JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Syllabus for Pre-Ph. D Examination
EEE

PAPER – II		Subject Code
S. No	**Subject**	
1	Electrical Distribution Systems	**1302101**
2	Electrical Machine Modeling and Analysis	**1302102**
3	Partial Discharge in HV Equipment	**1302103**
4	Electric Drives-I	**1302104**
5	Power Quality	**1302105**
6	Demand side Energy Management	**1302106**
7	Artificial Intelligence Techniques	**1302107**
8	System and Parameter Identification	**1302108**
9	Optimization Techniques	**1302109**
10	Advanced Power System Protection	**1302110**

PAPER – III		Subject Code
S. No	**Subject**	
1	Advanced Digital Signal Processing	**1302201**
2	Advanced Digital Control Systems	**1302202**
3	HVAC Transmission	**1302203**
4	Flexible Ac Transmission Systems	**1302204**
5	High Voltage Testing Techniques	**1302205**
6	Renewable Energy Systems	**1302206**
7	Electric Drives-II	**1302207**
8	Control of Special Machines	**1302208**
9	Power System Deregulation	**1302209**
10	Analysis of Power Electronic Converters	**1302210**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Syllabus for Pre-Ph. D Examination
EEE

PAPER – II

ELECTRICAL DISTRIBUTION SYSTEMS

Unit I : General : Introduction to Distribution systems, an overview of the role of computers in distribution system planning-Load modeling and characteristics: definition of basic terms like demand factor, utilization factor, load factor, plant factor, diversity factor, coincidence factor, contribution factor and loss factor-Relationship between the load factor and loss factor - Classification of loads
(Residential, Commercial, Agricultural and Industrial) and their characteristics.

Unit II : Distribution Feeders and Substations : Design consideration of Distribution feeders: Radial and loop types of primary feeders, voltage levels, feeder-loading. Design practice of the secondary distribution system. Location of Substations : Rating of a Distribution Substation, service area with primary feeders. Benefits derived through optimal location of substations.

Unit III : System analysis : Voltage drop and power loss calculations : Derivation for volt-drop and power loss in lines, manual methods of solution for radial networks, three-phase balanced primary lines, non-three-phase primary lines.

Unit IV : Protective devices and coordination : Objectives of distribution system protection, types of common faults and procedure for fault calculation. Protective Devices: Principle of operation of fuses, circuit reclosers, line sectionalizer and circuit breakers. Coordination of protective devices : General coordination procedure.

Unit V : Capacitive compensation for power factor control: Different types of power capacitors, shunt and series capacitors, effect of shunt capacitors (Fixed and switched) power factor correction, capacitor location. Economic justification. Procedure to determine the best capacitor location. Voltage control : Equipment for voltage control, effect of series capacitors, effect of AVB/AVR, line drop compensation.

Reference Books :

1. "Electric Power Distribution System Engineering " by Turan Gonen, Mc.Graw-Hill Book Company,1986.

2. Electric Power Distribution-by A.S.Pabla, Tata Mc Graw-Hill Publishing Company, 4th edition, 1997.

3. Electrical Distribution V.Kamaraju-Mc Graw Hill

4.Handbook of Electrical Power Distribution – Gorti Ramamurthy-Universities press

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Syllabus for Pre-Ph. D Examination
EEE

ELECTRICAL MACHINE MODELING & ANALYSIS

UNIT – 1:Basic concepts of Modeling
Basic Two-pole Machine representation of Commutator machines, 3-phase synchronous machine with and without damper bars and 3-phase induction machine, Kron's primitive Machine-voltage, current and Torque equations.

UNIT – II:DC Machine Modeling
Mathematical model of separately excited D.C motor – Steady State analysis-Transient State analysis-Sudden application of Inertia Load-Transfer function of Separately excited D.C Motor- Mathematical model of D.C Series motor, Shunt motor-Linearization Techniques for small perturbations

UNIT- III: Reference frame theory& Modeling of single phase Induction Machines
Linear transformation-Phase transformation - three phase to two phase transformation (abc to αβ0) and two phase to three phase transformation αβ0 to abc - -Power equivalence-Mathematical modeling of single phase induction machines.

UNIT – IV: Modeling of three phase Induction Machine
Generalized model in arbitrary reference frame-Electromagnetic torque-Derivation of commonly used Induction machine models- Stator reference frame model-Rotor reference frame model-Synchronously rotating reference frame model-state space model with flux linkages as variables

UNIT –V: Modeling of Synchronous Machine
Synchronous machine inductances –voltage equations in the rotor's dq0 reference frame-electromagnetic torque-current in terms of flux linkages-three synchronous machine model-modeling of PM Synchronous motor, modeling of BLDC motor, modeling of Switched Reluctance motor

Reference Books

1. Electric Motor Drives - Modeling, Analysis& control -R.Krishnan- Pearson Publications-1st edition -2002
2. Analysis of Electrical Machinery and Drive systems – P.C.Krause, Oleg Wasynczuk, Scott D.Sudhoff – Second Edition-IEEE Press.
3. Dynamic simulation of Electric machinery using Matlab / Simulink –Chee Mun Ong-Prentice Hall

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Syllabus for Pre-Ph. D Examination
EEE

PARTIAL DISCHARGES IN HV EQUIPMENT

Unit 1 : Types of partial discharges and its occurrence and recurrence and magnitudes : Definition of Partial discharges, inception of internal discharges, Inception of corona discharges.
Unit 2 : Discharges by electrical treeing. Discharges at AC Voltages, corona discharges, Discharges at D.C. Voltages, discharges at impulse voltages.
Object of discharge detection, Quantities related to the magnitude of discharges, choice of PD as a measure for discharges.

Unit 3 : Electrical discharge detection & Detection circuits : Basic diagram, amplification of impulses, sensitivity, resolution, observation. Straight detection.
Balanced detection, calibrators, Interferences, choice between straight detection & balance detection, common mode rejection.
Unit 4 : Location of Partial discharges : Non-electric location, location by separation of electrodes, location with electrical probes. location by traveling waves, PD location in cables & switchgear by traveling waves. Evaluation of discharges : Recognition, mechanisms of deterioration, evaluation, specification.
Unit 5 : Detection in actual specimen : Detection in capacitors, cables, bushings. Transformers, machine insulation, Gas-insulated switchgear.

Reference Book :

1. Partial Discharges in HV Equipment by F..Kruguer, Butterworths & Co., Publications Ltd., 1989.
2. *Partial Discharges in Electrical Power Apparatus.* by Dieter Konig, Y. *Narayana Rao*- VDE-Verlag publisher

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Syllabus for Pre-Ph. D Examination
EEE

ELECTRIC DRIVES – I

Unit-I Introduction and single phase convertor fed DC motor drive:
Basic power electronic drive system, components, stability of power electronic drive, single phase full-convertor and half-convertor fed dc drives for continuous and discontinuous mode of operation. Four quadrant operation of drive using dual convertor.

Unit-II Three phase AC-DC convertor fed DC motor drive:
Three phase full-convertor and half-convertor fed dc drives for continuous and discontinuous mode of operation. Four quadrant operation of drive using three phase dual convertor. Pulsating torque

Unit-III Modeling of AC-DC convertor fed DC drive components & design of controller:
Transfer function of Dc motor and load, convertor, current and speed controllers, current and speed feedback elements. Design of current controller and speed controller. Closed loop two quadrant DC motor drive, closed loop four quadrant DC motor drive, introduction to simulation of DC motor drive.

Unit-IV DC-DC convertor drive fed DC motor drive:
Four quadrant DC-DC convertor fed dc motor drive, steady state analysis of DC-DC convertor dc motor drive, pulsating torques.

Unit-V Closed loop operation of DC-DC convertor fed dc motor drive:
Design of current controller, design of speed controller, modeling of current and speed controller, introduction to simulation of speed controlled dc motor drive.

Reference Books:

1. Electrical Motor Drives Modeling, Analysis and Control – R. Krishna, Prentice Hall India.
2. Power Semiconductor Drives – G.K. Dubey.
3. Power Electronics and Motor control – Shepherd, Hulley, Liang-II Edition, Cambridge University Press.
4. Power electronic circuits, devices and applications – M.H.Rashid – PHI.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Syllabus for Pre-Ph. D Examination
EEE

POWER QUALITY

Unit-1 Introduction

Overview of Power Quality - Concern about the Power Quality - General Classes of Power Quality Problems – Transients -Long-Duration Voltage Variations - Short-Duration Voltage Variations - Voltage Unbalance - Waveform Distortion - Voltage fluctuation - Power Frequency Variations - Power Quality Terms - Voltage Sags and Interruptions - Sources of Sags and Interruptions – Nonlinear loads.

Unit-2 Transient Over Voltages

Source of Transient Over Voltages - Principles of Over Voltage Protection - Devices for Over Voltage Protection - Utility Capacitor Switching Transients - Utility Lightning Protection - Load Switching Transient Problems - Computer Tools for Transient Analysis

Unit-3 Harmonic Distortion and solutions

Voltage vs. Current Distortion - Harmonics vs. Transients - Power System Quantities under Nonsinusoidal Conditions - Harmonic Indices – Sources of harmonics - Locating Sources of Harmonics – System Response Characteristics - Effects of Harmonic Distortion – Interharmonics - Harmonic Solutions Harmonic Distortion Evaluation - Devices for Controlling Harmonic Distortion - Harmonic Filter Design - Standards on Harmonics

Unit- 4 Long Duration Voltage Variations

Principles of Regulating the Voltage - Device for Voltage Regulation - Utility Voltage Regulator Application - Capacitor for Voltage Regulation - End-user Capacitor Application - Regulating Utility Voltage with Distributed Resources – Flicker

Unit-5 Distributed Generation and Power Quality

Resurgence of Distributed Generation - DG Technologies - Interface to the Utility System - Power Quality Issues - Operating Conflicts - DG on Low Voltage Distribution Networks - Interconnection standards - Wiring and Grounding - Typical Wiring and Grounding Problems - Solution to Wiring and grounding Problems

TEXTBOOKS

1. Electrical Power Systems Quality, Dugan R C, McGranaghan M F, Santoso S, and Beaty H W, Second Edition, McGraw-Hill, 2002.
2. Power Quality Primer, Kennedy B W, First Edition, McGraw-Hill, 2000.

REFERENCES

1. Understanding Power Quality Problems: Voltage Sags and Interruptions, Bollen M H J, First Edition, IEEE Press; 2000.
2. Power System Harmonics, Arrillaga J and Watson N R, Second Edition, John Wiley & Sons, 2003.
3. Electric Power Quality control Techniques, W. E. Kazibwe and M. H. Sendaula, Van Nostrad Reinhold, New York.
4. Power Quality c.shankaran, CRC Press, 2001
5. Harmonics and Power Systems –Franciso C.DE LA Rosa-CRC Press (Taylor & Francis)
6. Power Quality in Power systems and Electrical Machines-Ewald F.fuchs, Mohammad A.S. Masoum-Elsevier

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Syllabus for Pre-Ph. D Examination
EEE

DEMAND SIDE ENERGY MANAGEMENT

Unit-1 : Energy Audit and Energy management information systems: Energy audit: Definitions-Need-concepts-Types of energy audit; Energy management information systems: Introduction-Need-components-designing-using the system-identifying plant outages

Unit-2 : Energy Economics: Introduction-Cost benefit risk analysis-Payback period-Straight line depreciation-Sinking fund depreciation—Reducing balance depreciation-Net present value method-Internal rate of return method-Profitability index for benefit cost ratio.

Unit-3 : Energy Conservation in Electric utilities and Industry: Electrical load management: Energy and load management devices-Conservation strategies; conservation in electric utilities and industry: Introduction-Energy conservation in utilities by improving load factor-Utility voltage regulation-Energy conservation in Industries-Power factor improvement.
Energy –efficient electric motors: Energy efficient motors-construction and technical features-case studies of EEMs with respect to cost effectiveness-performance characteristics; Economics of EEMs and system: life cycle-direct savings and payback analysis-efficiency factor or efficiency evaluation factor

Unit-4 : Electric Lighting: Introduction-Need for an energy management program-Building analysis-Modification of existing systems-Replacement of existing systems-priorities:
Illumination requirement : Task lighting requirements-lighting levels-system modifications-non illumination modifications-lighting for non task areas-reflectances-space geometry ;System elements: light sources - characteristics of families of lamps-lamp substitution in an existing systems-selection of Higher efficiency lamps for a new system-Luminaries-ballasts-energy conservation in lighting.

Unit-5 : Space Heating ,Ventilation, Air-Conditioning(HVAC) and Water Heating: Introduction-Heating of buildings-Transfer of Heat-Space heating methods-Ventilation and air-conditioning-Insulation-Cooling load-Electric water heating systems-Energy conservation methods.
Co-generation and storage: Combined cycle cogeneration-energy storage: pumped hydro schemes-compressed air energy storage(CAES)-storage batteries-superconducting magnetic energy storage (SMES)

References:

1.Energy management Hand book by Wayne C.Turner,John wiley and sons publications
2.Electric Energy Utilization and Conservation by S C Tripathy,Tata McGraw hill publishing company ltd.New Delhi
3.Energy efficient electric motors selection and application by John C.Andreas
4.Hand book on Energy Audit and Management by Amit kumar Tyagi,published by TERI(Tata energy research Institute)
5.Energy management by Paul W.O' Callaghan McGraw hill book company
6.Energy conversion systems by Rakosh Das Begamudre New age international publishers

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Syllabus for Pre-Ph. D Examination
EEE

ARTIFICIAL INTELLIGENCE TECHNIQUES

Unit – I: Introduction to Neural Networks
Introduction, Humans and Computers, Biological Neural Networks, Historical development of neural network, Terminology and Topology, Biological and artificial neuron models, Basic learning laws.

Unit- II: Feed Forward Neural Networks
Introduction, Perceptron models: Discrete, continuous and multi-category, Training algorithms: Discrete and Continuous Perceptron Networks, Perceptron convergence theorem, Limitations and applications of the Perceptron model, Generalized delta learning rule, Feedforward recall and error back propagation training-Radial basis function algorithms-Hope field networks

Unit III: Genetic algorithms & Modelling-introduction-encoding-fitness function-reproduction operators-genetic operators-cross over and mutation-generational cycle-convergence of genetic algorithm

Unit – VI: Classical and Fuzzy Sets
Introduction to classical sets - properties, operations and relations; Fuzzy sets, membership, Uncertainty, operations, properties, fuzzy relations, cardinalities, membership functions.
Fuzzy Logic System Components-Fuzzification, Membership value assignment, development of rule base and decision making system, defuzzification to crisp sets, defuzzification methods.

UNIT V: APPLICATION OF AI TECHNIQUES-load forecasting-load flow studies-economic load dispatch-load frequency control-reactive power control-speed control of dc and ac motors

TEXT BOOK:
1. Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications by Rajasekharan and Rai – PHI Publication.
2. Introduction to Artificial Neural Systems - Jacek M. Zuarda, Jaico Publishing House, 1997.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Syllabus for Pre-Ph. D Examination
EEE

SYSTEM AND PARAMETER IDENTIFICATION

Unit I Introduction:
System models and model classification, Iidentification problem, some fields of applications.
Unit-II Classical models:
Time response and frequency response methods of transfer function evolution, Impulse response identification using cross correlation test and orthogonal series expansion, methods of convolution, model learning technique.
Unit-III Least square Method:
Least square estimates and its properties, non recursive least square identification of dynamic system, extensions such as generalised least square repeated least square and instrumental variable method. Recurse Methods: Recursive least square, minimum variance algorithms, stochastic approximation method, maximum likelihood method.
Unit IV Identification of state variable models:
State Estimatior using Kalman and extended kalman filter, simultaneous state and parameter estimation of linear systems.
Unit V Non-Linear systems identification:
Identification of a volterra series models, identification of non-linear state models using extended kalman filter, quasilinearization method, invariant imbedding, gradient method, Numerical identification through model following approach.
Reference Books:

1. J.M.Mendel, 'DISCRETE TECHNIQUES OF PARAMETER ESIMATION', Marcel Dekker, 1973.
2. F.Eykhoff, 'SYSTEM IDENTIFICATION, PARAMETER AND STATE ESTIMATION, John Willey, 1974.
3. A.P.Sage and J.L.Melsa 'SYSTEM IDENTIFICATION',Academic press, 1971.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Syllabus for Pre-Ph. D Examination
EEE

OPTIMIZATION TECHNIQUES

UNIT – I:

Introduction and Classical Optimization Techniques:

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 – II:

Linear Programming

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 – III:

Unconstrained Nonlinear Programming:

One – dimensional minimization methods: Classification, Fibonacci method and Quadratic interpolation method. Univariate method, Powell's method and steepest descent method.

UNIT – IV:

Constrained Nonlinear Programming:

Characteristics of a constrained problem, Classification, Basic approach of Penalty Function method; Basic approaches of Interior and Exterior penalty function methods. Introduction to convex Programming Problem.

UNIT – V:

Dynamic Programming:

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.

TEXT BOOKS:

1. "Engineering optimization: Theory and practice"-by S. S.Rao, New Age International (P) Limited, 3rd edition, 1998.
2. "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, 3rd edition, 1996.
2. Operations Research – by Dr. S.D.Sharma.
3. "Operations Research: An Introduction" – by H.A. Taha, PHI Pvt. Ltd., 6th edition
4. Linear Programming–by G.Hadley.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Syllabus for Pre-Ph. D Examination
EEE

ADVANCED POWER SYSTEM PROTECTION

Unit 1 : Static Relays classification and Tools : Comparison of Static with Electromagnetic Relays, Basic classification, Level detectors and Amplitude and phase Comparators – Duality – Basic Tools – Schmitt Trigger Circuit, Multivibrators, Square wave Generation – Polarity detector – Zero crossing detector – Thyristor and UJT Triggering Circuits. Phase sequence Filters – Speed and reliability of static relays.

Unit 2 : Amplitude and Phase Comparators (2 Input) : Generalized equations for Amplitude and Phase comparison – Derivation of different characteristics of relays – Rectifier Bridge circulating and opposed voltage type amplitude comparators – Averaging & phase splitting type amplitude comparators – Principle of sampling comparators.

Phase Comparison : Block Spike and phase Splitting Techniques – Transistor Integrating type, phase comparison, Rectifier Bridge Type Comparison – Vector product devices.

Unit 3 : Static over current (OC) relays – Instantaneous, Definite time, Inverse time OC Relays, static distance relays, static directional relays, static differential relays, measurement of sequence impedances in distance relays, multi input comparators, elliptic & hyperbolic characteristics, switched distance schemes, Impedance characteristics during Faults and Power Swings,

Unit 4 : Carrier plot protection scheme: carrier current protection schemes, relative merits & demerits, carrier aided distance protection schemes, transfer schemes, blocking scheme and acceleration schemes.

Differential relay Principle and characteristics, maloperation of differential relay, protection of transformers, protection of generators.

Unit 5 :

Numerical Protection: Introduction , numerical relay, numerical relaying algorithms, mann-morrison technique,Differential equation technique, discrete fourier transform technique, rationalised harr transform technique, wavelet transform technique, numerical overcurrent protection , numerical distance protection , numerical differential protection.

Reference Books :

1. Power System Protection with Static Relays – by TSM Rao
2. Protective Relaying Vol-II Warrington
3. Art & Science of Protective Relaying - C R Mason
4. Power System Stability Kimbark Vol-II
5. Power system protection & switchgear by Badri Ram & D N viswakarma.
6. Electrical Power System Protection –C.Christopoulos and A.Wright- Springer
7. Protection & Switchgear –Bhavesh Bhalaja,R.P Maheshwari, Nilesh G.Chothani-Oxford publisher

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Syllabus for Pre-Ph. D Examination
EEE

PAPER-III

ADVANCED DIGITAL SIGNAL PROCESSING

UNIT-I: Digital Filter Structure

Block diagram representation-Equivalent Structures-FIR and IIR digital filter Structures All pass Filters-tunable IIR Digital Filters-IIR tapped cascaded Lattice Structures-FIR cascaded Lattice structures-Parallel-Digital Sine-cosine generator-Computational complexity of digital filter structures.

UNIT-II: Digital filter design

Preliminary considerations-Bilinear transformation method of IIR filter design-design of Low pass high pass-Band pass, and Band stop- IIR digital filters-Spectral transformations of IIR filters, FIR filter design-based on Windowed Fourier series- design of FIR digital filters with least –mean- Square-error-constrained Least-square design of FIR digital filters

UNIT-III: DSP algorithm implementation

Computation of the discrete Fourier transform- Number representation-Arithmetic operations-handling of overflow-Tunable digital filters-function approximation.

UNIT-IV : Analysis of finite Word length effects

The Quantization process and errors- Quantization of fixed -point and floating -point Numbers-Analysis of coefficient Quantization effects - Analysis of Arithmetic Round-off errors, Dynamic range scaling-signal- to- noise ratio in Low -order IIR filters-Low-Sensitivity Digital filters-Reduction of Product round-off errors using error feedback-Limit cycles in IIR digital filters- Round-off errors in FFT Algorithms.

UNIT V : Power Spectrum Estimation

Estimation of spectra from Finite Duration Observations signals – Non-parametric methods for power spectrum Estimation – parametric method for power spectrum Estimation, Estimation of spectral form-Finite duration observation of signals-Non-parametric methods for power spectrum estimation-Walsh methods-Blackman & torchy method.

Reference Books:

1. Digital signal processing-sanjit K. Mitra-TMH second edition
2. Discrete Time Signal Processing – Alan V.Oppenheim, Ronald W.Shafer - PHI-1996 1st edition-9th reprint
3 Digital Signal Processing principles, algorithms and Applications – John G.Proakis -PHI –3rd edition-2002
4. Digital Signal Processing – S.Salivahanan, A.Vallavaraj, C. Gnanapriya – TMH - 2nd reprint-2001
5. Theory and Applications of Digital Signal Proceesing-LourensR. Rebinar & Bernold
6. Digital Filter Analysis and Design-Auntonian-TMH

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Syllabus for Pre-Ph. D Examination
EEE

ADVANCED DIGITAL CONTROL SYSTEMS

UNIT I

Overview of modern digital control theories, Z- and inverse Z-transformation and properties, Discrete-time systems and difference equations, Sampling and reconstruction (A/D and D/A conversions), Z- and S-plane correspondence and stability test, Analysis of sampled data systems.

UNIT II

Discrete-time state equations, Sampled continuous-time systems, Canonical forms, transformation to controllable, observable and diagonal forms, Controllability and observability.

UNIT III

State determination and control, State feedback and eigenvalue placement of single input systems, State feedback and eigenvalue placement of multi-Input systems, Quadratic optimal control, Digital tracking systems.

UNIT IV

State estimation, State observer design for single out-put systems, State observer design for multi-output systems, System Identification.

UNIT V

Digitizing analog controllers, Designing between-sample response, Digital hardware control, Actuators limitation.

Reference Books:

1. Ms. Santina, A.R.Stuberud & G.H.Hostetter, Digital Control Systems Design, Oxford Univ Press, 2nd edition.
2. B.C Kuo, Digital Control Systems, 2nd Edition, Oxford Univ Press, Inc., 1992.
3. F. Franklin, J.D. Powell, and M.L. Workman, Digital control of Dynamic Systems, Addison - Wesley Longman, Inc., Menlo Park, CA , 1998.
4. Gopal, Digital Control and State Variable Methods, Tata McGraw Hill, India, 1997.
5. C. H. Houpis and G.B. Lamont, Digital Control Systems, McGraw Hill, 1985.
6. John S. Baey, Fundamentals of Linear State Space Systems, Mc. Graw – Hill, 1st edition
7. Bernard Fried Land, Control System Design, Mc. Graw – Hill, 1st edition
8. Dorsay, Continuous and Discrete Control Systems, McGraw - Hill.

.

HVAC TRANSMISSION

Unit 1 : E.H.V. A.C. Transmission , line trends and preliminary aspects ,standard transmission voltages – power handling capacities and line losses – mechanical aspects. Calculation of line resistance and inductance : resistance of conductors, temperature rise of conductor and current carrying capacity. Properties of bundled conductors and geometric mean radius of bundle, inductance of two conductor lines and multi conductor lines, Maxwell's coefficient matrix. Line capacitance calculation : capacitance of two conductor line, and capacitance of multi conductor lines, potential coefficients for bundled conductor lines, sequence inductances and capacitances and diagonalization.

Unit 2 : Calculation of electro static field of AC lines - Effect of high electrostatic field on biological organisms and human beings. Surface voltage Gradient on conductors, surface gradient on two conductor bundle and cosine law, maximum surface voltage gradient of bundle with more than 3 sub conductors, Mangolt formula.

Unit 3 : Corona : Corona in EHV lines – corona loss formulae – attenuation of traveling waves due to corona – Audio noise due to corona, its generation, characteristics and limits, measurement of audio noise.

Unit 4 : Power Frequency voltage control : Problems at power frequency, generalized constants, No load voltage conditions and charging currents, voltage control using synchronous condenser, cascade connection of components : Shunt and series compensation, sub synchronous resonance in series – capacitor compensated lines

Unit 5 : Static reactive compensating systems : Introduction, SVC schemes, Harmonics injected into network by TCR, design of filters for suppressing harmonics injected into the system.

Reference Books :

1. Extra High Voltage AC Transmission Engineering – Rakesh Das Begamudre, Wiley Eastern ltd., New Delhi – 1987.
2. EHV Transmission line reference book – Edison Electric Institute (GEC) 1986.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Syllabus for Pre-Ph. D Examination
EEE

FLEXIBLE AC TRANSMISSION SYSTEMS

Unit 1 : 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 2 : 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, comparison of current source converters with voltage source converters.

Unit 3 : 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 4 : SVC and STATCOM : The regulation and slope transfer function and dynamic performance, transient stability enhancement and power oscillation damping, operating point control and summary of compensation control.

Unit 5 : Static series compensators : Concept of series capacitive compensation, improvement of transient stability, power oscillation damping, 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.

Text Book :

1. "Understanding FACTS Devices" N.G.Hingorani and L.Guygi, IEEE Press.
   Indian Edition is available:--Standard Publications
2. Sang.Y.H and John.A.T, "Flexible AC Transmission systems" IEEE Press (2006).
3. HVDC & FACTS Controllers: applications of static converters in power systems-
   Vijay K.Sood- Springer publishers

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Syllabus for Pre-Ph. D Examination
EEE

HIGH VOLTAGE TESTING TECHNIQUES

Unit 1 : Non Destructive Testing Techniques : Measurement of DC Resistivity – Dielectric loss and dielectric constant of insulating materials – Schering bridge method – Transformer ratio arm bridge for high voltage and high current applications – null detectors.

Unit 2 : High Voltage Testing of Power Apparatus : Need for testing standards – Standards for porcelain/Glass insulators-Classification of porcelain/glass insulator tests – Tests for cap and pin porcelain/Glass insulators.

Unit 3 : High voltage AC testing methods-Power frequency tests-Over voltage tests on insulators, Isolators, Circuit Breakers and power cables. Artificial Contamination Tests : Contamination flashover phenomena-Contamination Severity-Artificial contamination tests-Laboratory Testing versus in-Service Performance-Case study.

Unit 4 : Impulse Testing : Impulse testing of transformers, insulators, Surge diverters, Bushings, cables, circuit breakers.

Unit 5 : Partial Discharge Measurement : PD equivalent model-PD currents-PD measuring circuits-Straight and balanced detectors-Location and estimation of PD in power apparatus-PD measurement by non electrical methods-Calibration of PD detectors. RIV Measurements : Radio Interference – RIV – Measurement of RI and RIV in laboratories and in field. Different test arrangements and their limitations.

Reference Books :

1. High Voltage Engineering – by E.KUFFEL and W.S.ZAENGL, Pergamon press, Oxford 1984.
2. High Voltage Engineering – by M.S.Naidu and V.Kamaraju, Tata Mc Graw Hill Publishing Company Limited, New Delhi – 2001.
3. Discharge Detection in H.V. Equipment – by KREUGER, F.H. Haywood London – 1964.
4. Outdoor Insulators – by Gorur & Cherney.
5. H.V. Testing Techniques Halfly

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Syllabus for Pre-Ph. D Examination
EEE

RENEWABLE ENERGY SYSTEMS

Unit-I

Solar Energy - Availability - Solar radiation data and measurement - Estimation of average solar radiation - Solar water heater types - Heat balance – Flat plate collector efficiency – Efficiency of heat removal - Thermo siphon flow calculation - Forced circulation calculation - Evacuated collectors - Basics of solar concentrators Solar Energy Applications - Solar air heaters – Solar Chimney - Crop driers - Passive solar system - Active solar systems - Water desalination - Output from solar still – Principle of solar ponds.

Unit-II

Wind Energy – Nature of wind – Characteristics – Variation with height and time – Power in wind –Aerodynamics of Wind turbine – Momentum theory – Basics of aerodynamics – Aero foils and their characteristics – HAWT – Blade element theory – Prandtl's lifting line theory (prescribed wake analysis) VAWT aerodynamics – Wind turbine loads – Aerodynamic loads in steady operation – Yawed operation and tower shadow. Wind Energy Conversion System – Siting – Rotor selection – Annual energy output – Horizontal axis wind turbine (HAWT) – Vertical axis wind turbine (VAWT) – Rotor design considerations – Number of blades – Solidity - Blade profile – Upwind/Downwind – Yaw system – Tower – Braking system - Synchronous and asynchronous generators and loads – Integration of wind energy converters to electrical networks – Inverters – Control system – Requirement and strategies – Noise Applications of wind energy

Unit-III

Biomass energy - Bio fuel classification – Examples of thermo chemical, Pyrolysis, biochemical and agrochemical systems – Energy farming – Direct combustion for heat – Process heat and electricity – Ethanol production and use – Anaerobic digestion for biogas – Different digesters – Digester sizing – Applications of Biogas - Operation with I.C.Engine

Unit-IV

Ocean Energy - OTEC Principle - Lambert's law of absorption - Open cycle and closed cycle - heat exchanger calculations – Major problems and operational experience. Tidal Power - Principles of power generation - components of power plant – Single and two basin systems – Turbines for tidal power - Estimation of energy – Maximum and minimum power ranges - tidal powerhouse.

Wave Energy – Concept of energy and power from waves – Wave characteristics – period and wave velocities - Different wave energy conservation devices (Saltor duck, oscillating water column and dolphin types) – operational experience.

Unit-V

Geothermal Energy - Classification- Fundamentals of geophysics - Dry rock and hot aquifier energy analysis - Estimation of thermal power - Extraction techniques - Prime movers.

References:

1. Renewable Energy Resources / John Twidell and Tony Weir / E & F.N.Spon
2. Renewable Energy Resources Basic Principles and Applications / G.N.Tiwari and M.K.Ghosal / Narosa
3. Solar Energy - Principles of thermal collection and storage/ S.P. Sukhatme / TMH

4. Solar Energy Thermal Processes,/Duffie & Beckman
5. Solar Heating and Cooling / Kreith & Kreider
6. Wind Energy Handbook / Tony Burton, David Sharpe, Nick Jenkins and Ervin Bossanyi / WileyWind Electrical Systems / S.N.Bhadra, D.Kastha and S.Banerjee / Oxford
7. Biogas Technology - A Practical Hand Book / K.Khendelwal & S.S. Mahdi / McGraw-Hill

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Syllabus for Pre-Ph. D Examination
EEE

ELECTRIC DRIVES – II

Unit-I: 3-phase induction motor drives – Part 1

Analysis of IM fed from non-sinusoidal supply, harmonic equivalent circuit, transient analysis – starting and plugging; variable frequency control, torque-slip relation, starting torque and braking torque, closed-loop VSI fed IM drive. Slip-ring IM control, closed-loop speed control with static rotor resistance, closed-loop speed control by using slip power recovery scheme.

Unit-II: 3-phase induction motor drives – Part 2

Concept of space vector, vector control of IM: direct or feed-back vector control, flux vector estimation, indirect or feed forward vector control, vector control of line side PWM converter, stator flux oriented vector control, vector control of converter fed inverter drive.

Unit-III: Synchronous motor and BLDC motor drives

Variable frequency control of synchronous motor, closed-loop control of inverter fed synchronous motor drive. Permanent magnet synchronous motor drive. BLDC motor drives, VSI fed BLDC motor drives, back emf, phase current and torque waveforms, control of BLDC motors with sensors, sensor-less control of BLDC motors

Unit-IV: Traction drives

Motors employed in railway traction and road-vehicles, control of railway traction dc motors using ac-dc converters, control of railway traction ac motors using ac-dc and dc-ac converters, power electronic control circuits of electric vehicles and hybrid electric vehicles

Unit-V: Switched reluctance and stepper motor drives

Switched reluctance motor operation and control: modes of operation, converter circuits closed-loop speed control. Stepper motor characteristics, drive circuits for uni-polar and bipolar stepper motors.

References:

1. "Electric motor drives, modeling, analysis and control", R. Krishnan, PHI Publishers
2. "Control of electric drives", W. Leonhard, Springer Verilog
3. "Vector control of AC machines", Arindam Ghosh, Gerard Ledwich
4. "Power Electronics: Converters,Application and design" ,Mohan,Undelandand Robbins,Wiley Publications.
5. "Urban transport and hybrid electric vehicles", Edited by Seref Soylu, Published online, 18 Aug 2010. Available:http://www.intechopen.com/books/urban-transport-and-……..
6. "Power control of AC motors", J.M.D. Murphy and F. G. Turnbul
7. "Power semiconductor drives", G. K. Dubey, Printice Hall International
8. "Fundamentals of electric drives", G. K. Dubey, Narosi Publishing House

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Syllabus for Pre-Ph. D Examination
EEE

CONTROL OF SPECIAL MACHINES

Unit I
Stepper Motors: Constructional features, Principle of operation, Modes of excitation torque production in Variable Reluctance (VR) stepping motor. Dynamic characteristics, Drive systems and circuit for open loop control, closed loop control of stepping motor.

Unit II
Switched Reluctance Motors : Constructional features, Principle of operation. Torque equation, Characteristics, Control Techniques, Drive Concept. Permanent Magnet Synchronous Motors: Principle of operation, EMF, power input and torque expressions, Phasor diagram, Power Controllers, Torque speed characteristics, Self control, Vector control, Current control Schemes.

Unit III
Permanent Magnet Brushless DC Motors: Commutation in DC motors, Difference between mechanical and electronic commutators, Hall sensors, Optical sensors, Multiphase Brushless motor, Square wave permanent magnet brushless motor drives, Torque and emf equation, Torque-speed characteristics, Controllers-Microprocessors based controller.

Unit IV
Servomotors: Types, Constructional features, Principle of Operation, Characteristics, Control,– Microprocessor based applications. AC Tachometers: Schematic diagram, Operating principle, numerical problems

Unit V
Linear Motors: Linear Induction Motor (LIM) Classification , Construction, Principle of operation, Concept of Current sheet, Goodness factor, DC Linear Motor (DCLM) types, Circuit equation, DCLM control, applications.

Reference Books:

1. Miller, T.J.E. “Brushless Permanent Magnet and Reluctance Motor Drives”, Clarendon Press, Oxford, 1989.
2. Kenjo, T, “Stepping Motors and their Microprocessor control”, Clarendon Press, Oxford, 1989.
3. Naser A and Boldea I, “Linear Electric Motors: Theory, Design and Practical Application”, Prentice Hall Inc., New Jersey,1987
4. Floyd E Saner,”Servo Motor Applications”, Pittman USA, 1993.
5. Kenjo, T and Naganori, S “Permanent Magnet and brushless DC motors”, Clarendon Press, Oxford, 1989.
6. Generalized Theory of Electrical Machines – P.S.Bimbra-Khanna publications-5th edition-1995

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Syllabus for Pre-Ph. D Examination
EEE

POWER SYSTEM DEREGULATION

Unit 1

Need and conditions for deregulation. Introduction of Market structure, Market Architecture, Spot market, forward markets and settlements. Review of Concepts marginal cost of generation, least-cost operation, incremental cost of generation. Power System Operation.

Unit 2

Electricity sector structures and Ownership /management, the forms of Ownership and management. Different structure model like Monopoly model, Purchasing agency model, wholesale competition model, Retail competition model.

Unit 3

Framework and methods for the analysis of Bilateral and pool markets, LMP based markets, auction models and price formation, price based unit commitment, country practices

Unit 4

Transmission network and market power. Power wheeling transactions and marginal costing, transmission costing. Congestion management methods- market splitting, counter-trading; Effect of congestion on LMPs- country practices

Unit 5

Ancillary Services and System Security in Deregulation. Classifications and definitions, AS management in various markets- country practices. Technical, economic, & regulatory issues involved in the deregulation of the power industry.

Reference Books:

1. Power System Economics: Designing markets for electricity - S. Stoft
2. Power generation, operation and control, -J. Wood and B. F. Wollenberg
3. Operation of restructured power systems - K. Bhattacharya, M.H.J. Bollen and J.E. Daalder
4. Market operations in electric power systems - M. Shahidehpour, H. Yamin and Z. Li
5. Fundamentals of power system economics - S. Kirschen and G. Strbac
6. Optimization principles: Practical Applications to the Operation and Markets of the Electric Power Industry - N. S. Rau
7. Competition and Choice in Electricity - Sally Hunt and Graham Shuttleworth

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Syllabus for Pre-Ph. D Examination
EEE

ANALYSIS OF POWER ELECTRONIC CONVERTERS

Unit-I AC voltage Controllers

Single Phase AC Voltage Controllers with PWM control only –synchronous tap changers - Three Phase AC Voltage controllers-Analysis of Controllers with star and delta connected resistive, resistive –inductive loads-Effects of source and load inductances–Application-numerical problems.

Unit –II AC-DC converters

Single phase full and half Converters with inductive load– Power factor improvements: Extinction angle control-symmetrical angle control - single phase sinusoidal PWM-Single phase series converters- numerical problems - Three Phase full and half Converter with inductive load– harmonic analysis -Power factor improvements-three phase PWM-twelve pulse converters- numerical problems

Unit-III Power Factor Correction Converters

Single-phase single stage boost power factor corrected rectifier, power circuit principle of operation, and steady state- analysis, three phase boost PFC converter

Unit –IV PWM Inverters

single phase full bridge inverters - sinusoidal PWM – modified PWM – phase displacement Control – Trapezoidal, staircase, stepped, harmonic injection and delta modulation – numerical problems - Three-Phase Inverters- Sinusoidal PWM- 60^0 PWM- Third Harmonic PWM- Space Vector Modulation- Comparison of PWM Techniques-current source inverters-Variable dc link inverter - numerical problems

Unit V: Multi level inverters

Multilevel Concept, Types of Multilevel Inverters- Diode-Clamped Multilevel Inverter, Features of Diode-Clamped Inverter, Improved Diode-Clamped Inverter- Flying-Capacitors Multilevel Inverter-Features of Flying-Capacitors Inverter- Cascaded Multilevel Inverter-Principle of Operation- Features of Cascaded Inverter- Switching Device Currents-DC-Link Capacitor Voltage Balancing- Features of Multilevel Inverters- Comparisons of Multilevel Converters

Textbooks

1. Power Electronics-Md.H.Rashid –Pearson Education Third Edition- First IndianReprint- 2008
2. Power Electronics- Ned Mohan, Tore M.Undelan and William P.Robbins –John Wiley& Sons -2nd Edition.
3. Power Electronics – Lander –Ed.2009
4. Modern power Electronics and AC Drives – B.K.Bose
5. Power Converter Circuits – William Shepherd & Li Zhang-Yes Dee Publishing Pvt Ltd.