ANNAMACHARYA UNIVERSITY

(ESTD UNDER AP PRIVATE UNIVERSITIES (ESTABLISHMENT AND REGULATION) ACT,
(UNIVERSITY LISTED IN UGC AS PER THE SECTION 2(f) OF THE UGC ACT, 1956)

RAJAMPET, YSR District, AP – 516126, INDIA

ELECTRICAL & ELECTRONICS ENGINEERING

Course Structure and Syllabi for Pre Ph.D. Programme

SUBJECT-1

S. No	Course Code	Title of the Course
1	26CMEC0TT	Research Methodology for Engineers

SUBJECT-2

S. No	Course Code	Title of the Course
1	26CEEE0NT	Research and Publications Ethics for Engineers

CORE SUBJECTS

Choose any Two subjects from the following list

S. No.	Course code	Title of the Course
1	26CEEE01T	Power System Stability and Control
2	26CEEE02T	Smart Grid Technologies
3	26CEEE03T	Advanced Power Electronics
4	26CEEE04T	Applications of Power Electronics to Power Systems
5	26CEEE05T	Modern Control Engineering
6	26CEEE06T	Restructured Power System
7	26CEEE07T	Distribution Automation & Control
8	26CEEE08T	Reliability Engineering and Applications to Power Systems
9	26CEEE09T	Distributed Generation and Microgrid Control
10	26CEEE0AT	Energy Auditing and Management
11	26CEEE0BT	Advanced Drives & Control
12	26CEEE0CT	Power Quality
13	26CEEE0DT	HVDC Transmission Systems
14	26CEEE0ET	Hybrid Electric Vehicle Systems
15	26CEEE0FT	Digital Control Systems
16	26CEEE0GT	Adaptive and Learning Control
17	26CEEE0HT	Solar Energy Conversion Systems

18	26CEEE0IT	Wind Energy Conversion Systems
19	26CEEE0JT	Optimization & Heuristic Search Techniques
20	26CEEE0KT	Intelligent Control Techniques
21	26CEEE0LT	Introduction to Machine Learning
22	26CEEE0MT	Modern Flexible AC Transmission System

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RAJAMPET, YSR District, AP – 516126, INDIA

Title of the Course	**:**	**Power System Stability & Control**
Course Code	**:**	**26CEEE01T**
Course offered to	**:**	EEE
Credits	**:**	4

Course Objectives

1. To develop advanced mathematical modeling and analytical techniques for investigating transient stability in single-machine and multimachine power systems.
2. To formulate and analyze small-disturbance dynamic stability models of synchronous machines using state-space methods and stability criteria.
3. To design and evaluate power system stabilizers for improving electromechanical oscillation damping using compensation and eigenvalue analysis
4. To develop mathematical models of excitation systems and investigate their influence on generator stability and power transfer limits.
5. To apply nonlinear stability theories to analyze power system stability and develop strategies for mitigating voltage instability and collapse.

Course Outcomes:

1. Formulate and analyze transient stability models of single-machine and multimachine power systems.
2. Analyze small-disturbance stability using state-space modeling and mathematical stability criteria.
3. Design and evaluate power system stabilizers using compensation techniques and eigenvalue analysis.
4. Model excitation systems and evaluate their effects on generator dynamics and stability limits.
5. Apply nonlinear stability methods to investigate power system stability and formulate solutions for voltage instability and collapse.

Unit 1 The Elementary Mathematical Model **9**

Introduction to equal area criteria - Power Angle curve of a Synchronous Machine - model of single machine connected to an infinite bus – model of multimachine system – Problems.
Classical Stability Study of multimachine system - Effect of the excitation system on Transient stability.

Unit 2 System Response to Small Disturbances and Dynamic Stability **9**

The unregulated synchronous Machine – Modes of oscillation of an unregulated multimachine system – Regulated synchronous machine – Voltage regulator with one time lag – Governor with one time lag – Problems.
Concept of Dynamic stability – State-space model of single machine system connected to infinite bus – Effect of excitation on Dynamic stability – Examination of dynamic stability by Routh-Hurwitz criterions

Unit 3 Power System Stabilizers **9**

Introduction to supplementary stabilizing signals - Block diagram of the linear system - Approximate model of the complete exciter – Generator system – Lead compensation – Stability analysis using eigen value approach.

Unit 4 Excitation Systems **9**

Introduction to excitation systems – non-continuously, continuously regulated systems – Excitation system compensation – State-space description of the excitation system - Simplified linear model – Effect of excitation on generator power limits. Type –2, Type-3 and Type –4 excitation systems and their state-space modeling equations.

Unit 5 Stability Analysis **9**

Review of Lyapunov's stability of non-liner systems using energy concept – Method based on first concept – Method based on first integrals – Zubov's method – Popov's method, Lyapunov function for single machine connected to infinite bus.

Voltage stability – Factors affecting voltage instability and collapse – Comparison of Angle and voltage stability – Analysis of voltage instability and collapse – Control of voltage instability.

Prescribed Textbooks:

1. P.M.Anderson, A.A.Fouad, "Power System Control and Stability", IOWA State University Press, Galgotia Publications, Vol-I, 1st Edition.

Reference Books:

1. M.A.Pai, Power System Stability-Analysis by the direct method of Lyapunov, North Holland Publishing Company, New York, 1981

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RAJAMPET, YSR District, AP – 516126, INDIA

Title of the Course : Smart Grid Technologies
Course Code : 26CEEE02T
Course offered to : EEE
Credits : 4

Course Objectives

1. To study smart grid architectures, standards, and operational frameworks.
2. To analyze smart grid communication, measurement, and monitoring technologies.
3. To evaluate load flow and contingency analysis techniques for smart grids.
4. To investigate stability assessment, state estimation, and energy management in smart grids
5. To examine renewable energy integration, storage, demand response, & electric vehicle technologies.

Course Outcomes:

1. Analyze smart grid architectures, standards, and operational frameworks
2. Evaluate communication, measurement, and monitoring technologies for smart grids.
3. Apply advanced load flow and contingency analysis techniques to smart grids.
4. Assess smart grid stability, state estimation, and energy management techniques.
5. Evaluate renewable energy integration, storage, and demand response strategies for sustainable smart grids.

Unit 1 Smart Grid Architectural Designs 9

Introduction – Comparison of Power grid with Smart grid – Power system enhancement, communication and standards - General View of the Smart Grid Market Drivers - Stakeholder Roles and Function - Measures Representative Architecture –

Functions of Smart Grid Components-Wholesale energy market in smart grid-smart vehicles in smart grid.

Unit 2 Smart Grid Communications and Measurement Technology 9

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

Unit 3 Performance Analysis Tools For Smart Grid Design 9

Introduction to Load Flow Studies - Challenges to Load Flow in Smart Grid and Weaknesses of the Present Load Flow Methods –

Load Flow State of the Art: Classical, Extended Formulations, and Algorithms –Load flow for smart grid design-Contingencies studies for smart grid**.**

Unit 4 Stability Analysis Tools For Smart Grid **9**

Voltage Stability Analysis Tools-Voltage Stability Assessment Techniques-Voltage Stability Indexing-Application and Implementation Plan of Voltage Stability in smart grid-Angle stability assessment in smart grid-Approach of smart grid to State Estimation-Energy management in smart grid

Unit 5 Renewable Energy & Storage **9**

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.

Prescribed Textbooks:

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.

Reference Books:

1.Fereidoon P. Sioshansi, "Smart Grid: Integrating Renewable, Distributed & Efficient Energy", Academic Press, 2012.
2. Clark W.Gellings, "The smart grid: Enabling energy efficiency and demand response",Fairmont Press Inc, 2009.

Title of the Course : **Advanced Power Electronics**
Course Code : **26CEEE03T**
Course offered to : EEE
Credits : 4

Course Objectives

1. To investigate the operating principles, characteristics, and modeling of advanced solid-state power semiconductor devices.
2. To analyze resonant converter topologies and evaluate soft-switching techniques for high-efficiency power conversion.
3. To evaluate multilevel inverter topologies, modulation techniques, and voltage-balancing strategies for advanced power conversion applications.
4. To investigate DC power supply topologies, control strategies, and bidirectional conversion techniques for high-performance applications.
5. To analyze advanced AC power supplies, power conditioning techniques, and UPS systems for improved power quality and reliability.

Course Outcomes:

1. Analyze and model advanced solid-state devices to evaluate their switching performance and suitability for power electronic applications.
2. Evaluate resonant converter topologies and soft-switching techniques for improving conversion efficiency and performance.
3. Design and assess multilevel inverter configurations and control strategies for high-performance power conversion.
4. Develop and evaluate DC power supply topologies and control methods for efficient and bidirectional power conversion.
5. Assess AC power supply architectures and power conditioning techniques to improve power quality, reliability, and system performance.

Unit 1 Advanced Solid-State Devices **9**

Power MOSFETs and IGBTs – Principle of voltage-controlled devices, construction, types, static and switching characteristics, steady-state and dynamic models of MOSFET and IGBTs - Basics of GTO, MCT (Mos Controlled Thyristor), FCT (Field Controlled Thyristor), RCT (Reverse Conducting Thyristor)

Unit 2 Resonant Converters **9**

Zero Current Switching Resonant Converters – L Type– M Type – Zero Voltage Switching Resonant Converters – Comparison Between ZCS And ZVS – Resonant Converters – Two Quadrant ZVS Resonant Converters – Resonant DC-Link Inverters – Numerical Problems.

Unit 3 Multilevel Inverters **9**

Multilevel Concept – Types of Multilevel Inverters – Diode Clamped Multilevel Inverter – Improved Diode Clamped Inverter – Flying Capacitors Multilevel Inverter – Cascaded Multilevel Inverter– Principle Of Operation – Main Features– Applications – Reactive Power Compensation, Back to Back Intertie System, Adjustable Drives– Switching Device Currents – DC Link Capacitor Voltage Balancing – Features of Multilevel Inverters –Comparisons of Multilevel Converters – Numerical Problems.

Unit 4 DC Power Supplies **9**

DC Power Supplies – Types – 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 – Numerical Problems.

Unit 5 AC Power Supplies: **9**

AC Power Supplies – Types – Switched Mode Ac Power Supplies, Resonant AC Power Supplies – Bidirectional Ac Power Supplies – Multistage Conversions – Control Circuits – Power Line Disturbances – Power Conditioners – Uninterruptible Power Supplies – Applications – Numerical Problems.

Prescribed Textbooks:

1.M. H. Rashid, “Power Electronics, circuits, Devices and Applications”, Pearson, 2002, India.

Reference Books:

1.Fundamentals of Power Electronics by Robert Warren Erickson and Dragan Maksimovic, Springer US, 2nd Edition, 2001.
2.N. Mohan, T. M. Undeland and W.P. Robbins, “Power Electronics, Converter, Application and Design”, Third Edition, John Willey & Sons, 2004.
3.R.S. Ramshaw, “Power Electronics Semiconductor Switches”, Champman & Hall, 1993.

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RAJAMPET, YSR District, AP – 516126, INDIA

Title of the Course : **Applications of Power Electronics to Power Systems**
Course Code : **26CEEE04T**
Course offered to : EEE
Credits : 4

Course Objectives

1. To investigate FACTS technologies and their role in enhancing transmission capacity, power flow control, and dynamic stability.
2. To analyze shunt compensators for voltage regulation, transient stability enhancement, and power oscillation damping.
3. To evaluate series compensation techniques for improving voltage stability, power transfer capability, and oscillation damping.
4. To investigate UPFC modeling and control strategies for independent real and reactive power flow regulation.
5. To analyze harmonic generation and develop advanced filtering techniques for improving power quality in electrical systems.

Course Outcomes:

1. Evaluate FACTS controllers for improving transmission performance, power flow, and system stability.
2. Analyze and design shunt compensation strategies for voltage support and dynamic stability enhancement.
3. Assess series compensation techniques for enhancing power transfer capability and system stability.
4. Develop and evaluate UPFC control strategies for independent real and reactive power flow management.
5. Investigate harmonic mitigation techniques and evaluate passive, active, and hybrid filters for power quality improvement.

Unit 1 General System considerations and FACTS: 9

Transmission Interconnections, Flow of Power in an AC System, Power Flow and Dynamic Stability Considerations of a Transmission Interconnection, principles of series and shunt compensation, Basic Types of FACTS Controllers, Benefits from FACTS, Application of FACTS.

Unit 2 Shunt Compensators 9

Objectives of Shunt Compensation, Midpoint Voltage Regulation for Line Segmentation, End of Line Voltage Support to Prevent Voltage Instability, improvement of Transient Stability, Power Oscillation Damping, Static Var Compensators, SVC and STATCOM, The Regulation Slope, Transfer Function and dynamic Performance, Transient Stability, Enhancement and Power Oscillation Damping.

Unit 3 Series Compensators **9**

Objectives of Series Compensation, concept of series capacitive compensation, voltage stability, improvement of transient stability, power oscillation damping, GTO thyristor-controlled series capacitor, Thyristor controlled series capacitor, SSSC.

Unit 4 Combined Compensators **9**

Introduction, Unified power flow controller, basic operating principles, independent real and reactive power flow control, and control structure, basic control system for P and Q control.

Unit 5 Mitigation of Harmonics **9**

Power quality problems, harmonics, harmonic creating loads, harmonic power flow, and mitigation of harmonics, filters, passive filters, active filters, shunt, series and hybrid filters.

Prescribed Textbooks:

1. Narain G. Hingorani, Laszlo Gyugyi, Understanding FACTS, IEEE press
2. Roger. C. Dugan, Mark. F. McGranagham, Surya Santoso, H. Wayne Beaty, Electrical Power Systems Quality, McGraw Hill,2003

Reference Books:

1. Y.H.Song, A.T.Johns, Flexible A.C.Transmission System, IEE, London, 1999

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RAJAMPET, YSR District, AP – 516126, INDIA

Title of the Course	**:**	**Modern Control Engineering**
Course Code	**:**	**26CEEE05T**
Course offered to	**:**	EEE
Credits	**:**	4

Course Objectives

1. To formulate and analyze state-space models of linear and nonlinear dynamic systems.
2. To investigate controllability, observability, state feedback, and pole-placement techniques.
3. To design full-order and reduced-order observers using advanced state estimation techniques.
4. To develop robust control strategies for system decoupling, tracking, and disturbance rejection
5. To analyze and design optimal linear regulators using Riccati equations and state estimation.

Course Outcomes:

1. Formulate and evaluate state-space models and state transition matrices for dynamic systems.
2. Analyze controllability, observability, and state-feedback methods for system stabilization
3. Design state observers and evaluate observer–controller configurations for dynamic systems.
4. Develop robust control strategies for decoupling, asymptotic tracking, and disturbance rejection
5. Design and evaluate optimal linear regulators using continuous-time, discrete-time, and Riccati-based methods

Unit 1 **9**

Fields, Vectors, and vector spaces; State space representation, state equations for dynamic systems, solution of state equations; State transition matrix – Properties of state transition matrix; evaluation. Fadeeva algorithm for conversion from state space to transfer function, Linearization of non-linear models

Unit 2 **9**

Non uniqueness of state model, Similarity transformation, Invariance of system properties. Controllability – necessary and sufficient condition - Pole assignment using State feedback – Ackerman's formula for feedback gain determination; Observability. Duality. Effect of state feedback on controllability and observability. Controllable subspace – decomposition of state into controllable and uncontrollable components.

Unit 3 **9**

Design of full order observer – Bass Gura algorithm. The separation principle - Combined observer controller compensator. Design of reduced order observer. Unobservable subspace – decomposition of state into observable and unobservable components–Canonical decomposition theorem.

Unit 4 **9**

Reducibility – realization of transfer function matrices. Model decomposition and decoupling by state feedback. Design of robust control system for asymptotic tracking and disturbance rejection using State variable equations. Transfer function interpretations – transfer function form of observer and state estimate feedback. State space interpretation of internal model principle.

Unit 5 **9**

Discrete time linear state regulator – Algorithm for the solution, Use of observer in implementing the control law. Continuous time linear state regulator – Matrix Riccati equation. Time invariant linear state regulator – the reduced matrix Riccati equation - An iterative method to solve the reduced matrix Riccati equation. Suboptimal linear regulator.

Prescribed Textbooks:

1. Modern Control Engineering, Katsuhiko Ogata, 5th Edition, Prentice Hall India, 1997

Reference Books:

1.Linear Systems, Thomas Kailath, Prentice Hall, 1980.
2.Graebe and Mario E. Salgado, Pearson Education, 2000.
3.Linear System Theory and Design, Chi-Tsong Chen, OXFORD University Press.
4.Richard C. Dorf and Robert H. Bishop, Modern Control Systems, 11th Edition, Pearson Edu India, 2009.

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RAJAMPET, YSR District, AP – 516126, INDIA

Title of the Course : Restructured Power System
Course Code : 26CEEE06T
Course offered to : EEE
Credits : 4

Course Objectives

1. To analyze electricity market restructuring, transmission pricing, and congestion management strategies.
2. To evaluate OASIS frameworks and investigate market power and its mitigation mechanisms.
3. To assess transfer capability, electricity pricing, and short-term price forecasting methods.
4. To investigate ISO and GENCO operational planning strategies in competitive electricity markets.
5. To evaluate transmission cost allocation methods and ancillary service management strategies

Course Outcomes:

1. Analyze competitive electricity market structures, transmission pricing, and congestion management.
2. Evaluate OASIS mechanisms and formulate strategies to mitigate electricity market power
3. Calculate transfer capability indices and analyze electricity pricing and forecasting techniques
4. Develop operational planning strategies for ISOs and GENCOs in competitive electricity markets.
5. Compare transmission cost allocation methods and evaluate ancillary service management approaches

Unit 1 Key Issues In Electric Utilities 9

Introduction – Restructuring models – Independent System Operator (ISO) – Power Exchange - Market operations – Market Power – Standard cost – Transmission Pricing – Congestion Pricing – Management of Inter zonal/ Intra zonal Congestion.

Unit 2 Open Access Same-Time Information System (OASIS) & Market Power 9

Structure of OASIS - Posting of Information – Transfer capability on OASIS.
Market Power: Introduction - Different types of market Power – Mitigation of Market Power - Examples.

Unit 3 Available Transfer Capability (ATC) & Electricity Pricing 9

Transfer Capability Issues – ATC – TTC – TRM – CBM Calculations – Calculation of ATC based on power flow. Electricity Pricing: Introduction – Electricity Price Volatility Electricity Price Indexes – **Challenges to Electricity Pricing** – Construction of Forward Price Curves – Short-time Price Forecasting.

Unit 4 Power System Operation In Competitive Environment 9

Introduction – Operational Planning Activities of ISO- The ISO in Pool Markets – The ISO in Bilateral Markets – Operational Planning Activities of a GENCO

Unit 5 Transmission Cost Allocation Methods & Ancillary Services Management 9

Introduction - Transmission Cost Allocation Methods: Postage Stamp Rate Method - Contract Path Method - MW-Mile Method – Unused Transmission Capacity Method - MVA-Mile method – Comparison of cost allocation methods.

Ancillary Services Management: Introduction – Reactive Power as an Ancillary Service – a Review – Synchronous Generators as Ancillary Service Providers.

Prescribed Textbooks:

1 Kankar Bhattacharya, Math H.J. Boller and JaapE.Daalder, Operation of Restructured Power System, Kulwer Academic Publishers, 2001.

2.Mohammad Shahidehpour and Muwaffaqalomoush, Restructured Electrical Power Systems, Marcel Dekker, Inc., 2001

Reference Books:

1. Loi Lei Lai, Power System Restructuring and Deregulation, John Wiley & Sons Ltd., England.

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RAJAMPET, YSR District, AP – 516126, INDIA

Title of the Course : **Distribution Automation & Control**
Course Code : **26CEEE07T**
Course offered to : EEE
Credits : 4

Course Objectives

1. To analyze distribution system planning, load characteristics, and primary and secondary network design for reliable and economical power delivery.
2. To evaluate capacitor applications, voltage regulation, and automation techniques for improving distribution system performance and power quality.
3. To investigate distribution protection schemes, protective device coordination, and fault analysis for enhancing system reliability and safety.
4. To examine distribution automation, demand-side management, voltage/VAR control, network reconfiguration, and optimization techniques.
5. To analyze advanced distribution protection strategies, fault current calculations, high-impedance faults, and lightning protection methods.

Course Outcomes:

1. Develop distribution system planning and network design strategies considering reliability, load demand, and economic constraints.
2. Evaluate capacitor placement, voltage regulation, and automation methods to improve power factor and distribution system performance.
3. Design and coordinate protective devices and analyze distribution system faults to ensure reliable and safe operation.
4. Apply distribution automation and optimization techniques for demand management, fault restoration, and power quality improvement.
5. Assess distribution system protection schemes and fault mitigation techniques for enhanced safety and operational reliability.

Unit 1 **9**

Distribution System Planning: Introduction, factors affecting planning, planning techniques and models, future distribution planning, role of computers, and impact of distributed generation and energy storage.

Load Characteristics: Basic load definitions, load factor, loss factor, and maximum diversified demand.

Primary Distribution System Design: Radial and loop feeders, primary networks, voltage levels, feeder loading, tie lines, feeder layouts, uniformly and non-uniformly distributed loads, circuit constants, system design, and cost analysis.

Secondary Distribution System Design: Secondary voltage levels, design practices, secondary banking, secondary networks, spot networks, economic design, unbalanced loads and voltages, and cost analysis.

Unit 2 **9**

Capacitor Applications in Distribution Systems: Power capacitors, series and shunt capacitors, power factor correction, capacitor applications, economic benefits, optimal capacitor placement and sizing, capacitor safety, and dynamic performance.

Voltage Regulation in Distribution Systems: Basic definitions, voltage standards, quality of service, voltage control methods, feeder voltage regulators, and line-drop compensation.

Distribution Automation and Voltage Quality: Capacitor automation, voltage fluctuations, and related problems.

Unit 3 **9**

Distribution System Protection: Basic Definitions, Over current Protection Devices, Objective of Distribution System Protection, Coordination of Protective Devices, Fuse-to-Fuse Coordination, Recloser-to-Recloser Coordination, Recloser-to-Fuse Coordination Recloser-to-Substation Transformer High-Side Fuse Coordination, Fuse-to-Circuit-Breaker Coordination, Recloser-to-Circuit-Breaker Coordination, Fault Current Calculations, Fault Current Calculations in Per Units, Secondary System Fault Current Calculations, High-Impedance Faults, Lightning Protection, Insulators, Problems.

Unit 4 **9**

Distribution Automation and Control Functions: Demand-Side Management, Voltage/VAr Control, Fault Detection (Distribution Automation Function), Trouble Calls Restoration Functions, Reconfiguration of Distribution Systems, Power Quality, Optimization Techniques

Unit 5 **9**

Distribution System Protection: Basic Definitions, Over current Protection Devices, Objective of Distribution System Protection, Coordination of Protective Devices, Fuse-to-Fuse Coordination, Recloser-to-Recloser Coordination, Recloser-to-Fuse Coordination Recloser-to-Substation Transformer High-Side Fuse Coordination, Fuse-to-Circuit-Breaker Coordination, Recloser-to-Circuit-Breaker Coordination, Fault Current Calculations, Fault Current Calculations in Per Units, Secondary System Fault Current Calculations, High-Impedance Faults, Lightning Protection, Insulators, Problems.

Prescribed Textbooks:

1 Electric Power Distribution System Engineering by Turen Gonen, 2nd Edition, CRC Press,2007.
2 Electric Power Distribution, Automation, Protection and Control by James A. Momoh,CRC Press, 2007

Reference Books:

1 Electric Power Distribution by A.S.Pabla, Tata Mc. Grawhill, 6th Edition, 2012

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RAJAMPET, YSR District, AP – 516126, INDIA

Title of the Course : **Reliability Engineering and Applications to Power Systems**
Course Code : **26CEEE08T**
Course offered to : EEE
Credits : 4

Course Objectives

1. To apply probability theory and network modeling techniques for analyzing system reliability
2. To evaluate reliability functions, lifetime distributions, and reliability indices of engineering systems.
3. To develop Markov models and frequency–duration techniques for assessing complex system reliability.
4. To analyze generation system reliability using probabilistic models and adequacy indices.
5. To investigate distribution system reliability using network reduction, cut-set, and performance assessment techniques.

Course Outcomes:

1. Formulate probabilistic models and analyze series, parallel, and complex network reliability.
2. Evaluate reliability functions, lifetime distributions, and reliability measures for repairable and non-repairable systems.
3. Develop Markov and frequency–duration models to evaluate system reliability indices
4. Assess generation adequacy using probabilistic modeling and indices such as LOLP, LOLE, and LOEE.
5. Evaluate distribution system reliability using network reduction, cut-set methods, and load-point and system performance indices

Unit 1 Basics of Probability Theory Distribution & Network Modelling **9**

Basic Probability Theory – Rules for Combining Probabilities of Events – Bernoulli's Trials, Probability Density and Distribution Functions – Binomial Distribution – Expected Value and Standard Deviation of Binomial Distribution. Analysis of Series, Parallel, Series-Parallel Networks – Complex Networks – Decomposition Method

Unit 2 Reliability Functions **9**

Reliability Functions: F(T), F(T), R(T), H(T) and Their Relationships – Exponential Distribution Expected Value and Standard Deviation of Exponential Distribution – Bath Tub Curve – Reliability Analysis of Series Parallel Networks Using Exponential Distribution – ReliabilityMeasures MTTF, MTTR, MTBF

Unit 3 Markov Modelling - Frequency & Duration Techniques **9**

Markov Chains – Concept of Stochastic Transitional Probability Matrix, Evaluation of Limiting State Probabilities – Markov Processes One Component Repairable System –Time Dependent Probability Evaluation Using Laplace Transform Approach – Evaluation of Limiting State Probabilities Using STPM – Two Component Repairable Models. Frequency and Duration Concept.

Evaluation of Frequency of Encountering State: Mean Cycle time, For One, Two Component Repairable Models – Evaluation of Cumulative Probability and Cumulative Frequency of Encountering of Merged States – Approximate System Reliability analysis – series parallel configuration – Basic probability indices – cutest approach

Unit 4 Applications To Power Systems -I

Generation System Reliability Analysis: Reliability Model of a Generation System– Recursive Relation for Unit Addition and Removal – Load Modeling - Merging of Generation Load Model – **Evaluation of Transition Rates for Merged State Model** – Cumulative Probability, Cumulative Frequency of Failure Evaluation – LOLP, LOLE, LOEE

Unit 5 Applications To Power Systems – Ii 9

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 single feeder - parallel configuration RDS.

Network reduction technique – cut set approaches – weather effects – repairable and non – repairable effects modeling and evaluation of basic probability indices

Prescribed Textbooks:

1 Reliability Evaluation of Engg. System – R. Billinton, R.N.Allan, Plenum Press, New York, reprinted in India by B.S.Publications, 2007.
2 Reliability Evaluation of Power systems – R. Billinton, R.N.Allan, Pitman Advance Publishing Program, New York, reprinted in India by B.S.Publications, 2007

Reference Books:

1 System Reliability Concepts by Dr.V.Sankar, Himalaya Publishing House Pvt.Ltd,, Mumbai

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RAJAMPET, YSR District, AP – 516126, INDIA

Title of the Course : **Distributed Generation and Microgrid Control**
Course Code : **26CEEE09T**
Course offered to : EEE
Credits : 4

Course Objectives

1. To investigate distributed generation, microgrid architectures, and grid-interconnection challenges.
2. To evaluate distributed energy resources and storage technologies for sustainable microgrid operation
3. To analyze microgrid management strategies, control systems, and active distribution network optimization.
4. To investigate SCADA architectures, communication protocols, and supervisory control of microgrids.
5. To assess the impact of distributed generation on power quality, reliability, and premium power delivery.

Course Outcomes:

1. Analyze microgrid configurations, operational challenges, and grid-interconnection strategies.
2. Evaluate distributed energy resources and storage technologies for microgrid applications.
3. Develop and assess microgrid management and control strategies for active distribution networks.
4. Evaluate SCADA systems and communication architectures for effective microgrid monitoring and control.
5. Investigate distributed generation impacts and formulate strategies to improve power quality and system reliability.

Unit 1 Introduction To Distributed Generation And Microgrid Concept 9

Introduction to distributed generation - Active distribution network - Concept of Microgrid - Microgrid configuration - Interconnection of Microgrids - Technical and economical advantages of Microgrid-Challenges and limitations of Microgrid development - Management and operational issues of a Microgrid - Dynamic interactions of Microgrid with main grid – low voltage DC grid.

Unit 2 Distributed Energy Resources 9

Introduction - Combined heat and power (CHP) systems: Micro-CHP systems - Wind energy conversion systems (WECS): Wind turbine operating systems - Solar photovoltaic (PV) systems: Classification of PV cell - Small-scale hydroelectric power generation - Other renewable energy sources - Storage devices

Unit 3 Microgrid And Active Distribution Network Management System 9

Introduction - Impact on heat utilization - Impact on process optimization - Impact on market - Impact on environment - Impact on distribution system - Impact on communication standards and protocols - Network management needs of Microgrid - Micro source controller - Central controller.

Unit 4 Scada And Active Distribution Networks

Introduction - Existing DNO SCADA systems - Control of DNO SCADA systems - SCADA in Microgrids - Human–machine interface (HMI) - Hardware components - Communication trends inSCADA - Distributed control system (DCS) - Sub-station communication standardization - SCADA communication and control architectures - Communication devices.

Unit 5 Impact Of Dg Integration On Power Quality & Reliability 9

Introduction - Power quality disturbances - Power quality sensitive customers - Power quality improvement technologies - Impact of DG integration - Issues of premium power in DG integration

Prescribed Textbooks:

1 S. Chowdhury, S.P. Chowdhury and P. Crossley, “Microgrids and Active Distribution Networks”, The Institution of Engineering and Technology, 2009.

Reference Books:

1 Ramesh C. Bansal (Ed.), Handbook of Distributed Generation: Electric Power Technologies, Economics and Environmental Impacts, Springer, 2017. Springer Nature Link
2 Math H. Bollen and Fainan Hassan, Integration of Distributed Generation in the Power System, Wiley-IEEE Press, 2011.
3 Christine Schwaegerl, Kurt Dedekind, and Ray Brown (Eds.), Distributed Energy Resources in Active Distribution Networks, CIGRE Green Books / Springer, 2026

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(UNIVERSITY LISTED IN UGC AS PER THE SECTION 2(f) OF THE UGC ACT, 1956)

RAJAMPET, YSR District, AP – 516126, INDIA

Title of the Course : **Energy Auditing and Management**
Course Code : **26CEEE0AT**
Course offered to : EEE
Credits : 4

Course Objectives

1. To study energy auditing techniques and energy conservation methods.
2. To analyze energy management principles and strategies.
3. To evaluate energy-efficient motors, power factor correction, and lighting systems.
4. To study energy measurement instruments and automation technologies.
5. To analyze the economic feasibility of energy conservation projects.

Course Outcomes:

1. Conduct energy audits and identify energy-saving opportunities
2. Develop effective energy management strategies.
3. Evaluate motor efficiency, power factor, and lighting performance.
4. Apply energy instruments for monitoring and assessment.
5. Evaluate energy projects using economic analysis techniques.

Unit 1 Basic Principles Of Energy Audit **9**

Energy audit- Definitions, concept, types of audit, energy index, cost index, pie charts,Sankey diagrams, load profiles, Energy conservation schemes - Energy audit of industries - Energy saving potential, energy audit of process industry, thermal power station, building energy audit.

Unit 2 Energy Management **9**

Principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting. Energy manger, qualities and functions, language, Questionnaire - Check list for top management.

Unit 3 Energy Efficient Motors, Power Factor Improvement **9**

Energy efficient motors, factors affecting efficiency, loss distribution, constructional details, characteristics - Variable speed, variable duty cycle systems, RMS hp - Voltage variation - Voltage unbalance - Over motoring - Motor energy audit. Power factor , Methods of improvement, location of capacitors, P.F with nonlinear loads, effect of harmonics on P.F, .P.F motor controllers - Good lighting system design and practice, lighting control, lighting energy audit.

Unit 4 Energy Instruments

Energy Instruments - Wattmeter, Data loggers, Thermocouples, Pyrometers, Lux meters, Tongue testers, Application of PLC’s

Unit 5 Economic Aspects And Analysis 9

Economics Analysis-Depreciation Methods, time value of money, rate of return, present worth method, replacement analysis, life cycle costing analysis - Energy efficient motors. Calculation of simple payback method, net present worth method- Power factor correction, lighting - Applications of life cycle costing analysis, return on investment

Prescribed Textbooks:

1 Paul O' Callaghan, Energy management, Mc-graw Hill Book company, 1st edition, 1998
2 W.C.Turner, Energy management hand book, John wiley and sons.

Reference Books:

1 Paul O' Callaghan, Energy management, Mc-graw Hill Book company, 1st edition, 1998
2 W.C.Turner, Energy management hand book, John wiley and sons.
3 Energy management and good lighting practice : fuel efficiency- booklet12-EEO

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RAJAMPET, YSR District, AP – 516126, INDIA

Title of the Course : **Advanced Drives & Control**
Course Code : **26CEEE0BT**
Course offered to : EEE
Credits : 4

Course Objectives

1. To analyze induction motor characteristics and phase-controlled drive systems.
2. To investigate inverter-fed induction motor drives and advanced speed control techniques.
3. To evaluate slip-power recovery schemes and vector control of induction motors.
4. To analyze advanced control strategies for synchronous motor drives.
5. To investigate modeling and vector control techniques for PMSM and BLDC drives

Course Outcomes:

1. Analyze induction motor performance and phase-controlled drive techniques
2. Evaluate inverter-fed induction motor drives and variable-frequency control methods.
3. Assess slip-power recovery and vector control techniques for induction motors.
4. Develop and evaluate control strategies for synchronous motor drives.
5. Model and analyze PMSM and BLDC drives using advanced control techniques.

Unit 1 Induction Motor- An Overview **9**

Review of Steady-State Operation of Induction Motor, Equivalent Circuit Analysis, Torque-Speed Characteristics. Phase Controlled Induction Motor Drive, Stator Voltage Control of Induction Motor, Phase-Controlled Converter Fed Induction Motor, Power Circuit and Gating, Reversible Phase-Controlled Induction Motor Drive, Torque-Speed Characteristics

Unit 2 Voltage Source Inverter Fed Induction Motor Drive **9**

Stator Voltage and Frequency Control of Induction Motor, Torque-Speed Characteristic Static Frequency Changers, PWM Inverter Fed Induction Motor Drive, Variable-Voltage Variable-Frequency Operation of Induction Motor, Constant E/f And V/f Control Schemes, Slip Regulation. Current Source Inverter Fed Induction Motor Drive, Stator Current and Frequency Control of Induction Motor, Auto Sequentially Commutated Inverter (ASCI), Power Circuit, Commutation, Phase Sequence Reversal, Regeneration, Steady-State Performance.

Unit 3 Rotor Side Control of Slip-Ring Induction Motor **9**

Slip-Power Recovery Schemes, Steady-State Analysis- Range of Slip, Equivalent Circuit, Performance Characteristics; Rating of Converters. Vector Control of Induction Motor, Principles of Vector Control, Direct Vector Control, Derivation of Indirect Vector Control, Implementation – Block Diagram, Estimation of Flux, Flux Weakening Operation.

Unit 4 Control of Synchronous Motor Drives **9**

Synchronous Motor and Its Characteristics- Control Strategies-Constant Torque Angle Control-Power Factor Control, Constant Flux Control, Flux Weakening Operation, Load Commutated Inverter Fed Synchronous Motor Drive, Motoring and Regeneration, Phasor Diagrams

Unit 5 PMSM and BLDC Drives **9**

Characteristics of Permanent Magnet, Synchronous Machines With Permanent Magnet, Vector Control of PMSM- Motor Model and Control Scheme, Constant Torque Angle Control, Constant Mutual Flux Linkages, Unity PF Control. Modeling of PM Brushless Dc Motor, Drive Scheme, Commutation Torque Ripple, Phase Advancing.

Prescribed Textbooks:

1 R. Krishnan, Electric Motor Drives Modeling, Analysis & control, Pearson Education, 2001

Reference Books:

1 B. K. Bose Modern Power Electronics and AC Drives, Pearson Publications-2001.
2 MD Murphy & FG Turn Bull, Pergaman press, Power Electronics control of AC motors
3 G.K. Dubey Fundamentals of Electrical Drives**,** Narosa Publications -1995.

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RAJAMPET, YSR District, AP – 516126, INDIA

Title of the Course : **Power Quality**
Course Code : **26CEEE0CT**
Course offered to : EEE
Credits : 4

Course Objectives

1. To investigate power quality disturbances, susceptibility criteria, and applicable power quality standards.
2. To analyze electrical transients, fault conditions, and voltage disturbance characteristics.
3. To evaluate harmonic distortion, its effects, and mitigation techniques in power systems.
4. To investigate electromagnetic interference, susceptibility, and mitigation strategies.
5. To assess power quality measurement techniques, instrumentation, and testing procedures.

Course Outcomes:

1. Analyze power quality issues and evaluate standards for disturbance mitigation.
2. Model and evaluate electrical transients and fault-related voltage disturbances.
3. Quantify harmonic distortion and assess harmonic mitigation techniques
4. Evaluate electromagnetic interference and develop suitable mitigation strategies.
5. Apply advanced measurement techniques to assess power quality disturbances and system performance.

Unit 1 Introduction to Power Quality and Power FrequencyDisturbance **9**

Introduction to Power Quality - Power Quality Issues - Susceptibility Criteria - Role of Power Suppliers and Users - Power Quality Standards. Introduction to Power Frequency Disturbances - Common Power Frequency Disturbances - Cures for Low Frequency Disturbances - Voltage Tolerance Criteria.

Unit 2 Electrical Transients **9**

Introduction to Power Quality - Power Quality Issues - Susceptibility Criteria - Role of Power Suppliers and Users - Power Quality Standards. Introduction to Power Frequency Disturbances - Common Power Frequency Disturbances - Cures for Low Frequency Disturbances - Voltage Tolerance Criteria.

Unit 3 Harmonics **9**

Definition of Harmonics - Odd and Even Order Harmonics - Harmonic Phase Rotation and Phase Angle – Causes of Voltage and Current Harmonics – Individual and Total Harmonic Distortion - Harmonic Signatures - Effect of Harmonics on Power System Devices - Guidelines for Harmonic Voltage and Current Limitation - Harmonic Current Mitigation

Unit 4 Electromagnetic Interference

Introduction to EMI - Frequency Classification - Electrical Fields - Magnetic Fields - EMI Terminology - Power Frequency Fields - High Frequency Interference - EMI Susceptibility - EMI Mitigation - Health Concerns of EMI.

Unit 5 POWER QUALITY PROBLEMS – EMI IMPACT 9

Introduction to Power Quality Measurements - Power Quality Measurement Devices - Power Quality Measurements - Test Locations - Test Duration - Instrument Setup - Instrument Guidelines

Prescribed Textbooks:

1 Power quality by C. Sankaran, CRC Press
2 Electrical Power Systems Quality, Roger C. Dugan, Mark F. McGranaghan, Surya Santoso, H.WayneBeaty, 2nd Edition, TMH Education Pvt. Ptd.

Reference Books:

1 Power quality by C. Sankaran, CRC Press
2 Electrical Power Systems Quality, Roger C. Dugan, Mark F. McGranaghan, Surya Santoso, H.WayneBeaty, 2nd Edition, TMH Education Pvt. Ptd.

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RAJAMPET, YSR District, AP – 516126, INDIA

Title of the Course : HVDC Transmission Systems
Course Code : 26CEEE0DT
Course offered to : EEE
Credits : 4

Course Objectives

1. To investigate HVDC transmission principles, applications, and emerging technologies
2. To analyze HVDC converter configurations, operating characteristics, and commutation processes.
3. To evaluate HVDC control strategies, power regulation, and reactive power compensation techniques.
4. To develop and analyze AC/DC power flow models and multiterminal HVDC systems.
5. To investigate HVDC converter faults, protection mechanisms, harmonic analysis, and filter design.

Course Outcomes:

1. Evaluate HVDC transmission technologies for efficient and reliable power transfer.
2. Analyze HVDC converter operation, characteristics, and commutation behavior.
3. Develop and assess HVDC control strategies for power regulation and reactive power management.
4. Formulate and solve AC/DC power flow models for multiterminal HVDC systems.
5. Analyze converter faults and harmonics and design suitable protection and filtering techniques.

Unit 1 Basic Concepts **9**

Introduction of DC Power transmission technology – Comparison of AC and DC transmission – Application of DC transmission – Description of DC transmission system – Power Handling Capabilities of HVDC Lines - Basic Conversion principles- Modern trends in DC transmission.

Unit 2 Analysis of HVDC Converters **9**

Converter station and Terminal equipment- Commutation process- Rectifier and inverter operation- Choice of Converter configuration – Analysis of Graetz – characteristics of 6 Pulse & 12 Pulse converters- Analysis of converter with grid control – with and without overlap angle - Equivalent circuit for converter – Special features of converter transformers.

Unit 3 Control of HVDC Converters **9**

Converter station and Terminal equipment- Commutation process- Rectifier and inverter operation- Choice of Converter configuration – Analysis of Graetz – characteristics of 6 Pulse & 12 Pulse converters- Analysis of converter with grid control – with and without overlap angle - Equivalent circuit for converter – Special features of converter transformers.

Unit 4 Power Flow Analysis In AC/DC Systems & MTDC Systems 9

Modelling of DC Links-DC Network-DC Converter-Controller Equations-Solution of DC load flow – P.U. System for DC quantities-solution of AC-DC Power flow-Simultaneous method- Sequential method. Series parallel and series parallel systems their operation and control.

Unit 5 Converter Faults, Harmonics & Protection 9

Converter faults – protection against over current and over voltage in converter station – surge arresters – smoothing reactors – DC breakers –Generation of Harmonics –Characteristics harmonics, calculation of AC Harmonics, Non- Characteristics harmonics, adverse effects of harmonics – Calculation of voltage & Current harmonics – Effect of Pulse number on harmonics-Types of AC filters, Design of Single tuned filters –Design of High pass filters

Prescribed Textbooks:

1. E.W. Kimbark: Direct current Transmission, Wiely Inter Science – New York.
2. J. Arillaga HVDC Transmission Peter Peregrinus ltd. London UK 1983
3. K R Padiyar: High Voltage Direct current Transmission Wiely Eastern Ltd New Delhi –1992

Reference Books:

1. E. Uhlman: Power Transmission by Direct Current , Springer Verlag, Berlin Helberg 1985

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RAJAMPET, YSR District, AP – 516126, INDIA

Title of the Course : Hybrid Electric Vehicle Systems
Course Code : 26CEEE0ET
Course offered to : EEE
Credits : 4

Course Objectives

1. To analyze vehicle performance models and assess the technological, environmental, and energy impacts of hybrid and electric vehicles.
2. To evaluate electric and hybrid drivetrain architectures, power flow control, and energy efficiency
3. To investigate electric propulsion systems and advanced motor drive control techniques for vehicle applications.
4. To evaluate energy storage technologies and hybrid storage configurations for electric vehicles
5. To develop and assess energy management strategies for optimal HEV and BEV performance.

Course Outcomes:

1. Develop and analyze vehicle performance models for hybrid and electric vehicle applications.
2. Evaluate drivetrain configurations and power flow strategies for improved vehicle efficiency.
3. Design and assess electric propulsion systems using advanced motor drive control techniques.
4. Compare energy storage technologies and evaluate hybrid storage systems for vehicle applications.
5. Formulate and evaluate energy management strategies for efficient HEV and BEV operation

Unit 1 Introduction to Hybrid Electric Vehicles 9

Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, and mathematical models to describe vehicle performance. History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trainson energy supplies.

Unit 2 Hybrid Electric Drive-trains 9

Basic concept of electric traction, introduction tovarious electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

Unit 3 Electric Propulsion unit 9

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

Unit 4 Energy Storage **9**

Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storageand its analysis, Hybridization of different energy storage devices.

Unit 5 Energy Management Strategies **9**

Introduction to energy management strategies used inhybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies. Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

Prescribed Textbooks:

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
2. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
3. Ali Emadi, Advanced Electric Drive Vehicles, CRC Press, 2017

Reference Books:

1. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003
2. Sheldon S. Williamson, Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles, Springer, 2013.
3. http://nptel.ac.in/syllabus/108103009

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RAJAMPET, YSR District, AP – 516126, INDIA

Title of the Course	**:**	**Digital Control Systems**
Course Code	**:**	**26CEEE0FT**
Course offered to	**:**	EEE
Credits	**:**	4

Course Objectives

1. To analyze digital control systems, sampling techniques, and signal reconstruction methods.
2. To investigate discrete-time system modeling, stability analysis, and digital controller design.
3. To formulate discrete-time state-space models and analyze controllability and observability.
4. To design pole-placement controllers and state observers for discrete-time systems.
5. To develop minimum-order observers and model-matching control strategies.

Course Outcomes:

1. To analyze digital control systems using sampling, quantization, and signal reconstruction techniques.
2. To design digital controllers and evaluate discrete-time system stability.
3. To develop state-space models and assess controllability and observability.
4. To design pole-placement controllers and state observers for discrete-time systems.
5. To develop minimum-order observers and model-matching controllers using polynomial methods.

Unit 1 **9**

Digital Control Systems – Block Schematic, Examples, Signal Forms, Advantages andDisadvantages of Digital Control, Data Conversion and Quantization, Sampling Process. Reconstruction of Original Signals from Sampled Signals - Sampling Theorem, Ideal Low – Pass Filter. Impulse Sampling and Data Hold-Transfer Function of Zero - Order Hold and First-Order Hold, Frequency Response Characteristics

Unit 2 **9**

The Z-Transform and Inverse Z Transform, Z - Transform Method for Solving Difference Equations. The Pulse Transfer Function (PTF) – PTFs of Closed - Loop Systems, Digital Controllers, Digital PID Controller and Digital Control Systems. Mapping Between The S-Plane and Z – Plane - Primary and Complementary Strips. Stability Analysis – Jury Test, Bilinear Transformation and Routh Criterion, Lyapunov Method for LTI Discrete time systems. Design based on the Frequency Response Method and Bilinear Transformation

Unit 3 **9**

State Space Representations of Discrete - Time Systems, Solution of The Time - Invariant Discrete-Time State Equation, State Transition Matrix , Z-Transform Approach to The Solution ofState Equation, Discretization of Continuous- Time State- Space Equations, Controllability and Observability of Discrete- Time Systems, Conditions, Principle of Duality

Unit 4 **9**

Design via Pole Placement – Necessary and Sufficient Condition for Pole Placement, Ackerman's Formula, Dead Beat Response, Design of Dead-Beat Controllers. State Observers – Necessary and Sufficient Condition for State Observation. Full Order State Observer, Error Dynamics of The Full Order State Observer, Design of Prediction Observers –Ackerman's Formula.

Unit 5 **9**

Design of Minimum-Order Observer, Observed- State Feedback Control System with Minimum-Order Observer. Diophantine Equation, Polynomial Equation approach to Control System Design. Design of Model Matching Control Systems

Prescribed Textbooks:

1. K. Ogata, Discrete Time Control Systems, PHI/Addison - Wesley Longman Pte. Ltd., India, Delhi, 1995.
2. B.C Kuo, Digital Control Systems, 2nd Edition, Oxford Univ Press, Inc., 1992.

Reference Books:

1. F. Franklin, J.D. Powell, and M.L. Workman, Digital control of Dynamic Systems, Addison Wesley Longman, Inc., Menlo Park, CA , 1998.
2. Gopal, Digital Control and State Variable Methods, Tata McGraw Hill, India, 1997.
3. C. H. Houpis and G.B. Lamont, Digital Control Systems, McGraw Hill, 1985.
4. John S. Baey, Fundamentals of Linear State Space Systems, Mc. Graw – Hill, 1st edition
5. Bernard Fried Land, Control System Design, Mc. Graw – Hill, 1st edition
6 Dorsay, Continuous and Discrete Control Systems, McGraw - Hill

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RAJAMPET, YSR District, AP – 516126, INDIA

Title of the Course : Adaptive and Learning Control
Course Code : 26CEEE0GT
Course offered to : EEE
Credits : 4

Course Objectives

1. To analyze adaptive control systems and parameter estimation techniques for dynamic processes.
2. To design self-tuning regulators using pole placement and adaptive control algorithms.
3. To investigate stochastic adaptive control strategies using minimum variance and linear quadratic methods.
4. To develop model reference adaptive controllers using MIT rule and Lyapunov theory.
5. To evaluate gain scheduling and self-oscillating adaptive systems for industrial applications.

Course Outcomes:

1. Analyze adaptive systems and estimate dynamic model parameters using least squares methods.
2. Design self-tuning regulators for deterministic and stochastic processes.
3. Develop adaptive controllers using minimum variance and linear quadratic control strategies.
4. Design model reference adaptive systems using MIT rule and Lyapunov-based approaches.
5. Evaluate gain scheduling and self-oscillating adaptive controllers for practical applications.

Unit 1 **9**

Introduction, Block Diagram of an Adaptive System, Effects of Process Variations on System Performance, Types of Adaptive Schemes, Formulation of the Adaptive Control Problem, Least Squares Method and Regression Models for Parameter Estimation, Estimating Parameters in Models of Dynamic Systems, the Finite Impulse Response Model, The Transfer Function and Stochastic Model.

Unit 2 **9**

Block Diagram of Deterministic Self Tuning Regulator (STR), Pole Placement Design – Process Model, Causality Conditions. Indirect STRs – Estimation, Continuous - Time STRs, Direct STRs Minimum Phase Systems, Adaptive Control Algorithm, Feed Forward Control, Non Minimum Phase Systems – Adaptive Control Algorithm, Algorithm For Hybrid STR

Unit 3

Design of Minimum Variance and Moving - Average Controllers, Stochastic STR – Indirect STR, Algorithm for Basic STR, Theorems on Asymptotic Properties. Unification of Direct STRs, Generalized Direct Self Tuning Algorithm, Self Tuning Feed Forward Control. Linear Quadratic STR – Theorems on LQG Control, Algorithms for Indirect LQG – STRs Based on Spectral Factorization and Riccati Equation.

Unit 4 **9**

Model Reference Adaptive System (MRAS), The MIT Rule, Block Diagram of an MRAS for adjustment of Feed Forward Gain based on MIT Rule. Adaptation Gain – Methods for determination. Design of MRAS using Lyapunov Theory – Block Diagram of an MRAS based on Lyapunov Theory for a First Order System. Proof of The Kalman – Yakubovich Lemma, Adjustment Rules for Adaptive Systems, Relation between MRAS and STR.

Unit 5 9

Gain Scheduling – Principle, Block Diagram, Design of Gain Scheduling Controllers, Nonlinear Transformations, Block Schematic of a Controller based on Nonlinear Transformations. Application of Gain Scheduling for Ship Steering, Flight Control. Self Oscillating Adaptive System (SOAS) – Principle, Block Diagram, Properties of The Basic SOAS, Procedure for Design of SOAS. Industrial Adaptive Controllers and applications.

Prescribed Textbooks:

1. K.J.Astrom and Bjorn Wittenmark, Adaptive control, Pearson Edu., 2nd Edn.

Reference Books:

1. V.V.Chalam, Adaptive Control System - Techniques & Applications, Marcel Dekker Inc.
2. Miskhin and Braun, Adaptive control systems, MC Graw Hill
3. Karl Johan Åström, Graham Clifford Goodwin, P. R. Kumar, Adaptive Control, Filtering and Signal Processing
4. G.C. Goodwin, Adaptive control.
5. Narendra and Anna Swamy, Stable Adaptive Systems

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RAJAMPET, YSR District, AP – 516126, INDIA

Title of the Course : Solar Energy Conversion Systems
Course Code : 26CEEE0HT
Course offered to : EEE
Credits : 4

Course Objectives

1. To analyze solar radiation characteristics and evaluate the role of photovoltaic technology in sustainable energy systems.
2. To investigate solar cell design parameters, mathematical models, and efficiency enhancement techniques.
3. To evaluate PV module configurations, mismatch effects, and power output optimization techniques.
4. To analyze PV system components, energy storage, power converters, and MPPT algorithms.
5. To design and evaluate standalone, hybrid, and grid-connected PV systems for diverse applications.

Course Outcomes:

1. Analyze solar radiation data and assess photovoltaic energy potential.
2. Evaluate solar cell parameters, performance models, and efficiency improvement techniques.
3. Assess PV module performance under mismatch conditions and optimize module configurations.
4. Analyze energy storage, power converters, and MPPT techniques for PV systems.
5. Design and evaluate standalone, hybrid, and grid-connected PV systems for efficient energy utilization.

Unit 1 Solar Cell Fundamentals **9**

Introduction to PV, world energy scenario – need for sustainable energy sources – current status ofRenewable energy sources – place of photovoltaic in Energy supply – solar radiation – the sun andearth movement – angle of sunrays on solar collectors – sun tracking – estimating solar radiation empirically – measurement of solar radiation

Unit 2 Design Of Solar Cells **9**

Introduction to Solar cells, Solar cell design- design for high I_{SC} – design for high V_{OC} – design for high F,F upper limits of cell parameters – short circuit current, open circuit voltage, fill factor, efficiency, losses in solar cells – model of a solar cell, effect of series and shunt resistance on efficiency , effect of solar radiation on efficiency, Analytical techniques.

Unit 3 Solar Photovoltaic Modules

Solar PV Modules from solar cells – series and parallel connection of cells – mismatch in module mismatch in series connection – hot spots in the module , bypass diode – mismatching in parallel diode – design and structure of PV modules – number of solar cells in a module, wattage of modules, fabrication of PV module – PV module power output

Unit 4 BALANCE OF SOLAR PV SYSTEMS

Basics of Electromechanical cell – factors affecting performance – batteries for PV systems – DC to DC converters – charge controllers – DC to AC converters (Inverters) – Maximum Power Point tracking (MPPT) – Algorithms for MPPT

Unit 5 PV System Design & Applications 9

Introduction to solar PV systems – standalone PV system configuration – design methodology of PV systems – design of PV powered DC fan without battery, standalone system with DC load using MPPT, design of PV powered DC pump, design of standalone system with battery and AC/DC load – wire sizing in PV system – precise sizing of PV systems – Hybrid PV systems – grid connected PV systems.

Prescribed Textbooks:

1. Solar Photovoltaics Fundamentals, Technologies and Applications" by Chetan singh solanki, PHI publications

Reference Books:

1. Solar Energy Fundamentals and applications by H.P. Garg, J. Prakash "Tata McGraw- Hill publishers Ist edition"
2. S.Rao & B.B.Parulekar, "Energy Technology", 4th edition, Khanna publishers, 2005

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RAJAMPET, YSR District, AP – 516126, INDIA

Title of the Course : **Wind Energy Conversion Systems**
Course Code : **26CEEE0IT**
Course offered to : EEE
Credits : 4

Course Objectives

1. To analyze wind energy conversion principles, turbine aerodynamics, and rotor design techniques.
2. To evaluate wind turbine control strategies, wind resource assessment, and optimal site selection.
3. To develop mathematical models of induction and synchronous machines for wind energy applications.
4. To analyze grid-connected and self-excited induction generators, including reactive power and harmonic management.
5. To evaluate variable-speed wind generation technologies and their integration with hybrid renewable energy systems.

Course Outcomes:

1. Analyze wind turbine aerodynamics and evaluate rotor performance characteristics.
2. Assess wind turbine control methods and determine suitable sites for wind energy installations.
3. Model and evaluate induction and synchronous machines for wind power generation.
4. Analyze induction generator operation and assess grid integration challenges and compensation techniques.
5. Evaluate variable-speed wind generation systems and hybrid wind–solar energy configurations.

Unit 1 Fundamentals of Wind Turbines **9**

Historical background - basics of mechanical to electrical energy conversion in wind energy - types of wind energy conversion devices – definition - solidity, tip speed ratio, power coefficient, wind turbine ratings and specifications - aerodynamics of wind rotors - design of the wind turbine rotor.

Unit 2 Wind Turbine Control Systems & Site Analysis **9**

Wind Turbine - Torque speed characteristics - Pitch angle control – stall control – power electronic control – Yaw control – Control strategy – Wind speed measurements – Wind speed statistics – Site and turbine selection

Unit 3 Basics Of Induction & Synchronous Machines **9**

The Induction Machine – constructional features - equivalent circuit model - performance characteristics - saturation characteristics – dynamic d-q model – the wound – field synchronous

machine – the permanent magnet synchronous machine – power flow between two synchronous sources – induction generator versus synchronous generator

Unit 4 Grid Connected & Self-Excited Induction Generator Operation 9

The Induction Machine – constructional features - equivalent circuit model - performance characteristics - saturation characteristics – dynamic d-q model – the wound – field synchronous machine – the permanent magnet synchronous machine – power flow between two synchronous sources – induction generator versus synchronous generator

Unit 5 Wind Generation with Variable-Speed Turbine & Application 9

Classification of schemes – operating area – induction generators – doubly fed induction generator
wound field synchronous generator – the permanent magnet generator – Merits and limitationsof wind energy conversion systems – application in hybrid energy systems – diesel generator and photovoltaic systems – wind photovoltaic systems.

Prescribed Textbooks:

1. S.N.Bhadra,D.Kastha, S.Banerjee, " wind electrical systems" Oxford University Press.

Reference Books:

1. S.Rao & B.B.Parulekar, "Energy Technology", 4th edition, Khanna publishers, 2005
2. Renewable Energy sources & Conversion Technology by N.K.Bansal, Manfred Kleemann, Michael Meliss. Tata Mcgraw Hill Publishers

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RAJAMPET, YSR District, AP – 516126, INDIA

Title of the Course : **Optimization & Heuristic Search Techniques**
Course Code : **26CEEE0JT**
Course offered to : EEE
Credits : 4

Course Objectives

1. To formulate optimization problems and apply classical techniques for constrained and unconstrained optimization.
2. To analyze and solve linear programming problems using simplex and related methods.
3. To apply transportation, one-dimensional minimization, and dynamic programming techniques to optimization problems.
4. To evaluate gradient-based and direct search methods for solving unconstrained optimization problems.
5. To investigate metaheuristic algorithms for solving complex, nonlinear, and large-scale optimization problems.

Course Outcomes:

1. Formulate optimization problems and determine optimal solutions using classical methods.
2. Solve linear programming problems using simplex algorithms and related mathematical techniques.
3. Optimize transportation and multistage decision problems using appropriate numerical methods.
4. Apply and compare unconstrained optimization techniques for nonlinear problems.
5. Develop and evaluate metaheuristic algorithms for complex engineering optimization problems.

Unit 1 Introduction & Classical Optimization Techniques 9

Statement of an Optimization problem – design vector – design constraints – constraint surface – objective function – objective function surfaces – classification of Optimization problems. Single variable Optimization – multi variable Optimization without constraints – necessary and sufficient conditions for minimum/maximum – multivariable Optimization with equality constraints. Solution by method of Lagrange multipliers – multivariable Optimization with inequality constraints – Kuhn – Tucker conditions

Unit 2 Linear Programming 9

Standard form of a linear programming problem – geometry of linear programming problems – definitions and theorems – solution of a system of linear simultaneous equations – pivotal reduction of a general system of equations – motivation to the simplex method – simplex algorithm

Unit 3 Transportation Problem **9**

Finding initial basic feasible solution by north – west corner rule, least cost method and Vogel's approximation method – testing for optimality of balanced transportation problems. One – dimensional minimization methods: Classification, Fibonacci method and Quadratic interpolation method. Dynamic programming multistage decision processes – types – concept of sub optimization and the principle of optimality – computational procedure in dynamic programming –examples illustrating the calculus method of solution - examples illustrating the tabular method of solution

Unit 4 Unconstrained Optimization Techniques

Univariate method, Random Search methods, Grid Search method, Pattern Directions, Powell's method, Simplex method, Gradient of a function, Steepest Descent (Cauchy) method, Conjugate Gradient (Fletcher-Reeves) method, Newton's method.

Unit 5 Heuristic Optimization Techniques 9

Meta heuristic search methods: Genetic Algorithm based optimization, Simulated Annealing Techniques, Swarm Intelligent Algorithms, PSO, etc

Prescribed Textbooks:

1. Modern Heuristic Optimization Techniques" by Kwang Y. Lee, Mohamed A. El-Sharkawi2.
2. Engineering optimization: Theory and practice"-by S. S.Rao, New Age International (P) Limited, 3rdedition, 1998
3. Introductory Operations Research" by H.S. Kasene & K.D. Kumar, Springer(India), Pvt.LTd

Reference Books:

1. Optimization Methods in Operations Research and systems Analysis" – by K.V. Mital and C. Mohan, New Age International (P) Limited, Publishers, 3 rd edition, 1996.
2. Operations Research – by Dr. S.D.Sharma.
3. "Operations Research: An Introduction" by H.A. Taha, PHI Pvt. Ltd., 6thedition
4. Linear Programming by G. Hadley

Title of the Course : **Intelligent Control Techniques**
Course Code : **26CEEE0KT**
Course offered to : EEE
Credits : 4

Course Objectives

1. To investigate intelligent control architectures, expert systems, and advanced data preprocessing techniques for complex control applications.
2. To develop neural network models and analyze their applications in dynamic system identification and control.
3. To formulate and optimize control problems using genetic algorithms and advanced meta-heuristic search techniques.
4. To design fuzzy logic models and controllers using fuzzy set theory and approximate reasoning.
5. To investigate intelligent control architectures, expert systems, and advanced data preprocessing techniques for complex control applications.

Course Outcomes:

1. Analyze intelligent control architectures and apply knowledge-based reasoning and data preprocessing methods to engineering problems.
2. Design and evaluate neural network-based controllers for linear and nonlinear dynamic systems.
3. Apply genetic algorithms and metaheuristic optimization techniques to complex control problems.
4. Develop fuzzy logic controllers using fuzzification, inference, defuzzification, and fuzzy rule-based reasoning.
5. Implement and assess intelligent fuzzy control schemes for nonlinear SISO/MIMO systems, considering stability and performance.

Unit 1 9

Introduction to control techniques, need of intelligent control. Architecture for intelligent control. Symbolic reasoning system, rule - based systems, the AI approach. Knowledge representation. Expert systems. Data Pre - Processing: Scaling, Fourier transformation, principal - component analysis and wavelet transformations

Unit 2 9

Concept of Artificial Neural Networks and its basic mathematical model, McCulloch - Pitts neuron model, simple perceptron, Adaline and Madaline, Feed - forward Multilayer Perceptron. Learning and training the neural network. Networks: Hopfield network, Self - organizing network and Recurrent network. Neural Network based controller, Case studies: Identification and control of linear and nonlinear dynamic systems using Matlab / Neural Network toolbox

Unit 3 **9**

Genetic Algorithm: Basic concept of Genetic algorithm and detail algorithmic steps, adjustment of free parameters. Solution of typical control problems using genetic algorithm. Concept on some other than GA search techniques like tabu search and ant - colony search techniques for solving optimization problems

Unit 4 **9**

Introduction to crisp sets and fuzzy sets, basic fuzzy set operation and approximate reasoning. Introduction to Fuzzy logic modeling and control of a system. Fuzzification, inference and defuzzification. Fuzzy knowledge and rule bases

Unit 5 **9**

Fuzzy modeling and control schemes for nonlinear systems. Self - organizing fuzzy logic control. Implementation of fuzzy logic controller using Matlab fuzzy - logic toolbox. Stability analysis of fuzzy control systems. Intelligent Control for SISO/MIMO Nonlinear Systems. Model Based Multivariable Fuzzy Controller.

Prescribed Textbooks:

1. Simon Haykins, Neural Networks: A comprehensive Foundation, Pearson Edition, 2003.
2. T.J.Ross, Fuzzy logic with Fuzzy Applications, Mc Graw Hill Inc, 1997.
3. David E Goldberg, Genetic Algorithms

Reference Books:

1. Martin T. Hagan, Howard B. Demuth, Mark H. Beale, and Orlando De Jesús, Neural Network Design, 2nd Edition, Martin Hagan Publishing, 2014.
2. Ali Zilouchian and Mo Jamshidi (Editors), Intelligent Control Systems Using Soft Computing Methodologies, CRC Press, 2001.
3. Kevin M. Passino and Stephen Yurkovich, Fuzzy Control, Addison-Wesley Longman, 1998.
4. S. Rajasekaran and G. A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis and Applications, PHI Learning, 2011.

ANNAMACHARYA UNIVERSITY

(ESTD UNDER AP PRIVATE UNIVERSITIES (ESTABLISHMENT AND REGULATION) ACT,
(UNIVERSITY LISTED IN UGC AS PER THE SECTION 2(f) OF THE UGC ACT, 1956)

RAJAMPET, YSR District, AP – 516126, INDIA

Title of the Course	**:**	**Introduction to Machine Learning**
Course Code	**:**	**26CEEE0LT**
Course offered to	**:**	EEE
Credits	**:**	4

Course Objectives

1. To analyze statistical learning methods for regression, classification, and dimensionality reduction in complex datasets.
2. To investigate advanced machine learning algorithms, neural networks, support vector machines, and decision trees for predictive modeling.
3. To evaluate model performance using validation techniques, ensemble learning, and probabilistic classification methods.
4. To explore graphical models, hidden Markov models, and advanced clustering techniques for probabilistic inference and unsupervised learning.
5. To examine learning theory and reinforcement learning methods for developing intelligent, data-driven decision-making systems.

Course Outcomes:

1. Apply statistical learning techniques to develop and analyze regression, classification, and dimensionality-reduction models.
2. Design and evaluate neural networks, support vector machines, and decision-tree models for complex predictive tasks.
3. Assess predictive models using cross-validation, evaluation metrics, ensemble methods, and Bayesian learning techniques.
4. Analyze graphical models and implement clustering algorithms for probabilistic reasoning and unsupervised data analysis.
5. Apply learning theory and reinforcement learning principles to solve complex sequential decision-making problems.

Unit 1 **9**

Introduction: Statistical Decision Theory - Regression, Classification, Bias Variance, Linear Regression, Multivariate Regression, Subset Selection, Shrinkage Methods, Principal Component Regression, Partial Least squares, Linear Classification, Logistic Regression, Linear Discriminant Analysis.

Unit 2 **9**

Perceptron, Support Vector Machines, Neural Networks - Introduction, Early Models, Perceptron Learning, Backpropagation, Initialization, Training & Validation, Parameter Estimation - MLE, MAP, Bayesian, Estimation Decision Trees, Regression Trees, Stopping Criterion & Pruning loss functions, Categorical Attributes, Multiway Splits, Missing Values, Decision Trees - Instability Evaluation Measures.

Unit 3 **9**

Bootstrapping & Cross Validation, Class Evaluation Measures, ROC curve, MDL, Ensemble Methods-Bagging, Committee Machines and Stacking, Boosting, Gradient Boosting, Random Forests, Multi-class Classification, Naive Bayes, Bayesian Networks.

Unit 4 **9**

Undirected Graphical Models, HMM, Variable Elimination, Belief Propagation, Partitional Clustering, Hierarchical Clustering, Birch Algorithm, CURE Algorithm, Density- based Clustering, Gaussian Mixture Models, Expectation Maximization

Unit 5 **9**

Learning Theory, Introduction to Reinforcement Learning, Optional videos (RL framework, TD learning, Solution Methods, Applications).

Prescribed Textbooks:

1. The Elements of Statistical Learning, by Trevor Hastie, Robert Tibshirani, Jerome H. Friedman

Reference Books:

1. Pattern Recognition and Machine Learning, by Christopher Bishop

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RAJAMPET, YSR District, AP – 516126, INDIA

Title of the Course : **Modern Flexible AC Transmission System**
Course Code : **26CEEE0MT**
Course offered to : EEE
Credits : 4

Course Objectives

1. To analyze FACTS concepts, transmission system constraints, dynamic stability, and the operational benefits of controllable power-flow devices.
2. To investigate voltage-source and current-source converter topologies and evaluate their performance for FACTS applications.
3. To analyze and compare SVC and STATCOM technologies for dynamic reactive power compensation and voltage regulation.
4. To evaluate static series compensators for controlling transmission impedance, power flow, and system stability.
5. To investigate UPFC, IPFC, and multifunctional FACTS controllers for independent real and reactive power flow control.

Course Outcomes:

1. Analyze FACTS controllers and assess their impact on transmission capacity, power flow, and dynamic stability.
2. Evaluate converter topologies, pulse-width modulation techniques, and converter configurations for FACTS applications.
3. Compare SVC and STATCOM performance for reactive power compensation and voltage control under varying operating conditions.
4. Analyze and select suitable series compensation techniques for improving power transfer and transmission system performance.
5. Design and evaluate UPFC and IPFC control strategies for coordinated real and reactive power flow management.

Unit 1

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 2 **9**

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 3 **9**

Objective of shunt compensation, methods of controllable Var generation, static Var compensator, SVC and STA TCOM, comparison between, SVC and STA TCOM.

Unit 4 **9**

Objective of shunt compensation, methods of controllable Var generation, static Var compensator, SVC and STA TCOM, comparison between, SVC and STA TCOM.

Unit 5 **9**

The Unified Power Flow Controller-Basic Operating Principles, Conventional Transmission Control Capabilities, Independent Real and Reactive Power Flow Control. Control Structure, Basic Control System for P and Q Control, Dynamic Performance, The Interline Power Flow Controller (IPFC), Basic Operating Principles and Characteristics, Generalized and Multifunctional FACTS Controllers.

Prescribed Textbooks:

1. Hingorani H G and Gyugyi. L "Understanding FACTS-Concepts and Technology of Flexible AC Transmission Systems" New York, IEEE Press, 2000
2. Padiyar.K. R, "FACTS Controllers in Power Transmission and Distribution" New Age Int. Publishers, 2007.
3. Mathur, R.M. and Verma, R.K., Thyristor Based FACTS Controllers for Electrical Transmission Systems, IEEE Press (2002).

Reference Books:

1. Zhang, Xiao-Ping, Rehtanz, Christian, Pal, Bikash "Flexible AC Transmission Systems: Modelling and Control", Springer, 2012.
2. Yong-Hua Song, Allan Johns, "Flexible AC Transmission Systems", IET, 1999