COURSE STRUCTURE & SYLLABUS

For

PRE-PH.D.

IN

ELECTRICAL AND ELECTRONICS ENGINEERING

(Engineering & Technology)

(2021-2022)

CHAITANYA (DEEMED TO BE UNIVERSITY)

Kishanpura, Hanamkonda, Warangal Urban, Telangana-506001

www.chaitanya.edu.in

PAPER -I

RESEARCH METHODOLOGY

Common to All Science Research Programs(Effective from 2021–2022)

Number of Contact hours:40
Credits: 4 **Marks: 100**

OBJECTIVE: This paper highlights the various postulates of research problems, research design, writing a thesis and modern statistical methods. This helps to carry out research problem individually in a perfect scientific method.

UNIT-I: MEANING OF RESEARCH - FUNCTION OF RESEARCH

MEANING OF RESEARCH: Function of Research – Characteristics of Research – Steps involved in Research – Research in Pure and Applied Sciences - Inter Disciplinary Research, Factors which hinder Research – Significance of Research - Research and scientific methods – Research Process– Criteria of good Research – Problems encountered by Researchers – Literature review

Identification of Research Problem Selecting the Research problem – Necessity of defining the problem – Goals and Criteria for identifying problems for research, Perception of Research problem – Techniques involved in defining the problem – Source of problems – Personal consideration.

UNIT-II: RESEARCH DESIGN

FORMULATION OF RESEARCH DESIGN: Need for Research design – Features of a good design- Important concept related to Research design. Different research designs – Basic principles of experimental designs – Computer and internet in designs.

DATA COLLECTION AND ANALYSIS: Execution of the research - Observation and Collection of data - Methods of data collection – Sampling Methods- Data Processing and Analysis strategies - Data Analysis with Statistical Packages - Hypothesis-testing - Generalization and Interpretation

UNIT-III: REPORTING AND THESIS WRITING

Structure and components of scientific reports - Types of report – Technical reports and thesis – Significance – Different steps in the preparation – Layout, structure and Language of typical reports – Illustrations and tables. Bibliography, referencing and footnotes - Oral presentation – Planning – Preparation – Practice – Making presentation – Use of visual aids - Importance of effective communication

UNIT-IV: STATISTICAL TECHNIQUES AND TOOLS

Introduction of statistics – Functions – Limitations – Measures of central tendency - Arithmetic mean – Median – Mode – Standard deviation – Co-efficient of variation (Discrete serious and continuous serious) – Correlation - Regression – Multiple Regression. Sampling distribution – Standard error – Concept of point and interval estimation – Level of significance – Degree of freedom – Analysis of variance – One way and two way classified data – 'F'-test

UNIT-V: APPLICATIONS OF RESULTS AND ETHICS

Environmental impacts - Ethical issues - ethical committees - Commercialization – Copyright – royalty - Intellectual property rights and patent law – Trade Related aspects ofIntellectual Property Rights – Reproduction of published material – Plagiarism - Citation and acknowledgement - Reproducibility and accountability.

TEXTBOOKS:

1. A Hand Book of Methodology of Research, Raja mall, P. Devadoss and K.Kulandaivel,RMM Vidyalaya press, 1976.
2. Research Methodology Methods & Techniques, C.R. Kothari – New Age international Publishers, Reprint 2008.

REFERENCES:

1. Thesis and Assignment Writing, J. Anderson, Wiley Eastern Ltd., 1997.
2. Research Methodology, Mukul Gupta, Deepa Gupta – PHI Learning Private Ltd., New Delhi, 2011.
3. Fundamentals of Mathematical statistics, S.C. Gupta and V.K. Kapoor, Sultan Chand & Sons,New Delhi,1999.
4. Statistical Methods, G.W. Snedecor, W.G. Cochrans, Lowa state University Press,1967.

Sl. No	Sl. No	**Paper-II (Choose any one subject)**
1	PEE001	Power Quality Improvement Techniques
2	PEE002	Modern Control Engineering
3	PEE003	Modern Power Electronics
4	PEE004	Artificial Neural Networks in Power Engineering
5	PEE005	Power Electronic Control of DC Drives
6	PEE006	Electric Power System Reliability
7	PEE007	Digital Control Systems
8	PEE008	Power Electronic Control of AC Drives
9	PEE009	Modern Flexible AC Transmission
10	PEE010	Power System Dynamics
11	PEE011	Advanced Smart Grid technology
12	PEE012	Non-Conventional Energy Sources
13	PEE013	Distributed Generation
14	PEE014	AI techniques in Electrical Engineering
15	PEE015	Special Electrical Machines

PEE001 POWER QUALITY IMPROVEMENT TECHNIQUES

UNIT- I: POWER QUALITY

Significance of power quality, Power quality terms: Transients, Long duration voltage variations, Short-duration voltage variations, Voltageimbalance, Waveform distortion, Voltage fluctuation, CBEMA and ITI curves

WAVEFORM DISTORTION:

Introduction, Voltage versus current distortion, Harmonics versus transients, Harmonics indices: Total Harmonics Distortion (THD) and Total Demand distortion (TDD); Harmonic standards; Harmonic analysis; Harmonic phase sequence; Triplen harmonics; Inter harmonics

UNIT- II: HARMONIC SOURCES

Introduction; Harmonics generated from electrical machines such as transformers and rotating machines; Arcing devices; Static power conversion: Phase controlled and uncontrolled rectifiers, AC voltage regulators, Cycloconverters, Pulse width modulated inverters; Converter fed ac and dc drives

EFFECTS OF HARMONIC DISTORTION:

Introduction; Resonances; Effects of harmonics on rotating machines; Effect of harmonics on static power plant; Power assessment with distorted waveforms; Effect of harmonics on measuring instruments; Harmonic interference with ripple control systems; Harmonic interference with power system protection; Effect of harmonics on consumer equipment; Interference with communication systems.

UNIT-III: HARMONIC ELIMINATION

Introduction; Passive power filters: Design, A Shuntactive power filters: Configurations, State of the art, Design and control strategies. Three- phase four wire shunt active power filters

UNIT- IV: VOLTAGE QUALITY

Introduction; Sources of Sags, Swell, Unbalance and Flicker; Voltage quality standards; Effects of sags, Swell, Unbalance and Flicker; Voltage sag magnitude due to fault; Voltage sag magnitude calculation based on influence of crosssection of conductor, transformer and fault levels; Critical distance for a voltage sag magnitude; Causes of phase-angle jumps in voltage; Classification of voltage sags, voltage sag transformation due to transformers.

UNIT V: METHODS FOR IMPROVING VOLTAGE QUALITY

Introduction; Dynamic Voltage Restorer (DVR): Operating principle, Configurations, State of the art, Design and control strategies. Three-phase four-wire DVR.

UNIFIED POWER QUALITY CONDITIONER (UPQC):

Introduction; design and control; Three phasethree-wire UPQC and three-phase four-wire UPQC topologies, Multilevel inverters basedUPQC topologies, Mitigation of Flicker

TEXTBOOKS:

1. Bhim Singh, Ambrish Chandra, and Kamal Al-Haddad: Power Quality: Problemsand Mitigation Techniques, Wiley, 2015.
2. Math H. J. Bollen: Understanding power quality problems, Ist edition, Wiley-IEEE Press, 2000
3. Ghosh Arindam, Ledwich Gerard: Power Quality Enhancement Using Custom Power Devices, Springer, 2009.

REFERENCES:

1. Hirofumi Akagi, Edson Hirokazu Watanabe, Mauricio Aredes: InstantaneousPower Theory and Applications to Power Conditioning, Wiley-IEEE Press, 2017.
2. Roger C. Dugan, Mark F. McGranaghan, Surya Santoso and H. Wayne Beaty: Electrical Power Systems Quality, McGraw Hill, 3rd edition, 2012.
3. J. Arrillaga, N.R. Watson: Power System Harmonics, Wiley, 2nd Edition, 2003.

PEE002 MODERN CONTROL ENGINEERING

UNIT -I: MATHEMATICAL PRELIMINARIES AND STATE VARIABLE ANALYSIS

Fields, Vectors and Vector Spaces – Linear combinations and Bases – Linear Transformations and Matrices – Scalar Product and Norms – Eigen values, Eigen Vectors and a Canonical form representation of Linear systems – The concept of state – State space modelof Dynamic systems – Time invariance and Linearity – Non uniqueness of state model – State diagrams for Continuous-Time State models - Existence and Uniqueness of Solutions to Continuous-Time State Equations – Solutions of Linear Time Invariant Continuous-Time State Equations – State transition matrix and it's properties. Complete solution of state space model due to zero input and due to zero state.

UNIT-II: CONTROLLABILITY AND OBSERVABILITY

General concept of controllability – Controllability tests, different state transformations such as diagonalization, Jordon canonical forms and Controllability canonical forms forContinuous-Time Invariant Systems – General concept of Observability – Observability tests for Continuous-Time Invariant Systems – Observability of different State transformation forms.

UNIT- III: STATE FEEDBACK CONTROLLERS AND OBSERVERS

State feedback controller design through Pole Assignment, using Ackkermans formula– State observers: Full order and Reduced order observers

UNIT-IV: NON-LINEAR SYSTEMS

Introduction – Non Linear Systems - Types of Non-Linearity – Saturation – Dead-Zone - Backlash –Jump Phenomenon etc.; Linearization of nonlinear systems, Singular Points andits types– Describing function–describing function of different types of nonlinear elements, – Stability analysis of Non-Linear systems through describing functions. Introduction to phase- plane analysis, Method of Isoclines for Constructing Trajectories, Stability analysis of nonlinear systems based on phase-plane method

UNIT-V: STABILITY ANALYSIS

Stability in the sense of Lyapunov, Lyapunov's stability and Lypanov's instability theorems – Stability Analysis of the Linear continuous time invariant systems by Lyapunov second method – Generation of Lyapunov functions – Variable gradient method – Krasooviski's method.

TEXTBOOKS:

1. Modern Control System Theory by M.Gopal – New Age International -1984.
2. Modern Control Engineering by Ogata.K – Prentice Hall - 1997

REFERENCES:

1. N K Sinha, Control Systems, New Age International – 3rd edition.
2. Donald E.Kirk, Optimal Control Theory an Introduction, Prentice - Hall Network series – Firstedition.

PEE003 MODERN POWER ELECTRONICS

UNIT-I: MODERN POWER SEMICONDUCTOR DEVICES

Modern power semiconductor devices – MOS turn Off thyristor (MTO) – Emitter Turn Off thyristor (ETO) – Integrated Gate-Commutated thyristor (IGCTs) – MOS-controlled thyristors (MCTs) – Static Induction circuit – comparison of their features.

UNIT-II: RESONANT PULSE INVERTERS

Resonant pulse inverters – series resonant inverters – series resonant inverters with unidirectional switches – series resonant inverters with bidirectional Switches – analysis of half bridge resonant inverter - evaluation of currents and Voltages of a simple resonant inverter – analysis of half bridge and full bridge resonant inverter with bidirectional switches – Frequency response of series resonant inverters – for series loaded inverter – for parallel loaded inverter – For series and parallel loaded inverters –parallel resonant inverters – Voltage control of resonant inverters – class E inverter and Class E rectifier – numerical problems.

RESONANT CONVERTERS:

Resonant converters – Zero current switching resonant converters – L type ZCS resonant converter – M type ZCS resonant converter – zero voltage Switching resonant converters – comparison between ZCS and ZVS resonant Converters – Two quadrant ZVS resonant converters – resonant de-link Inverters – evaluation of L and C for a zero current switching inverter – Numerical problems.

UNIT-III: MULTILEVEL INVERTERS

Multilevel concept – Classification of multilevel inverters – Diode clamped multilevel inverter – principle of operation – main features – improved diode Clamped inverter – principle of operation – Flying capacitors multilevel inverter – principle of operation – main features. Cascaded multilevel inverter – principle of operation – main features – Multilevel inverter applications – reactive power compensation – back to back intertie system – adjustable drives – Switching device currents – de link capacitor voltage balancing – features of Multilevel inverters – comparisons of multilevel converters

UNIT-IV: DC POWER SUPPLIES

DC power supplies – classification – switched mode dc power supplies – fly back Converter – Forward converter – push-pull converter – half bridge converter – Full bridge converter – Resonant dc power supplies – bidirectional power supplies – Applications.

UNIT-V: AC POWER SUPPLIES

AC power supplies – classification – switched mode ac power supplies – Resonant AC power supplies – bidirectional ac power supplies – multistageconversions – control circuits – applications

POWER CONDITIONERS & UPS:

Introduction – power line disturbances – power conditioners – uninterruptible Power supplies - applications

TEXTBOOKS:

1. Power Electronics – Mohammed H. Rashid – Pearson Education – Third Edition
2. Power Electronics – Ned Mohan, Tore M. Undeland and William P. Robbins – John Wiley and Sons – Second Edition.

PEE004 ARTIFICIAL NEURAL NETWORKS IN POWER ENGINEERING

UNIT-I

Biological neuron Vs Artificial neuron, structure and activation functions – Neural network architectures-learning methods, stability and convergence. Single layer networks -Mc Culloh-Pitts neuron model, Perceptron training and algorithm, Delta learning, Widrow- Hoff learningrules, limitations, Adaline and modification.

UNIT-II

Multilayer Networks-Architectures and Modelling, BP algorithm, radial basis functions.

Unsupervised learning-Winner take all learning, out star learning, Counter propagation networks, Self-organizing networks-Kohonen,

UNIT-III

Gross berg, Hamming NET, MAXNET, Hopfield networks, recurrent and associative memory, BAM and ART architectures Fuzzy sets and system – geometry of fuzzy sets – theorems – fuzzy and neural function estimators – FAM system architectures – Uncertainty and estimation – Types of uncertainty

UNIT-IV

Measures of Fuzziness – Classical measures of uncertainty – Measures of dissonance – confession specificity – knowledge base defuzzification

UNIT-V: Application to load forecasting, Load flow, Fault detection- unit commitments, LF control – Economic dispatch, Neuro Fuzzy controllers

TEXTBOOKS:

1. Artificial Neural Networks – B.Yegna Narayana – PHI - 1st edition, 1999.
2. Neural Networks – Simon Haykin - Prentice Hall International Inc., 1999.

REFERENCE BOOKS:

1. Neural Networks and Fuzzy System – Bart Kosko - 2nd edition, 2001.
2. Neural Network Fundamentals with Graphs, Algorithms & Applications – N. K. Boseand Liang – Mc Graw Hill, 1996.
3. Fuzzy logic with Fuzzy Applications – T.J.Ross – Mc Graw Hill Inc, 1997.

PEE005 POWER ELECTRONIC CONTROL OF DC DRIVES

UNIT-I: CONTROLLED BRIDGE RECTIFIER (1-PHASE) WITH DC MOTOR LOAD

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-II: CONTROLLED BRIDGE RECTIFIER (3-PHASE) WITH DC MOTOR LOAD

Three phase semi converter and three phase full converter for continuous and discontinuous modes of operations – power and power factor - Addition of Freewheeling diode – Three phase double converter.

THREE PHASE NATURALLY COMMUTATED BRIDGE CIRCUIT AS A RECTIFIER OR AN INVERTER:

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-III: PHASE CONTROLLED DC MOTOR DRIVES

Three phase controlled converter, control circuit, control modeling of three phase converter – Steady state analysis of three phase converter control DC motor drive – Two quadrant, Three phase converter controlled DC motor drive – DC motor and load, converter.

CURRENT AND SPEED CONTROLLED DC MOTOR DRIVES:

Current and speed controllers - Current and speed feedback – Design of controllers – Current and speed controllers – Motor equations – filter in the sped feedback loop speed controller – current reference generator – current controller and flow chart for simulation – Harmonics and associated problems – sixth harmonics torque.

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 OF DC MOTOR DRIVES:

Speed controlled drive system – current control loop – pulse width modulated current controller – hysteresis current controller – modelling 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.

TEXT BOOKS:

1. Power Electronics and motor control – Shepherd, Hulley, Liang – II Edition Cambridge University Press.
2. Electronic motor drives modelling Analysis and control – R. Krishnan – I EditionPrentice 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.

PEE006 ELECTRIC POWER SYSTEM RELIABILITY

UNIT-I: GENERATING SYSTEM RELIABILITY ANALYSIS-I

Generation system model – capacity outage probability tables – Recursive relation for capacitive model building – sequential addition method – unit removal – Evaluation of loss ofload and energy indices – Examples

UNIT-II: GENERATING SYSTEM RELIABILITY ANALYSIS-II

Frequency and Duration methods – Evaluation of equivalent transitional rates of identical andnon-identical units – Evaluation of cumulative probability and cumulative frequency of non- identical generating units – 2- level daily load representation - merging generation and load models – Examples

UNIT-III: OPERATING RESERVE EVALUATION

Basic concepts - risk indices – PJM methods – security function approach – rapid start and hot reserve units – Modelling using STPM approach.

BULK POWER SYSTEM RELIABILITY EVALUATION

Basic configuration – conditional probability approach – system and load point reliability indices – weather effects on transmission lines – Weighted average rate and Markov model – Common mode failures.

UNIT-IV: INTERCONNECTED SYSTEM RELIABILITY ANALYSIS

Probability array method – Two inter connected systems with independent loads – effects of limited and unlimited tie capacity - imperfect tie – Two connected Systems with correlated loads – Expression for cumulative probability and cumulative frequency.

DISTIBUTED SYSTEM RELIABILITY ANALYSIS-I (RADIAL CONFIGURATION)

Basic Techniques – Radial networks –Evaluation of Basic reliability indices, performance indices – load point and system reliability indices – customer oriented, loss and energy oriented indices – Examples

UNIT-V: DISTIBUTED SYSTEM RELIABILITY ANALYSIS-II (PARALLEL CONFIGURATION)

Basic techniques – inclusion of bus bar failures, scheduled maintenance – temporary and transient failures – weather effects – common mode failures –Evaluation of various indices – Examples

SUBSTATIONS AND SWITCHING STATIONS:

Effects of short-circuits - breaker operation – Open and Short-circuit failures – Active and Passive failures – switching after faults – circuit breaker model – preventive maintenance – exponential maintenance times.

REFERENCE BOOKS:

1. Reliability Evaluation of Power Systems by Roy Billinton and Ronald N. Allan, Plenum press, New York and London (Second Edition), 1996.
2. Reliability Modeling in Electric Power Systems by J. Endrenyi, John Wiley and Sons, 1978. (First Edition)

PEE007 DIGITAL CONTROL SYSTEMS

UNIT-I: SAMPLING AND RECONSTRUCTION:

Introduction, sample and hold operations, Sampling theorem, Reconstruction of originalsampled signal to continuous-time signal.

THE Z-TRANSFORMS: Introduction, Linear difference equations, pulse response, Z – transforms, Theorems of Z – Transforms, the inverse Z – transforms, Modified Z- Transforms

Z-PLANE ANALYSIS OF DISCRETE TIME CONTROL SYSTEM: Z-Transform method for solving difference equations; Pulse transforms function, block diagram analysis of sampled – data systems, mapping between s-plane and z-plane: Primary strips and Complementary Strips.

UNIT-II: STATE SPACE ANALYSIS

State Space Representation of discrete time systems, Pulse Transfer Function Matrix solving discrete time state space equations, State transition matrix and its Properties, Methods for Computation of State Transition Matrix, Discretization of continuous time state – space equations

CONTROLLABILITY & OBSERVABILITY: Concepts of Controllability and Observability, Tests for controllability and Observability. Duality between Controllability and Observability, Controllability and Observability conditions for Pulse Transfer Function.

UNIT-III: STABILITY ANALYSIS

Stability Analysis of closed loop systems in the Z-Plane. Jury stability test – Stability Analysis by use of the Bilinear Transformation and Routh Stability criterion. Stability analysis using Liapunov theorems.

UNIT-IV: DESIGN OF DISCRETE TIME CONTROL SYSTEM BY CONVENTIONAL METHODS

Design of digital control based on the frequency response method – Bilinear Transformation and Design procedure in the w-plane, Lead, Lag and Lead-Lag compensators and digital PID controllers. Design digital control through deadbeat response method.

UNIT-V: STATE FEEDBACK CONTROLLERS AND OBSERVERS: Design of state feedback controller through pole placement – Necessary and sufficient conditions, Ackerman's formula State Observers – Full order and Reduced order observers.

LINEAR QUADRATIC REGULATORS: Min/Max principle, Linear Quadratic Regulators, Kalman filters, State estimation through Kalman filters, introduction to adaptive controls.

TEXTBOOKS:

1. Discrete-Time Control systems - K. Ogata, Pearson Education/PHI, 2nd Edition
2. Digital Control and State Variable Methods by M.Gopal, TMH

REFERENCE BOOKS:

1. Digital Control Systems, Kuo, Oxford University Press, 2nd Edition, 2003.
2. Digital Control Engineering, M.Gopal

PEE008 POWER ELECTRONIC CONTROL OF AC DRIVES

UNIT -I: INTRODUCTION TO AC DRIVES

Introduction to motor drives – Torque production – Equivalent circuit analysis – Speed – Torque Characteristics with variable voltage operation, Variable frequency operation constant v/f operation - Variable stator current operation – Induction motor characteristics in constant torque and field weakening regions

UNIT- II: CONTROL OF INDUCTION MOTOR DRIVES AT STATOR SIDE

Scalar control – Voltage fed inverter control – Open loop volts/Hz control – speed control slip regulation – speed control with torque and flux control – current controlled voltage fed inverter drive – current – fed inverter control – Independent current and frequency control – Speed and flux control in Current –Fed inverter drive – Volts/Hz control of Current –fed inverter drive – Efficiency optimization control by flux program

UNIT- III: CONTROL OF INDUCTION MOTOR DRIVES AT ROTOR SIDE

Slip power recovery drives – Static Kramer Drive – Phasor diagram – Torque expression – speed control of Kramer Drive – Static Scheribus Drive – modes of operation

VECTOR CONTROL OF INDUCTION MOTOR DRIVE

Principles of Vector control – Vector control methods – Direct methods of vector control – Indirect methods of vector control – Adaptive control principles – Self tuning regulator Model referencing control.

UNIT- IV: CONTROL OF SYNCHRONOUS MOTOR DRIVES

Synchronous motor and its characteristics – Control strategies – Constant torque angle control – Unity power factor control – Constant mutual flux linkage control.

CONTROLLERS

Flux weakening operation – Maximum speed – Direct flux weakening algorithm – Constant Torque mode controller – Flux Weakening controller – indirect flux weakening – Maximum permissible torque – speed control scheme – Implementation strategy speed controller design

UNIT- V: VARIABLE RELUCTANCE MOTOR DRIVES

Variable Reluctance motor drive – Torque production in the variable reluctance motor Drive characteristics and control principles – Current control variable reluctance motor service drive

BRUSHLESS DC MOTOR DRIVES: Three phase full wave Brushless dc motor – Sinusoidal type of Brushless dc motor- current controlled Brushless dc motor Servo drive

TEXT BOOKS:

1. Electric Motor Drives Pearson Modeling, Analysis and control – R. Krishnan – Publications – 1st edition – 2002.
2. Modern Power Electronics and AC Drives B K Bose – Pearson Publications 1st edition
3. Power Electronics and Control of AC Motors – MD Murthy and FG Turn Bull pergman Press (For Chapters II, III, V) 1st edition

REFERENCE BOOKS:

1. Power Electronics and AC Drives – BK Bose – Prentice Hall Eagle wood diffs New Jersey (for chapters I, II, IV) - 1st edition
2. Power Electronic circuits Deices and Applications – M H Rashid – PHI – 1995.
3. Fundamentals of Electrical Drives – G. K. Dubey – Narora publications–1995 (forchapter II)
4. Power Electronics and Variable frequency drives – BK Bose – IEEE Press – Standard a. publications - 1st edition – 2002

PEE009 MODERN FLEXIBLE A.C. TRANSMISSION SYSTEM

UNIT-I:FACTS CONCEPTS

Transmission interconnections power flow in an AC system, loading capability limits, Dynamic stability considerations, importance of controllable parameters basic types of FACTS controllers, benefits from FACTS controllers.

UNIT-II: VOLTAGE SOURCE CONVERTERS

Single phase three phase full wave bridge converters transformer connections for 12 pulse 24 and 48 pulse operation. Three level voltage source converter, pulse width modulation converter, basic concept of current source Converters, and comparison of current source converters with voltage source converters.

UNIT-III: STATIC SHUNT COMPENSATION

Objectives of shunt compensation, midpoint voltage regulation voltage instability prevention, improvement of transient stability, Power oscillation damping, Methods of controllable var generation, variable impedance type static VAR generators switching converter type var generators hybrid var generators

UNIT-IV: SVC & STATCOM

The regulation and slope transfer function and dynamic performance, transient stability enhancement and power oscillation damping operating point control and summary of compensator control.

STATIC SERIES COMPENSATORS: Concept of series capacitive compensation, improvement of transient stability, power oscillation damping

UNIT-V

Functional requirements GTO thyristor controlled series capacitor (GSC), thyristor switched series capacitor (TSSC), and thyristor controlled series capacitor (TCSC) control schemes for GSC TSSC and TCSC.

TEXTBOOKS

"Understanding FACTS Devices" N.G. Hingoraniand L. Guygi.IEEE Press Publications2000.

PEE010 POWER SYSTEM DYNAMICS

UNIT -I

Basic concepts: Power system stability states of operation and system security system dynamics problems system model analysis of steady State stability and transient stability, simplified representation of Excitation control.

UNIT -II

Modelling of synchronous machine: synchronous machine park's Transformation, Transformation of flux linkages, Transformation of stator voltage equations and rotor equations, Analysis of steady state performance, per unit quantities - Equivalent circuits of synchronous machine - determination of parameters of equivalent circuits

UNIT -III

Excitation system: Excitation system modelling, excitation systems block Diagram system representation by state equations.

Dynamics of a synchronous generator connected to infinite bus: system model Synchronous machine model, stator equations rotor equations, Synchronous machine model with field circuit and with field circuit and one equivalent damper winding on q axis (model 1.1), calculation of Initial conditions.

UNIT -IV

Analysis of single machine system: small signal analysis with block diagram Representation characteristic equation and application of Routh-Hurwitz criterion synchronizing anddamping torque analysis, small signal model State equations.

UNIT -V

Application of power system stabilizers: basic concepts in applying PSS, Control signals, structure and tuning of PSS, washout circuit, dynamic compensator analysis of single machine infinite bus system with and without PSS.

TEXTBOOKS: Power system dynamics K.R. PADIYAR, B.S. Publications Hyderabad

REFERENCES: Power system control and stability P.M. Anderson and A.A. Fouad John wiley sons

PEE011 ADVANCED SMART GRID TECHNOLOGIES

UNIT- I: INTRODUCTION TO SMART GRID

Basics of power systems, definition of smart grid, need for smart grid, smart grid domain, and enablers of smart grid, smart grid priority areas, regulatory challenges, and smart-grid activities in India.

UNIT- II: SMART GRID ARHITECTURE

Smart grid architecture, standards-policies, smart-grid control layer and elements, network architectures, IP-based systems, power line communications, supervisory control and data acquisition system, advanced Metering infrastructure. The fundamental components of Smart Grid designs, Transmission Automation, Distribution Automation, Renewable Integration

UNIT- III: TOOLS AND TECHNIQUES FOR SMART GRID

Computational Techniques – Static and Dynamic Optimization Techniques for power applications such as Economic load dispatch – Computational Intelligence Techniques – Evolutionary Algorithms in power system – Artificial Intelligence techniques and applications in power system

UNIT- IV: DISTRIBUTION GENERATION TECHNOLOGIES

Introduction to Distribution Energy Sources, Renewable Energy Technologies – Microgrids – Storage Technologies –Electric Vehicles and plug – in hybrids – Environmental impact and Climate Change –Economic Issues. Communication Technologies in Smart Grid

UNIT-V: INTRODUCTION TO COMMUNICATION TECHNOLOGY:

Two Way Digital Communications Paradigm, Synchro Phasor Measurement Units (PMUs) – Wide Area Measurement Systems (WAMS) - Introduction to Internet of things (IoT) - Applications of IoT in Smart Grid

SMART CITIES: Smart city pilot projects, essential elements of smart cities, active distribution networks, microgrids, distribution system automation, Reliability and resiliency studies, decentralized operation of power network.

TEXT BOOKS:

1. S. Borlase, “Smart Grids, Infrastructure, Technology and Solutions”, CRC Press, 1stEdition, 2013.
2. G. Masters, “Renewable and Efficient Electric Power System”, Wiley–IEEE Press, 2nd Edition, 2013.

PEE012 NON-CONVENTIONAL ENERGY SOURCES

UNIT-I:

Review of Conventional and Non-Conventional energy sources - Need for non-conventional energy sources Types of Non- conventional energy sources - Fuel Cells - Principle of operation with special reference to H2O2 Cell - Classification and Block diagram of fuel cell systems - Ion exchange membrane cell - Molten carbonate cells - Solid oxide electrolyte cells - Regenerative system- Regenerative Fuel Cell - Advantages and disadvantages of Fuel Cells Polarization - Conversion efficiency and Applications of Fuel Cells.

UNIT-II:

Solar energy - Solar radiation and its measurements - Solar Energy collectors -Solar Energy storage systems - Solar Pond - Application of Solar Pond - Applications of solar energy.

UNIT-III:

Wind energy- Principles of wind energy conversion systems - Nature of wind - Power in the Wind- Basic components of WECS -Classification of WECS -Site selection considerations - Advantages and disadvantages of WECS -Wind energy collectors -Wind electric generating and control systems - Applications of Wind energy -Environmental aspects.

UNIT- IV:

Energy from the Oceans - Ocean Thermal Electric Conversion (OTEC) methods - Principles of tidal power generation -Advantages and limitations of tidal power generation -Ocean waves - Wave energy conversion devices -Advantages and disadvantages of wave energy – Geo Thermal Energy -Types of Geo-Thermal Energy Systems - Applications of Geo-Thermal Energy.

UNIT-V:

Energy from Biomass - Biomass conversion technologies / processes - Photosynthesis - Photosynthetic efficiency - Biogas generation - Selection of site for Biogas plant - Classification of Biogas plants - Details of commonly used Biogas plants in India - Advantages and disadvantages of Biogas generation -Thermal gasification of biomass -Biomass gasifiers.

SUGGESTED READINGS:

1. Rai G.D, Non-Conventional Sources of Energy, Khandala Publishers, New Delhi, 1999.
2. M.M. El-Wakil, Power Plant Technology. McGraw Hill, 1984.

PEE013 DISTRIBUTED GENERATION

UNIT – I : NEED FOR DISTRIBUTED GENERATION

Renewable sources in distributed generation – Current scenario in distributed generation – Planning of DGs – Siting and sizing of DGs – Optimal placement of DG sources in distribution systems.

UNIT – II : GRID INTEGRATION OF DGS

Different types of interfaces – Inverter based DGs and rotating machine based interfaces – Aggregation of multiple DG units – Energy storage elements – Batteries, ultracapacitors, flywheels.

UNIT – III : TECHNICAL IMPACTS OF DGS

Transmission systems, Distribution systems, De-regulation – Impact of DGs upon protective relaying – Impact of DGs upon transient and dynamic stability of existing distribution systems.

UNIT-IV : ECONOMIC AND CONTROL ASPECTS OF DGS

Market facts, issues and challenges – Limitations of DGs – Voltage control techniques, Reactive power control, Harmonics, Power quality issues – Reliability of DG based systems – Steady state and Dynamic analysis.

UNIT – V : INTRODUCTION TO MICRO-GRIDS

Types of micro-grids – Autonomous and non-autonomous grids – Sizing of micro-grids – Modeling & analysis – Micro-grids with multiple DGs – Micro-grids with power electronic interfacing units – Transients in micro-grids – Protection of micro-grids – Case studies.

TEXT BOOKS:

1. H. Lee Willis, Walter G. Scott , 'Distributed Power Generation – Planning and Evaluation', Marcel Decker Press, 2000.
2. M.Godoy Simoes, Felix A.Farret, 'Renewable Energy Systems – Design and Analysis with Induction Generators', CRC press.
3. Robert Lasseter, Paolo Piagi, ' Micro-grid: A Conceptual Solution', PESC 2004, June 2004.
4. F. Katiraei, M.R. Iravani, 'Transients of a Micro-Grid System with Multiple Distributed Energy Resources', International Conference on Power Systems Transients (IPST'05) in Montreal, Canada on June 19-23, 2005.
5. Z. Ye, R. Walling, N. Miller, P. Du, K. Nelson, 'Facility Microgrids', General Electric Global Research Center, Niskayuna, New York, Subcontract report, May 2005.

PEE014 AI TECHNIQUES IN ELECTRICAL ENGINEERING

UNIT-I: ARTIFICIAL NEURAL NETWORKS

Introduction, Models of Neuron Network-Architectures –Knowledge representation, Artificial Intelligence and Neural networks–Learning Process-Error correction learning, Hebbian learning – Competitive learning-Boltzmann learning, supervised learning-Unsupervised learning– Reinforcement learning-Learning tasks.

UNIT-II: ANN PARADIGMS

Multi-layer perceptron using Back propagation Algorithm (BPA), Self –Organizing Map (SOM), Radial Basis Function Network-Functional Link Network (FLN), Hopfield Network.

UNIT-III: FUZZY LOGIC

Introduction –Fuzzy versus crisp, Fuzzy sets-Membership function –Basic Fuzzy set operations, Properties of Fuzzy sets –Fuzzy Cartesian Product, Operations on Fuzzy relations –Fuzzy logic– Fuzzy Quantifiers, Fuzzy Inference-Fuzzy Rule based system, Defuzzification methods.

UNIT-IV: GENETIC ALGORITHMS

Introduction-Encoding –Fitness Function-Reproduction operators, Genetic Modeling – Genetic operators- Cross over-Single site cross over, two-point cross over –Multi point cross over Uniform cross over, Matrix cross over-Cross over Rate-Inversion & Deletion, Mutation operator –Mutation –Mutation Rate- Bit-wise operators, Generational cycle convergence of Genetic Algorithm.

UNIT-V: APPLICATIONS OF AI TECHNIQUES

Load forecasting, Load flow studies, Economic load dispatch, Load frequency control, Single area system and two area system, Reactive power control , Speed control of DC and AC Motors

TEXT BOOKS:

1. S. Rajasekaran and G.A.V.Pai Neural Networks, Fuzzy Logic &Genetic Algorithms, PHI, New Delhi,2003.

2. Rober J. Schalkoff, Artificial Neural Networks, Tata McGraw Hill Edition,2011.

REFERENCES:

1. P.D. Wasserman; Neural Computing Theory & Practice, Van Nostrand Reinhold, New York, 1989.

2. Bart Kosko; Neural Network & Fuzzy System, PrenticeHall,1992 3. D.E.Goldberg, Genetic Algorithms, Addison-Wesley 1999.

PEE015 SPECIAL ELECTRICAL MACHINES

UNIT-I: SYNCHRONOUS RELUCTANCE MOTORS

Constructional features – Types – Axial and Radial flux motors – Operating principles – Variable Reluctance Motors – Voltage and Torque Equations – Phasor diagram – performance characteristics – Applications.

UNIT-II: STEPPER MOTORS

Constructional features – Principle of operation – Variable reluctance motor – Hybrid motor – Single and multi-stack configurations – Torque equations – Modes of excitation – Characteristics – Drive circuits – Microprocessor control of stepper motors – Closed loop control – Concept of lead angle – Applications.

UNIT-III: SWITCHED RELUCTANCE MOTORS (SRM)

Constructional features – Rotary and linear SRM – Principle of operation –Torque production – Steady state performance prediction – Analytical method – power converters and their controllers – Methods of rotor position sensing – Sensor less operation – characteristics and closed loop control – applications.

UNIT-IV: PERMANENT MAGNET BRUSHLESS D.C. (BLDC) MOTORS

Permanent magnet materials – Minor hysteresis loop and recoil line – Magnetic characteristics – Permeance coefficient – Principle of operation – Types – Magnetic circuit analysis – EMF and torque equations – Commutation – Power converter circuits and their controllers – Motor characteristics and control – Applications.

UNIT-V: PERMANENT MAGNET SYNCHRONOUS MOTORS (PMSM)

Principle of operation – Ideal PMSM – EMF and torque equations – Armature MMF – Synchronous Reactance – Sine wave motor with practical windings – Phasor diagram – Torque/speed characteristics – Power controllers – Converter volt-ampere requirements – Applications

TEXT BOOKS:

1. K.Venkataratnam, 'Special Electrical Machines', Universities Press (India) Private Limited, 2008.

2. T.J.E. Miller, 'Brushless Permanent Magnet and Reluctance Motor Drives', Clarendon Press, Oxford, 1989.

3. T.Kenjo, 'Stepping Motors and Their Microprocessor Controls', Clarendon Press London, 1984.

REFERENCES:

1. R.Krishnan, 'Switched Reluctance Motor Drives – Modeling, Simulation, Analysis, Design and Application', CRC Press, New York, 2001.

2. P.P. Aearnley, 'Stepping Motors – A Guide to Motor Theory and Practice', Peter Perengrinus London,1982.

3. T. Kenjo and S. Nagamori, 'Permanent Magnet and Brushless DC Motors', Clarendon Press, London,1988.

4. E.G. Janardanan, 'Special electrical machines',PHI learning Private Limited, Delhi,2014