DEENBANDHU CHHOTU RAM UNIVERSITY OF SCIENCE & TECHNOLOGY, MURTHAL (SONIPAT)-131039
SCHEME OF STUDIES & EXAMINATIONS FOR
M. Tech. in Electrical Engineering (Power Systems)
(Effective from 2012-13)
Scheme of Course

SEMESTER – I

S. No	Course No.	Course Title	Marks						
			L	P	Sessional	Exam	Total	Credit	Duration of Exam
1.	MPS501B	Electric Power Quality	4	-	25	75	100	4	3
2.	MPS503B	Power System Control and Instrumentation	4	-	25	75	100	4	3
3.	MPS505B	Advanced Power System Analysis	4	-	25	75	100	4	3
4.	MPS507 B	General Aspects of Energy management & Energy Efficiency	4	-	25	75	100	4	3
5.	MPS509B	FACTS & HVDC	4	-	25	75	100	4	3
6.	MPS513B	Power System Hardware Lab	-	3	20	30	50	1.5	-
	Total		20	3	145	505	650	21.5	-

NOTE:

1. **The students in the examination will be allowed to use only non-programmable scientific calculator. However, sharing/exchange of calculator is prohibited in the examination.**
2. **Electronics gadgets including cellular phones are not allowed in the examination.**

II Semester

S. No	Course No.	Course Title	Marks						
			L	P	Sessional	Exam	Total	Credit	Duration of Exam
1.	MPS502B	Restructured Electric Power System	4	-	25	75	100	4	3
2.	MPS504B	Advanced in Switch Gear & Protection	4	-	25	75	100	4	3
3.	MPS506B	Energy Audit in Power Distribution System	4	-	25	75	100	4	3
4.	MPS508B	Electric Drives & Control	4	-	25	75	100	4	3
5.	MPS518B	Power System Control & Dynamics	4	-	25	75	100	4	3
6.	MPS516B	Power System Software Lab	-	3	20	30	50	1.5	-
	Total		20	3	145	505	650	21.5	

NOTE:

1. **The students in the examination will be allowed to use only non-programmable scientific calculator. However, sharing/exchange of calculator is prohibited in the examination.**
2. **Electronics gadgets including cellular phones are not allowed in the examination.**

(Effective from 2013-14)

III Semester

S. No	Course No.	Course Title	Marks						
			L	P	Sessional	Exam	Total	Credit	Duration of Exam
1.	MPS601B	Intelligent Methods in Power Systems	4	-	25	75	100	4	3
2.	MPS603B	Sustainable sources of Energy	4	-	25	75	100	4	3
3.	MPS605B	Smart Grid	4	-	25	75	100	4	3
4.	MPS 6B	Elective	4	-	25	75	100	4	3
5.	MPS607B	Seminar	-	2	50	-	50	1	-
6.	MPS609B	Dissertation (Phase –I)	-	6	100	-	100	6	-
	Total		16	4	250	300	550	23	

NOTE:

1. **The students in the examination will be allowed to use only non-programmable scientific calculator. However, sharing/exchange of calculator is prohibited in the examination.**
2. **Electronics gadgets including cellular phones are not allowed in the examination.**

IV Semester

S. No.	Course No	Course Title	Marks					
			L	P	Sessional	Exam	Total	Credit
1.	MPS602B	Dissertation	-	20	50	100	150	20
	Total		-	20	50	100	150	20

NOTE:

List of Elective

Course No.		Course No.	
MIC619B	BIOMEDICAL INSTRUMENTATION	MIC611B	GENETIC ALGORITHMS BASED OPTIMIZATION
MPS631B	HIGH VOLTAGE ENGINEERING	MIC613B	ROBOTICS & AUTOMATION ENGINEERING
MPS633B	POWER SYSTEM RELIABILITY	MIC617B	BIO-INSPIRED OPTIMIZATION TECHNIQUES

MPS501B **ELECTRICAL POWER QUALITY**

M. TECH. ELECTRICAL ENGINEERING (POWER SYSTEMS) SEMESTER-I

L	T	P	Credits
4	-	-	4

Class Work Marks	:	25 marks
Exam Marks	:	75 marks
Total Marks	:	100 marks
Duration of Exam.	:	3 hours

Description & Objectives: This subject aims to introduce to students to give detailed knowledge of Electrical Power Quality, Phenomenon, Monitoring, evaluation and solutions to power quality problems. The main objective of the subject is to learn the issues in Electrical Power Quality, Monitoring, evaluation and solutions to power quality problems.

Outcomes: This course is assessed through assignments, surprise tests, Quiz tests, minor tests & main examination. The students get aware about Electrical power quality and their application. The students get excellent technical expertise of Electrical power quality, and being able to apply the knowledge to practical industry systems and appliances.

UNIT- I

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.

UNIT- II

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.

UNIT- III

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.

UNIT- IV

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.

NOTE:

In the semester examination, the examiner will set eight questions in all selecting two from each unit. The candidates will be required to attempt five questions in all selecting at least one from each unit. All questions carry equal marks.

MPS505B ADVANCED COMPUTER POWER SYSTEM ANALYSIS
M.TECH. ELECTRICAL ENGINEERING (POWER SYSTEMS) SEMESTER-I

L	T	P	Credits
4	-	-	4

Class Work Marks	:	25 marks
Exam Marks	:	75 marks
Total Marks	:	100 marks
Duration of Exam.	:	3 hours

Description & Objectives: The practical power system network is very large and complex. It is not possible to analyze the system under normal and under fault condition by hand calculation. This course has been designed to extend the power of computer in the solution of power system problems and analysis. The students shall be able to represent the power system network to be understood by computer for steady state or dynamic analysis.

Outcomes: This course is assessed through assignments, surprise tests, Quiz tests, minor tests & main examination. The student shall be able to represent the Power System network to be understood by computer and any steady state or dynamic analysis with the latest applications. The students are able to analyze power system problem with digital techniques. The students are able to understand the concepts of computer applications in load flow studies and fault analysis in power systems.

Unit- I

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

Unit-II

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.

Unit-III

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.

Unit- IV

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.

Note:
In the semester examination, the examiner will set eight questions in all selecting two from each unit. The candidates will be required to attempt five questions in all selecting at least one from each unit. All questions carry equal marks.

MPS507B GENERAL ASPECTS OF ENERGY MANAGEMENT AND ENERGY EFFICIENCY
M.TECH. ELECTRICAL ENGINEERING (POWER SYSTEMS) SEMESTER-I

L	T	P	Credits
4	-	-	4

Class Work Marks	:	25 marks
Exam Marks	:	75 marks
Total Marks	:	100 marks
Duration of Exam.	:	3 hours

Description & Objectives: The objective of this course is to make the students familiar with the fundamental concepts of energy & environment, energy management & energy efficiency in thermal & electrical utilities so as to deal with the saving & conservation of energy & minimizing energy losses in an effective manner.

Outcomes: This course is assessed through assignments, surprise tests, Quiz tests, minor tests & main examination. On completion of this course, students will be able to learn the fundamental concepts of energy management & energy efficiency in thermal & electrical utilities and apply these energy efficient & financial techniques in the industries, commercial buildings, educational institutes etc. to minimize energy losses.

Unit- I

Energy Scenario & Environmental Concerns: Commercial and Non-commercial energy, primary energy resources, Indian energy scenario, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment, energy security, energy conservation and its importance, energy strategy for the future, Global environmental issues, ozone layer depletion, global warming, loss of bio-diversity, climate change problem & response. Electrical energy & thermal energy basics, Material and Energy balance**:** basic Principle, Sankey diagram & its use, methods for preparing process flow, material and energy balance diagrams.

Unit-II

Financial & Project Management: Investment-need, appraisal and criteria, financial analysis techniques-simple payback period, return on investment, net present value, internal rate of return, cash flows, risk and sensitivity analysis; financing options, energy performance contracts and role of ESCOs. Definition & scope of project, steps in project management, Project planning techniques: Gantt chart, CPM & PERT, Defining Energy monitoring & targeting, elements of monitoring & targeting system.

Unit- III

Energy Efficiency in Electrical Utilities: Introduction to electric power supply systems, electricity billing, load management & maximum demand control, power factor improvement & benefits, energy performance assessment of motors, basic terms in lighting system & features, Procedure for assessment of Lighting systems, Methodology of lighting system energy efficiency study, Energy efficient technologies in Electrical systems**:** Maximum demand controllers, automatic power factor controllers, energy efficient motors & transformers, soft starter, variable speed drives, electronic ballasts, energy efficient lighting controls.

Unit-IV

Energy Efficiency in Thermal Utilities: Properties of Fuel oil, Coal & Gas, Principles of Combustion**,** Boiler systems, performance evaluation of boilers, energy conservation opportunities in Boiler systems, Furnaces, Performance Evaluation of a furnace, energy efficiency measures in furnaces insulation & refractories, heat loss calculations, Need for Cogeneration, principle of cogeneration, introduction to waste heat recovery.

TEXT BOOKS:

1. Guide Book for National Certification for Energy Managers & Energy Auditors.

REFERENCE BOOKS:

1. Energy Management by W.R. Murphy & G Mc Kay: OSCAR
2. Solution for energy security & Facility Management Challenges by Wells: TBI Pub
3. Sustainable Energy Choosing among options by Tester: PHI
4. Combustion Engineering & Fuel Technology, Oxford & IBH Publishing Company A.K. Shaha

Hand book on refractories by D N Nandi, Tata McGraw-Hill Publishing Company Limited, New Delhi.

Note: In the semester examination, the examiner will set eight questions in all selecting two from each unit. The candidates will be required to attempt five questions in all selecting at least one from each unit. All questions carry equal marks.

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MPS509B **FACTS & HVDC**

M.TECH. ELECTRICAL ENGINEERING (POWER SYSTEMS) SEMESTER-I

L	T	P	Credits
4	-	-	4

Class Work Marks	:	25 marks
Exam Marks	:	75 marks
Total Marks	:	100 marks
Duration of Exam.	:	3 hours

Description & Objectives: - FACTS (Flexible AC Transmission System) and HVDC (High Voltage Direct Current) are controllable devices whose functions are to enhance the security, capacity and flexibility of power transmission systems. Application of these components in power systems implies an improvement of transient and voltage stability, power oscillation damping and optimal power flow. Also, issues (or problems) that an electric power system may face will be discussed. Then, it will be shown that FACTS and HVDC systems may be a technical solution to these issues. It will be also discussed how these components are designed and what functions they have. Then basic mathematical models and control strategies will be presented for these components to analyze their impact on power system stability and power oscillation damping, which is the main objective of this course.

Outcomes: **Upon completion of the course the student should be able to**

- **describe how FACTS and HVDC are designed,**
- **explain and analyze their functions,**
- **derive basic mathematical models for these components,**
- **analyze the impact of these components on power system stability,**
- **perform calculations on different control strategies for these devices**

unit- I

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.

Unit-II

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.

Unit-III

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

Unit-IV

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)

Note:

In the semester examination, the examiner will set eight questions in all selecting two from each unit. The candidates will be required to attempt five questions in all selecting at least one from each unit. All questions carry equal marks

MPS513B **POWER SYSTEM HARDWARE LAB**

M.TECH. ELECTRICAL ENGINEERING (POWER SYSTEMS) SEMESTER-I

L	T	P	Credits
-	-	3	1.5

Class Work Marks	:	20 marks
Exam Marks	:	30 marks
Total Marks	:	50 marks
Duration of Exam.	:	3 hours

1. To study on IDMT over current relay. Obtain & plot its current-time characteristics for various plugs setting time multiplier & measure pickup / reset ratio.
2. To plot operating Characteristics of percentage differential relay.
3. To plot operating Characteristics of under voltage relay.
4. To plot operating Characteristics of over voltage relay.
5. To plot operating Characteristics of Negative sequence relay.
6. To Measure ABCD parameters of a transmission line model using the defining relations.
7. To determine the dielectric strength of a given transformer oil with the help of standard testing equipments.
8. To determine equivalent circuit parameters of three phase, three winding transformer, by open circuit & short circuit test.
9. To study performance of transmission line under different loads.
10. To study three phase fault.
11. To study fault location in a cable by Murray Loop Test.
12. To study C.T. testing by comparison method.
13. To study P.T. testing by comparison method.

Experiments may be selected as per the theory courses including testing calibration of equipment and other leading to R & D and Consultancy work.

Syllabi for II-Semester Courses

MPS502B **RESTRUCTURED ELECTRIC POWER SYSTEM**
M. TECH. ELECTRICAL ENGINEERING (POWER SYSTEMS) SEMESTER-II

L	T	P	Credits
4	-	-	4

Class Work Marks	: 25 marks
Exam Marks	: 75 marks
Total Marks	: 100 marks
Duration of Exam.	: 3 hours

Description & Objectives: The fundamental operating functions of a deregulated power system are presented. Unbundling of these functions and cost allocations are discussed. Topics of ancillary services, power marketing, transmission pricing are covered. The objectives of this course include the following:-

(i) Provide an in-depth coverage of power system operations in the deregulated electricity market environment.

(ii) Present basic principles of power system operation & economics with an emphasis on recent research in this area.

Outcomes: This course is assessed through assignments, surprise tests, Quiz tests, minor tests and main examination. This course will provide students with a solid understanding of the basic engineering and economic terms, issues, and methods of analysis necessary to be successful in electricity markets.

Unit-I

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.

Unit-II

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.

Unit-III

Transmission Pricing and Congestion management: Power trading, Transmission pricing in Open-access 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.

Unit-IV

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

Note:
In the semester examination, the examiner will set eight questions in all selecting two from each unit. The candidates will be required to attempt five questions in all selecting at least one from each unit. All questions carry equal marks
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MPS504B ADVANCED SWITCH GEAR & PROTECTION
M. TECH. ELECTRICAL ENGINEERING (POWER SYSTEMS) SEMESTER-II

L	T	P	Credits
4	-	-	4

Class Work Marks	: 25 marks
Exam Marks	: 75 marks
Total Marks	: 100 marks
Duration of Exam.	: 3 hours

Description & Objectives: The power system networks are growing in size and complexity at very fast rate. It is very important to continuously keep on monitoring various power system parameters and take suitable action accordingly in order to stabilize the power system network. This course work aims to give a brief introduction to power system switchgear and protective equipment. Moreover, it is intended to study the recent advancement in relaying and protection to protect various devices like transformer, generator and transmission lines.

Outcomes: This course shall be assessed through assignments, surprise tests, Quiz tests, minor tests & main examination. The students will learn about the design and development of protecting system for power networks and it will definitely help the students in acquiring the technical expertise in the area of power system switchgear and protection.

Unit-I

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.

Unit-II

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.

Unit-III

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

Unit-IV

Static and Numerical Relays: Classification of static relays, amplitude and phase comparators, and block-spike 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. Digital Protection: Protective relay from Electro Mechanical to Microprocessor by L. P. Singh: Wiley Eastern.
4. A course in Electrical Power by Soni, Gupta and Bhatnagar: Dhanpat Rai & Sons.
6. Power System Engg by I.J. Nagrath and D.P. Kothari :TMH.
7. Power System Engineering by V. K. Mehta.
8. Switchgear and protection by S. S. Rao: Khanna Pub
9. Power Systems Engineering by S. K. Gupta, Umesh Publication

Note:
In the semester examination, the examiner will set eight questions in all selecting two from each unit. The candidates will be required to attempt five questions in all selecting at least one from each unit. All questions carry equal marks
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MTPS506B **ENERGY AUDIT IN POWER DISTRIBUTION SYSTEMS**
M.TECH. ELECTRICAL ENGINEERING (POWER SYSTEMS) SEMESTER-II

L	T	P	Credits
4	-	-	4

Class Work Marks	: 25 marks
Exam Marks	: 75 marks
Total Marks	: 100 marks
Duration of Exam.	: 3 hours

Description & Objectives: The objective of this course is to make the students familiar with the study of components of power distribution system, energy accounting procedure, factors contributing to high technical, commercial & revenue losses in a power distribution company & suggest measures to reduce these losses, demand side management.

Outcomes: This course is assessed through assignments, surprise tests, Quiz tests, minor tests & main examination. On completion of this course, students will be able to understand the energy accounting & energy audit in a power distribution company and apply energy audit & suggest measures for reducing technical, commercial & revenues losses in a power distribution company.

Unit-I

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.

Unit-II

.**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.

Unit-III

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.

Unit-IV

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.

Note: Main examination shall consist of two questions from each unit. One question from each unit is to be attempted by the examinee. In addition one compulsory short answer type question is to be attempted which shall be from the syllabi of all four units.

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

Note:

In the semester examination, the examiner will set eight questions in all selecting two from each unit. The candidates will be required to attempt five questions in all selecting at least one from each unit. All questions carry equal marks

MPS508B **ELECTRIC DRIVES & CONTROL**

M.TECH. ELECTRICAL ENGINEERING (POWER SYSTEMS) SEMESTER-II

L	T	P	Credits
4	-	-	4

Class Work Marks	:	25 marks
Exam Marks	:	75 marks
Total Marks	:	100 marks
Duration of Exam.	:	3 hours

Description & Objectives: This subject aims to introduce to students to give detailed knowledge of transformers and dc machines. The main objective of the subject is to learn the dynamics, control, and application of Electric Drives.

Outcomes: This course is assessed through assignments, surprise tests, Quiz tests, minor tests & main examination. The students get aware about details of Electric Drives and their application. The students get excellent technical expertise of Electric Drives, and being able to apply the knowledge to practical industry systems and appliances.

UNIT-I

Electrical Drives: Introduction, advantages, choice of electrical drives, status of ac and dc drives.

Dynamics of Electrical Drives: Fundamental torque equations, multi-quadrant operation, equivalent values of drive parameters, load torque components, types of loads, steady state stability, load equalization.

Control of Electrical Drives: Modes of operation, closed loop control of drives, sensing of current and speed**.**

UNIT- II

DC Motor Drives: Speed-torque characteristics of different types of dc motors, starting, types of braking, transient analysis, speed control methods, static control of dc motors. Converter fed dc drive & chopper fed dc drive.

UNIT-III

Induction motor Drives: Characteristics, analysis and performance, starting methods, braking methods, transient analysis, methods of speed control, vector control. Static control techniques- stator frequency control, stator voltage control, rotor resistance control. Static Scherbius system & static Kramer system.

UNIT-IV

Selection of motor power rating: Heating and cooling, determination of motor rating, continuous, short time and intermittent duties, determination of moment of inertia of the flywheel.

Traction Drives: Nature of traction load, important features of traction drives, static control of traction drives; comparison between ac and dc tractions.

Note: Main examination shall consist of two questions from each unit. One question from each unit is to attempted by the examinee. In addition one compulsory short answer type question is to be attempted which shall be from the syllabi of all four units.

TEXT BOOKS:

1. Fundamentals of Electrical Drives, G.K.Dubey, Narosa Publishing House

REFERENCE BOOKS:

1. Power Semiconductor controlled drives, G.K.Dubey, Prentice Hall.
2. Electric Drives: V.Subrahmaniyam TMH
3. Electric Drives: Leonard, Narosa Pub.
4. Electric Drives: Diwan

NOTE:

In the semester examination, the examiner will set eight questions in all selecting two from each unit. The candidates will be required to attempt five questions in all selecting at least one from each unit. All questions carry equal marks

MPS518B POWER SYSTEM CONTROL & DYNAMICS

M. TECH. ELECTRICAL ENGINEERING (POWER SYSTEMS) SEMESTER-II

L	T	P	Credits
4	-	-	4

Class Work Marks	: 25 marks
Exam Marks	: 75 marks
Total Marks	: 100 marks
Duration of Exam.	: 3 hours

Description & Objectives: The practical power system network is very large and complex. The demand and supply are continuously need fully changing that causes states of the system in dynamic condition, Power systems control is the area of continuous research for the industry as this improves the operation of power systems through AGC and voltage control and enhancing the capability vis a vis the stability of the system. The aim is to handle such issues after going through this course.

Outcomes: This course is assessed through assignments, surprise tests, Quiz tests, minor tests & main examination. The students are able to tackle frequency & voltage control of the systems. The students are able to handle stability issues and problems associated with and caused by enhancing the capability of the power system using detail analysis. The student shall be able to model the Power System and perform any steady state or dynamic analysis with the latest applications.

Unit-I

Introduction: Dynamic models of synchronous machine, mechanical system, power flow through transmission lines, power transmission capability of line, shunt and series compensation, low frequency oscillation, SSR, torsional oscillation, induction generator effect, counter measure.

Unit-II

Power Frequency Control: Single area load frequency control, load frequency Vs economic control, two area load frequency control, speed governor, dead band, digital load flow control, decentralized control, application to MATLAB.

Unit-III

Excitation Control: Exciters, boost buck excitation system, static excitation system, brushless excitation system, and development of excitation system and transfer function, application of optimal control theory to excitation systems. Application of MATLAB to various excitation system, first bench mark model, second bench mark model, corpals bench mark model, multi machine system, .

Unit-IV

Stability Study: Definitions: angular stability- steady state stability, dynamic stability, transient stability, mechanics of angular momentum, swing equation, synchronizing power coefficient, effect of excitation on stability, steady state stability of an unregulated system, effect of dampers and governor action, steady state stability with automatic voltage regulator, reduction of power system to one machine system, equal area criteria, critical clearing angle, solution of swing equation, stability study in multi-machine system, application of MATLAB, pole place technique, eigen value analysis, energy function approach for stability evolution technique of improving transient stability, Voltage stability, voltage collapse, voltage instability in transmission system, voltage stability angle, V-P and V-Q curves.

Note: Main examination shall consist of two questions from each unit. One question from each unit is to be attempted by the examinee. In addition one compulsory short answer type question is to be attempted which shall be from the syllabi of all four units.

TEXT BOOKS:

1. Power Systems Engineering by S. K. Gupta, Umesh Publication
2. Power system analysis by O I Elgerd: TMH Publication New Delhi
3. Modern Power System by Nagrath Kothari: TMH Publication New Delhi
4. Power system analysis and Stability by S. S. Vadhera: Khanna Publication New Delhi
5. Power system analysis by Hadi Sadat: TMH Publication, New Delhi

REFERENCE BOOKS:

1. Advanced Power System Analysis & Dynamics by L P Singh: Wiley Eastern LTD New Delhi
2. Elements of Power System Analysis by W. D. Stevenson: MGH Publication New Delhi
3. Power System Dynamics by M A Pai: Prentice Hall New Delhi
4. Switch Gear Protection by S S Rao Khanna Publication, New Delhi
5. Control & Instrumentation Technology in HVAC by Michail Hordeski: Fairmont Press
   Electric Power Systems by S L Uppal: Khanna
6. Power System Optimization By Nagarath & Kothari : TMH publication New Delhi
7. Dynamic control of Large Electric Power Systems by ILIC: Tbi pub,

Note:

In the semester examination, the examiner will set eight questions in all selecting two from each unit. The candidates will be required to attempt five questions in all selecting at least one from each unit. All questions carry equal marks

MTPS516B **POWER SYSTEM SOFTWARE LAB**

M.Tech. ELECTRICAL ENGINEERING (POWER SYSTEMS) SEMESTER-II

L	T	P	Credits
-	-	3	1.5

Class Work Marks	:	20 marks
Exam Marks	:	30 marks
Total Marks	:	50 marks
Duration of Exam.	:	3 hours

Study of Softwares such as MATLAB, DigSILENt, LabView etc.

Computer Programes on the following:

1. Formation of Y-bus.
2. Formation of Z-Bus
3. Guass seidel method of Solving power flow equations
4. N-R Method
5. Fast decoupled Method
6. Excitation Control
7. Load frequency control
8. Application of Optimal Control theory
9. Calculation ATC
10. Economic Dispatch
11. Fault Analysis
12. Transient Analysis
13. Stability Analysis.

Syllabi for III-Semester Courses

MPS601B INTELLIGENT METHODS IN POWER SYSTEMS

M.Tech. ELECTRICAL ENGINEERING (POWER SYSTEMS) SEMESTER-III

L	T	P	Credits
4	-	-	4

Class Work Marks	: 25 marks
Exam Marks	: 75 marks
Total Marks	: 100 marks
Duration of Exam.	: 3 hours

Description & Objectives: Soft Computing Techniques (Artificial Neural Networks, Genetic Algorithms, Fuzzy Logic Models,) have become attractive alternatives to the standard, well established "hard computing" paradigms. Soft computing techniques proved to be important practical tools for many contemporary problems. The objective of this course is to make the students familiar with these three techniques so as to deal with the optimization & design problems more effectively & efficiently.

Outcomes: This course is assessed through assignments, surprise tests, Quiz tests, minor tests & main examination. On completion of this course, students will be able to use soft computing techniques in the power systems for optimization problems & to apply these intelligent controllers which can drive complex power system problems with a greater degree of autonomy.

Unit-I

Fuzzy Set Theory: Vagueness, fuzzy logic versus probability theory, crisp sets, defining a fuzzy set, Membership functions, features of the membership functions, Basic Fuzzy set operations, properties of fuzzy sets, crisp relations, fuzzy relations, fuzzy Cartesian product & operations on fuzzy relations, Fuzzy arithmetic, numbers & the Extension Principle.

Unit-II

Fuzzy Systems: The Mamdani FKBC architecture, elements of Fuzzy logic controller, Crisp & Fuzzy logic, Different Fuzzy implications, Fuzzy Inferencing- Compositional Rule base inferencing & Individual rule based inferencing, Representing a set of rules., choice of membership functions, choice of scaling factors, choice of fuzzification procedure, choice of defuzzification procedure, comparison and evaluation of defuzzification methods.

Unit-III

Artificial Neural Networks: Historical development of Neural Networks, overview of biological Neuro-system, Mathematical Models of Neurons, ANN architecture, Learning rules, Learning Paradigms-Supervised, Unsupervised and reinforcement Learning, ANN Training algorithms for McCulloch-Pitts Neuron Model, Hebb net, single layer perceptron network, Back Propagation network.

Unit-IV

Genetic Algorithms: History of evolutionary computation of GA, Basic concepts, Search spaces & fitness landscapes, Encoding a problem for a GA, Fitness Function, Elements of genetic algorithms, selection methods-Roulette-wheel, SUS, Boltzmann, rank, tournament, Genetic operators-Crossover & Mutation, Parameters for GAs, Fundamental Theorem of GAs/Schema Theorem, adapting the encoding.

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TEXT BOOKS:

1. Neural Networks, Fuzzy Logic & Genetic Algorithms -Synthesis & Applications by s. Rajasekaran & GA Vijayalakshmi Pai, PHI.
2. Goldberg D.E., Genetic Algorithms in Search optimization & Machine Learning; Addison-Wesley Pub. Co.
3. Artificial Neural Systems by J.M. Zurada; West Publishing Co., N.York. Also Jaico Pub. House, Bombay.
4. Simon Haykin, 'Neural Networks – A Comprehensive Foundation', Prentice Hall, Upper Saddle River, New Jersy 07458.

REFERENCE BOOKS:

1. Fuzzy Control Systems, Abraham Kandel & Gidon Ingholz., Narosa Book Distributors Pvt. Ltd., New Delhi.
2. Neural Networks & Fuzzy Systems, Bart Kosko, PHI
3. Fuzzy Logic with Engineering Applications, Timothy Ross, TMH
4. Artificial Neural Networks, B.Yegnanarayana, PHI
5. Michalewiez, Z., "Genetic Algorithms + Data Structures =Evolution Programs',

Note:

In the semester examination, the examiner will set eight questions in all selecting two from each unit. The candidates will be required to attempt five questions in all selecting at least one from each unit. All questions carry equal marks

MPS603B SUSTAINABLE SOURCES OF ENERGY

M.Tech. ELECTRICAL ENGINEERING (POWER SYSTEMS) SEMESTER-III

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L	T	P	Credits
4	-	-	4

Class Work Marks	:	25 marks
Exam Marks	:	75 marks
Total Marks	:	100 marks
Duration of Exam.	:	3 hours

Description & Objectives: The sustainable energy sources technologies and their smooth integration has been given in this co**urse** work.

Unit-I

INTRODUCTION: Energy Sources and their availability, potential of renewable energy sources (RES) in India, cost of energy.

SOLAR ENERGY: Solar radiation mapping, Basic Principle of Solar Energy conversion, solar PV and solar thermal power plant layout.

Unit-II

WIND ENERGY: Wind Mapping, site selection, power curves, coefficient of power, electric generators for Wind Energy Conversion Systems(WECS)- self excited induction generator. Grid connected induction generator. Variable speed generators for WECS.

Unit-III

FUEL CELL, MHD, TIDAL ENERGY, GEOTHERMAL ENERGY, BIO MASS ENERGY: Basic Principle, site selection, Power plant layout.

Unit-IV

GRID CONNECTION OF RES: Grid Interconnection issues and grid codes, maximum power point tracking methods. Generator side Control, grid side control

PROTECTION ISSUES: Protection requirements of RES, protection conflicts, voltage and frequency control in a weak grids.

REFERENCES:

1. P. Gipe, Wind Power, Chelsea Green Publishing Company, Post Mills, Vermount, USA. 1995
2. N. Jenkins, R. Allan, P. P. Crossley, D. Kirschan and G. Strbac, Embedded Generation, IEEE Power and Energy Series 31, 2000.
3. A.Ghosh and G. Ledwich, Power Quality Enhancement Using Custom Power Devices, Kluwer Academic Publishers, 2002.
4. Wind Energy System : Bhadra, Kastha & Banerjee, Oxford Univ. Press-2005.
5. I. Boldea, Variable Speed Generators, CRC Press Taylor & Francis Group, Boca Raton, FL, 2006.
6. R.Krishanan, Electric Motor Drives-Modelling, Analysis and Control , Pearson Education, 2003.
7. Draft Standard for Interconnecting Distributed Resources with Electric Power Systems. IEEE std. P1547/07.
8. Electric Power Systems Quality : R.C. Dugan, M.F. MacGraghan, S. Santoso & H.W. Beaty, TATA McGraw Hill Ed.
9. Wind power in power system, Edited by Thomas Ackermann, Wiley, 2012.
10. POWER CONTROL FOR WIND TURBINES INWEAK GRIDS, Edited by H. Binder, European commission report.

Note:

In the semester examination, the examiner will set eight questions in all selecting two from each unit. The candidates will be required to attempt five questions in all selecting at least one from each unit. All questions carry equal marks

MPS605B **SMART GRID**

M.TECH. ELECTRICAL ENGINEERING (POWER SYSTEMS) SEMESTER-III

L	T	P	Credits
4	-	-	4

Class Work Marks	:	25 marks
Exam Marks	:	75 marks
Total Marks	:	100 marks
Duration of Exam.	:	3 hours

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Description & Objectives: The electric smart grid promises increased capacity, reliability and efficiency through the marriage of cyber technology with the existing electricity network.
The smartness in conventional electrical grid can be achieved by inclusion of smart grid technologies and smooth integration of distributed generation resources. Thus, this **course** work aims to give a brief introduction to latest development in the area of smart grid and challenges it faces through cyber attack and integration of intermittent energy sources.

Outcomes: This course shall be assessed through assignments, surprise tests, Quiz tests, minor tests & main examination. The students will learn about the cutting edge technologies being used worldwide to make conventional grid more smart, reliable, and efficient. It will definitely help the students in acquiring the technical expertise in the emerging area of smart grid.

UNIT-I

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.

UNIT-II

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

UNIT-III

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

UNIT-IV

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. ISBN: 0-8493-5806-X.
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,

Note:
In the semester examination, the examiner will set eight questions in all selecting two from each unit. The candidates will be required to attempt five questions in all selecting at least one from each unit. All questions carry equal marks
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MTPS – 607 **SEMINAR**

M.TECH. ELECTRICAL ENGINEERING (POWER SYSTEMS) SEMESTER-3

L	P	Credit		
-	2	2	Class Work	: 50 Marks
			Total	: 50 Marks

The objectives of the course remain:

- To learn how to carryout literature search
- To learn the art of technical report writing
- To learn the art of verbal communication with the help of modern presentation techniques

Part 1: Students are expected to prepare seminar on a topic in emerging areas of Engineering & Technology under the guidance of assigned faculty. Seminar should encourage students to know the research methodology and required to select one research paper, decode and present the technical understanding. Process should focus to understand the research process, problem identification, survey of relevant research papers, and basic form of research paper writing, referencing etc.

Part 2: Further students should also be exposed to teaching methodology, where student will prepare one or two lecture and present in front of junior students/ classmates under the guidance of Faculty. Faculty and feedback from audience will be the basis for the improvement; upon incorporating suggestions students must present another lecture in similar manner. In the process concerned faculty should expose student about Lecture preparation, planning, class room presentations, usage of Board, time management, importance of voice modulation etc.

The teacher(s) associated in the committee will each be assigned 2 hours teaching load per week.

MTPS609B **DISSERTATION (PHASE –I)**

M.TECH. ELECTRICAL ENGINEERING (POWER SYSTEMS) SEMESTER-III

L	T	P	Credits	Class Work	:	100 Marks
-	-	6	6			

The primary objective of this course is to develop in student the capacity for analysis & judgment and the ability to carry out independent investigation in design /development through a dissertation work involving creativity, innovation and ingenuity. The work must start with comprehensive literature search and critical appreciation thereof so as to select research problem the student wishes to work on.

Each student will carry out independent dissertation under the supervision of some teacher(s) who will be called Supervisor(s). In no case more than two supervisors can be associated with one dissertation work.

The dissertation involving design/ fabrication/ testing/ computer simulation/ case studies etc. which commences in the III Semester will be completed in IV Semester. The evaluation of the dissertation phase –I besides approval of the dissertation topic of the students will be done by a committee constituted as under:

Chairperson of Department	: Chairperson
M Tech Coordinator/ Sr Faculty	: Member Secretary
Respective dissertation supervisor	: Member

The student will be required to submit two copies of his/her report to the department for record (one copy each for the department and participating teacher).

MPS602B **Dissertation**

M.Tech. ELECTRICAL ENGINEERING (POWER SYSTEMS) SEMESTER-IV

L	T	P	Credits		
-	-	20	20	Class Work	: 50 Marks
				Exam	: 100 Marks

The dissertation started in III Semester will be completed in IV Semester and will be evaluated in the following manner.

Internal Assessment

Internal Assessment (class work evaluation) will be effected as per ordinance through interim report, presentation and discussion thereon by the following committee of three persons:

Chairperson of Department	: Chairperson
M Tech Coordinator/ Sr Faculty	: Member Secretary
Respective dissertation supervisor	: Member

External Assessment

Final dissertation will be assessed by a panel of examiners consisting of the following:

Chairperson of Department	: Chairperson
Respective Supervisor(s)	: Member(s)
External expert	: To be appointed by the University

Note: The External Expert must be from the respective area of specialization. The chairperson & M Tech Coordinator with mutual consultation will divide the submitted dissertations into groups depending upon the area of specialization and will recommend the list of experts for each group separately to the V C for selecting the examiners with the note that an external expert should be assigned a maximum of FIVE dissertations for evaluation.

The student will be required to submit THREE copies of his/her report to the M Tech Coordinator for record and processing.

Syllabi for Elective Courses (Selected) for 3rd Semester

MPS631B HIGH VOLTAGE ENGINEERING
M.TECH. ELECTRICAL ENGINEERING (POWER SYSTEMS) SEMESTER-III (ELECTIVE)

L	T	P	Credits
4	-	-	4

Class Work Marks	:	25 marks
Exam Marks	:	75 marks
Total Marks	:	100 marks
Duration of Exam.	:	3 hours

UNIT-I

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, Electro-convection Breakdown, Breakdown in solid Dielectrics, Intrinsic Breakdown, Electromechanical Breakdown, Breakdown due to Treeing and Tracking, Thermal Breakdown, Electrochemical Breakdown

UNIT-II

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

UNIT-III

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

UNIT-IV

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. on behalf of I.E.E Power Engg. Series.
2. Rakos Das Begamudre, *Extra EHV A.C Transmission.* PHI Publication.
3. C.L. Wadhwa , *High Voltage Engineering*. Pub.: New Age International Ltd.

Note:

In the semester examination, the examiner will set eight questions in all selecting two from each unit. The candidates will be required to attempt five questions in all selecting at least one from each unit. All questions carry equal marks

MIC611B **GENETIC ALGORITHMS BASED OPTIMIZATION**
M. TECH. ELECTRICAL ENGG. (I&C) SEMESTER-II

L	T	P	Credits
4	-	-	4

Class Work Marks	:	25 marks
Exam Marks	:	75 marks
Total Marks	:	100 marks
Duration of Exam.	:	3 hours

UNIT-I

Introduction: Early developments in Genetic Algorithms (GAs); Pragmatic appeal of GAs; Scenarios of evolutionary computation; Distinction of GAs from Evolution Programs; Definition of GAs; Distinction of GAs from traditional computer programs; Distinction between GAs and traditional optimization / search methods (i.e., calculus-based, steepest-ascent hill climbing, Next-ascent hill climbing, Random-mutation hill climbing), Enumerative search, Random search; Uni-modality v/s multimodality; comparison of GAs terms with those of natural biology.

UNIT-II

Elements of Canonical GAs and Schema Theorem: Random initialization of population: Selection; Crossover; Mutation; Algorithms for three operators: Roulette Wheel selection, Algorithm for single point crossover, Algorithm for mutation; Genesis of GA's processing power: implicit parallelism; Similarity templates (schemata); Schema order and Defining length; The fundamental theorem of GAs (Schema Theorem): Individual effects selection, crossover and mutation on schemata and their combined effect, derivation of schema growth equation, Building blocks hypothesis.

UNIT-III

Further Operators / Variants and Implementation Issues: Problems / limitations of Roulette wheel selection and ways to overcome limitations: Stochastic universal sampling, Sigma scaling, Boltzmann selection, Rank selection, Steady state selection; Problems with single point crossover: Positional bias, Spurious correlation, End point effects; Two point crossover; Parametrized Uniform crossover; Evolving crossover hotspots; Inversion; Hitch in combining inversion with single-point crossover and solution thereof.

UNIT-IV

Applications of GAs: Evolving computer programs, Evolving Lisp programs, Koza's algorithm; Data analysis and prediction: Predicting dynamical systems (Norman Packard's form of GAs), Meyer and Packards form of GAs for predicting chaotic time series; Evolving neural networks: Primer on ANNs, Evolvable aspects of NNs, Evolving weights in a fixed network.

Text Books:

1. Melanie Mitchell, "An Introduction to Genetic Algorithms," PHI.
2. D.E. Goldberg, "Genetic Algorithms in Search, Optimization and Machine Learning," Addition-Wesley Pub. Co.

Reference Books:

1. L. Davis, "Handbook of Genetic Algorithms". New York: Van Nostrand, Reinhold, 1991.
2. Z. Michalewicz, "Genetic Algorithms + Data Structures = Evolution Programs". Berlin: Springer-Verlag, 1992.

Note: In the semester examination, the examiner will set eight questions in all selecting two from each unit. The candidates will be required to attempt five questions in all selecting at least one from each unit. All questions carry equal marks.

MIC613B **ROBOTICS & AUTOMATION ENGINEERING**
M. TECH. ELECTRICAL ENGG. (I&C) SEMESTER-III

L	T	P	Credits
4	-	-	4

Class Work Marks	:	25 marks
Exam Marks	:	75 marks
Total Marks	:	100 marks
Duration of Exam.	:	3 hours

UNIT-I

Introduction to Automation & Automated Inspection: Reasons for automation, Automation strategies, automated inspection: Principles & methods, Sensor technologies for automated inspection, Coordinate measuring machine, other contact inspection methods, machine vision, optical inspection methods, non-contact inspection methods.

UNIT-II

Basic Concepts of Robotics & Power Sources: Definition and origin of robotics, different types of robots, various generations of robots, Asimov's laws of robotics, Dynamic stabilization of robots. Hydraulic, pneumatic and electric drives, Determination of HP of motor and gearing ratio, variable speed arrangements, path determination.

UNIT-III

Sensors, Manipulators, Actuators & Grippers: Micro machines in robotics, machine vision, ranging, Laser, acoustic, magnetic, fibre optic and tactile sensors. Construction of manipulators – manipulator dynamics and force control, electronic & pneumatic manipulator control circuits, end effectors, various types of grippers, Design considerations.

UNIT-IV

Kinematics & Path Planning: Solution of inverse kinematics problem,multiple solution, Jacobian work envelop, hill climbing techniques, robot programming languages, robots in manufacturing & non-manufacturing applications, selection of robot.

Text Books:

1. P.Mikell, G.M. Weiss, R.N. Nagel, N.G. Odrajb, "Industrial Robotics", McGraw-Hill, Singapore,1996
2. G.M. Mair, , 'Industrial Robotics', Prentice Hall, NY, 1988.
3. R.D. Khafter, T.A. Chimelewski & M. Negin, , "Robot Engineering–An Integrated Approach," PHI.
4. M. Braddley et al., "Robot Motion: Planning and Control," MIT Press, Cambridge, Mass, 1982.
5. John J.Craig, "Introduction to Robotics, Mechanics and Control", Pearson.

Reference Books:

1. R.P. Paul, "Robot Manipulators: Mathematics, Programming and Control," MIT Press, Cambridge, Mass, 1981.
2. Mittal and Nagrath, "Robotics and Control," TMH.
3. M. Sponge, and M. Vidyasagar, "Robot Dynamics and Control," John Wiley New York 1989.

Note: In the semester examination, the examiner will set eight questions in all selecting two from each unit. The candidates will be required to attempt five questions in all selecting at least one from each unit. All questions carry equal marks**.**

MIC617B **BIO-INSPIRED OPTIMIZATION TECHNIQUES**
M.TECH. ELECTRICAL ENGG. (I&C) SEMESTER-III

L	T	P	Credits
4	-	-	4

Class Work Marks	:	25 marks
Exam Marks	:	75 marks
Total Marks	:	100 marks
Duration of Exam.	:	3 hours

UNIT-I

Introduction: Challenges of control and automation (appropriate for non-controls person), scientific foundations of biomimicry. Elements of Decision-Making: Neural network substrates for control instincts, rule-based control, planning systems, attentional systems (including stability analysis).Learning: Learning and control (off/on-line approximation perspective, heuristic adaptive control), linear least squares methods (batch and recrusive least squares), gradient methods (e.g. Levenberg-Marquardt), adaptive control (optimization perspective, introduction to stable adaptive control).

UNIT- II

Evolution: Genetic algorithm, stochastic and nongradient optimization for design (e.g., pattern search methods, response surface methodology), evolution and learning: synergistic effects.
Foraging: Cooperative foraging and search (optimization models, swarm stability), competitive and intelligent foraging (game-theoretic formulations, outlook on future of area).

UNIT- III

Ants' Foraging Behavior and Optimization, toward Artificial Ants, Artificial Ants and Minimum Cost Paths, Combinatorial Optimization, ACO Metaheuristic, Ant Colony Optimization Algorithms for the Traveling Salesman, Parallel Implementations, ACO Plus Local Search, Implementing ACO Algorithms, Theoretical Considerations on ACO, The Problem and the Algorithm, Convergence Proofs, ACO and Model-Based Search.

UNIT- IV

Biogeography based optimization, Particle swarm optimization, and their hybrid optimization techniques with GA.

Reference Books:

1. Kevin M. Passino, "Biomimicry for Optimization, Control, and Automation", Springer 2005.
2. Marco Dorigo and Thomas Stützle, "Ant Colony Optimization",MIT Press, 2004.
3. Dan Simon, "Biogeography-Based Optimization", IEEE Transactions On Evolutionary Computation, vol. 12, no. 6, pp. 702-713,2008.
4. Aleksandar Lazinica, "Particle Swarm Optimization",In-Tech, 2009.

Note: In the semester examination, the examiner will set eight questions in all selecting two from each unit. The candidates will be required to attempt five questions in all selecting at least one from each unit. All questions carry equal marks**.**

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MIC619B **BIOMEDICAL INSTRUMENTATION**
M.TECH. ELECTRICAL ENGG. (I&C) SEMESTER-III

L	T	P	Credits
4	-	-	4

Class Work Marks	:	25 marks
Exam Marks	:	75 marks
Total Marks	:	100 marks
Duration of Exam.	:	3 hours

UNIT-I

Biomedical Instrumentation: Overview, role of technology in modern healthcare, role of biomedical engineer, Man-Instrument System, origin of Biosignals, Classification of Biomedical Instruments, performance parameters of -instruments, physiological systems.

UNIT-II

Bio-Potential Electrodes, Amplifiers and measurements Systems

Bio-Potential electrodes-Electrode-Electrode interface, Half-cells and their potentials, Silver-Silver chloride electrodes, biomedical Recording electrodes, circuit model of electrode.

Bioelectric amplifiers-carrier amplifiers, chopper amplifiers, phase sensitive or lock-in amplifiers, isolation amplifiers, instrumentation amplifiers.

UNIT-III

Sensory and behavioural measurements & Patient Monitoring systems.

Audiometer, Galvanic skin Response(GSR),Biofeedback Instrumentation.

Computer-assisted patient monitoring system: Bedside monitors, central monitors ., measurement of heart rate, measurement of blood pressure, measurement of respiratory rate, impedance pnuemography, apnea detectors, Intelligent patient monitoring: Intelligent monitoring system architecture.

UNIT-IV

Telemedicine & Medical Informatics.

Telemedicine and its applications: Teleradiology, telecardiology , telepsychiatry, teledermatology, telesurgery, advantages and disadvantages of telemedicine. Hospital Information systems, Computer Networks in healthcare.

Text-book:

1. Introduction to Biomedical Instrumentation, Mandeep Singh, PHI.

Reference –book:

1. Biomedical Signal Analysis: A case-study Approach, Rangayyan , Wile
2. Bioinstrumentation, Webster, Wiley
3. Medical Instrumentation: Application and Design,3ed, Webster, Wiley
4. Introduction to biomedical equipment technology,4e, Carr, Pearson

Note: In the semester examination, the examiner will set eight questions in all selecting two from each unit. The candidates will be required to attempt five questions in all selecting at least one from each unit. All questions carry equal marks**.**

MPS633B **POWER SYSTEM RELIABILITY**

M.TECH. ELECTRICAL ENGINEERING (POWER SYTEMS) SEMESTER-III

L	T	P	Credits
4	-	-	4

Class Work Marks	: 25 marks
Exam Marks	: 75 marks
Total Marks	: 100 marks
Duration of Exam	: 3 hours

UNIT-I

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.

UNIT-II

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.

UNIT-III

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.

UNIT-IV

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

Note: In the semester examination, the examiner will set eight questions in all selecting two from each unit. The candidates will be required to attempt five questions in all selecting at least one from each unit. All questions carry equal marks**.**