MTEE 305	Self Study Paper				1	-			25
6	MTEE 306	DISSERTATION-PHASE I	0	0	4	4	150	-	-	150
			6	2	6	17				

***Note: To be Chosen from the pool of Open Electives provided by the University**

SCHEME OF STUDIES AND EXAMINATIONS FOR MASTER OF TECHNOLOGY IN ELECTRICAL ENGINEERING

SEMESTER-IV

S.No.	Course Code	Course Title	Teaching Schedule			Credits	Class Work	Examination		Total
			L	T	P			Theory	Practical	
1	MTEE401	DISSERTATION FINAL PHASE	0	0	20	20	200	-	400	600
	TOTAL				20	20	200	-	400	600

NOTE:

1. **The Dissertation shall be evaluated by an examination committee consisting of the head of the department, Dissertation Supervisor and one External examiner. The evaluation should be based on above grades.**
2. **The grading system is define at the end of scheme of studies & examinations and will be supplied by the University to the examiner(s).**

SCHEME OF STUDIES AND EXAMINATIONS FOR MASTER OF TECHNOLOGY IN ELECTRICAL ENGINEERING

LIST OF ELECTIVES

S.No.	Course Code	Course Title	Teaching Schedule			Class Work	Examination		Total
			L	T	P		THEORY	PRACTICAL	
ELECTIVE-I									
1	MTEE301A	ENERGY AUDIT IN POWER DISTRIBUTION SYSTEMS	3	1	0	50	100	-	150
2	MTEE301B	ELECTRICAL POWER QUALITY	3	1	0	50	100	-	150
3	MTEE301C	SMART GRID	3	1	0	50	100	-	150
ELECTIVE-II									
1	MTEE302A	POWER SYSTEM RELIABILITY	3	1	0	50	100	-	150
2	MTEE302B	POWER SYSTEM OPERATION AND CONTROL	3	1	0	50	100	-	150
3	MTEE302C	RESTRUCTURED ELECTRIC POWER SYSTEM	3	1	0	50	100	-	150

***Student has to take one subject out of subjects offered by department from this list.**

ADVANCED COMPUTER POWER SYSTEM ANALYSIS

MTEE101 **Sessional Marks: 50**
L-T-P **Theory paper Marks: 100**
3-1-0 **Total Marks: 150**
Exam. Duration: 3 Hrs.

NOTE: Examiner will set 9 questions in total, with two questions from each section and one question covering all sections which will be Q.1. This Q.1 is compulsory and of short answers type. Each question carries equal mark (20 marks). Students have to attempt 5 questions in total at least one question from each section.

Section - A

INTRODUCTION: Introduction to the growth of power systems, Model representation of transmission line introduction, performance of transmission systems, Ferranti effect, Introduction to energy control centers, various states of a power system, State Estimation.

Section-B

Network Analysis in Power Systems: Introduction, Bus Admittance Matrix, Formation of Y Bus,
Tree graph, Co-tree, Primitive admittance matrix with or without mutual inductances, Bus Incidence matrix, Formulation of Y Bus using singular transformation, Formation of twing admittance matrix, Formation of Z loop, Bus Impedance matrix, Algorithm for formulation of Z- Bus. All types of modifications.

Section - C

LOAD FLOW STUDIES: Load flow equations, Approximate Load flow study, Gauss-Seidel method for Load flow Study, Algorithm and flow Chart for Computer application to Load flow studies, Newton-Raphson method for Load flow studies, Algorithm and flow chart for Computer Application. Decoupled Load flow Studies, Fast Decoupled Load flow. Comparison between G-S & N-R methods. DC Load Flow study, Load flow Study of Distribution System.

Section-D

SYMMETRICAL AND UNSYMMETRICAL FAULT ANALYSIS: Symmetrical Components, Sequence networks for synchronous machines, transforms and transmission Lines, digital technique in short circuit Studies of: Single line to ground fault, Line to Line fault, Double line to Ground fault and symmetrical fault. Consideration of Pre fault currents.

TEXT BOOKS:

1. Power Systems Engineering by S. K. Gupta, Umesh publication
2. Power System Analysis & Design with CD by Glover, Cengage Learning
3. Power System Engg., by B.R.Gupta: S. Chand.
4. Power System Analysis: Hadi Saadat, TMH, New Delhi.
5. Computer Techniques in Power System analysis by M. A. Pai.

REFERENCE BOOKS:

1. Advance power system analysis and dynamics by L.P. Singh: Wiley Eastern ltd.
2. Electrical Energy system theory: An introduction by O.I.Elgerd : TMH.
3. Elements of power system analysis by W. D. Stevenson: M.G.H.
4. Power System Engineering by I.J.Nagrath & D.P.Kothari: TMH.
5. Computer methods in power system by G. W. Stagg and A. H. El-Abiad: M.G.H.

ADVANCED DIGITAL SIGNAL PROCESSING

MTEE102	**Sessional Marks : 50**
L-T-P	**Theory paper Marks: 100**
3-1-0	**Total Marks: 150**
	Exam. Duration: 3 Hrs.

NOTE: Examiner will set 9 questions in total, with two questions from each section and one question covering all sections which will be Q.1. This Q.1 is compulsory and of short answers type. Each question carries equal mark (20 marks). Students have to attempt 5 questions in total at least one question from each section.

Section - A

Introduction of DSP: Introduction to Signal Processing, Discrete Linear Systems, superposition Principle, Unit-Sample response, stability & causality Criterion.
Fourier Transform & inverse Fourier transform: Frequency domain design of digital filters, Fourier transform, use of Fourier transform in Signal processing. The inverse fourier transform, Sampling continuous function to generate a sequence, Reconstruction of continuous -time signals from Discrete-time sequences.

Section - B

Digital Filter Structure & Implementation: Linearity, time invariance & causality, the discrete convolution, the transfer function, stability tests, steady state response, Amplitude & Phase Characteristics, stabilization procedure, Ideal LP Filter, Physical reliability & specifications. FIR Filters, Truncation windowing & Delays, design example, IIR Filters: Review of design of analog filters & analog frequency transformation. Digital frequency transformation. Design of LP filters using impulse invariance method, bilinear transformation, Phase equalizer, digital all pass filters.

Section - C

Implementation of Filters: Realization block diagrams, Cascade & parallel realization, effect of infinite-word length, transfer function of degree 1&2, Sensitivity comparisons, effects of finite precision arithmetic on Digital filters.

Section - D

DFT & FFT & Z transform with Applications: Discrete Fourier transform, properties of DFT, Circular Convolution, Fast Fourier Transform, Realizations of DFT. The Z-transform, the system function of a digital filter, Digital Filter implementation from the system function, the inverse Z- transform, properties & applications, Special computation of finite sequences, sequence of infinite length & continuous time signals, computation of Fourier series & time sequences from spectra.

Text Books

1. Alam V. Oppenheim & Ronald W. Schafer, “Digital Signal Processing” PHI.
2. JG Proakis, “Digital Signal Processing”, (PHI) 3rd Edition.

Reference Books

1. Rabiner & Gold, “Theory & application of digital Signal Processing”, PHI 1992.
2. Roman kuc, “Introduction to Digital Signal Processing,” Tata McGraw hill Edition.

REACTIVE POWER COMPENSATION AND MANAGEMENT

MTEE103
L-T-P
3-1-0

Sessional Marks: 50
Theory paper Marks: 100
Total Marks: 150
Exam. Duration: 3 Hrs.

NOTE: Examiner will set 9 questions in total, with two questions from each section and one question covering all sections which will be Q.1. This Q.1 is compulsory and of short answers type. Each question carries equal mark (20 marks). Students have to attempt 5 questions in total at least one question from each section.

Section - A

Load Compensation: Objectives and specifications – reactive power characteristics – inductive and capacitive approximate biasing – Load compensator as a voltage regulator – phase balancing and power factor correction of unsymmetrical loads- examples.

Steady – state reactive power compensation in transmission system: Uncompensated line – types of compensation – Passive shunt and series and dynamic shunt compensation - examples

Section - B

Transient state reactive power compensation in transmission systems: Characteristic time periods passive shunt compensation – static compensations- series capacitor compensation –compensation using synchronous condensers – examples

Reactive power coordination: Objective – Mathematical modeling – Operation planning – transmission benefits – Basic concepts of quality of power supply – disturbances- steady – state variations – effects of under voltages – frequency – Harmonics, radio frequency and electromagnetic interferences

Section - C

Demand side management: Load patterns – basic methods load shaping – power tariffs- KVAR based tariffs penalties for voltage flickers and Harmonic voltage levels

Distribution side Reactive power Management: System losses – loss reduction methods – examples – Reactive power planning – objectives – Economics Planning capacitor placement – retrofitting of capacitor banks

Section - D

User side reactive power management: KVAR requirements for domestic appliances – Purpose of using capacitors – selection of capacitors – deciding factors – types of available capacitor, characteristics and Limitations

Reactive power management in electric traction systems and are furnaces: Typical layout of traction systems – reactive power control requirements – distribution transformers- Electric arc furnaces – basic operations- furnaces transformer –filter requirements – remedial measures –power factor of an arc furnace.

REFERENCE BOOKS

1. Reactive power control in Electric power systems by T.J.E.Miller, John Wiley and sons, 1982
2. Reactive power Management by D.M. Tagare, Tata McGraw Hill, 2004

ADVANCED MICROPROCESSOR & MICROCONTROLLERS

MTEE104
L-T-P
3-1-0

Sessional Marks: 50
Theory paper Marks: 100
Total Marks: 150
Exam. Duration: 3 Hrs.

NOTE: Examiner will set 9 questions in total, with two questions from each section and one question covering all sections which will be Q.1. This Q.1 is compulsory and of short answers type. Each question carries equal mark (20 marks). Students have to attempt 5 questions in total at least one question from each section.

Section - A

Design of basic microprocessor architectural Concepts : Microprocessor architecture, word Lengths, addressable memory, Microprocessor's speed architectural characteristics, registers, instruction, memory addressing architecture, ALU, GPR's Control logic & internal data bus.

Section - B

Microprocessor Instructions & Communication: Instruction Set ,Mnemonics, Basic Instruction Types, Addressing modes, Microprocessor I/O connecting I/O put to Microprocessor ,Polling and Interrupts , Interrupt and DM. Controllers.
Microprocessor I/O: Data Communication, parallel I/O serial communication, Serial interface and UART modems, I/O devices, D/A, A/D interface, special I/O devices.

Section - C

Microcontroller: Introduction 8051 architecture and programming model. Internal RAM and registers, I/O parts, Interrupt system & Instruction sets.

Section - D

Advanced microprocessors: Intel X86 family of advanced Microprocessor, programming model for 86 family. X85 addressing modes, instruction set, hardware. Motorola 68 XXX family of microprocessor, 68XXX addressing modes , instruction set, hardware.
Developing Microprocessor Based Products: Introduction to the Design Process, Preparing the specifications, Developing a design, Implementing and Testing and design, Regulatory Compliance Testing, design tool for Microprocessor Development.

Text Books:

1. C.M. Gilmore, "Microprocessors Principals and Application", MGH
2. Rajkamal, "Embedded System, Architecture & Programming", TMH

Reference Books:

1. Berry B. Berry, " Inter Series of microprocessors", PHI
2. D. V. Hall, " Microprocessor & Interfacing", TMH
3. Peatman, "Microprocessor Based System Design", Pearson

HIGH VOLTAGE ENGINEERING

MTEE105 **Sessional Marks: 50**
L-T-P **Theory paper Marks: 100**
3-1-0 **Total Marks: 150**
Exam. Duration: 3 Hrs.

NOTE: Examiner will set 9 questions in total, with two questions from each section and one question covering all sections which will be Q.1. This Q.1 is compulsory and of short answers type. Each question carries equal mark (20 marks). Students have to attempt 5 questions in total at least one question from each section.

Section - A

Break Down Mechanism of Gaseous Materials : Mechanism of Breakdown of gases, Townsend's first Ionization Co-efficient, Townsend's second Ionization Co-efficient, Townsend's Breakdown Mechanism, Streamer Theory of Breakdown in gases, Paschen's law.

Breakdown in Liquid and Solid Dielectrics: Suspended Particle Theory, Cavity Breakdown, Electroconvection Breakdown, Breakdown in solid Dielectrics, Intrinsic Breakdown, Electromechanical Breakdown, Breakdown due to Treeing and Tracking, Thermal Breakdown, Electrochemical Breakdown

Section - B

Generation of High Voltage AC. and D.C: Half wave and Full wave Rectifier, Cockroft Walton Voltage Multiplier Circuit, Ripple in Multiplier Circuit, Electrostatic Vandegraff Generator, Generation of High Alternative Voltage, Cascade Transformer, Resonant Transformer, Generation of High Frequency A.C. High Voltage

Generation of Impulse Voltages and Currents: Standard Impulse Wave Shapes, Impulse Generator Circuit, Multistage Impulse Generator, Marx's Circuit, Generation of Switching Surges, Impulse Current Generation, Tripping and Control of Impulse Generator

Section - C

Measurement of High Voltage and Current: Sphere-Gap, Uniform field Spark gap, Rod Gap, Electrostatic Voltmeter, Generating Voltmeter, Impulse Voltage Measurement using Voltage divider, Measurement of high DC, AC and Impulse Current.

High Voltage Testing of Electrical Equipments: Testing of line Insulator, Testing of Cable, Testing of Bushings, Testing of Power Capacitor, Testing of Power Transformers, Testing of Circuit Breaker. Standard wave-shapes for testing, wave-shaping circuits: principles and theory; impulse generator, generation of ac high voltage for testing, generation of direct voltage, measurement of high voltage, general layout of H.V. Laboratory

Section - D

Voltage gradients on conductors: Electrostatic fields of sphere gaps, fields of line charges and their properties, charge-potential relations for multi-conductor lines, surface voltage gradients on conductors, distribution of voltage gradient on sub conductors of bundle.

Corona: Corona and corona loss, corona loss formula, attenuation of travelling waves due to corona, audible noise-generation and characteristics, corona pulses--their generation and properties, properties of pulse, radio interference.

Lightening: Lightening phenomenon, lightning stroke mechanism, principle of lightning protection, tower foot resistance, insulator flash over and withstand voltage, lightning arresters and their characteristics.

TEXT BOOKS:

1. E.H.V. AC Transmission: R.D. Begamudre, Wiley Eastern Ltd.
2. H.V. Engg.: V. Kamaraju and M.S. Naidu, T.M.H., N.Delhi.
3. High Voltage Engineering By M.S. Naidu & V. Kamaraju -TMH Publication

REFERENCE BOOKS:

1. J. Arrillaga, *High Voltage Direct Current Transmission.* Pub: Peter Peregrinus Ltd.
2. Rakos Das Begamudre, *Extra EHV A.C Transmission.* PHI Publication.
3. C.L. Wadhwa , *High Voltage Engineering*. Pub.: New Age International Ltd.

ADVANCED POWER SYSTEM LAB

MTEE106 **Sessional Marks: 50**
L-T-P **Practical Marks: 50**
0-0-2 **Total Marks: 100**

1. Characteristics of IDMTOver Current Relay.
2. Characteristic of Negative Sequence Relay.
3. Characteristic of Over Voltage Relay.
4. To Verify Swinburne's Speed Control By Armature And Field Control.
5. Simulation of Ferranti Effect of 220KV Transmission line model.
6. Simulation of Surge Impedance loadings of 220KV Transmission line model.
7. To Calculate The Flash Over Vol. of Transformer Oil.
8. Power Angle Characteristics of A Salient Pole Synchronous Machine.
9. Angular Displacement of Measurement Of Synchronous Motor.
10. Characteristics of Percentage Biased Differential Relay.

ADVANCED SWITCH GEAR & PROTECTION

MTEE201 **Sessional Marks: 50**
L-T-P **Theory paper Marks: 100**
3-1-0 **Total Marks: 150**
Exam. Duration: 3 Hrs.

NOTE: Examiner will set 9 questions in total, with two questions from each section and one question covering all sections which will be Q.1. This Q.1 is compulsory and of short answers type. Each question carries equal mark (20 marks). Students have to attempt 5 questions in total at least one question from each section.

Section - A

Circuit Breakers: Theory of arc interruption, restriking voltage transients, current chopping in circuit breaker, circuit breaker ratings, duties of switch gear, automatic switch, air circuit breaker, bulk oil, minimum oil, air blast, SF6 CB, vacuum and DC circuit breakers, Design & Testing of CB, Basic concepts recommended for design of CB, Simple testing station, Equipment used in the station, testing procedure, direct test, indirect test.

Section - B

Protective Relays: Nature and causes of faults, consequences, zone of protection, essential qualities, primary and backup protections, relay classification, principal types of electromagnetic relays, i.e. attracted armature, induction disc, induction cup types, Relay Characteristics: Over -current, instantaneous over current, IDMT, directional and differential relays, distance relays, plain impedance, mho, reactance, offset mho type, pilot wire and carrier current protection, neutral grounding.

Section - C

Apparatus Protection: Transformer, generator, motor and bus zone protection, transmission and feeder.

Section - D

Static and Numerical Relays: Classification of static relays, amplitude and phase comparators, and blockspike and block-average comparators, rectifier type relays. Traveling wave relay, relaying schemes based on microwave and optical fiber link, protection of FACTS devices, digital relaying, its architecture, Numerical Protection: Block diagram of numerical relay, sampling and Digital filtering, Numerical over current protection, Numerical transformer differential protection, Numerical protection of transmission line.

TEXT BOOKS:

1. Power System protection and switchgear by B.Ram, D.N.Vishvakarma: TMH.
2. Fundamental of Power System Protection by Y G Paithankar, S. R. Bhide: PHI
3. Power System Protection & Switch Gear by Ravindra Nathan & Chaner: New Age Pub.
4. Protection and Switchgear by B. Bhalja, R. P. Maheshwari, N. G. Chothani: Oxford University Press.

REFERENCE BOOKS:

1. Protective Relays -Their Theory and Practice Vol.I & II by W.Van: Warrington.
2. Advanced power system analysis and dynamics by L.P.Singh: Wiley Eastern N.Delhi.
3. A course in Electrical Power by Soni, Gupta and Bhatnagar: Dhanpat Rai & Sons.
4. Power System Engg by I.J. Nagrath and D.P. Kothari :TMH.
5. Power System Engineering by V. K. Mehta.
6. Switchgear and protection by S. S. Rao: Khanna Pub

TRANSDUCERS AND MEASUREMENT TECHNIQUES

MTEE202 **Sessional Marks: 50**
L-T-P **Theory paper Marks: 100**
3-1-0 **Total Marks: 150**

NOTE: Examiner will set 9 questions in total, with two questions from each section and one question covering all sections which will be Q.1. This Q.1 is compulsory and of short answers type. Each question carries equal mark (20 marks). Students have to attempt 5 questions in total at least one question from each section.

Section - A

Transducer Fundamentals, Resistive transducers, inductive transducers, capacitive transducers; piezoelectric transducers, semiconductor and other sensing structure. Displacement transducers, tachometers and velocity transducers; accelerometers and gyros; strain gauges; force and torque transducers; flow meters and level sensors; pressure transducers; sound and ultrasonic transducers, Smart sensors

Section - B

Phototubes and photodiodes; photovoltaic and photoconductive cells, Photoemission, photo-electromagnetic detectors pressure actuated photoelectric detectors, design and operation of optical detectors, detector characteristics

Section - C

Transducer Performance: Electrical tests, measurement units, measurement of voltage, current, frequency, impedance, noise, loading errors, resolution and threshold tests. Calibration, dynamic tests, environmental test, life test Application of transducer; displacement, velocity, acceleration, force, stress, strain, pressure and temperature measurement, Angular and linear encoders, Radar, laser.

Section - D

Basic Principle of Bio-medical instruments, problem for interfacing, bio-medical, electric and electronic equipments with living system, Measuring instruments for bio-signals (ECG, EMG, EEG), Bio-medical transducer for pressure, flow and temperature measurement, Bio-sensors, Bio-magnetic measurement & imaging, cardiac output measurement techniques. Diagnostic and Therapeutic instruments

REFERENCE BOOKS:

1. D.V.S. Murti, Transducers & Instrumentation', PHI.
2. E.O. Deoblin, 'Electronics Instrumentation & Measurement; Mc. Graw Hill.
3. Handbook of Biomedical Instrumentation – By R.S. Khandpur.
4. Medical Instrumentation Application and designed; Houghton Miffin. Co. Boston by John G. Webster.
5. A.K. Sawhney, 'Electrical & Electronics Measurement & Instrumentation', Dhanpat Rai & Co. (P) Ltd.
6. Introduction to Bio-medical equipment Technology-Carr: Pearson Education Bio-Medical Instrumentation-Khandpur: TMH Publication.

FACTS & HVDC

MTEE203
L-T-P
3-1-0

Sessional Marks: 50
Theory paper Marks: 100
Total Marks: 150
Exam. Duration: 3 Hrs.

NOTE: Examiner will set 9 questions in total, with two questions from each section and one question covering all sections which will be Q.1. This Q.1 is compulsory and of short answers type. Each question carries equal mark (20 marks). Students have to attempt 5 questions in total at least one question from each section.

Section - A

Introduction:- to FACTS Technology and its objectives, basic types of FACTS Controllers, FACTS Devices such as STATCOM, SSG, SVC, TCR, TSC, SVG, SVS, TCPST, IPC, TCVL, TCVR, TSSR, TCSR, TSSC, TCBR.

Section - B

Series Compensation: - Concept of series compensation, applications, Improving transient stability, Power oscillation damping, series compensators like CSE, TCSC and SSSC, Combined Compensators [UPFC] and Phase Shifters devices such as SPS, TCPAR.

Section - C

Shunt Compensation: - Principles of operation control schemes and the characteristics of shunt compensation, FACTS devices like SVC, STATCOM, SMES.

Section - D

HVDC: Comparison of AC and DC transmission, Application of DC transmission, Planning of HVDC transmission ,Configuration of DC Transmission Links, Rectifying and Inverting, Circuit Components, Types of Configuration Links, Parallel Operation AC & DC Systems, In Perspective: HVDC or FACTS.

TEXT BOOKS:

1. Electric Power Generation, Transmission and Distribution by S. N. Singh: PHI publication.
2. Understanding FACTS by N G Higorani & L Gyuggi: Standard Publication Distribution
3. Flexible AC Transmission Systems (FACTS), Y.H. Song (JEEE Series).
4. EW Kimbark, “Direct Current Transmission”, Vol. I, Wiley Inter Science.

REFERENCE BOOKS:

1. Modeling Power System components by Murty : B. S. Publication
2. Power System Stability & Control by Anderson – Fuaod: Galgitia Publication
3. SSR in Power System by Anderson, Agrawal & Vanness: IEEE press
4. Thyristor Based FACTS Controller for Electric Transmission Systems-R Mathur & P.K Verma, IEEE Press (Wiley)

POWER SYSTEM DYNAMICS & STABILITY

MTEE204
L-T-P
3-1-0

Sessional Marks: 50
Theory paper Marks: 100
Total Marks: 150
Exam. Duration: 3 Hrs.

NOTE: Examiner will set 9 questions in total, with two questions from each section and one question covering all sections which will be Q.1. This Q.1 is compulsory and of short answers type. Each question carries equal mark (20 marks). Students have to attempt 5 questions in total at least one question from each section.

Section - A

Introduction Basic Concepts, Definitions and Classification of Power System Stability Voltage stability: Basic concepts related to voltage stability, voltage collapse, voltage stability analysis – static and dynamic analysis, the continuation power flow analysis, prevention of voltage collapse.

Section - B

Transient stability: Equal area criterion, numerical integration methods, simulation of power system dynamic response, direct methods of transient stability analysis – description of transient energy function approach, limitations of the direct methods. Methods of improving transient stability. Digital simulation of transient stability: Swing equation, Machine equation.

Section - C

Synchronous machine modeling for stability studies: Basic equations of a synchronous machine, the dq0 transformation, per unit representation, equivalent circuits for direct and quadrature axes, steady state analysis, transient performance, magnetic saturation`, equations of motion, swing equation, constant flux linkage model.
Excitation Systems : Rotating Self-excited Exciter with direct acting Rheostatic type, voltage regulator – Rotating main and Pilot Exciters with Indirect Acting Rheostatic Type Voltage Regulator.

Section - D

Rotating Main Exciter, Rotating Amplifier and Static Voltage Regulator, Static excitation scheme, Brushless excitation system.
Effect of governor action and exciter on power system stability. Effect of saturation, saliency & automatic voltage regulators on stability.

TEXT/REFERENCE BOOKS:

1. Power System Stability by Kimbark Vol. I&II, III – 1968, Dover Publication Inc, New York 1968.
2. Power System control and stability by Anderson and Fund, Vol – I, P.M.Arolerson&A.A.fouad, Galgotia Publications 3B/12, Uttarimarg Rajunder Nagar, New Delhi – 110060, 1981, 1 st edition.
3. Power System Dynamics Stability and Control by K.R.Padiyar, Second edition B.S.Publications 2002.
4. Computer Applications to Power Systems–Glenn.W.Stagg&Ahmed. H.El.Abiad
5. Power Systems Analysis & Stability – S.S.VadheraKhanna Publishers.
6. Power System Analysis by "HadiSaadat" – Tata McGraw Hill Publications
7. Power System Analysis by John J.Graniger William D.Stevenson. JR. – Tata McGraw

COMPUTER COMMUNICATION AND NETWORKING

MTEE205 **Sessional Marks: 50**
L-T-P **Theory paper Marks: 100**
3-1-0 **Total Marks: 150**
Exam. Duration: 3 Hrs.

NOTE: Examiner will set 9 questions in total, with two questions from each section and one question covering all sections which will be Q.1. This Q.1 is compulsory and of short answers type. Each question carries equal mark (20 marks). Students have to attempt 5 questions in total at least one question from each section.

Section A

Data communication: Introduction to data communication.Concept of analog and digital signals. Bandwidth. Transmissionmedia. Wired and wireless connectivity. FDM, TDM and CDMA.Circuit and packet switching. Frame relay and ATM switching.ISDN. Basics of OSI and TCP/IP referencemodels. Example architecture of other reference models.

Section B

Network protocols: Local area network protocols. IEEEstandards for LAN. Fibre optic networks. Satellite networks. Datalink layer design issues: its functions and protocol Internet protocol. Routing algorithms.Congestion control algorithms. IP addressing schemes. Internetworking and sub-netting.

Section C

Transport and application layer: Transport and applicationlayer design issues. Connection management. Transport protocolon top of X.25. File transfer and access management.

Section D

Modelling and Analysis: Modelling and Analysis of ComputerCommunication Networks: Pure Birth and Birth-Death Process.Bernoulli Trials-Markov Chains PoissonProcess.CalculationofDelay-Little's Formula, Burke's Theorem. Queueing Models: M/M/1, M/M/1/N, M/M/S, M/M/S/N queues. Imbedded MarkovChains-M/G/1 queue. Network layout and reliability considerations.

Text Books

1. Stallings, "Data communication & Networking", PHI
2. Tanenbaum, "Computer Networks", PHI

References Books:

1. Jeremiah F. Hayes: Modelling and Analysis of Computer Communication Networks, PHI
2. Forouzan, "Data communications and networking", TMH
3. Godbole, "Data communications and network", TMH

POWER SYSTEM SIMULATION LAB

MTEE206 **Sessional Marks: 50**
L-T-P **Theory paper Marks: 100**
3-1-0 **Total Marks: 150**
Exam. Duration: 3 Hrs

NOTE:
Ten experiments are to be performed, out of which at least seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & setup by the concerned institution as per the scope of the syllabus.

1. TO COMPUTES R, L, AND C IN PER UNIT LENGTH FROM THE ABCD
2. TO CALCULATE BALANCED THREE PHASE FAULT
3. TO PLOT THE LOAD CYCLE OF A GIVEN INTERVAL
4. TO PLOT ONE MACHINE SYSTEM SWING CURVE.
5. TO ANALYSE FAST DECOUPLED METHOD
6. TO ANALYSE ITERATIVE SOLUTION USING NEWTON METHOD
7. TO CHECK L-G FAULT.
8. NEWTON RAPHSON METHOD
9. TO ANALYSE POWER PERTURBATION METHOD
10. TO SOLVE THE SWING EQUATION OF A SYSTEM WHEN SUBJECTD TO
11. THREE PHASE FAULT.
12. TO CALCULATE BUS ADMITTANCE MATRIX

ENERGY AUDIT IN POWER DISTRIBUTION SYSTEMS (ELECTIVE-I)

MTEE301A **Sessional Marks: 50**
L-T-P **Theory paper Marks: 100**
3-1-0 **Total Marks: 150**
Exam. Duration: 3 Hrs.

NOTE: Examiner will set 9 questions in total, with two questions from each section and one question covering all sections which will be Q.1. This Q.1 is compulsory and of short answers type. Each question carries equal mark (20 marks). Students have to attempt 5 questions in total at least one question from each section.

Section-A

Introduction to the power distribution system: Description of the power distribution system- voltage levels, conductors & HVDS, Components of the distribution system- Substation, Transformer, feeders, meters for measurement of energy & other electrical quantities, distribution system planning, operation & maintenance objectives, activities involved in O&M, grid management, load scheduling & dispatch, load balancing, 66-33/11 KV substation equipment, 11/0.4 KV substation equipment, distribution line equipment- overhead lines & underground cables, Distribution transformers- reasons for DT failures , transformer testing.

Section -B

Energy Accounting & Energy Audit: Need for energy accounting, objectives & functions of energy accounting, Energy flow diagram in power distribution system, energy accounting procedure- Energy measurement, special cases & cautions in measurements, problems in energy accounting & overcoming these problems in energy accounting, information technology interventions for energy accounting, Definition, need and types of energy audit, energy audit instruments, Evaluating of energy conservation opportunities, procedure for conducting an energy audit, final energy audit report.

Section -C

AT&C Loss Reduction & Efficiency Improvement: Concepts and principles of distribution losses transmission & distribution losses, AT&C losses in power distribution network, factors contributing to high technical & commercial losses. Technical loss reduction- Short term measures for technical loss reduction, long term plans for technical loss reduction, acceptable technical loss levels, Commercial loss reduction- reasons for commercial losses, measures for commercial loss reduction, legal measures, Metering & Billing system- Metering technologies & techniques, metering standards, calibration & testing of energy meters, revenue protection & technology interventions in metering, billing and collection.

Section-D

Demand side management: An introduction, Why DSM?, Benefits of DSM, DSM in power systems: load management, DSM techniques and emerging trends, EC Act 2001, Electricity regulatory commissions & DSM, DSM on consumer side – the industrial sector, the agricultural sector, the domestic & commercial sectors, ESCO-a route for DSM, issues in DSM implementation.

TEXT BOOKS:

1. Handbook of Energy Engineering, The Fairmont Press, INC.-Albert Thumann & Paul Mehta.
2. Energy Management Supply & Conservation, Butterworth Heinemann, 2002-dr. Clive Beggs.

REFERENCE BOOKS:

Hand book on energy audit & environment management by ISBN 81-1993.0920 TERI

ELECTRICAL POWER QUALITY (ELECTIVE-I)

MTEE301B **Sessional Marks: 50**
L-T-P **Theory paper Marks: 100**
3-1-0 **Total Marks: 150**
Exam. Duration: 3 Hrs.

NOTE: Examiner will set 9 questions in total, with two questions from each section and one question covering all sections which will be Q.1. This Q.1 is compulsory and of short answers type. Each question carries equal mark (20 marks). Students have to attempt 5 questions in total at least one question from each section.

Section -A

Introduction to Electrical Power Quality: Power Quality, Concern in Power System, Power Quality Issues, Standards of Power Quality.

Voltage Sags and Interruptions: Sources of Sags and Interruptions, Fundamental Principles of Protection, Solutions at End User Level, Comparison of Different Ride-Through Alternatives.

Section -B

Transient Overvoltages: Sources of Transient Overvoltages, Principles of Overvoltage Protection, Devices for Overvoltage Protection, Strategies for Utility System Lightning Protection, Switching Transient Problems with Loads.

Harmonics: Harmonics Distortion, Power System Quantities under Nonsinusoidal Conditions, Harmonic Indices, Harmonics Sources from Commercial and Industrial Loads, Effects of Harmonic Distortion on Power System Equipments.

Section - C

Wiring and Grounding: Reasons for Grounding, Typical Wiring and Grounding Problems, Solutions to wiring and Grounding Problems.

Power Quality Monitoring and Evaluation: Power Quality Monitoring and its Objective, Power Quality Measurement Equipments, Power Quality Evaluation, Different Power Quality Indices used in Power Quality Evaluation.

Section - D

Power Quality Conditioners: Passive Filters, Active Filters, Hybrid Filters, STATCOM, DSTATCOM, DVR, UPQC.

Distributed Generation and Power Quality: Distributed Generation and its Advantages and Disadvantages, Different Distributed Generation Technologies, Different Interfacing Electrical Systems, Power Quality Issues in Distributed Generation.

TEXT BOOKS:

1. Electric Power Systems Quality : R.C. Dugan, M. F. McGranaghan and H.W. Beaty, McGraw-Hill.

REFERENCE BOOKS:

1. Power System Harmonics: J. Arrillaga, D.A. Bradely and P.S. Bodger, Wiley.
2. Electric Power Quality: G.T. Heydt, Stars in a Circle.
3. Embedded Generation: N. Jenkins, R. Allan, P. Crossley, D. Kirschan and G. Strbac, IEEE Power and Energy Series.
4. Power Quality: C. Sankaran, CRC press.
5. IEEE Recommended Practices and Requirements for Harmonic Control in Electric Power Systems, IEEE Std. 519, 1992.
6. IEEE Recommended Practices on Monitoring Electric Power Quality, IEEE Std.1159, 1995.

SMART GRID (ELECTIVE – III)

MTEE301C
L-T-P
3-1-0

Sessional Marks: 50
Theory paper Marks: 100
Total Marks: 150
Exam. Duration: 3 Hrs.

NOTE: Examiner will set 9 questions in total, with two questions from each section and one question covering all sections which will be Q.1. This Q.1 is compulsory and of short answers type. Each question carries equal mark (20 marks). Students have to attempt 5 questions in total at least one question from each section.

Section - A

Introduction: Concept of smart grid, smart grid control, Communications and Sensing in a Smart Grid, Hardware Architecture, Software architecture, Protocol detail, Discrete control and Analog control, application & benefits, PLCs Vs RTUs, IED's, RTU Block diagram, PMU communication interface, Future trends.

Section - B

Cyber Security of the Smart Grid: Smart Grid Threats, Vulnerabilities and Cyber Security Strategies, Cyber Security Environment, False Data Injection and Attacks in Electric Power Grids Cyber-Physical System Security.

Section - C

Smart Grid Technologies: Energy Management System, Demand side management: peak clipping, valley filling, load shifting etc. ,state estimation, load forecasting.

Section - D

Distributed Generation & Control: Concept of distribution generation, introduction of various distributed generation sources, e.g. Wind, solar, fuel-cell, micro-hydro, PHEV's etc. Grid integration and control of distributed sources**.**

TEXT BOOKS:

1. T. Gönen, Electric Power Distribution System Engineering, McGraw-Hill, 1986..
2. Distribution System Protection Manual, McGraw-Edison Power Systems, 1990.
3. Westinghouse Electric Utility Ref. Book, Vol.3, Distribution Systems, 1965.
4. R. E. Brown, Electric Power Distribution Reliability, Marcel Dekker Inc., 2002.

REFERENCE BOOKS:

1. IEEE Power and Energy Magazine, July/August 2007 Issue
2. James Burke, Power Distribution Engineering, Mercel Dekker, 1994. ISBN: 0-8247-9237-8.
3. A.J. Pansini, Electrical Distribution Engineering McGrawHill, 1983.
4. E. Lakervi, E.J.Holmes, Electricity Distribution Network Design, IEE series, 1989.
5. J. Gers and E. J. Holmes Protection of Electricity Distribution Networks 2nd Edition,

POWER SYSTEM RELIABILITY (ELECTIVE - II)

MTEE302A
L-T-P
3-1-0

Sessional Marks: 50
Theory paper Marks: 100
Total Marks: 150
Exam. Duration: 3 Hrs.

NOTE: Examiner will set 9 questions in total, with two questions from each section and one question covering all sections which will be Q.1. This Q.1 is compulsory and of short answers type. Each question carries equal mark (20 marks). Students have to attempt 5 questions in total at least one question from each section.

Section - A

Introduction: Definition of reliability, types of failures, definition and factors influencing system effectiveness, various parameters of system effectiveness, laws of probability, conditional probability, Bay's theorem; various distributions; data collection, recovery of data, data analysis Procedures, empirical reliability calculations.

Section - B

Reliability Mathematics: Types of system- series, parallel, series parallel, stand by and complex; development of logic diagram, methods of reliability evaluation; cut set and tie-set methods, matrix methods event trees and fault trees methods, reliability evaluation using probability distributions, Markov method, frequency and duration method.

Section - C

Reliability of Generation and transmission System: Generating system model, Loss of Load, Loss of Energy, Scheduled outage, Load forecast uncertainty, Transmission system model, Network configurations, state selection, System and load point indices, Numerical evaluation, Application to practical interconnected transmission system.

Section - D

Reliability of Distribution System: Reliability evaluation of distribution system, various interruption indices: customer-oriented indices, Load and energy oriented indices, system performance, system prediction, Application to radial distribution system, Effects of disconnects, Effect of protection failures, Effects of transferring loads.

Text Books:

1. R. Billintan & R.N. Allan," Reliability Evaluation of Engineering and Systems", Plenum Press.
2. S.K. Sinha & B.K. Kale, "Life Testing and Reliability Estimation", Wiely Eastern Ltd.

Reference Books:

1. K.C. Kapoor & L.R. Lamberson, "Reliability in Engineering and Design", John Wiely and Sons.
2. M.L. Shooman, "Probabilistic Reliability, An Engineering Approach", McGraw Hill.
3. L.S. Srinath, Reliability Engineering, Affiliated East-West Press, New Delhi.
4. A.K.Govil, Reliability Engineering, Tata Mc-Graw Hill, New Delhi

POWER SYSTEM OPERATION AND CONTROL (ELECTIVE –II)

MTEE302B
L-T-P
3-1-0

Sessional Marks: 50
Theory paper Marks: 100
Total Marks: 150
Exam. Duration: 3 Hrs.

NOTE: Examiner will set 9 questions in total, with two questions from each section and one question covering all sections which will be Q.1. This Q.1 is compulsory and of short answers type. Each question carries equal mark (20 marks). Students have to attempt 5 questions in total at least one question from each section.

Section - A

Unit commitment problem : Introductions to UCP, thermal & Hydral constraints in Unit commitment : Priority list scheme method, unit commitment problem solution by priority list scheme method, Unit commitment problem solutions by Dynamic programming Approach. Introduction, advantages of DP method over priority list scheme, Back word DP approach, forward DP approach algorithm and their flow charts solution UCP using Dynamic program method.

Section - B

Load Frequency Control-I : Necessity of keeping frequency constant. Definition of control area, single area control, Block diagram representation of an isolated Power System, Steady State analysis, Dynamic response-Uncontrolled case.

Load Frequency Control-II : Load frequency control of 2-area system : uncontrolled case and controlled case, tie-time bias control

Section - C

Proportional plus Integral control of single area and its block diagram representation, steady state response, load frequency control and Economic dispatch control. Optimal LF control-steady state representation, performance Index and optimal parameter adjustment.

Section - D

Generation with limited Energy supply : Take-or-pay fuel supply contract, composite generation production cost function. Solution by gradient search techniques, Hard limits and slack variables, Fuel scheduling by linear programming.

Interchange Evaluation and Power Pools Economy Interchange, Economy interchange Evaluation, Interchange Evaluation with unit commitment, Multiple Interchange contracts.

REFERENCE BOOKS

1. Electrical Energy Systems Theory - by O.I.Elgerd, Tata McGraw-Hill Publishing Company Ltd, 2nd edition.
2. Power System Analysis by HadiSaadat – Tata McGraw Hill Publications
3. Power Generation, Operation and Control - by A.J.Wood and B.F.Wollenberg,Johnwiley& sons Inc. 19844. Modern Power System Analysis - by I.J.Nagrath&D.P.Kothari, Tata McGraw-Hill Publishing Company ltd, 2nd edition.

RESTRUCTURED ELECTRIC POWER SYSTEM (ELECTIVE - II)

MTEE302C
L-T-P
3-1-0

Sessional Marks: 50
Theory paper Marks: 100
Total Marks: 150
Exam. Duration: 3 Hrs.

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NOTE: Examiner will set 9 questions in total, with two questions from each section and one question covering all sections which will be Q.1. This Q.1 is compulsory and of short answers type. Each question carries equal mark (20 marks). Students have to attempt 5 questions in total at least one question from each section.

Section - A

Fundamentals of Deregulation: Privatization and Deregulation, Motivations for Restructuring the Power Industry, Power System Restructuring Models and Trading Arrangements: Models based on energy trading, Models based on contracting arrangements, Role of ISO: Functions & Responsibilities, ISO Models, Bidding & Auction Mechanisms.

Section - B

Transmission Open Access: Deregulation in Asia including India, Forward and Future market, Operation and Control: Old v/s New, Electricity Act 2003 and its impact on ESI in India, Concept of ATC, its principles and factors affecting ATC, Determination of ATC. Market Power and its effects, Types of market power, Causes of market power, Analysis of market power, and Integration of market power.

Section - C

Transmission Pricing and Congestion management: Power trading, Transmission pricing in Openaccess Systems: Rolled-in Pricing Methods, Incremental (Marginal) Pricing Methods, Embedded Cost Recovery, Congestion Management in Deregulated Power Market, and its Impact on Marginal Price, Inter and Intra Zonal congestion management.

Section - D

Ancillary Services in Restructured Power Market: Wheeling charges, Wheeling methodologies, Ancillary Services and its types such as Voltage support, Energy imbalance services, Operating resource services, Black Start Capability services, Scheduling and dispatch services.

TEXT BOOKS:

1. Lei Lee Lal, *Power System Restructuring and Deregulation*. UK: John Wiley and Sons, 2001.
2. Kankar Bhattacharya, Math H.J.Bollen and Jaap E. Daalder, *Operation of Restructured Power*
Systems. USA: Kluwer Academic Publishers, 2001.
3. Md. Shahidehpour and Muwaffaq Alomoush, *Restructured Electrical Power Systems*. Marcel
Dekker, Inc.
4. Overview of Power Sector in India 2005: Indian Core Publishing.
5. Power Systems Engineering by S. K. Gupta, Umesh Publication.

SEMINAR

MTEE303 **Sessional Marks: 50**
L-T-P **Theory paper Marks: 50**
3-1-0 **Total Marks: 100**

Seminar shall be based on tentative topic on dissertation such as review paper on some specific well defined area/specialized stream of electrical engineering. Each student has to prepare a write up of about 25 pages of "A4" size sheets and submit it in duplicate as the term work.

The student has to deliver a seminar talk in-front of faculty members of the department and his classmates. The faculty members, based on the quality of the work and preparation and understanding of the candidate, shall do an assessment of the seminar internally-jointly. Some marks should be reserved for the attendance of the student in the seminars of the others students.

DISSERTATION - PHASE I

MTEE304 **Sessional Marks: 50**
L-T-P **P/Viva Marks: 100**
0-0-4 **Total Marks: 150**

The term work under this, submitted by the student shall include-

1. Work diary maintained by the student and counter signed by his guide.
2. The contents of work diary shall reflect the efforts taken by candidate for
(a) Searching the suitable project work
(b) Visit to different factories or organizations
(c) Brief report of journals and various papers referred
(d) Brief report of web sites seen for project work
(e) The brief of feasibility studies carried to come to final conclusion
(f) Rough sketches
(g) Design calculation etc. carried by the student

The student has to make a presentation in front of experts in addition to guide as decided by department head.

DISSERTATION- FINAL PHASE

MTEE401
L-T-P
0-0-20

Sessional Marks: 200
P/Viva Marks:400
Total Marks:600

The dissertation submitted by the student on topic already approved by university authorities on the basis of initial synopsis submitted by the candidate shall be according to following guidelines Format of dissertation report.
The dissertation work report shall be typed with double space on A4 bond paper. The total number of pages not more than 150 and not less than 60. Figures, graphs, annexure etc. be added as per requirement. The report should be written in the following format:

1 Title sheet
2 Certificate
3 Acknowledgement
4 List of figures/ photographs/ graphs/ tables
5 Abbreviations
6 Abstract/ final synopsis
7 Contents
8 Text with usual scheme of chapters
9 Discussion of the results and conclusion
10 Bibliography (The source of illustrative matter should be acknowledge clearly at appropriate place.