DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

M.TECH: POWER SYSTEMS - FIRST SEMESTER

SYLLABUS

PSPC 01: POWER SYSTEM ANALYSIS

Instruction Hours/week: 3(L) **Credits: 3**

Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

Power System Network Matrices: Graphs, Incidence matrices, Primitive network, formation of Bus admittance matrix by singular transformations, direct inspection method for determination of Y_{BUS}, Formation of Bus impedance matrix - Addition of a branch and Addition of a link. Simple problems.

UNIT-II

Fault Analysis: Short circuit calculations using Bus impedance matrix, Fault Currents and Fault Voltages, Generalized method of fault analysis.

UNIT-III

Load Flow Studies: Load flow problem, Gauss-Seidal method, Newton Raphson method, Decoupled and fast decoupled load flow methods, Comparison of load flow methods

UNIT-IV

Security Analysis: Security state diagram, contingency analysis, Sensitivity factors: Generation shift factors, Line outage distribution factor

UNIT-V

Voltage Stability: Voltage collapse, P-V and V-Q curves, Voltage stability analysis, continuation power flow, voltage collapse proximity indices.

Text Books:

1. J.J. Grainger &W.D.Stevenson, “Power system analysis ”, McGraw Hill ,2003
2. A. R. Bergen & Vijay Vittal , “Power System Analysis” ,Pearson , 2000
3. L.P. Singh , “Advanced Power System Analysis and Dynamics”, New Age International, 2006
4. G.L. Kusic, “Computer aided power system analysis” ,Prentice Hall India, 1986
5. A.J. Wood, “ Power generation, operation and control” , John Wiley, 1994
6. P.M. Anderson, “Faulted power system analysis” , IEEE Press , 1995
7. Computer methods in Power System Analysis by Stagg and El Abiad, Mc.Graw Hill Book Company.
8. Advanced Power system analysis and dynamics by L.P.Singh, Wiley Eastern – 1981

Course outcomes-

Students will be able to:

1. Find the bus admittance and bus impedance matrices of the given power system network
2. Calculate fault currents in each phase
3. Calculate voltage phasors at all buses for the given data using various methods of load flow
4. Rank various contingencies according to their severity
5. Estimate closeness to voltage collapse and calculate PV curves using continuation power flow

PSPC 02: ELECTRIC POWER DISTRIBUTION SYSTEM

Instruction Hours/week: 3(L) **Credits: 3**
Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

Distribution of Power, Management, Power Loads, Power System Loading, Short-term & Long-term Load Forecasting, Technological Forecasting. Urban/Rural Distribution, Energy Management

UNIT-II

Power Factor Correction, Calculation of Optimum Number of Switches, Capacitors, Optimum Switching Device Placement in Radial Distribution Systems, Sectionalizing Switches – Types, Benefits, Bellman's Optimality Principle.

UNIT-III

Distribution Management System(D.M.S.)-Need, advantages, functions, Distribution Automation: Definition, Restoration / Reconfiguration of Distribution Network-Different Methods and Constraints. Interconnection of Distribution, Control & Communication Systems, Remote Terminal Units, Energy efficiency in electrical distribution & Monitoring

UNIT-IV

SCADA: Introduction, Block Diagram, SCADA Applied To Distribution Automation. Common Functions of SCADA, Advantages of Distribution Automation through SCADA

UNIT-V

Remote Metering-Automatic Meter Reading and its implementation, Maintenance of Automated Distribution Systems, Difficulties in Implementing Distribution Automation in Actual Practice. AI techniques applied to Distribution Automation

Text Books:

1. M.K. Khedkar, G.M. Dhole, "A Text Book of Electrical power Distribution Automation", University Science Press, New Delhi
2. A.S. Pabla, " Electric Power Distribution", Tata McGraw Hill Publishing Co. Ltd., Fourth Edition.
3. Anthony J Panseni, "Electrical Distribution Engineering", CRC Press.
4. James Momoh, "Electric Power Distribution, automation, protection & control", CRC Press

Course outcomes-

Students will be able to:

1. Knowledge of power distribution system
2. Study of Distribution automation and its application in practice
3. To learn SCADA system

PROFESSIONAL ELECTIVE- I

PSPE 11: RENEWABLE ENERGY SOURSES

Instruction Hours/week: 3(L) **Credits: 3**

Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

Introduction: Introduction to Energy Conversion, Principle of Renewable Energy Systems, Technical and Social Implications, Solar Radiation, Thermoelectric Conversion, Principles of Solar Energy collection, Characteristics and principles of different types of collectors and their efficiencies. Solar energy applications. Introduction to Photovoltaic cells, PV array and PV module, Maximum power point tracking system.

UNIT-II

Wind energy: Wind energy, Characteristics, Aerodynamics, Power extraction, Types of wind machines, Performance of Wind Machines, Wind Mills, Applications, Economics of wind power.

UNIT-III

Ocean & Geothermal Energy: Ocean Thermal Energy Conversion Systems, Tidal and Wave power-applications. Principle of working of Geothermal Power Plants, Advantages and Disadvantages over other energy forms, Applications of Geothermal Energy

UNIT-IV

BIO- Energy: Energy from Bio-mass, Bio conversion processes. Bio-gas generation and utilization, Bio-gas plants various types, Industrial Wastes, Municipal waste, Burning, Plants, Energy from the Agricultural wastes.

UNIT-V

MHD Power Generation, Fuel Cells & Hybrid- Energy System: MHD Generators, Application of MHD generation, Fuel cells types, applications. Diesel Generator and Photo-Voltaic System, Wind-Diesel System, Wind-Photovoltaic Systems

Text Books:

1. Non-Conventional Energy Sources, G.D.Rai, Khanna publishers, Fourth Edition, 2009.
2. Wind electrical systems, S.N.Bhadra, D. Kastha, S. Banerjee Oxford University press.

REFERENCES

1. Solar Energy: Principles of Thermal Collection and Storage, Sukhatme, S.P., Tata McGraw-Hill, New Delhi.
2. Fuel Cell Systems, James Larminie , Andrew Dicks , John Weily& Sons Ltd.
3. Wind Energy Explained ,J.F.Manwell,J.G.McGowan,A.L.Rogers ,John Weily& Sons Ltd.
4. MHD Power Generation Engineering Aspects, E.J. Womack, Chapman and Hall Publication.

Course outcomes-

Students will be able to:

1. Gain knowledge on renewable sources like solar, biomass, wind energies
2. Realize solar energy applications using photo voltaic cells
3. Analyze biogas performance and testing and Hybrid Energy Systems

PSPE 12: SMART GRIDS

Instruction Hours/week: 3(L) **Credits: 3**
Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

Introduction to Smart Grid, Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Concept of Robust & Self Healing Grid Present development & International policies in Smart Grid

UNIT-II

Introduction to Smart Meters, Real Time Prizing, Smart Appliances, Automatic Meter Reading(AMR), Outage Management System(OMS), Plug in Hybrid Electric Vehicles(PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation, Smart Substations, Substation Automation, Feeder Automation .

UNIT-III

Geographic Information System(GIS), Phase Measurement Unit(PMU), Concept of micro-grid, need & applications of micro-grid, formation of micro-grid, Issues of interconnection, protection & control of micro-grid.

UNIT-IV

Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit

UNIT-V

Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighborhood Area, Network (NAN), Wide Area Network (WAN), Bluetooth, ZigBee, GPS, Wi-Fi, Wi-Max based communication, Wireless Mesh Network, Basics of CLOUD Computing & Cyber Security for Smart Grid, Broadband over Power line (BPL), IP based protocols

Text Books:

1. Ali Keyhani, “Design of smart power grid renewable energy systems”, Wiley IEEE, 2011
2. Clark W. Gellings, “The Smart Grid: Enabling Energy Efficiency and Demand Response”, CRC Press , 2009
3. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, “Smart Grid: Technology and Applications”, Wiley 2012
4. Stuart Borlase, “Smart Grid: Infrastructure, Technology and solutions “ CRC Press. .
5. A. G. Phadke, “Synchronized Phasor Measurement and their Applications”, Springer

Course outcomes-

Students will be able to:

1. Appreciate the difference between smart grid & conventional grid
2. Apply smart metering concepts to industrial and commercial installations
3. Formulate solutions in the areas of smart substations, distributed generation and wide area measurements
4. Come up with smart grid solutions using modern communication technologies

PSPE 13: HIGH POWER CONVERTERS

Instruction Hours/week: 3(L) **Credits: 3**
Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

High-Power Switching Devices : Gate Turn-Off (GTO) Thyristor, Gate-Commutated Thyristor (GCT), Insulated Gate Bipolar Transistor (IGBT), Other Switching Devices, Operation of Series-Connected Devices Main Causes of Voltage Unbalance , Voltage Equalization for GCTs, Voltage Equalization for IGBTs

UNIT-II

Two-Level Voltage Source Inverters: Introduction, Sinusoidal PWM, Modulation Schemes, Harmonic Content Over-modulation, Third Harmonic Injection PWM, Space Vector Modulation Switching States, Space Vectors, Dwell Time Calculation, Modulation Index Switching Sequence, Spectrum Analysis, Even-Order Harmonic Elimination, Discontinuous Space Vector Modulation

UNIT-III

Cascaded H-Bridge Multilevel Inverters: Introduction, H-Bridge Inverter Bipolar Pulse-Width Modulation, Unipolar Pulse-Width Modulation, Multilevel Inverter Topologies, CHB Inverter with Equal dc Voltage, H-Bridges with Unequal dc Voltages, Carrier Based PWM Schemes, PWM Schemes, Staircase Modulation

UNIT-IV

A **Diode-Clamped Multilevel Inverters :** Three-Level Inverter, Converter Configuration, Switching State, Phase-Shifted Multicarrier Modulation, Level-Shifted Multicarrier Modulation, Comparison Between Phase- and Level-Shifted Commutation, Space Vector Modulation, Stationary Space Vectors, Dwell Time Calculation, Relationship Between *Vref*, Location and Dwell Times Switching Sequence Design, Inverter Output Waveforms and Harmonic Content, Even-Order Harmonic Elimination, Neutral-Point Voltage Control, Causes of Neutral-Point Voltage Deviation, Effect of Motoring and Regenerative Operation, Feedback Control of Neutral-Point Voltage

UNIT-V

Other Space Vector Modulation Algorithms: Discontinuous Space Vector Modulation , SVM Based on Two-Level Algorithm , High-Level Diode-Clamped Inverters, Four- and Five-Level Diode-Clamped Inverters, Carrier-Based PWM, NPC/H-Bridge Inverter: Inverter Topology, Modulation Scheme, Waveforms and Harmonic Content

Text Books:

1. Bin Wu ," High Power Converters and AC Drives (IEEE Press 2008)
2. By Dorian O Neacsu, " Power Switching Converters: Medium and High Power"

Course outcomes-

Students will be able to:

1. Learn the characteristics of GTOs, IGBTs and use them in practical systems
2. Knowledge of working of multi-level VSIs, DC-DC switched mode converters, cyclo-converters and PWM techniques and the ability to use them properly
3. Acquire knowledge of power conditioners and their applications
4. Ability to design power circuit and protection circuit of PSDs and converters

PSPE 14: WIND AND SOLAR SYSTEMS

Instruction Hours/week: 3(L) **Credits: 3**
Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

Historical development and current status, characteristics of wind power generation, network integration issues

UNIT-II

Generators and power electronics for wind turbines, power quality standards for wind turbines, Technical regulations for interconnections of wind farm with power systems

UNIT-III

Isolated wind systems, reactive power and voltage control, economic aspects. Impacts on power system dynamics

UNIT-IV

Introduction of solar systems, merits and demerits, concentrators, various applications

UNIT-V

Solar thermal power generation, PV power generation, Energy Storage device. Designing the solar system for small installations

Text Books:

1. Thomas Ackermann, Editor, "Wind power in Power Systems", John Willy and sons ltd.2005
2. Siegfried Heier, "Grid integration of wind energy conversion systems", John Willy and sons ltd., 2006
3. K. Sukhatme and S.P. Sukhatme, "Solar Energy". Tata MacGraw Hill, Second Edition, 1996

Course outcomes-

Students will be able to:

1. Appreciate the importance of energy growth of the power generation from the renewable energy sources and participate in solving these problems
2. Demonstrate the knowledge of the physics of wind power and solar power generation and all associated issues so as to solve practical problems
3. Identify, formulate and solve the problems of energy crises using wind and solar energy

PSPE 15: ENERGY AUDITING AND MANAGEMENT

Instruction Hours/week: 3(L) **Credits: 3**
Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

System approach and End use approach to efficient use of Electricity, Electricity tariff types.
Energy auditing: Types and objectives - audit instruments, ECO assessment and Economic methods, Specific energy analysis-Minimum energy paths-consumption models- Case study

UNIT-II

Electric motors-Energy efficient controls and starting efficiency-Motor Efficiency and Load Analysis-Energy efficient /high efficient Motors-Case study, Load Matching and selection of motors Variable speed drives; Pumps and Fans-Efficient Control strategies- Optimal selection and sizing-Optimal operation and Storage-Case study, Transformer Loading/Efficiency analysis, Feeder/cable loss evaluation- case study

UNIT-III

Reactive Power management-Capacitor Sizing-Degree of Compensation-Capacitor losses-Location-Placement-Maintenance -Case study, Peak Demand controls- Methodologies-Types of Industrial loads-Optimal Load scheduling-case study, Lighting- Energy efficient light sources-Energy conservation in Lighting Schemes, Electronic ballast-Power quality issues-Luminaries, case study

UNIT-IV

Cogeneration-Types and Schemes-Optimal operation of cogeneration plants-case study, Electric loads of Air conditioning & Refrigeration, Energy conservation measures- Cool storage Types-Optimal operation case study

UNIT-V

Electric water heating-Geysers-Solar Water Heaters, Power Consumption in Compressors, Energy conservation measures, Electrolytic Process, Computer Controls- software-EMS

Text Books:

1. Anthony J. Pansini, Kenneth D. Smalling, .Guide to Electric Load Management., Pennwell Pub; (1998)
2. Howard E. Jordan, .Energy-Efficient Electric Motors and Their Applications., Plenum Pub Corp; 2ndedition (1994)
3. Giovanni Petrecca, .Industrial Energy Management: Principles and Applications., The Kluwerinternational series -207,1999
4. Handbook on Energy Audit and Environment Management , Y P Abbi and Shashank Jain, TERI,2006
5. Handbook of Energy Audits Albert Thumann, William J. Younger, Terry Niehus, 2009

Course outcomes-

Students will be able to:

1. Acquire the background required for engineers to meet the role of energy managers and to acquire the skills and techniques required to implement energy management
2. Identify and quantify the energy intensive business activities in an organization
3. Able to perform Basic Energy Audit in an Organization

PROFESSIONAL ELECTIVE- II

PSPE 21: POWER SYSTEM DYNAMICS-I

Instruction Hours/week: 3(L) **Credits: 3**
Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

Synchronous Machines: Per unit systems, Park's Transformation (modified), Flux-linkage equations

UNIT-II

Voltage and current equations, Formulation of State-space equations, Equivalent circuit

UNIT-III

Sub-transient and transient inductance and Time constants, Simplified models of synchronous machines, Small signal model: Introduction to frequency model

UNIT-IV

Excitation systems and Philips-Heffron model, PSS Load modeling

UNIT-V

Modeling of Induction Motors, Prime mover controllers

Text Books:

1. P. M. Anderson & A. A. Fouad "Power System Control and Stability", Galgotia , New Delhi, 1981
2. J Machowski, J Bialek& J. R W. Bumby, "Power System Dynamics and Stability", John Wiley & Sons, 1997
3. P.Kundur, "Power System Stability and Control", McGraw Hill Inc., 1994.
4. E.W. Kimbark, "Power system stability", Vol. I & III, John Wiley & Sons, New York 2002

Course outcomes-

Students will be able to:

1. Understand the modeling of synchronous machine in details
2. Carry out simulation studies of power system dynamics using MATLAB-SIMULINK, MI POWER
3. Carry out stability analysis with and without power system stabilizer (PSS)

PSPE 22: MATHEMATICAL METHODS FOR POWER ENGINEERING

Instruction Hours/week: 3(L) **Credits: 3**
Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

Vector spaces, Linear transformations, Matrix representation of linear transformation, Eigen values and Eigen vectors of linear operator

UNIT-II

Linear Programming Problems, Simplex Method, Duality, Non Linear Programming problems

UNIT-III

Unconstrained Problems, Search methods, Constrained Problems

UNIT-IV

Lagrange method, Kuhn-Tucker conditions, Random Variables, Distributions

UNIT-V

Independent Random Variables, Marginal and Conditional distributions, Elements of stochastic processes

Text Books:

1. Kenneth Hoffman and Ray Kunze, "Linear Algebra", 2nd Edition, PHI, 1992
2. Erwin Kreyszig, "Introductory Functional Analysis with Applications", John Wiley & Sons, 2004
3. Irwin Miller and Marylees Miller, John E. Freund's "Mathematical Statistics", 6th Edn, PHI, 2002
4. J. Medhi, "Stochastic Processes", New Age International, New Delhi., 1994
5. A Papoulis, "Probability, Random Variables and Stochastic Processes", 3rd Edition, McGraw Hill, 2002
6. John B Thomas, "An Introduction to Applied Probability and Random Processes", John Wiley, 2000
7. Hillier F S and Liebermann G J, "Introduction to Operations Research", 7th Edition, McGraw Hill, 2001
8. Simmons D M, "Non Linear Programming for Operations Research", PHI, 1975

Course outcomes-

Students will be able to:

1. Knowledge about vector spaces, linear transformation, Eigen values and eigenvectors of linear operators
2. To learn about linear programming problems and understanding the simplex method for solving linear programming problems in various fields of science and technology
3. Acquire knowledge about nonlinear programming and various techniques used for solving constrained and unconstrained nonlinear programming problems
4. Understanding the concept of random variables, functions of random variable and their probability distribution
5. Understand stochastic processes and their classification

PSPE 23: PULSE WIDTH MODULATION FOR PE CONVERTERS

Instruction Hours/week: 3(L) **Credits: 3**
Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

Fundamental Concepts of PWM: Fundamental Concepts of PWM, Evaluation of PWM Schemes, Double Fourier Integral Analysis of a Two-Level Pulse Width- Modulated Waveform, Naturally Sampled Pulse Width Modulation Sine-Sawtooth Modulation, Sine-Triangle Modulation, PWM Analysis by Duty Cycle Variation, Sine-Sawtooth Modulation, Sine-Triangle Modulation

UNIT-II

Regular Sampled Pulse Width Modulation: Sawtooth Carrier Regular Sampled PWM, Symmetrical Regular Sampled PWM, Asymmetrical Regular Sampled PWM, direct Modulation

UNIT-III

Modulation of One Inverter Phase Leg: Fundamental Concepts of PWM Evaluation of PWM Schemes, Double Fourier Integral Analysis of a Two-Level Pulse Width- Modulated Waveform, Naturally Sampled Pulse Width Modulation, PWM Analysis by Duty Cycle Variation, Regular Sampled Pulse Width Modulation, Sawtooth Carrier Regular Sampled PWM, Symmetrical Regular Sampled PWM, Asymmetrical Regular Sampled PWM, Direct Modulation, Integer versus Non-Integer Frequency Ratios

UNIT-IV

Modulation of Single-Phase Voltage Source Inverters: Topology of a Single-Phase Inverter Three-Level Modulation of a Single-Phase Inverter Analytical Calculation of Harmonic Side band Modulation, Switched Pulse Position, Continuous Modulation, Discontinuous Modulation Losses, Switched Pulse Sequence, Discontinuous PWM

UNIT-V

Zero Space Vector Placement Modulation Strategies: Space Vector Modulation, Principles of Space Vector Modulation, SVM Compared to Regular Sampled PWM, Phase Leg References for Space Vector Modulation Naturally Sampled SVM, Analytical Solution for SVM, Harmonic Losses for SVM ,Placement of the Zero Space Vector, Discontinuous Modulation, 1200 Discontinuous Modulation, 600 and 300 Discontinuous Modulation

Text Books:

1. D. Grahame Holmes, Thomas A. Lipo, “Pulse width modulation of Power Converter: Principles and Practice”, John Wiley & Sons, 03-Oct-2003
2. J Ned Mohan, Undeland, Robbins, “Power electronics : converters, applications, and design” (John wiley and Sons 2003)

Course outcomes-

Students will be able to:

1. Learn different types of PWM schemes and their applications
2. Asses the THD for different types of PWM schemes
3. Choose suitable PWM scheme for different topologies of power electronic circuits

PSPE 24: ELECTRIC AND HYBRID VEHICLES

Instruction Hours/week: 3(L) **Credits: 3**
Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

History of hybrid and electric vehicles, Social and environmental importance of hybrid and electric vehicles, Impact of modern drive-trains on energy supplies, Basics of vehicle performance, vehicle power source characterization, Transmission characteristics, Mathematical models to describe vehicle performance

UNIT-II

Basic concept of hybrid traction, Introduction to various hybrid drive-train topologies, Power flow control in hybrid drive-train topologies, Fuel efficiency analysis.

UNIT-III

Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Introduction Motor drives configuration and control of Permanent Magnet Motor drives Configuration and control of Switch Reluctance, Motor drives, drive system efficiency

UNIT-IV

Matching the electric machine and the internal combustion engine (ICE) Sizing the propulsion motor, sizing the power electronics Selecting the energy storage technology, Communications, supporting subsystems

UNIT-V

Introduction to energy management and their strategies used in hybrid and electric vehicle, Classification of different energy management strategies Comparison of different energy management strategies Implementation issues of energy strategies

Text Books:

1. Sira -Ramirez, R. Silva Ortigoza, “Control Design Techniques in Power Electronics Devices”, Springer.
2. Siew-Chong Tan, Yuk-Ming Lai, Chi Kong Tse, “Sliding mode control of switching Power Converters”

Course outcomes-

Students will be able to:

1. Acquire knowledge about fundamental concepts, principles, analysis and design of hybrid and electric vehicles.
2. To learn electric drive in vehicles and traction

PSPE 25: REACTIVE POWER CONTROL AND MANAGEMENT

Instruction Hours/week: 3(L) **Credits: 3**
Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

The Steady State Reactive Power Control in Electrical Transmission Systems: Basics of Reactive Power Control, uncompensated transmission lines, compensated transmission lines, passive shunt compensation, series compensation

UNIT-II

Reactive Power Compensation and The Dynamic Performance of Transmission System: Introduction, passive shunt compensation, Static compensators, Synchronous condenser, characteristics, comparison of compensations

UNIT-III

Principles of Static Compensators: Introduction, Compensator applications, properties and types of static compensators, Thyritor controlled reactor(TCR) and types of compensation, Thyristor switched capacitor(TSC), SVC Schemes/Configurations, Fixed Capacitance (FC)

UNIT-IV

Demand Side Management: Load patterns – basic methods load shaping – power tariffs- KVAR based tariffs penalties for voltage flickers and Harmonic voltage levels
Distribution side Reactive power Management: System losses –loss reduction methods – examples – Reactive power planning – objectives –Economics Planning capacitor placement – retrofitting of capacitor banks

UNIT-V

User Side Reactive Power Management: KVAR requirements for domestic appliances – Purpose of using capacitors – selection of capacitors – deciding factors – types of available capacitor, characteristics and Limitations

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

Text Books:

1. Reactive Power Control in Electrical Power Systems by T. J. E. Miller
2. Reactive power Management by D.M.Tagare, Tata McGraw Hill,2004.(Units IV to V)

Course outcomes-

Students will be able to:

1. Understand the significance of reactive power control in power system and principles of various controllers.
2. To know about the importance of reactive power management and various management techniques employed in power system networks

PSCP 01: POWER SYSTEM STEADY STATE ANALYSIS LAB

Instruction Hours/week: 4(P) **Credits: 2**
Sessional Marks: 40 **Semester-End Examination: 60**

S.No	Experiments
1	Formation of Y_{BUS}
2	Formation of Z_{BUS}
3	Load Flow Studies – Gauss-Seidal method
4	Load Flow Studies – Newton Raphson method
5	Short Circuit Studies.
6	Transient Stability Studies.
7	Economic Load Dispatch
8	Load Forecasting and Unit Commitment

PSCP 02: RENEWABLE ENERGY LAB

Instruction Hours/week: 4(P) **Credits: 2**
Sessional Marks: 40 **Semester-End Examination: 60**

S.No	Experiments
1	Power Curves
2	Build a Wind Farm
3	Test the Capabilities of the Hydrogen Fuel Cells and Capacitors
4	Effect of Temperature on Solar Panel Output
5	Variables Affecting Solar Panel Output
6	Effect of Load on Solar Panel Output
7	Wind Turbine Output: The Effect of Load
8	Test the Capabilities of Solar Panels and Wind Turbines

PGPC 01: RESEARCH METHODOLOGY AND IPR

Instruction Hours/week: 2(L) **Credits: 2**
Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT-II

Effective literature studies approaches, analysis, Plagiarism, Research ethics

UNIT-III

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT-IV

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT. Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications

UNIT-V

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

References:

1. .Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & Engineering students"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition , "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
5. Mayall , "Industrial Design", McGraw Hill, 1992.
6. Niebel , "Product Design", McGraw Hill, 1974.
7. Asimov , "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

Course outcomes-

At the end of this course, students will be able to

1. Understand research problem formulation.
2. analyze research related information
3. follow research ethics
4. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understand that when IPR would take such important place in growth of individuals & nation, it

is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.

6. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

AUDIT COURSE-I

PGPA 11: ENGLISH FOR RESEARCH PAPER WRITING

Instruction Hours/week: 2(L) **Credits: 0**

Sessional Marks: 100 **Semester-End Examination: --**

UNIT-I

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

UNIT-II

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

UNIT-III

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature

UNIT-IV

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT-V

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

References :

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook .
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

Course outcomes :

At the end of the course, students will be able to

1. understand how to improve writing skills and level of readability
2. learn about what to write in each section
3. understand the skills needed when writing a Title

PGPA 12: DISASTER MANAGEMENT

Instruction Hours/week: 2(L) **Credits: 0**
Sessional Marks: 100 **Semester-End Examination: --**

UNIT I

Introduction

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT II

Repercussions Of Disasters And Hazards

Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Manmade disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT III

Disaster Preparedness And Management Preparedness

Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

UNIT IV

Risk Assessment Disaster Risk

Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.

UNIT V

Disaster Mitigation Meaning

Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

References:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L. , Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi.

Course outcomes:

At the end of the course, students will be able to:

1. Demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. Develop the standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in

PGPA 13: SANSKRIT FOR TECHNICAL KNOWLEDGE

Instruction Hours/week: 2(L) **Credits: 0**
Sessional Marks: 100 **Semester-End Examination: --**

UNIT I

Alphabets in Sanskrit, Past/Present/Future Tense

UNIT II

Simple Sentences Order

UNIT III

Introduction of roots

UNIT IV

Technical information about Sanskrit Literature

UNIT V

Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

References:

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Outcomes:

At the end of the course, students will be able to
1. understand basic Sanskrit language
2. understand the Ancient Sanskrit literature about science & technology
3. help to develop logic, being a logical language

PGPA 14: VALUE EDUCATION

Instruction Hours/week: 2(L) **Credits: 0**
Sessional Marks: 100 **Semester-End Examination: --**

UNIT I

Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgements.

UNIT II

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature ,Discipline

UNIT III

Personality - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness, Avoid fault Thinking. Free from anger, Dignity of labour.

UNIT IV

Behavior Development, Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

UNIT V

Character and Competence, Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence ,Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively

References:

1 Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

Course outcomes:

At the end of the course, students will be able to

1. acquire the knowledge of self-development
2. learn the importance of Human values
3. Develop the overall personality

M.TECH: POWER SYSTEMS - SECOND SEMESTER
SYLLABUS

PSPC 03: ADVANCED POWER SYSTEM PROTECTION

Instruction Hours/week: 3(L) **Credits: 3**
Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

Static Relays:

Fundamentals of static relays, Basic Block diagram and principle, Advantages of Static Relays, Types of static relays, Static Over-current relays, Differential relays, Percentage Differential relays, distance relays, characteristics of static relays.

UNIT-II

Comparators:

Need of comparators, General Equations of Comparators, Phase and amplitude Comparators, Analysis of Amplitude and Phase Comparators, Operating principles, Pilot relaying and Carrier current protection schemes, Multi Input Comparator circuits

UNIT-III

Protection of Transmission lines & Transformers:

Classification of protection schemes, zones of protection, 3–zone protection schemes, carrier aided distance schemes, switched distance schemes, Transformer protection, mal operation of relays, Harmonic Restraint relay, Wavelet applications in transformer protection, realization of Elliptical and Quadrilateral characteristics

UNIT-IV

Basic elements of Digital Protection:

Historical Developments in digital protection, performance and operational characteristics of digital protection, basic structure of digital relays, components of digital relay, signal conditioning subsystem, conversion subsystem, digital relay subsystem

UNIT-V

Digital Protection Of Power System Components:

New developments in relaying principles, Generator protection, Transmission lines protection, transformer protection, protection of bus bars, fundamentals of travelling wave protection and applications

Text Books:

1. A.G. Phadke and J. S. Thorp, “Computer Relaying for Power Systems”, Wiley/Research studies Press, 2009
2. A.T. Johns and S. K. Salman, “Digital Protection of Power Systems”, IEEE Press,1999
3. Gerhard Zeigler, “Numerical Distance Protection”, Siemens Publicis Corporate Publishing, 2006
4. S.R.Bhide “Digital Power System Protection” PHI Learning Pvt.Ltd.2014
5. Electrical Power Systems – C.L. Wadwa

Course outcomes-

Students will be able to:

1. Learn the importance of static Relays
2. Apply appropriate comparator
3. Learn about digital Protection

PSPC 04: POWER QUALITY

Instruction Hours/week: 3(L) **Credits: 3**
Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

Introduction-power quality-voltage quality-overview of power quality phenomena, classification of power quality issues-power quality measures and standards-THD-TIF-DIN-C Flicker factor transient phenomena-occurrence of power quality problems - power acceptability curves-IEEE guides, standards and recommended practices

UNIT-II

Harmonics-individual and total harmonic distortion, Triplen harmonics-important harmonic introducing devices, effect of power system harmonics on power system equipment and loads. Shunt capacitors-transformers-electric machines-ground systems - loads that cause power quality problems

UNIT-III

Power factor improvement- Passive Compensation, Passive Filtering, Resonance, Active Power Factor Correction, Control Methods for Single Phase APFC, Three Phase APFC and Control Techniques

UNIT-IV

Static VAR compensators-SVC and STATCOM Active Harmonic Filtering-Shunt Injection, Filter for single phase, three-phase three-wire and three-phase four- wire systems, series active power filtering techniques for harmonic cancellation and isolation

UNIT-V

Dynamic Voltage Restorers for sag, swell and flicker problems. Grounding and wiring introduction, NEC grounding requirements-reasons for grounding. typical grounding and wiring problems solutions to grounding and wiring problems

Text Books:

1. G.T. Heydt, “Electric power quality”, McGraw-Hill Professional, 2007
2. Math H. Bollen, “Understanding Power Quality Problems”, IEEE Press, 2000
3. J. Arrillaga, “Power System Quality Assessment”, John wiley, 2000
4. J. Arrillaga, B.C. Smith, N.R. Watson & A. R.Wood ,”Power system Harmonic Analysis”, Wiley, 1997

Course outcomes-

Students will be able to:

1. Acquire knowledge about the harmonics, harmonic introducing devices and effect of harmonics on system equipment and loads
2. To develop analytical modeling skills needed for modeling and analysis of harmonics in networks and components
3. To introduce the student to active power factor correction based on static VAR compensators and its control techniques
4. To introduce the student to series and shunt active power filtering techniques for harmonics

PROFESSIONAL ELECTIVE- III

PSPE 31: RESTRUCTURED POWER SYSTEMS

Instruction Hours/week: 3(L) **Credits: 3**
Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

Fundamentals of restructured system, Market architecture, Load elasticity, Social welfare maximization

UNIT-II

OPF: Role in vertically integrated systems and in restructured markets, congestion management

UNIT-III

Optimal bidding, Risk assessment, Hedging, Transmission pricing, Tracing of power

UNIT-IV

Ancillary services, Standard market design, Distributed generation in restructured markets, Developments in India

UNIT-V

IT applications in restructured markets, Working of restructured power systems, PJM, Recent trends in Restructuring

Text Books:

1. LorrinPhilipson, H. Lee Willis, "Understanding electric utilities and de-regulation", Marcel Dekker Pub.,1998.
2. Steven Stoft, "Power system economics: designing markets for electricity", John Wiley and Sons, 2002.
3. Kankar Bhattacharya, Jaap E. Daadler, Math H.J. Boolen, "Operation of restructured power systems", Kluwer Academic Pub., 2001.
4. Mohammad Shahidehpour, MuwaffaqAlomoush, "Restructured electrical power systems: operation, trading and volatility", Marcel Dekker.

Course outcomes-

Students will be able to:

1. Describe various types of regulations in power systems.
2. Identify the need of regulation and deregulation.
3. Define and describe the Technical and Non-technical issues in Deregulated Power Industry.
4. Identify and give examples of existing electricity markets.
5. Classify different market mechanisms and summarize the role of various entities in the market.

PSPE 32: ADVANCED DIGITAL SIGNAL PROCESSING

Instruction Hours/week: 3(L) **Credits: 3**
Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

Discrete time signals, Linear shift invariant systems-Stability and causality. Sampling of continuous time signals-Discrete time Fourier transform- Discrete Fourier series- Discrete Fourier transform, Z transform-Properties of different transforms

UNIT-II

Linear convolution using DFT, Computation of DFT Design of IIR digital filters from analog filters, Impulse invariance method, Bilinear transformation method

UNIT-III

FIR filter design using window functions, Comparison of IIR and FIR digital filters, Basic IIR and FIR filter realization structures, Signal flow graph representations Quantization process and errors, Coefficient quantisation effects in IIR and FIR filters

UNIT-IV

A/D conversion noise- Arithmetic round-off errors, Dynamic range scaling, Overflow oscillations and zeroInput limit cycles in IIR filters, Linear Signal Models

UNIT-V

All pole, All zero and Pole-zero models, Power spectrum estimation- Spectral analysis of deterministic signals, Estimation of power spectrum of stationary random signals

Text Books:

1. Sanjit K Mitra, "Digital Signal Processing: A computer-based approach ", TataMc Grow-Hill Edition1998
2. Dimitris G .Manolakis, Vinay K. Ingle and Stephen M. Kogon, "Statistical and Adaptive Signal Processing", Mc Grow Hill international editions. -2000

Course outcomes-

Students will be able to:

1. Knowledge about the time domain and frequency domain representations as well analysis of discrete time signals and systems
2. Study the design techniques for IIR and FIR filters and their realization structures.
3. Acquire knowledge about the finite word length effects in implementation of digital filters.
4. Knowledge about the various linear signal models and estimation of power spectrum of stationary random signals
5. Design of optimum FIR and IIR filters

PSPE 33: DYNAMICS OF ELECTRICAL MACHINES

Instruction Hours/week: 3(L) **Credits: 3**
Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

Stability, Primitive 4 Winding Commutator Machine, Commutator Primitive Machine, Complete Voltage Equation of Primitive 4 Winding Commutator Machine

UNIT-II

Torque Equation Analysis of Simple DC Machines using the Primitive Machine Equations, The Three Phase Induction Motor, Transformed Equations, Different Reference Frames for Induction Motor Analysis Transfer Function Formulation

UNIT-III

Three Phase Salient Pole Synchronous Machine, Parks Transformation, Steady State Analysis

UNIT-IV

Large Signal Transient, Small Oscillation Equations in State Variable form, Dynamical Analysis of Interconnected Machines

UNIT-V

Large Signal Transient Analysis using Transformed Equations, DC Generator /DC Motor System, Alternator /Synchronous Motor System

Text Books:

1. D.P. Sengupta& J.B. Lynn," Electrical Machine Dynamics", The Macmillan Press Ltd. 1980
2. R Krishnan "Electric Motor Drives, Modeling, Analysis, and Control", Pearson Education., 2001
3. P.C. Kraus, "Analysis of Electrical Machines", McGraw Hill Book Company,1987.
4. I. Boldia& S.A. Nasar,,"Electrical Machine Dynamics", The Macmillan Press Ltd. 1992
5. C.V. Jones, "The Unified Theory of Electrical Machines", Butterworth, London. 1967

Course outcomes-

Students will be able to:

1. Formulation of electro-dynamic equations of all electric machines and analyze the performance characteristics
2. Knowledge of transformations for the dynamic analysis of machines
3. Knowledge of determination of stability of the machines under small signal and transient conditions
4. Study about synchronous machine

PSPE 34: POWER APPARATUS DESIGN

Instruction Hours/week: 3(L) **Credits: 3**
Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

Principles of Design of Machines -Specific loadings, choice of magnetic and electric loadings, Real and apparent flux densities, temperature rise calculation, Separation of main dimension for DC machines, Induction machines and synchronous machines

Design of Transformers-General considerations, output equation, emf per turn, choice of flux density and current density, main dimensions, leakage reactance and conductor size, design of tank and cooling tubes

UNIT-II

Separation of main dimension for DC machines, Induction machines and synchronous machines, Heating and cooling of machines, types of ventilation, continuous and intermittent rating

UNIT-III

General considerations, output equation for induction machines, Choice of specific electric and magnetic loadings, efficiency, power factor, Number of slots in stator and rotor, Elimination of harmonic torques

UNIT-IV

Design of stator and rotor winding, slot leakage flux, Leakage reactance, equivalent resistance of Magnetizing current, efficiency from design data

UNIT-V

Types of alternators, comparison, specific loadings, output co-efficient, design of main dimensions, Introduction to Computer Aided Electrical Machine Design Energy efficient machines.

Text Books:

1. Clayton A.E, "The Performance and Design of D.C. Machines", Sir I. Pitman & sons, Ltd.
2. M.G. Say, "The Performance and Design of A.C. Machines ", Pitman
3. Sawhney A.K, "A course in Electrical Machine Design", DhanpatRai & Sons, 5th Edition

Course outcomes-

Students will be able to:

1. To give a systematic approach for design and analysis of all rotating machines under both transient and steady state conditions with the dimensions and material used
2. Ability to design all types of transformers and special machines

PSPE 35: OPERATION & CONTROL OF INTERCONNECTED POWER SYSTEMS

Instruction Hours/week: 3(L) **Credits: 3**

Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

Unit Commitment: Introduction, constraints in unit commitment, thermal unit constraints, unit commitment solution methods, priority-list methods, Dynamic-Programming solution, forward DP Approach, Lagrange relaxation solution. State Estimation-Power System State Estimation, Weighted Least Square Estimation, State Estimation of an AC Network

UNIT-II

Load Frequency Control: Necessity of keeping frequency constant, definition of control area, single area control, block diagram representation of an isolated power system, steady state analysis, dynamic response, uncontrolled case, load frequency control of 2-area system, uncontrolled case and controlled case, tie-line bias control

UNIT-III

Generation with Limited Energy Supply: Introduction, take-or-pay fuel supply contract, composite generation production cost function, solution by gradient search techniques, hard limits and slack variables, fuel scheduling by linear programming

UNIT-IV

Hydro thermal Coordination: Introduction, long range hydro scheduling, short-range hydro-scheduling, hydroelectric plant models, scheduling problems, types of scheduling problems, scheduling energy, the short term hydro-thermal scheduling problem, short term hydro scheduling, gradient approach, pumped storage hydro plants, dynamic programming solution to the hydrothermal scheduling problem

UNIT-V

Interchange of Power and Energy: Introduction, economy interchange between interconnected utilities, inter-utility economy energy evaluation, interchange evaluation with unit commitment, multiple-utility interchange transactions, types of interchange, capacity interchange, diversity interchange, emergency power interchange, inadvertent power exchange, power pools, transmission effects and issues, problems

Text Books:

1. Power Generation Operation and Control, Allen J. Wood, Bruce F.Wollenberg, 2nd ed. John Wiley & Sons Inc. 2006.
2. Electrical Energy Systems Theory , O.I.Elgerd, Tata McGraw-Hill Publishing Company Ltd, 2nd edition.
3. Modern Power System Analysis, I.J. Nagrath& D.P. Kothari, TMH,3rd edition, 9th reprint, 2007

Course outcomes-

Students will be able to:

1. Acquire knowledge on unit commitment, load frequency control, optimum operation, scheduling and coordination of hydrothermal plants, economic generation and power and energy interchange.
2. Solve unit commitment, load frequency control, hydrothermal and fuel scheduling and economy interchange problems using various solution methods.
3. Select and apply appropriate methods to operate inter connected power systems most economically and at constant frequency by optimum utilization of fuels at different loads.

PROFESSIONAL ELECTIVE- IV

PSPE 41: POWER SYSTEM DYNAMICS-II

Instruction Hours/week: 3(L) **Credits: 3**
Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

Basic Concepts of Dynamic Systems and Stability Definition, Small Signal Stability (Low Frequency Oscillations) of Unregulated and Regulated System

UNIT-II

Effect of Damper, Flux Linkage Variation and AVR

UNIT-III

Large Signal Rotor Angle Stability, Dynamic Equivalents And Coherency, Direct Method of Stability Assessment, Stability Enhancing Techniques, Mitigation Using Power System Stabilizer

UNIT-IV

Dynamic Analysis of Voltage Stability- Generator-Load Example. Load Modelling. Effect of Load-Dynamics on Voltage Stability Power Flow Analysis. Continuation Methods. Optimization or Direct Methods. Timescale Decomposition Mitigation of Voltage Stability Problems

UNIT-V

Voltage Collapse, Frequency Stability, Automatic Generation Control, Primary and Secondary Control, Sub-Synchronous Resonance and Counter Measures

Text Books:

1. P. Kundur, "Power System Stability and Control", McGraw Hill Inc, 1994
2. J. Machowski, Bialek, Bumby, "Power System Dynamics and Stability", John Wiley & Sons, 1997
3. L. Leonard Grigsby (Ed.); "Power System Stability and Control", Second edition, CRC Press, 2007
4. V. Ajjarapu, "Computational Techniques for voltage stability assessment & control"; Springer, 2006

Course outcomes-

Students will be able to:

1. Gain valuable insights into the phenomena of power system including obscure ones.
2. Understand the power system stability problem.
3. Analyze the stability problems and implement modern control strategies.
4. Simulate small signal and large signal stability problems.

PSPE 42: ADVANCED MICRO-CONTROLLER BASED SYSTEMS

Instruction Hours/week: 3(L) **Credits: 3**
Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

Basic Computer Organization, Accumulator based Processes-Architecture, Memory Organization-I/O Organization

UNIT-II

Micro-Controllers-Intel 8051, Intel 8056- Registers, Memories, I/O Ports, Serial Communication, Timers, Interrupts, Programming

UNIT-III

Intel 8051 – Assembly language programming, Addressing-Operations, Stack & Subroutines, Interrupts-DMA

UNIT-IV

PIC 16F877- Architecture Programming, Interfacing Memory/ I/O Devices, Serial I/O and data communication

UNIT-V

Digital Signal Processor (DSP), Architecture – Programming, Introduction to FPGA, Microcontroller development for motor control applications, Stepper motor control using micro controller

Text Books:

1. John.F.Wakerly: "Microcomputer Architecture and Programming", John Wiley and Sons 1981
2. Ramesh S.Gaonker: "Microprocessor Architecture, Programming and Applications with the 8085", Penram International Publishing (India), 1994
3. Raj Kamal: "The Concepts and Features of Microcontrollers", Wheeler Publishing, 2005
4. Kenneth J. Ayala, "The 8051 microcontroller", Cengage Learning, 2004
5. John Morton," The PIC microcontroller: your personal introductory course", Elsevier, 2005
6. Dogan Ibrahim," Advanced PIC microcontroller projects in C: from USB to RTOS with the PIC18F Series", Elsevier, 2008
7. Microchip datasheets for PIC16F877

Course outcomes-

Students will be able to:

1. To learn how to program a processor in assembly language and develop an advanced processor based system
2. To learn configuring and using different peripherals in a digital system
3. To compile and debug a Program
4. To generate an executable file and use it

PSPE 43: SCADA SYSTEM AND APPLICATIONS

Instruction Hours/week: 3(L) **Credits: 3**

Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

Introduction to SCADA, Data acquisition systems, Evolution of SCADA, Communication technologies, Monitoring and supervisory functions

UNIT-II

Industries SCADA System Components, Schemes- Remote Terminal Unit (RTU), Intelligent Electronic Devices(IED), Programmable Logic Controller (PLC), Communication Network, SCADA Server, SCADA/HMI Systems

UNIT-III

SCADA Architecture, Various SCADA architectures, advantages and disadvantages of each system, single unified standard architecture -IEC 61850

UNIT-IV

SCADA Communication, various industrial communication technologies, wired and wireless methods and fiber optics, Open standard communication protocols

UNIT-V

SCADA Applications**:** Utility applications, Transmission and Distribution sector operations, monitoring, analysis and improvement, Industries - oil, gas and water, Case studies, Implementation, Simulation Exercises

Text Books:

1. Stuart A. Boyer: "SCADA-Supervisory Control and Data Acquisition", Instrument Society of America Publications,USA,2004
2. Gordon Clarke, Deon Reynders: "Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems", Newnes Publications, Oxford, UK,2004
3. William T. Shaw, "Cybersecurity for SCADA systems", PennWell Books, 2006
4. David Bailey, Edwin Wright, "Practical SCADA for industry", Newnes, 2003
5. Michael Wiebe, "A guide to utility automation: AMR, SCADA, and IT systems for electric power", PennWell 1999

Course outcomes-

Students will be able to:

1. Describe the basic tasks of Supervisory Control Systems (SCADA) as well as their typical applications
2. Acquire knowledge about SCADA architecture, various advantages and disadvantages of each system
3. Knowledge about single unified standard architecture IEC 61850
4. To learn about SCADA system components: remote terminal units, PLCs, intelligent electronic devices, HMI systems, SCADA server

PSPE 44: ARTIFICIAL INTELLIGENCE TECHNIQUES

Instruction Hours/week: 3(L) **Credits: 3**
Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

Biological foundations to intelligent Systems, Artificial Neural Networks, Single layer and Multilayer Feed Forward NN, LMS and Back Propagation Algorithm, Feedback networks and Radial Basis Function Networks

UNIT-II

Fuzzy Logic, Knowledge Representation and Inference Mechanism, Defuzzification Methods

UNIT-III

Fuzzy Neural Networks, some algorithms to learn the parameters of the network like GA

UNIT-IV

System Identification using Fuzzy and Neural Network

UNIT-V

Genetic algorithm, Reproduction cross over, mutation, Introduction to evolutionary program, Applications of above mentioned techniques to practical problems

Text Books:

1. J M Zurada , "An Introduction to ANN",Jaico Publishing House
2. Simon Haykins, "Neural Networks", Prentice Hall
3. Timothy Ross, "Fuzzy Logic with Engg. Applications", McGraw. Hill
4. Driankov, Dimitra, "An Introduction to Fuzzy Control", Narosa Publication
5. Golding, "Genetic Algorithms", Addison-Wesley Publishing Com

Course outcomes- Students will be able to:

1. Learn the concepts of biological foundations of artificial neural networks
2. Learn Feedback networks and radial basis function networks and fuzzy logics
3. Identifications of fuzzy and neural network
4. Acquire the knowledge of GA

PSPE 45: EMBEDDED SYSTEMS

Instruction Hours/week: 3(L) **Credits: 3**

Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

Introduction: Processor embedded into system, Embedded Hardware Units, Embedded Software in a system, Embedded system-on-Chip(SOC), Design process, Classification of embedded systems

UNIT-II

8051 and Advanced Processor architecture, Memory Organization and Real- World Interfacing: 8051 architecture, Real world interfacing, Introduction to advanced architecture, Processor and memory organization, Instruction-level-parallelism, Performance matrices, Processor selection, Memory selection

UNIT-III

Devices and Communication buses for Devices and network: I/O types and examples, serial communication devices, Parallel device ports, Wireless devices, Timer and Counting devices, Watch dog timer, real time clock

UNIT-IV

Device Drivers and Interrupts service Mechanism. Programmed I/O Busy- Approach with interrupt service mechanism, ISR concept, Interrupt sources, Interrupt handling mechanism, multiple interrupts, DMA, Device driver programming

UNIT-V

Real-Time- Operating systems: OS Services, Process management, Timer functions, Event functions, Memory management, Real- time Operating systems, Basic design using an RTOS. Introduction to Real time Operating Systems: Windows CE, OSEK, Linux 2.6.X and RT Linux

Text Books:

1. Raj Kamal, "Embedded Systems" (T M H), 2008.
2. Peter Marwedel, "Embedded System Design" – Springer Verlog, 2006.
3. Jane W. S. Liu, "Real time Systems", -Pearson Education, 2000

Course outcomes-

Students will be able to:

1. Program embedded system with 8051 as processor.
2. Understand different types of communication through, parallel ports, wireless
3. Understand significance of device drivers and interrupt mechanism
4. Understand features of different types of real time OS.

PSCP 03: POWER SYSTEM PROTECTION LAB

Instruction Hours/week: 4(P) **Credits: 2**

Sessional Marks: 40 **Semester-End Examination: 60**

S.No	Experiments
1	Introduction to Power System Protection
2	Impact of Induction Motor Starting on Power System
3	Modelling of Differential Relay using MATLAB
4	Radial Feeder Protection
5	Parellel Feeder Protection
6	Principle of Reverse Power Protection
7	Differential Protection of Transformer
8	To the study time vs.voltage characteristics of over voltage induction relay

PSCP 04: ARTIFICIAL INTELLIGENCE LAB

Instruction Hours/week: 4(P) **Credits: 2**
Sessional Marks: 40 **Semester-End Examination: 60**

S.No	Experiments
1	Write A Program For Best First Search
2	Write A Program to Generate the output for A* Algorithm.
3	Write a Program To Show the Tic Tac Toe Game for 0 and X.
4	Write A Program For Expert System By Using Forward Chaining.
5	Comparing the Search Methods
6	Implement the Greedy Search Algorithm
7	Implement the min-max Algorithm
8	Adding a Heuristic

AUDIT COURSE-II

PGPA 21: CONSTITUTION OF INDIA

Instruction Hours/week: 2(L) **Credits: 0**
Sessional Marks: 100 **Semester-End Examination: --**

UNIT- I

History and philosophy of the Indian Constitution

History -Drafting Committee, (Composition & Working) - Preamble - Salient Features

UNIT- II

Contours of Constitutional Rights & Duties: Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT - III

Organs of Governance: Parliament – Composition - Qualifications and Disqualifications - Powers and Functions, Executive President – Governor - Council of Ministers - Judiciary, Appointment and Transfer of Judges, Qualifications - Powers and Functions

UNIT- IV

Local Administration:

District's Administration Head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: ZilaPachayat. Elected officials and their roles, CEO ZilaPachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

UNIT- V

Election Commission: Election Commission: Role and Functioning - Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning.
Institute and Bodies for the welfare of SC/ST/OBC and women.

References:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes:

At the end of the course, students will be able to discuss
1. The growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. The intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. The circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. The passage of the Hindu Code Bill of 1956

PGPA 22: PEDAGOGY STUDIES

Instruction Hours/week: 2(L) **Credits: 0**

Sessional Marks: 100 **Semester-End Examination: --**

UNIT- I

Introduction and Methodology:

Aims and rationale, Policy background, Conceptual framework and terminology, Theories of learning, Curriculum, Teacher education, Conceptual framework, Research questions, Overview of methodology and Searching.

UNIT- II

Thematic overview:

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

UNIT- III

Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT- IV

Professional development: alignment with classroom practices and follow-up support, Peer support, Support from the head teacher and the community. Curriculum and assessment, Barriers to learning: limited resources and large class sizes

UNIT- V

Research gaps and future directions:

Research design, Contexts, Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact.

References:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign. 7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course Outcomes:

At the end of the course, students will be able to understand

1. The pedagogical practices being used by teachers in formal and informal classrooms in developing countries.
2. the evidence on the effectiveness of these pedagogical practices
3. Learns how teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.

PGPA 23: STRESS MANAGEMENT BY YOGA

Instruction Hours/week: 2(L) **Credits: 0**
Sessional Marks: 100 **Semester-End Examination: --**

UNIT- I

Definitions of Eight parts of yog. (Ashtanga)

UNIT- II

Yam - Ahinsa, satya, astheya, bramhacharya and aparigraha

UNIT- III

Niyam - Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

UNIT- IV

Asan - Various yog poses and their benefits for mind & body

UNIT - V

Pranayam - Regularization of breathing techniques and its effects-Types of pranayam 8

References:

1. 'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami Yogabhyasi Mandal, Nagpur

2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata

Course Outcomes:

At the end of the course, students will be able to

1. develop healthy mind in a healthy body thus improving social health also
2. improve efficiency

PGPA 24: PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT

SKILLS

Instruction Hours/week: 2(L) **Credits: 0**
Sessional Marks: 100 **Semester-End Examination: --**

UNIT- I

Neetisatakam-Holistic development of personality
Verses- 19,20,21,22 (wisdom) - Verses- 29,31,32 (pride & heroism) - Verses- 26,28,63,65 (virtue)

UNIT- II

Verses- 52,53,59 (dont's) - Verses- 71,73,75,78 (do's)

UNIT- III

Approach to day to day work and duties.
Shrimad BhagwadGeeta : Chapter 2-Verses 41, 47,48- Chapter 3-Verses 13, 21, 27, 35 - Chapter 6-Verses 5,13,17, 23, 35 - Chapter 18-Verses 45, 46, 48.

UNIT- IV

Statements of basic knowledge.
Shrimad BhagwadGeeta: Chapter2-Verses 56, 62, 68 - Chapter 12 -Verses 13, 14, 15, 16,17, 18

UNIT-V

Personality of Role model. Shrimad BhagwadGeeta: Chapter2-Verses 17 - Chapter 3-Verses 36,37,42 Chapter 4 - Verses 18, 38,39 - Chapter18 – Verses 37,38,63.

References :

1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Course Outcomes :

At the end of the course, students will be able to

1. develop personality and achieve the highest goal in life
2. lead the nation and mankind to peace and prosperity
3. Help in developing versatile personality.

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

M.TECH: POWER SYSTEMS - THIRD SEMESTER

SYLLABUS

PROFESSIONAL ELECTIVE- V

PSPE 51: FACTS AND CUSTOM POWER DEVICES

Instruction Hours/week: 3(L) **Credits: 3**

Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

Reactive power flow control in Power Systems, Control of dynamic power unbalances in Power System - Power flow control, Constraints of maximum transmission line loading, Benefits of FACTS Transmission line compensation, Uncompensated line -Shunt compensation, Series compensation Phase angle control, Reactive power compensation, Shunt and Series compensation principles

UNIT-II

Static versus passive VAR compensator, Static shunt compensators: SVC and STATCOM, Operation of TSC, TCR and STATCOM, Comparison between SVC and STATCOM

UNIT-III

Static series compensation: TSSC, SSSC - TCVR and TCPAR principle of Operation, GCSC, TCSC and Static synchronous series compensators operation

UNIT-IV

SSR and its damping, Unified Power Flow Controller Circuit, Arrangement Operation of UPFC, Introduction to interline power flow controller.

UNIT-V

Power quality problems in distribution systems, passive filters, active filtering – shunt , series and hybrid, Voltage swells , sags, flicker, unbalance and mitigation of these problems by power line conditioners, IEEE standards on power quality.

Text Books:

1. Padiyar, “FACTS Controllers in Power Transmission and Distribution”, New Age InternationalPublishers, 2007
2. X P Zhang, C Rehtanz, B Pal, “Flexible AC Transmission Systems- Modelling and Control”, SpringerVerlag, Berlin, 2006
3. N.G. Hingorani, L. Gyugyi, “Understanding FACTS: Concepts and Technology of Flexible
4. ACTransmission Systems”, IEEE Press Book, Standard Publishers and Distributors, Delhi, 2001.
5. K.S.Sureshkumar ,S.Ashok , “FACTS Controllers & Applications”, E-book edition, Nalanda DigitalLibrary, NIT Calicut,2003
6. G T Heydt , “Power Quality”, McGraw-Hill Professional, 2007
7. T J E Miller, “Static Reactive Power Compensation”, John Wiley and Sons, Newyork, 1982.

Course outcomes-

Students will be able to:

1. Acquire knowledge about the fundamental principles of Passive and Active Reactive Power Compensation Schemes at Transmission and Distribution level in Power Systems.
2. Learn various Static VAR Compensation Schemes like Thyristor/GTO Controlled Reactive Power Systems, PWM_Inverter based Reactive Power Systems and their controls.
3. To develop analytical modeling skills needed for modeling and analysis of such Static VAR Systems.

PSPE 52: INDUSTRIAL LOAD MODELING AND CONTROL

Instruction Hours/week: 3(L) **Credits: 3**
Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

Electric Energy Scenario-Demand Side Management-Industrial Load Management, Load Curves-Load Shaping Objectives, Methodologies-Barriers, Classification of Industrial Loads, Continuous and Batch processes -Load Modeling

UNIT-II

Electricity pricing – Dynamic and spot pricing -Models, Direct load control- Interruptible load control, Bottom up approach- scheduling- Formulation of load Models, Optimization and control algorithms - Case studies

UNIT-III

Cooling and heating loads, load profiling, Modeling- Cool storage, Types-Control strategies, Optimal operation, Problem formulation- Case studies

UNIT-IV

Captive power units, Operating and control strategies, Power Pooling- Operation models, Energy banking, Industrial Cogeneration

UNIT-V

Selection of Schemes Optimal Operating Strategies, Peak load saving, Constraints Problem formulation- Case study, Integrated Load management for Industries

Text Books:

1. C.O. Bjork " Industrial Load Management - Theory, Practice and Simulations", Elsevier, the Netherlands,1989
2. C.W. Gellings and S.N. Talukdar,. Load management concepts. IEEE Press, New York, 1986, pp. 3-28
3. Y. Manichaikul and F.C. Schweppe ," Physically based Industrial load", IEEE Trans. on PAS, April 1981
4. H. G. Stoll, "Least cost Electricity Utility Planning", Wiley Interscience Publication, USA, 1989.
5. I.J.Nagarath and D.P.Kothari, .Modern Power System Engineering., Tata McGraw Hill publishers, NewDelhi, 1995
6. IEEE Bronze Book- "Recommended Practice for Energy Conservation and cost effective planning in Industrial facilities", IEEE Inc, USA

Course outcomes-

Students will be able to:

1. Knowledge about load control techniques in industries and its application
2. Learn different types of industrial processes and optimize the process using tools like LINDO and LINGO
3. Apply load management to reduce demand of electricity during peak time 4: Apply different energy saving opportunities in industries

PSPE 53: POWER SYSTEM TRANSIENTS

Instruction Hours/week: 3(L) **Credits: 3**
Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

Fundamental circuit analysis of electrical transients, Laplace Transform method of solving simple Switching transients, Damping circuits-Abnormal switching transients, Three-phase circuits and transients, Computation of power system transients

UNIT-II

Principle of digital computation – Matrix method of solution, Modal analysis- Z transform-Computation using EMTP, Lightning, switching and temporary over voltages, Lightning, Physical phenomena of lightning

UNIT-III

Interaction between lightning and power system, Influence of tower footing resistance and Earth Resistance, Switching: Short line or kilometric fault, Energizing transients - closing and re-closing of lines, line dropping, load rejection – over voltages induced by faults

UNIT-IV

Switching HVDC line Travelling waves on transmission line, Circuits with distributed Parameters Wave Equation, Reflection, Refraction, Behaviour of Travelling waves at the line terminations Lattice Diagrams – Attenuation and Distortion, Multi-conductor system and Velocity wave

UNIT-V

Protective devices, Protection of system against over voltages, lightning arresters, substation earthling

Text Books:

1. Allan Greenwood, “Electrical Transients in Power System”, Wiley & Sons Inc. New York, 1991

Course outcomes-

Students will be able to:

1. Knowledge of various transients that could occur in power system and their mathematical formulation
2. Ability to design various protective devices in power system for protecting equipment and personnel
3. Coordinating the insulation of various equipments in power system
4. Modelling the power system for transient analysis

PSPE 54: DYNAMICS OF LINEAR SYSTEMS

Instruction Hours/week: 3(L) **Credits: 3**
Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

State Variable Analysis: Concepts of state, state variables, state vector and state variable representation of systems – Mathematical Modeling of systems, transfer function and transfer function matrix, solutions of state equations – Homogeneous and Non-homogeneous.

UNIT-II

Controllability and Observability: Controllability tests for continuous time systems, Observability tests for continuous time systems, Minimal realization of MIMO systems, analysis of linear time varying systems, the concepts of stability

UNIT-III

Time Response of Linear system: controllability by state variable feedback – pole placement by state feedback design - state observers – observer design – Full order and reduced order – asymptotic observers for state measurements – stabilization by output feedback.

UNIT-IV

Stability: Lyapunov functions and its properties, Lyapunov stability analysis, stability analysis of linear systems – estimating the transient response behavior of dynamic systems.

UNIT-V

State variable analysis of discrete systems: solution of state equations, controllability and observabilty, stability analysis using Lyapunov method, State feedback of linear discrete time systems

Text Books:

1. Thomas Kailath, "Linear Systems", Prentice Hall Inc., Englewood Cliffs, N.J. 1980.
2. K. Ogata, "State Space Analysis of Control Systems", Prentice Hall Inc., Englewood Cliffs, N.J., 1965.
3. K. Ogata, "Modern Control Engineering, (second edition)" , Prentice Hall Inc., Englewood Cliffs, N.J., 1990
4. M.Gopal, "Digital Control and State Variable Methods", Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997
5. C.T. Chen, "Linear System Theory and Design", New York: Holt Rinehart and Winston ,1984
6. R.C. Dorf, and R. T. "Bishop, Modern Control Systems", Addison Wesley Longman Inc., 1999.

Course outcomes-

Students will be able to:

1. To learn linear system modeling, analysis and design so as to obtain the ability to apply the same to engineering problems in a global perspective
2. Design observers and controllers for linear systems
3. Acquire Knowledge of discrete time linear systems modeling, analysis and design.
4. Know the stability analysis using Lyapunov methods

PSPE 55: MODELING AND ANALYSIS OF HVDC TRANSMISSION SYSTEMS

Instruction Hours/week: 3(L) **Credits: 3**

Sessional Marks: 40 **Semester-End Examination: 60**

UNIT-I

Analysis of HVDC Converters: Pulse number – choice of converter configuration – simplified analysis of graetz circuit – converter bridge characteristics.

Converter and HVDC system control : Principles of DC link control – converter control characteristics – system control hierarchy – firing angle control – current and extinction angle control – starting and stopping of DC link power control

UNIT-II

Components for the analysis of AC/DC systems: General – converter model – converter control – modeling of DC networks – modeling of AC Networks.

Power flow analysis in AC/DC systems: Modeling of DC links – solution of DC load flow –per unit system for DC quantities – solution of AC/DC power flows.

UNIT-III

Transient stability Analysis – Converter model – Converter control models – DC network models – solution methodology – Direct methods for stability Evaluation.

Dynamic Stability and power modulation: Power modulation for damping low frequency oscillations – Basic principles – practical consideration in the application of power modulation controllers – Gamma or reactive power modulation – power modulation in MTDC system – voltage stability in AC/DC system

UNIT-IV

Harmonic and Torsional Interactions: Harmonic Interactions – Torsion Interactions – Torsional interactions with in HVDC systems – counter measures to torsion interactions with DC systems.

Simulation of HVDC systems: System simulation – philosophy & Tools – HVDC system simulation – modeling of HVDC systems

UNIT-V

Digital dynamic simulation of converters and DC systems : Valve model, Gate pulse generation – generation of control voltage – transformer model – converter model – transient simulation of DC and AC systems

Text Books:

1. HVDC power transmission systems – Technology & system interaction – by KR. Padiyar published by WE limited

Course outcomes-

Students will be able to:

1. Gain the knowledge on Converter and HVDC system control, Harmonic and Tortional interactions
2. Appreciate different components for the analysis of AC-DC systems and their power flow analysis
3. Be aware of Transient Stability and Dynamic Stability and power modulation of AC-DC systems
4. Simulate HVDC systems and Converters

OPEN ELECTIVES

PGOE 11: BUSINESS ANALYTICS

Instruction Hours/week: 3(L) **Credits: 3**

Sessional Marks: 40 **Semester-End Examination: 60**

UNIT- I

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

UNIT- II

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics technology.

UNIT- III

Organization Structures of Business analytics, Team management, Management Issues, designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear optimization.

UNIT- IV

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

UNIT- V

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.
Recent Trends in : Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

References:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

Course outcomes:

At the end of the course, students will demonstrate
1. The knowledge of data analytics.
2. The ability of think critically in making decisions based on data and deep analytics.
3. The ability to use technical skills in predicative and prescriptive modeling to support business decision-making.
4. The ability to translate data into clear, actionable insights.

PGOE 12: INDUSTRIAL SAFETY

Instruction Hours/week: 3(L) **Credits: 3**

Sessional Marks: 40 **Semester-End Examination: 60**

UNIT- I

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT- II

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT-III

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT- IV

Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in achine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT- V

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

References:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

Course outcomes:

At the end of the course, students will be able to

1. Understand the preventive steps for industrial safety
2. Apply the corrosion prevention methods
3. Find the causes and tracking of faults in machine tools and equipment
4. Understand the periodic and preventive maintenance of mechanical and electrical equipment

PGOE 13: OPERATIONS RESEARCH

Instruction Hours/week: 3(L) **Credits: 3**

Sessional Marks: 40 **Semester-End Examination: 60**

UNIT- I

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

UNIT- II

Formulation of a LPP - Graphical solution revised simplex method- duality theory - dual Simplex method - sensitivity analysis - parametric programming

UNIT- III

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

UNIT- IV

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

UNIT -V

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

References:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

Course Outcomes:

At the end of the course, students will be able to
1. Apply the dynamic programming to solve problems of discreet and continuous variables.
2. Apply the concept of non-linear programming
3. Carry out sensitivity analysis
4. Model the real world problem and simulate it.

PGOE 14: COST MANAGEMENT OF ENGINEERING PROJECTS

Instruction Hours/week: 3(L) **Credits: 3**

Sessional Marks: 40 **Semester-End Examination: 60**

UNIT- I

Introduction and Overview of the Strategic Cost Management Process, Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

UNIT- II

Project: meaning, Different types, why to manage, cost overruns centers, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents, Project team: Role of each member. Importance Project site: Data required with significance.

UNIT- III

Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning,

UNIT- IV

Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

UNIT- V

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

References:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

Course outcomes:

At the end of the course, students will be able to

1. Understand the cost concepts in decision - making
2. Commission, execute and manage Engineering projects
3. Apply the quality management techniques in the execution of projects
4. Apply the quantitative techniques for cost management of projects

PGOE 15: COMPOSITE MATERIALS

Instruction Hours/week: 3(L) **Credits: 3**

Sessional Marks: 40 **Semester-End Examination: 60**

UNIT–I:

INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT – II:

REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

UNIT – III:

Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT–IV

Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT – V:

Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

References:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R.Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.
3. Hand Book of Composite Materials-ed-Lubin.
4. Composite Materials – K.K.Chawla.
5. Composite Materials Science and Applications – Deborah D.L. Chung.
6. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

Course outcomes:

At the end of the course, students will be able to

1. Demonstrate the characteristics of composite materials and composite performance
2. Understand the use of fibres as reinforcement
3. Understand the manufacturing process of metal and polymer matrix composites
4. Demonstrate the failure criteria

PGOE 16: ENERGY GENERATION FROM WASTES

Instruction Hours/week: 3(L) **Credits: 3**

Sessional Marks: 40 **Semester-End Examination: 60**

UNIT- I

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNIT- II

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT- III

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT- IV

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, design, construction and operation - Operation of all the above biomass combustors.

UNIT- V

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production Urban waste to energy conversion - Biomass energy programme in India.

References:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

Course outcomes :

At the end of the course, students will be able to
1. Demonstrate the energy generation from wastes
2. Understand the biomass pyrolysis and gasification
3. Design, construct and operate biomass combustors
4. Develop bio-energy system.