IS-EPEPS-101T

Advanced Power Electronics

(Code No. EIDC 101T/EIPS101T/EPEPS 101T)

(Common to M.Tech CBCS Industrial Drives and Control IDC , M.Tech CBCS Power Electronics and Power System PEPS and M.Tech CBCS Integrated Power System IPS)

Unit-I: Power Semiconductor Devices

Characteristics, protection and industrial applications of power devices. Various pulse width modulation techniques for different converter topologies.

Unit-II: AC-AC Converters

Introduction, single and three-phase ac–ac voltage controllers, Cyclo-converter, Matrix converters, application of ac-ac converters.

Unit-III: DC-DC Converters

Introduction, step-down converters- Buck, transformer version of buck converters, step up converters, Buck-Boost converters, application of dc to dc converters

Unit IV-: Resonant and soft switching converters

Introduction, classification, resonant switch-ZC Resonant switch, ZV Resonant switch, Quasi resonant converters, multi resonant converters, load resonant converters and their applications.

Unit V-: DC-AC converters

Introduction, classification, single-phase VSI (Half & Full Bridge), Three -phase VSI with SPWM, SVPWM, Selective harmonic elimination, SPWM with zero sequence signal injection with industrial applications.

Text Books:

1. "Power electronics handbook by Muhammad Rashid , Academic Press.
2. "Modern Power Electronics" by P. C. Sen , A. H. Wheeler Publishing Co.
3. "Thyristorized Power Controller " by Dubey , Joshi Doradla Sinha PHI Publication

Reference Books:

1. "Power Electronics" Cyril W Lander ,MHL
2. "Power Electronics", Ned Mohan, Tora M. Udeland, William P. Riobbins, John Wiley & sons
3. Related IEEE Papers / NPTEL Lectures.

IS-EPEPS-102T

Power System Modeling

(Code No. EIPS102T/EPEPS 102T)

(Common to M.Tech CBCS Power Electronics and Power System PEPS and M.Tech CBCS Integrated Power System IPS)

UNIT-I: Synchronous Machine Modeling
Description of a Synchronous Machine: Basic Synchronous Machine parameters, Voltage generation, Open-circuit voltage, Armature reaction, Terminal Voltage, Power delivered by generator.

UNIT-II: Synchronous Machine Modeling
Per unit system and normalization: Equations of a synchronous machine: Stator circuit equations, Stator self, Stator mutual and stator to rotor mutual inductances, The Park's transformation, Flux-linkage equations, Voltage and current equations for stator and rotor in dq0 coordinates, Phasor representation, Steady state analysis, Transient & sub-transient analysis, Equivalent Circuits for direct and quadrature axes, Transient & sub-transient inductances and Time constants.

UNIT-III: Excitation and prime-mover controllers
Excitation system, excitation system modeling, excitation system–standard block diagram, prime mover control system, examples.

UNIT-IV: Transmission line Modeling&Load Modeling
Introduction, derivation of terminal V, I relations, waves on transmission lines, transmission matrix, lumped circuit equivalent, simplified models, complex power transmission (short line, radial line, long or medium lines).Basic load- modeling concept, static load models, dynamic load model, acquisition of load model parameters.

UNIT-V : Transformer modeling & the per unit system
Introduction, single phase transformer model , three phase transformer connection , per phase analysis, p.u. normalization, p.u. three phase quantities, p.u. analysis of normal system , regulating transformer for voltage & phase angle control.

Text Books:
1. Power System Analysis: Arthur R. Bergen, Vijay Vithal, Pearson Education Asia
2. Power System Control and Stability: Anderson P. M. and Fouad A. A., Galgotia Publications,(1981).
3. Generalized Theory of Machine: P. S. Bimbra, Vol. 2, Khanna Publishers (1987)
4. Power System Stability and Control: Kundur, P., McGraw Hill Inc., (1994).

Reference Books:
1. Power System Dynamics, Stability and Control: Padiyar K. R., Interline Publishing Private Ltd., Banglore (1998).
2. Power System Analysis Operation and Control: 3rd ed., A. Chakrabarti, S. Halder, PHI, Eastern Economy Edition.

IS-EPEPS-103T

ADVANCE CONTROL THEORY

(Code No. EIDC 103T/ EPEPS 103T)

(Common to M.Tech CBCS Industrial Drives and Control IDC and M.Tech CBCS Power Electronics and Power System PEPS)

Unit-I

State Variable : Analysis, Controllability and Observability

Unit-II

Digital Control Systems, Models of Digital control Devices, State description of Digital processors and sampled continuous time plants, discretization of digital continuous time state equations, Solution of state difference equation, Stability By Bilinear Transformation & Jury's Test.

Unit-III

Controllability and observability tests for digital control systems, Stability of discrete time Systems, Pulse transfer function and its realization, Stability improvement by state feedback, Pole-placement design and state observers.

Unit-IV

Lyapunov Stability Analysis: Basic concepts, Stability definitions, Stability Theorems, Lyapunov functions for linear and non-linear systems.

Unit-V

Optimal Control: Parameter optimization techniques, Lagrange parameter techniques, Calculus of variations, Unconstrained and Constrained minimization of functional, Two point boundary value problems, Pontrygin's minimum principle, Optimal regulator and tracking problems, Optimal digital control systems.

Reference Books

1. M.Gopal.; Digital Control and State Variable Methods; Tata McGraw Hill, New Delhi, 1997.
2. D.E. Kirk.; Optimal Control Theory; Prentice Hall, 1970.
3. M.Gopal.; Digital Control Engineering; Wiley Eastern, 1988.
4. B.C. Kuo.; Digital Control System Engineering; Saunders College publishing, 1992.
5. Advanced Control System ,First Edition, M. Rihan

IS-EPEPS-104T Elective I-(1)

Power System Dynamics and Control

(Code No. EIPS104T (1) / EPEPS 101T(1))

(Common to M.Tech CBCS Power Electronics and Power System PEPS and M.Tech CBCS Integrated Power System IPS

Unit-I

Representation of Power System: Elements like Synchronous machines, transformers, transmission lines, power semiconductor devices, loads, power system load flow, short circuit studies and power system stability studies using MATLAB-SIMULINK PSCAD, CAPS softwares.

Unit-II

Transient Stability Problem, Augmentation of Transient Stability by Discrete Supplementary Controls, Concept of resynchronization with discrete phase rotation for improvement in transient stability.

Unit-III

Fault analysis of large power systems, Transient stability – Review of classical methods, Dynamic and transient stability investigations and simulation of single machine infinite bus and multi-machine systems.

Unit-IV

Transient stability by step by step solution of swing equation, Euler's & modified Euler's method, Runga-kutta method, Transient state phasor diagram of synchronous machine.**Effects of various types of disturbances**, parameters and controls on stability, Effect of excitation control. Excitation system modeling, standard block diagram of excitation system.

Unit-V

Augmentation of stability by conventional methods, second swing instability, problems on salient pole synchronous generator. Effect of turbine governor control, simple block diagram,

Text Books:

1. Padiyar K.R.; Power System Dynamics, Stability and Control; B.S. Publications, Hyderabad 2002
2. Kimbark, E.W.; Power system stability, Vol. I & III, John Wiley & Sons, New York 2002
Stagg G.W. & El-Abiad A.H.; Computer Methods in Power System Analysis, McGraw Hill Co., Ltd., Tokyo

IS-EPEPS-104T Elective I-(2)

Application of Microcontroller in Electrical System

(Code No. EIDC 104T(2) / EIPS104T(2) /EPEPS 101T(2))

(Common to M.Tech CBCS Industrial Drives and Control IDC ,M.Tech CBCS Power Electronics and Power System PEPS and M.Tech CBCS Integrated Power System IPS)

Unit- I: Review of Microprocessor 8085/8086

Introduction To 16 Bit Microprocessors, 8086/8088 CPU Architecture,Memory Organization,Floating point arithmetic,Bus structure & timings,8086/8088 Instruction Set.

Unit-II: Microcontroller 8031/8051

Microcontroller: 8051 Architecture/ Pin Diagram,Special Function Register (SFR), Internal RAM/ROM, 8051 Instruction Set,Interrupts, Assembly Language Programming and their application,Interfacing to External Memory,Programming Techniques for looping, indexing,counting & bit manipulation,

Unit-III: Basic I/O Interfacing Concept

Memory mapped I/O programmable peripherals,I/O mapped I/O programmable peripherals,Introduction to PPI 8254/8255, Architecture,Modes of operation of 8255,Interfacing of peripherals with 8255,Introduction to PIC 8259, Architecture,Modes of operation of 8259,Interfacing of peripherals with 8259,Interfacing of keyboard & display ,ADC/DAC, USART.

Unit-IV: Interfacing of Microcontroller 8031/8051

Interfacing with ADC/DAC display, interfacing with Keyboard,Interfacing with LCD Display & Stepper Motor with 8251,Power factor improvements, Introduction to DSP processor & its application to power system, Generation of PWM signals using Timer/Counter. Harmonics analysis, FFT etc.

Unit-V: Microcontroller dsPIC33EP256MC202

Microcontroller: Architecture/ Pin Diagram, General Input/output ports, Control Registers for PPS, Interrupts, Oscillator, Timer, Generation of High Speed PWM. Applications to Motor Speed Control, AC-DC, DC-AC Conversion, Battery Charger, UPS, INVERTER, and Power factor Correction.

Text Books:

1. Hall: Microprocessor & Interfacing,: Programming & Hardware; Mc-Graw Hill Books.
2. Gaonkar: Microprocessor Architecture, programming Application with 8085,penram international publishing(India)
3. Texas Instruments DSPs.
4. Bhupendra Singh Chhabra: 8086/8088 Microprocessor Architecture Programming, Design & Interfacing, Dhanpat Rai & Sons.
5. Ramakant Gaikwad: Op-amps & Linear IC's; Prentice Hall of India
6. Kenneth J. Ayala: The 8051 Microcontroller-Architecture, Programming & Application: penram international publishing(India)
7. Muhammad Ali Mazidi: The 8051 Microcontroller and Embedded Systems Using Assembly & C:Second Edition : Pearson Publication.
8. Data sheets of dspIC33EPMC202.

IS-EPEPS-104T Elective I-(3)

Micro and Smart grid

(Code No. EIDC104T(3) / EIPS104T(3) /EPEPS 101T(3))

(Common to M.Tech CBCS Industrial Drives and Control IDC ,M.Tech CBCS Power Electronics and Power System PEPS and M.Tech CBCS Integrated Power System IPS)

Unit-I:MICROGRIDS

Concept and definition of microgrid, microgrid drivers and benefits, review of sources of microgrids, typical structure and configuration of a microgrid, AC and DC microgrids, Power Electronics interfaces in DC and AC microgrids, communication infrastructure, modes of operation and control of microgrid: grid connected and islanded mode, Active and reactive power control, protection issues, anti-islanding schemes: passive, active and communication based techniques

Unit-II:POWER QUALITY ISSUES IN MICROGRIDS

Power quality issues in microgrids- Modeling and Stability analysis of Microgrid, regulatory standards, Microgrid economics, Introduction to smart microgrids.

Unit-III: INTRODUCTION TO SMART GRID

Basics of Power Systems: Load and Generation Power Flow Analysis, Economic Dispatch and Unit Commitment Problems, Smart Grid: Definition, Applications, Government and Industry, Standardization,Functions of Smart Grid Components-Wholesale energy market in smart grid-smart vehicles in smart grid.

Unit-IV:SMART GRID COMMUNICATIONS AND MEASUREMENT TECHNOLOGY

Communication and Measurement - Monitoring, Phasor Measurement Unit (PMU), Smart Meters, Wide area monitoring systems (WAMS)- Advanced metering infrastructure- GIS and Google Mapping Tools,IP-based Systems , Network Architectures

UNIT V - RENEWABLE ENERGY AND STORAGE

Renewable Energy Resources-Sustainable Energy Options for the Smart Grid-Penetration and Variability Issues Associated with Sustainable Energy Technology-Demand Response Issues-Electric Vehicles and Plug-in Hybrids-PHEV Technology-Environmental Implications-Storage Technologies-Grid integration issues of renewable energy sources.

Text books/REFERENCES:

1. James Momoh, “Smart Grid: Fundamentals of design and analysis”, John Wiley & sons Inc, IEEE press 2012.
2. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, “Smart Grid: Technology and Applications”, John Wiley & sons inc, 2012.
3. Fereidoon P. Sioshansi, “Smart Grid: Integrating Renewable, Distributed & Efficient Energy”, Academic Press, 2012.
4. Clark W.Gellings, “The smart grid: Enabling energy efficiency and demand response”, Fairmont Press Inc, 2009.

IIS-EPEPS-201T

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HVDC and FACTS

(High voltage DC and Flexible AC Transmission System)

(Code No. EIPS 201T/EPEPS 201T)

(Common to M.Tech CBCS Power Electronics and Power System PEPS and M.Tech CBCS Integrated Power System IPS)

Unit I: HVDC Technologies

Developments in HVDC Technology, types of HVDC systems, equipments required for HVDC systems, comparison of HVDC system with AC systems in terms of technical performance, reliability of HVDC systems, comparison of HVDC link with EHVAC link, HVDC-VSC transmission systems.

Unit II: Rectifier and Inverter of HVDC systems

Rectifier and inverter operation, two valve, two/three valve, three/four valve operation, voltage current equations, control chart. Control techniques of HVDC converter and systems.

Unit III: Multi terminal HVDC system and FACTS

Multi terminal HVDC systems:Types, parallel operation, operation and control, control of power, faults and protection. Multi terminal networks for non conventional power sources. Flexible AC Transmission System (FACTS): Their role in power system, types of FACTS controller, principle of series and shunt controllers.

Unit IV: Shunt and series FACTS controllers

Shunt controllers: Objectives, static switched capacitor, Thyristor controlled rectifier and STATCOM. Serious controllers: Objectives, GTO thyristor controlled series capacitor, thyristor controlled series capacitor, thyristor controlled series compensators (TCSC), static synchronous series compensator (SSSC)

Unit V: Other FACTS controller

Working principle, control strategies and application of: Unified power flow controller (UPFC), interline power flow controller (IPFC)

Text / Reference Books:

1. S. Kamakshaiah, V. Kamaraju, "HVDC TRANSMISSION,"McGraw Hill Education (India) Private Limited, New Delhi, 2011
2. K. R. Padiyar, "HVDC POWER TRANSMISSION SYSTEMS,"New Age International Publishers, 2012
3. Narain G. Hingorani, Laszlo Gyugyi,"Understanding FACTS concept and technology of Flexible AC Transmission Systems,"IEEE PRESS, WILEY INDIA EDITION, 2000

4. K. R. Padiyar, "FACTS CONTROLLERS IN POWER TRANSMISSION AND DISTRIBUTION,"NEW AGE INTERNATIONAL PUBLISHERS, 2007

IIS-EPEPS-202T

Power Quality

(Code No. EIPS 202T/EPEPS 202T)

(Common to M.Tech CBCS Power Electronics and Power System PEPS and M.Tech CBCS Integrated Power System IPS)

UNIT-1: Introduction

Characterization of Electric Power Quality: Transients, short duration and long duration voltage variations, Voltage imbalance, waveform distortion, Voltage fluctuations, Power frequency variation, Power acceptability curves – power quality problems: poor load power factor, Nonlinear and unbalanced loads, DC offset in loads, Notching in load voltage, Disturbance in supply voltage – Power quality standards.

UNIT-2: Non Linear Loads

Single phase / Three phase static converters, Battery chargers, Arc furnaces, Fluorescent lighting, pulse modulated devices, Adjustable speed drives.

UNIT-3: Analysis and Conventional Mitigation Methods

Analysis of power outages, Analysis of unbalance: Symmetrical components of phasor quantities, Instantaneous symmetrical components, Instantaneous real and reactive powers, Analysis of distortion: On– line extraction of fundamental sequence components from measured samples – Harmonic indices.

UNIT-4 : Voltage Sag

Analysis of voltage sag: Detorit Edison sag score, Voltage sag energy, Voltage Sag Lost Energy Index (VSLEI)- Analysis of voltage flicker, Reduced duration and customer impact of outages, Classical load balancing problem: Open loop balancing, Closed loop balancing, current balancing, Harmonic reduction, Voltage sag reduction.

UNIT-5: Power Quality Improvement

Utility-Customer interface –Harmonic filters: passive,–Custom power devices: Network reconfiguring Devices, Load compensation using DSTATCOM, Voltage regulation using DSTATCOM, protecting sensitive loads using DVR, UPQC – control strategies: P-Q theory, Synchronous detection method – Custom power park – Status of application of custom power devices.

Text books:

1 Power Quality Enhancement Using Custom Power Devices 2002 ArindamGhosh Kluwer Academic Publishers
2 Electric Power Quality 1994(2nd edition) G.T.Heydt Stars in a Circle Publications
3 Power Quality Edition (Year of publication) R.C. Duggan

Reference books:

1 Power system harmonics A.J. Arrillga
2 Power electronic converter harmonics Derek A. Paice

IIS-EPEPS-203T

Advanced Drives

(Code No. EPEPS 203T)

UNIT –I Dynamics of Electric Drives: Basic elements of an electric drives, Classification of electric drives, Stability consideration of electric drives.

UNIT–II: SINGLE-PHASE CONTROLLED RECTIFIERS FED DC MOTOR
Separately excited DC motors with rectified single –phase supply – single-phase semi converter and single phase full converter for continuous and discontinuous modes of operation – power and power factor.

UNIT–III: THREE-PHASE CONTROLLED RECTIFIERS FED DC MOTOR
Three-phase semi converter and Three phase full converter for continuous and discontinuous modes of operations – power and power factor - Addition of Free wheeling diode – Three phase double converter. Three phase controlled bridge rectifier with passive load impedance, resistive load and ideal supply – Highly inductive load and ideal supply for load side and supply side quantities, shunt capacitor compensation, three phase controlled bridge rectifier inverter.

UNIT–IV: CHOPPER CONTROLLED DC MOTOR DRIVES
Principle of operation of the chopper – Four – quadrant chopper circuit – Chopper for inversion – Chopper with other power devices – model of the chopper – input to the chopper – steady state analysis of chopper controlled DC motor drives – rating of the devices – Pulsating torque. **Closed loop operation:** Speed controlled drive system – current control loop – pulse width modulated current controller – hysteresis current controller – modeling of current controller – design of current controller.

UNIT–V: SIMULATION OF DC MOTOR DRIVES
Dynamic simulations of the speed controlled DC motor drives – Speed feedback speed controller – command current generator – current controller.

REFERENCES:
1. Power Electronics and motor control – Shepherd, Hulley, Liang – II Edition Cambridge University Press.
2. Electronic motor drives modeling Analysis and control – R. Krishnan – I Edition Prentice Hall India.
3. Power Electronics circuits, Devices and Applications – MH Rashid – PHI – 1 Edition 1995.
4. Fundamentals of Electric Drives – GK Dubey Narosa Publishers 1995
5. Power Semiconductor drives – SB Dewan and A Straughen -1975.
6.Bridges I. & Nasar S.A.; Electric Machine Dynamics Macmilan Publishing Company, NY,1986.

7. Krishnan, R.; Electric Motor Drives, Modelling, Analysis and Control; Prentice Hall India, 2003.

IIS-EIPS-204T Elective III-(1)

Energy Audit and Management

(Code No. EIDC 204 T(1) /EIPS204 T(1) /EPEPS 204T(1))

(Common to M.Tech CBCS Industrial Drives and Control IDC , M.Tech CBCS Power Electronics and Power System PEPS and M.Tech CBCS Integrated Power System IPS)

Unit-I- Energy Scenario: Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance, Energy Conservation Act-2001 and its Features. Basics of Energy and its various forms, Material and Energy balance

Unit II- Energy Management & Audit: Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution, Energy audit Instruments energy management, Roles and responsibilities of energy Manager and Accountability, Financial analysis techniques, Financing options, Energy performance contracts and role of ESCOs. Defining monitoring & targeting, Elements of monitoring & targeting, Data and information-analysis, Techniques energy consumption, Production, Cumulative sum of differences.

Unit III-Energy Efficiency in Electrical system: Electricity billing, Electrical load management and maximum demand Control, Maximum demand controllers; Power factor improvement, Automatic power factor controllers, efficient operation of transformers, Energy efficient transformers; Induction motors efficiency, motor retrofitting, energy efficient motors, Soft starters, Variable speed drives; Performance evaluation of fans and pumps, Flow control strategies and energy conservation opportunities in fans and pumps, Energy efficiency measures in lighting system, Electronic ballast, Occupancy sensors, and Energy efficient lighting controls. Factors affecting selection of DG system, Energy performance assessment of diesel conservation avenues

Unit IV:-Energy Conservation in Thermal Systems -Types of boilers, Combustion in boilers, Performances evaluation, Feed water treatment, Blow down, Energy conservation opportunities in boiler, Properties of steam, Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system, Identifying opportunities for energy savings. Classification, General fuel economy measures in furnaces, Excess air, Heat Distribution, Temperature control, Draft control, Waste heat recovery. Insulation-types and application, Economic thickness of insulation, Heat savings and application criteria.Introduction, Mechanism of fluidized bed combustion, Advantages, Types of FBC boilers, Operational features, Retrofitting FBC system to conventional boilers, saving potential. HVAC system: Coefficient of performance, Capacity, Factors affecting Refrigeration and Air conditioning system performance and savings opportunities. Classification and Advantages of Waste Heat Recovery system, analysis of Waste heat recovery for Energy saving opportunities

Unit V: Energy Performance Assessment: On site Performance evaluation techniques, Case studies based on: Motors and variable speed drive, Fans and pumps, HVAC system calculations; Lighting System: Installed Load Efficacy Ratio (ILER) method. Financial Analysis: simple payback period, NPV, IRR,

Text Books:

1. Handbook of Electrical Installation Practice. , By Geofry Stokes, Blackwell Science
2. Designing with light: Lighting Handbook., By Anil Valia, Lighting System
3. Energy Management Handbook., By W.C. Turner, JohnWiley and Sons
4. Handbook on Energy Audits and Management.Edited by Amit Kumar Tyagi, Tata Energy Research Institute (TERI).
5. Energy Management Principles., By C.B.Smith, Pergamon Press
6. Energy Conservation Guidebook., Dale R. Patrick, Stephen Fardo, Ray E.Richardson,Fairmont Press
7. Handbook of Energy Audits., By Albert Thumann,William J. Younger, Terry Niehus, CRC Press

IIS-EIPS-204T Elective III-(2)

Converters for Non Conventional Energy Sources

(Code No. EIDC 204 T(2) /EIPS204 T(2) /EPEPS 204T(2))

(Common to M.Tech CBCS Industrial Drives and Control IDC , M.Tech CBCS Power Electronics and Power System PEPS and M.Tech CBCS Integrated Power System IPS)

UNIT- 1:**Introduction**

Wind Energy Conversion (WEC) system, Photovoltaic (PV) based Power conversion system. Introduction to converter in WEC and PV system.Modes of Operation of Converters; Grid Connection Mode, Stand-Alone Mode,Battery Charging Mode.

UNIT- 2 **Analysis of Wind and PV Systems**

Standalone operation of fixed and variable speed wind energy conversion systems and solar PV system. Gridconnection Issues,operation of Grid integrated PMSG, SCIG and DFIG Based WECS.Grid Integrated solar PV system.

UNIT- 3:**Converter Topologies**

Topologiesfor two-Level Converter and three level converters.Modulation Strategies-Pulse WidthModulation, Carrier-Based Strategies, Space Vector Strategies.

UNIT- 4:**Photovoltaic Inverter Structures**

Inverter Structures Derived from H-Bridge Topology; Basic Full-Bridge Inverter, H5 Inverter (SMA), HERIC Inverter (Sunways), REFU Inverter Summary of H-Bridge Derived Topologies. Inverter Structures Derived from NPC Topology Neutral Point Clamped (NPC) Half-Bridge

Inverter;NPC Inverter, Summary of NPC-Derived Inverter Topologies, Three-Phase PV Inverters, Control Structures, Conclusions and Future Trends.

UNIT-5:**Converter Structures for Wind Turbine Systems**
Introduction, WTS Power Configurations, Grid Power Converter Topologies; Single-Cell Voltage source converters, Multicell (Interleaved or Cascaded) converters and back to back converters, WTS Control; Generator-Side Control Grid side Control, Future trends in wind conversion system converters.

Text Books:

1. Modern Power Electronics by P.C. Sen AH Wheeler Publication
2. Power Electronics hand book By Rashid M.H. Academic Press
3. Non Conventional Energy Sources by G.D.Rai Khanna Publishers.
4. Grid Converter for Photovoltaic and Wind Power Systems by Remus Teodorescu,Marco Liserre,
   Pedro Rodr´ ıguez IEEE Press John Viley and Sons
5. Power Electronics Converter for Microgrids by Suleiman M. Sharkh, Mohammad A. Abusara, Georgios I. Orfanoudakis IEEE Press John Wiley and Sons
6. Power Electronics by Ned Mohan, Tora M. Udeland,William P. Robbins John Wiley and Sons
7. Non Conventional Energy Sources by B.H.Khan Mc Graw Hill

IIS-EIPS-204T Elective III-(3)

Power System Planning

(Code No. EIPS204 T (3))

UNIT-1: Introduction
Introduction of power planning, National and Regional Planning, structure of P.S., planning tools, Electricity Regulation

UNIT-2: Load Forecasting & Generation Planning
Electrical Forecasting, forecasting techniques modeling. Generation planning, Integrated power generation cogeneration/captive power, Power pooling and power trading.

UNIT-3 : Transmission planning and Power System Economics
Transmission and distribution planning, Power system Economics, Power sector finance, financial planning, private participation Rural Electrification investment, concept of Rational tariffs.

UNIT-4: Reliability

Power supply Reliablity, Reliability planning, Reliability evaluation, Functional zones, Generation reliability, Generation & Transmission reliability, Quality of Supply.

UNIT-5 : System Operation & Environmental Aspects in Planning

System operation planning, load management, load prediction, reactive power balance, online power flow studies, state estimation, computerized management, power system simulator. Computer aided planning, wheeling, Environmental effects, Greenhouse effect, Technological impacts, Insulation coordination, Reactive compensation.

Text books:

1 Electrical Power System Planningby A.S.Pabla Macmillan India Ltd.
2 Power Generations, Operation & Control 2011 Allen J. Wood, B.F. Wollenberg Wiley India, Reprint
3 Modern Power System Analysis 4 th Edition D.P. Kothari, I.J. Nagrath Tata Mcgraw Hill Education Pvt. Ltd

IS-EIPS-105T Elective III-(1)

Artificial Intelligence

(Open Elective III from Electrical Engineering Board)

(Code No. PG OPEN 105 T ( ))

Unit 01: Introduction to Artificial Neural Network:

Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Historical Developments. Essentials of Artificial Neural Networks: Artificial Neuron Model, operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures

Unit 02: Classification Taxonomy of ANN:

Connectivity, Neural Dynamics (Activation and Synaptic), Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules. Perceptron Models: Training Algorithms: Discrete and Continuous Perceptron Networks, Perceptron Convergence theorem. Multilayer feed forward Neural Networks

Unit 03: Memory:

Associative Memory, Bi-directional Associative Memory (BAM) Architecture, BAM Training Algorithms: Storage and Recall Algorithm, BAM Energy Function, Self-Organizing Maps (SOM) and Adaptive Resonance Theory (ART).

Unit 04: Introduction to Fuzzy Logic system:

Fuzzy versus crisp, fuzzy sets: membership function, Basic fuzzy set operations, properties of fuzzy sets, fuzzy relations. Fuzzy Control**,** Predicate logic (Interpretation of predicate logic formula, Inference in predicate logic), fuzzy logic (Fuzzy quantifiers, fuzzy Inference), fuzzy rule based system, defuzzification methods

Unit 05: Introduction to other intelligent tools:

Introduction to Genetic Algorithm: biological background, GA operators, selection, encoding, crossover, mutation, chromosome. Expert System: software architecture, rule base system.

Text Books:

1. Simon Haykin, "Neural Networks: A Comprehensive Foundation", 2nd Edition, Pearson Education
2. S. Rajsekaram, G. A. Vijayalaxmi Pai, "Neural Networks, Fuzzy Logic & Genetic Algorithms Synthesis & Applications", Practice Hall India
3. James A. Anderson, "An Introduction to Neural Networks", Practice Hall India Publication
4. Mohamed H. Hassoun, "Fundamentals of Artificial Neural Network", Practice Hall India

Reference books:

1. Kelvin Waruicke, Arthur Ekwlle, Raj Agarwal, "AI Techniques in Power System", IEE London U.K.
2. S. N. Sivanandam, S. Sumathi, S. N. Deepa, "Introduction to Neural Network Using MATLAB 6.0", Tata McGraw Hill
3. Jacek Zurada, "Introduction to Artificial Neural Network", Jaico Publishing House India

IS-EIPS-105T Elective III-(2)

Utilization of Electrical Energy

(Open Elective III from Electrical Engineering Board)

(Code No. PG OPEN 105 T ( ))

UNIT-I

ELECTRIC DRIVES:

Type of electric drives, choice of motor, starting and running characteristics, speed control, temperature rise, Particular applications of electric drives, Types of industrial loads, continuous, Intermittent and variable loads, load Equalization.

UNIT-II

ELECTRIC HEATING: Advantages and methods of electric heating, resistance heating, induction heating and dielectric heating.

UNIT-III

ELECTRIC WELDING: Electric welding, resistance and arc welding, electric welding equipment, comparison between A.C. and D.C. Welding.

UNIT-IV

ILLUMINATION FUNDAMENTALS & VARIOUS ILLUMINATION METHODS:

Introduction, terms used in illumination, laws of illumination, polar curves, photometry, integrating sphere, sources of light. Discharge lamps, MV and SV lamps – comparison between tungsten filament lamps and fluorescent tubes, Basic principles of light control, Types and design of lighting and flood ighting.

UNIT-V

ELECTRIC TRACTION: System of electric traction and track electrification. Review of existing electric traction systems in India. Special features of traction motor, methods of electric braking-plugging rheostatic braking and regenerative braking, Mechanics of train movement. Speed-time curves for different services – trapezoidal and quadrilateral speed time curves. Calculations of tractive effort, power, specific energy consumption for given run, effect of

varying acceleration and braking retardation, adhesive weight and braking retardation adhesive weight and coefficient of adhesion.

TEXT BOOKS:

1. J.B. Gupta, "Utilization of Electric Power and Electric Traction", Kataria & Sons publishers, Delhi, IX Edtion, 2004.
2. C.L. Wadhwa, "Generation, Distribution and Utilization of electrical Energy", New Age International (P) Limited Publishers, 3rd Edition, 2010.

REFERENCES:

1. N.V. Suryanarayana, "Utilization of Electrical Power including Electric drives and Electric traction", New Age International (P) Limited Publishers, 1st Edition,1994.
2. E. Open Shaw Taylor, "Utilization of Electric Energy", Orient Longman,1st Edition,1937.

IIIS-EIPS-301T Open Elective IV

PLC & SCADA

(Open Elective IV from Electrical Engineering Board)
(Code No. PG OPEN 301 T ( ))

Unit 01: Introduction to PLC

Role of automation in Industries, benefits of automation, Necessity of PLC, History and evolution of PLC, Definition, types, selection criterion, Overall PLC system, PLC Input and output modules (along with Interfaces), CPU, programmers and monitors, power supplies, Solid state memory , advantages and disadvantages

Unit 02: Programming of PLC

Programming equipment, Various techniques of programming, Ladder diagram fundamentals, proper construction of ladder diagram, basic components and their symbols in ladder diagram, MCR (master control relay) and control zones, Boolean logic and relay logic Timer and counter-types along with timing diagrams, shift registers, sequencer function, latch instruction Arithmetic and logical instruction with various examples

Unit 03: Advance PLC function

Input ON/OFF switching devices, Input analog devices, Output ON/OFF devices, Output analog devices, programming ON/OFF Inputs to produce ON/OFF outputs. Analog PLC operation, PID control of continuous processes, simple closed loop systems, problems with simple closed loop systems, closed loop system using Proportional, Integral & Derivative (PID), PLC interface, and Industrial process example.

Unit 04: Applications of PLC

PLC interface to various circuits : Encoders, transducer and advanced sensors (Thermal, Optical, Magnetic, Electromechanical, Flow, Level sensors) Measurement of temperature, flow, pressure, force, displacement, speed, level Developing a ladder logic for Sequencing of motors, Tank level

control, ON OFF temperature control, elevator, bottle filling plant, car parking Motors Controls: AC Motor starter, AC motor overload protection, DC motor controller, Variable speed (Variable Frequency) AC motor Drive.

Unit 05: SCADA Systems:

Introduction, definitions and history of Supervisory Control and Data Acquisition, typical SCADA system Architecture, Communication requirements, Desirable Properties of SCADA system, features, advantages, disadvantages and applications of SCADA. SCADA Architectures (First generation - Monolithic, Second generation - Distributed, Third generation – Networked Architecture), SCADA systems in operation and control of interconnected power system, Power System Automation (Automatic substation control and power distribution), Petroleum Refining Process, Water Purification System, Chemical Plant. Interfacing of SCADA with PLC.

Text Books:

1. Gary Dunning, "Introduction to Programmable Logic Controllers", Thomson, 2nd Edition
2. John R. Hackworth, Frederick D., Hackworth Jr., "Programmable Logic Controllers Programming Methods and Applications", PHI Publishers
3. John W. Webb, Ronald A. Reis, "Programmable Logic Controllers: Principles and Application", PHI Learning, New Delhi, 5th Edition
4. Ronald L. Krutz, "Securing SCADA System", Wiley Publications.
5. Stuart A Boyer, "SCADA supervisory control and data acquisition", ISA, 4th Revised edition
6. Sunil S. Rao, "Switchgear and Protections", Khanna Publications.
7. L.A. Bryan, E. A. Bryan, "Programmable Controllers Theory and Implementation" Industrial Text Company Publication, Second Edition

Reference books:

1. Batten G. L., "Programmable Controllers", McGraw Hill Inc., Second Edition
2. Bennett Stuart, "Real Time Computer Control", Prentice Hall, 1988
3. Doebelin E. O., "Measurement Systems", McGraw-Hill International Editions, Fourth Edition, 1990 4. Gordan Clark, Deem Reynders, "Practical Modern SCADA Protocols", ELSEVIER
5. Krishna Kant, "Computer Based Industrial Control", PHI
6. M. Chidambaram, "Computer Control of Process", Narosha Publishing
7. P. K. Srivstava, "Programmable Logic Controllers with Applications", BPB Publications
8. Poppovik, Bhatkar, "Distributed Computer Control for Industrial Automation", Dekkar Publications
9. S. K. Singh, "Computer Aided Process Control", PHI
10. Webb J. W, "Programmable Controllers", Merrill Publishing Company, 1988

IIIS-EIPS-301T Open Elective IV

Digital Control System

(Open Elective IV from Electrical Engineering Board)

(Code No. PG OPEN 301 T ( ))

Unit 01: Discrete systems and Signals

Standard discrete test signals, Basic operations on signals. Classification of discrete systems. Detail analysis of frequency aliasing & quantization, Brief review of Sampling theorem, Ideal low pass filter. Transfer function of ZOH, Frequency domain characteristics of ZOH, First order hold, frequency domain characteristics of first order hold.

Unit 02: Stability Analysis

Brief review of pulse transfer function, mapping between S-plane and Z-plane, constant frequency loci and constant damping ratio loci. Stability analysis of closed loop system in the Z-Plane. Jury's stability test, Stability analysis by use of Bilinear transformation & Routh Stability Criterion. Digital compensator design using frequency response (Bode plot).

Unit 03: State - Space analysis

Conversion of Pulse transfer functions to State space model and vice a versa. Solution of LTI Discrete –time state equation; State Transition Matrix (STM) and properties of STM; Computation of STM by Z-transform method, by power series expansion method, by Cayley Hamilton theorem, by Similarity transformation method, Discretization of continuous time state space equation.

Unit 04: Design using state space

Controllability and observability of linear time invariant discrete-data system, Tests for Controllability and obervability; Principal of Duality; Effect of pole- zero cancellation; Relationship between controllability, observability and stability. Pole placement design using linear state-feedback. State estimation and full order observer design. Ackermann's formula.

Unit 05: Digital control system applications

Hybrid system simulation, Computer program structure for simulation of discrete time control of continuous time plant. Digital temperature control, position control, Stepper motor control, Block diagram presentation and control algorithms.

Text Books:

1. K. Ogata, "Discrete Time Control System", 2nd Edition, PHI Learning Pvt. Ltd. 2009
2. B. C. Kuo, "Digital Control Systems", 2nd Edition, Oxford University Press
3. M. Gopal, "Digital Control Engineering", New Age International Publishers
4. M. Gopal, "Digital Control and State Variable Methods", 3rd Edition The McGraw Hill Co.

Reference books:

1. Load D. Landau, Gianluca Zito, 'Digital Control Systems: design, Identification and Implementation' Springer.

2. Mohammed Santina, Allen Stubberud, Gene Hostetter ‘Digital control System Design’, Sanders College publishing.
3. K.J. Astrom, B Wittenmark ‘Computer Controlled Systems: Theory and Design’ Prentice-Hall Inc New Jersey , 2011 Dover .