SEMESTER – I

<table>
<thead>
<tr>
<th>S. No</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Marks</th>
<th>Credit</th>
<th>Duration of Exam</th>
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<tr>
<td>1.</td>
<td>MPS501B</td>
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<td>2.</td>
<td>MPS503B</td>
<td>Power System Control and Instrumentation</td>
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<td>3.</td>
<td>MPS505B</td>
<td>Advanced Power System Analysis</td>
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<td>4.</td>
<td>MPS507B</td>
<td>General Aspects of Energy management &amp; Energy Efficiency</td>
<td>4</td>
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<td>5.</td>
<td>MPS509B</td>
<td>FACTS &amp; HVDC</td>
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<td>6.</td>
<td>MPS513B</td>
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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

<table>
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<th>Course Title</th>
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<th>Credit</th>
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<td>1.</td>
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<td>Advanced in Switch Gear &amp; Protection</td>
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<td>3.</td>
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<td>4.</td>
<td>MPS508B</td>
<td>Electric Drives &amp; Control</td>
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### III Semester

<table>
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<th>S. No</th>
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<td>MPS601B</td>
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<td>MPS603B</td>
<td>Sustainable sources of Energy</td>
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<td>Smart Grid</td>
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<td>Elective</td>
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<td>5.</td>
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<td>Dissertation (Phase –I)</td>
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**NOTE:**
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### IV Semester

<table>
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**NOTE:**

### List of Elective

<table>
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<th>Course No.</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>MIC619B</td>
<td>BIOMEDICAL INSTRUMENTATION</td>
</tr>
<tr>
<td>MPS631B</td>
<td>HIGH VOLTAGE ENGINEERING</td>
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<tr>
<td>MPS633B</td>
<td>POWER SYSTEM RELIABILITY</td>
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<tr>
<td>MIC611B</td>
<td>GENETIC ALGORITHMS BASED OPTIMIZATION</td>
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<td>MIC613B</td>
<td>ROBOTICS &amp; AUTOMATION ENGINEERING</td>
</tr>
<tr>
<td>MIC617B</td>
<td>BIO-INSPIRED OPTIMIZATION TECHNIQUES</td>
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Description & Objectives: This subject aims to introduce 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
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

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

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

TEXT BOOKS:


REFERENCE BOOKS:

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.
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

Unit-III


TEXT BOOKS:

1. Power Systems Engineering by S. K. Gupta, Umesh publication
2. Power System Analysis & Design with CD by Glover, Cengage Learning
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.
3. Elements of power system analysis by W. D. Stevenson: M.G.H.
5. Computer methods in power system by G. W. Stagg and A. H. El-Abiad: M.G.H.

Note:
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.
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

TEXT BOOKS:


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

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.
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, TCSR, TCPST, IPC, TCVL, TCVR, TSC, 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:


REFERENCE BOOKS:

1. Modeling Power System components by Murty : B. S. 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.
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
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

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

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:

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.
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

REFERENCE BOOKS:

7. Switchgear and protection by S. S. Rao: Khanna Pub
8. 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
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.


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:

REFERENCE BOOKS:

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.
ELECTRIC DRIVES & CONTROL
M.TECH. ELECTRICAL ENGINEERING (POWER SYSTEMS) SEMESTER-II

L  T  P  Credits  Class Work Marks : 25 marks
4  -  -  4  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:

REFERENCE BOOKS:
2. Electric Drives: V.Subrahmaniyam TMH
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
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, steady state 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, equivalent 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
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
4. Switch Gear Protection by S S Rao Khanna Publication, New Delhi
7. Power System Optimization By Nagarath & Kothari : TMH publication New Delhi
8. 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
Study of Softwares such as MATLAB, DigSILENT, LabView etc.

Computer Programs on the following:
1. Formation of Y-bus
2. Formation of Z-Bus
3. Gauss 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
MPS601B INTELLIGENT METHODS IN POWER SYSTEMS
M.Tech. ELECTRICAL ENGINEERING (POWER SYSTEMS) SEMESTER-III

L T P Credits Class Work Marks : 25 marks
4 - - 4 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

Unit-III

Unit-IV

TEXT BOOKS:
1. Neural Networks, Fuzzy Logic & Genetic Algorithms -Synthesis & Applications by s. Rajasekaran & GA Vijayalakshmi Pai, PHI.

REFERENCE BOOKS:
2. Neural Networks & Fuzzy Systems, Bart Kosko, PHI
3. Fuzzy Logic with Engineering Applications, Timothy Ross, TMH
4. Artificial Neural Networks, B.Yegnanarayana, PHI

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

Unit-I

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


Unit-II


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:

10. POWER CONTROL FOR WIND TURBINES IN WEAK 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.
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

UNIT-III

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:

REFERENCE BOOKS:
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.
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.
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
MTech 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).
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:

<table>
<thead>
<tr>
<th>Role</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chairperson of Department</td>
<td>Chairperson</td>
</tr>
<tr>
<td>M Tech Coordinator/ Sr Faculty</td>
<td>Member Secretary</td>
</tr>
<tr>
<td>Respective dissertation supervisor</td>
<td>Member</td>
</tr>
</tbody>
</table>

## External Assessment

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

<table>
<thead>
<tr>
<th>Role</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chairperson of Department</td>
<td>Chairperson</td>
</tr>
<tr>
<td>Respective Supervisor(s)</td>
<td>Member(s)</td>
</tr>
<tr>
<td>External expert</td>
<td>To be appointed by the University</td>
</tr>
</tbody>
</table>

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
UNIT-I


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 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


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:
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:

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
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-modal vs 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, Evolvable weights in a fixed network.

Text Books:

Reference Books:

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.
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


UNIT-IV


Text Books:

Reference Books:
2. Mittal and Nagrath, "Robotics and Control," TMH.

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.
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 recursive 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

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

Reference Books:

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.
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 pneumography, 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.
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

UNIT-IV

Text Books:

Reference Books

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.