Ph.D. Course work

Pre-Ph.D. Examination Syllabus

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

KONERU LAKSHMAIAH EDUCATION FOUNDATION

VADDESWARAM - 522502,

ANDHRA PRADESH, INDIA.

KONERU LAKSHMAIAH EDUCATION FOUNDATION
DEPARTMENT OF ELECTRIAL AND ELECTRONICS ENGINEERING

List of Pre-Ph.D Courses

L-T-P-S: 3-0-0-0

S.No	Paper 1	Subject Code
1	RESEARCH METHODOLOGY	21RES104

S. No.	Paper 2	Subject Code	Pape r- 3	Subject Code
1	SMART METERS AND SMART CITIES	21EE201	SMART GRIDS TECHNOLOGIES	21EE301
2	CHARGING STATION FOR ELECTRIC VEHICLES	21EE202	BATERY MANAGEMENT SYSTEM FOR ELECTRIC VEHICLES	21EE302
3	FACTS DEVICES	21EE203	POWER QUALITY	21EE303
4	REAL TIME CONTROL OF POWER SYSTEMS	21EE204	ADAPTIVE CONTROL SYSTEMS	21EE304
5	RENEWABLE ENERGY SOURCES AND INTEGRATION	21EE205	DIGITAL PROTECTION OF POWER SYSTEMS	21EE305
6	IOT FOR INDUSTRIAL AUTOMATION	21EE206	AI TECHNIQUES IN POWER SYSTEMS	21EE306
7	ADVANCED POWER CONVERTERS	21EE207	ADVANCED ELECTRICAL DRIVES	21EE307

PART – 2

KONERU LAKSHMAIAH EDUCATION FOUNDATION
Pre-Ph.D. Examination

SMART METERS AND SMART CITIES

SYLLABUS

SMART METERING: Introduction, Smart metering, Evolution of electricity metering, Key components of smart metering, Smart meters: An overview of the hardware used Signal acquisition, Signal conditioning, Analogue to digital conversion, Computation, Input/output, Communication.

COMMUNICATIONS INFRASTRUCTURE AND PROTOCOLS FOR SMART METERING: Home-area network, Neighbourhood area network, Data concentrator, Meter data management system, Protocols for communications, Demand-side integration, Services provided by DSI, Implementations of DSI, Hardware support to DSI implementations, Flexibility delivered by prosumers from the demand side, System support from DSI. Smart Appliances, Automatic Meter Reading (AMR).

SMART CITY: Vision and goals of smart city, concept of smart city and its features, issues and challenges of urbanization in India, international scenario, issues and probable solutions, need for smarter approaches process of selection of smart cities, developing and demonstrating new technologies, smart city strategies, digital and information technologies, urban planning best practices.

SMART TRANSPORTATION: Importance and significance of mobility, data collections, smart sensors, role of geographic information system, integration of GIS and ITS, related air quality; accidents and safety analysis; advanced traffic management systems, commercial vehicle operations, advanced transportation systems, advanced vehicle control systems, case studies, public transportation management; electronic payment, connected vehicle technology and application, mobile applications.

Text books:

1. Janaka Ekanayake, N. Jenkins, K. Liyanage, J. Wu, Akihiko Yokoyama, *Smart Grid: Technology and Applications*, Wiley.
2. Bob Williams, *Intelligent Transport Systems Standards*, Artech House Publishers, 2008
3. Austroads, *The Implication of Intelligent Transport Systems for Road Safety*, Austroads Incorporated, 1999.

KONERU LAKSHMAIAH EDUCATION FOUNDATION
Pre-Ph.D. Examination

CHARGING STATION FOR ELECTRIC VEHICLE
SYLLABUS

CHARGER TOPOLOGIES: Charging time and charging speed, Defining power levels- Normal charging, Semi-fast charging, Overview of power levels ,DC conductive charging, AC conductive charging, Low power Charger, Automotive standard charger, High power topologies, Multi-port Charger

POWER ELECTRONICS FOR EV BATTERY CHARGING: Forward/ Flyback Converters**,** Half-Bridge DC–DC Converter**,** Full-Bridge DC–DC Converter**,** Power Factor Correction**,** Bidirectional Battery Chargers**,** Dual active bridge dc-dc converter

CHARGING MODES: Constant-current charging, Constant-voltage charging, Pulse Charging, Reflex charging, Float charge, Trickle Charge

CHARGING INFRASTRUCTURE: Charger - Existing National & International Charger Architecture Standards - SAE J1773, VDE-AR-E 2623-2-2, JEVS G105-1993 (CHAdeMO), CCS, Type-1 AC, Type-2 AC, Bharat DC-001, Bharat AC-001, Cords and Cables, Earthing, Fault Protection, Testing, Charging Safety, Protection against electric shock. Digital Communication between EV and Charging Station

INSTALLATION; Govt. of India guideline on Public Charging Stations, IEC Standards- 60068-2(1, 2, 14, 30), 61683, 60227, 60502, 60947 part I,II, III and 61215, Site assessment, EVSE Typical Site Plans, Design Guidelines and Site Drawings, Planning Considerations, Station Configuration, Selection and erection of electrical equipment - Isolation, switching and control, Load management at charging station and peak load management

Text books:

1. Daniel W.Hart, *Power Electronics*, McGraw-Hil, 2010.
2. Haitham Abu-Rub, MariuszMalinwoski, Kamal Al-Haddad, *Power Electronics for Renewable Energy Systems, Transportation and industrial Applications*, John Wiley & Sons, Ltd, 2014.

KONERU LAKSHMAIAH EDUCATION FOUNDATION
Pre-Ph.D. Examination

FACTS DEVICES
SYLLABUS

FACTS CONCEPT AND GENERAL SYSTEM CONSIDERATIONS: Transmission interconnections, Power Flow in AC system, Dynamic stability Considerations and the importance of the controllable parameters, Introduction to Facts devices, Basic types of FACTS Controllers, benefits from FACTS controllers.

STATIC SHUNT COMPENSATION: Objectives of shunt compensation, Methods of controllable VAR generation, variable impedance type static VAR generators (SVC): TCR, TSR, TSC, FC-TCR, TSC-TCR, switching converter type VAR generators: STATCOM, Comparison between SVC and STATCOM, STATCOM for transient and dynamic stability enhancement.

STATIC SERIES COMPENSATION: Objectives of series compensation, variable impedance type static series controllers: GCSC, TSSC, TCSC, switching converter type controller: SSSC, Operation and Control External system Control for series Compensator SSR and its damping – Static Voltage and Phase angle Regulators - TCVR and TCPAR – Operation and Control.

UPFC AND IPFC: The unified power flow Controller – Operation –Comparison with other FACTS devices – control of P and Q – dynamic performance – special Purpose FACTS controllers – Interline Power flow Controller – Operation and Control.

Text Books:

1. Enrique Acha, Claudio R. Fuerte-Esquivel, Hugo Ambriz-Pérez, César Angeles-Camacho, *FACTS: Modelling and Simulation in Power Networks*, WILEY.
2. K.R.Padiyar, *FACTS Controller in power Transmission and Distribution*, New Age Int Publisher, 2007.
3. Xiao-Ping Zhang, Christian Rehtanz, Bikash Pal, *Flexible AC Transmission Systems: Modelling and Control*, Springer.

Reference Books:

1. N.G Hingorani&L.Gyugyi, *Understanding FACTS: Concepts and Technology of Flexible AC Transmission System*, IEEE Press,2000
2. Ned Mohan et.al, *Power Electronics*, John wiley& Sons,2 nd edition ,2002
3. T.J.E Miller, *Reactive power control in electric Systems*, John willey& sons,1982.

KONERU LAKSHMAIAH EDUCATION FOUNDATION
Pre-Ph.D. Examination

REAL TIME CONTROL OF POWER SYSTEMS
SYLLABUS

SYSTEM OPTIMIZATION: Strategy for two generator systems-generalized strategies-effect of transmission losses-Sensitivity of the objective function-Formulation of optimal power flow-solution by Gradient method-Newton's method - Unit Commitment, Hydro-Thermal Coordination.

LOAD FREQUENCY CONTROL: AGC multi area system, static and dynamic response, Load frequency control of 2-area system,

SECURITY CONTROL: Security analysis and monitoring, generator and line outages by linear sensitivity factors,

STATE ESTIMATION: Power system state estimation, Weighted least square state estimation, state estimation of AC network, Treatment of bad data – network observability and pseudo measurements.

TEXT BOOKS:

1. Allen J. Wood and Bruce F. Wollenberg, *Power Generation, Operation & Control*, 2nd edition, John Wiley and Sons, 1996.
2. I.J. Nagarath& D. P. Kothari , *Modern power system analysis*, 3rd Edition, TMH, New Delhi, 2003.

REFERENCE BOOKS:

1. I. Elgard , *Electric Energy Systems Theory – An Introduction*, TMH, 1983.
2. Abhijit Chakrabarti&SunitaHalder, *Power System Analysis operation and Control*, 1st edition, PHI, 2006.
3. Mahalanabis A.K., Kothari D.P. and Ahson S.I., *Computer aided power system analysis and control*, 4th Edition, 2011, TMH.
4. J.J.Grainger, W.D.Stevenson JR, *Power system analysis*, Tata McGraw Hill N.D. 2007.
5. A. Handschin and E. Petroiaenu, *Energy Management Systems, Operations and Control of Electric Energy Transmission Systems*, Springer-Verlag, Berlin, Heidelberg, 1991.

KONERU LAKSHMAIAH EDUCATION FOUNDATION
Pre-Ph.D. Examination

RENEWABLE ENERGY SOURCES AND INTEGRATION
SYLLABUS

SOLAR ENERGY: Generic Photovoltaic Cell, Equivalent Circuits, Cells to Modules to Arrays, I –V Curve, Impacts of Temperature and Insolation, Shading impacts on I–V curves, I–V Curves for different loads, MPPT, System sizing, System Performance, Economics. Modelling of Solar PV system components: Mathematical models -PV cell, PV Array, Battery pack, dc-dc converter, P&O MPPT technique, DC bus voltage regulation

WIND ENERGY: Components of WECS, Power obtained from the wind, Simple momentum theory, Power coefficient, Aerodynamics of WT, Betz's Limit, Blade Element Theory, Blade Design, Control Strategies: Power Regulation, yaw control, Pitch control, stall control, Schemes for Maximum Power Extraction. Wind Turbine Technology & Generators: HAWT, VAWT, Constant Speed constant frequency, Variable speed variable frequency, Modeling of DFIG, PMSG. Grid Connected Systems:

GEOTHERMAL ENERGY: Introduction to geothermal energy, structure of the earth interior, geothermal gradients, geothermal resources, geothermal power generation – liquid dominated and vapour dominated geothermal electric power plants. **TIDAL ENERGY:** Introduction to tidal energy, tidal characteristics, tidal range, tidal energy estimation, types of tidal power plants – single basin single effect plant, single basin double effect plant, double basin double effect plants.

INTEGRATION OF ALTERNATE SOURCES OF ENERGY: Introduction, principles of power injection: converting technologies, power flow; instantaneous active and reactive power control approach; integrating multiple renewable energy sources; DC link integration; AC link integration; HFAC link integration; islanding and interconnection.

Text books

1.Kalogirou .S.A., *Solar Energy Engineering: Processes and Systems*, Academic Press, 2009.
2.G. D. Rai, *Non-Conventional Energy Sources*, Khanna Publishers, First edition
3.H.P. Garg & J. Prakash, *Solar Energy - Fundamentals and Applications*, Indian Edition - First Revised Edition, Mc Graw Hill Education.
4. Felix A. Farret and M. Godoy Simoes, *Integration of Alternative sources of Energy*, IEEE Press – Wiley-Interscience publication, 2006.

Reference books

1. Roger H.Charlier, Charles W., *Ocean Energy- Tide and Tidal Power,* ISBN: Library of Congress Control Number: 2008929624_c Springer-VerlagBrerlin Heidelberg 2009.
2. John Twidell& Toney Weir: E&F.N. Spon, *Renewable Energy Sources*, Taylor &Francis New York, 2nd edition.

KONERU LAKSHMAIAH EDUCATION FOUNDATION
Pre-Ph.D. Examination

IOT FOR INDUSTRIAL AUTOMATION

SYLLABUS

INTRODUCTION & ARCHITECTURE: What is IIoT and connected world? the difference between IoT and IIoT, Architecture of IIoT, IOT node, Challenges of IIOT. IIOT Components-Fundamentals of Control System, introductions, components, closed loop & open loop system. Introduction to Sensors (Description and Working principle): What is sensor? Types of sensors, working principle of basic Sensors -Ultrasonic Sensor, IR sensor, MQ2, Temperature and Humidity Sensors (DHT-11).Digital switch, Electro Mechanical switches.

COMMUNICATION TECHNOLOGIES OF IIOT: Communication Protocols: IEEE 802.15.4, ZigBee, Z Wave, Bluetooth, BLE, NFC, RFID Industry standards communication technology (LoRAWAN, OPC UA, MQTT), connecting into existing Modbus and Profibus technology, wireless network communication.

VISUALIZATION AND DATA TYPES OF IIOT: Front-end EDGE devices, Enterprise data for IIoT, Emerging descriptive data standards for IIoT, Cloud data base, Could computing, Fog or Edge computing. Connecting an Arduino/Raspberry pi to the Web: Introduction, setting up the Arduino/Raspberry pi development environment, Options for Internet connectivity with Arduino, Configuring your Arduino/Raspberry pi board for the IoT. Retrieving Data - Extraction from Web: Grabbing the content from a web page, Sending data on the web, Troubleshooting basic Arduino issues, Types of IoT interaction, Machine to Machine interaction (M2M).

CONTROL & SUPERVISORY LEVEL OF AUTOMATION: Programmable logic controller (PLC), Real-time control system, Supervisory Control & Data Acquisition (SCADA). HMI in an automation process, ERP & MES. Application of IIOT - Case study: Health monitoring, Iot smart city, Smart irrigation, Robot surveillance.

Text Books

1. Mahmood, Zaigham, *The Internet of Things in the Industrial Sector*, Springer Publication.
2. Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat , *Industrial Internet of Things: Cyber manufacturing System***,** Springer Publication.
3. Ismail Butun, *Industrial IoT Challenges, Design Principles, Applications, and Security*.

KONERU LAKSHMAIAH EDUCATION FOUNDATION
Pre-Ph.D. Examination

ADVANCED POWER CONVERTERS
SYLLABUS

RESONANT DC-DC CONVERTERS: Switching loss, hard switching, and basic principles of soft switching- classification of resonant converters- load resonant converters – series and parallel – resonant switch converters – operation and analysis of ZVS, ZCS converters comparison of ZCS/ZVS Introduction to ZVT/ZCT PWM converters - Numerical problems.

SPECIAL INVERTER TOPOLOGIES: Series Inverters -Switched Mode Rectifier - Single phase and three phase boost type APFC and control -Three phase utility inter phases and control Push-Pull and Forward Converter Topologies - Voltage Mode Control Half and Full Bridge Converters - Flyback Converter.

SOFT SWITCHING CONVERTERS: Resonant (Pulsating) DC Link Inverter -Active-clamped Resonant DC Link Inverter- Quasi-resonant Soft-switched Inverter - Numerical problems.

MULTILEVEL INVERTERS- MULTILEVEL & BOOST INVERTERS: Multilevel concept – diode clamped – flying capacitor – cascade type multilevel inverters -Comparison of multilevel inverters - application of multilevel inverters – PWM techniques for MLI – Single phase & Three phase Impedance source inverters -Introduction-Matrix converter circuit-Control strategies.

TEXT BOOKS:

1. N.Mohan, T.M.Undeland, W.P Robbins, *Power Electronics, Converters, Applications & Design*", Wiley India Pvt. Ltd.-2013
2. William Shepherd and Li Zhang, *Power Converter Circuits* , CRC press ,Taylor & Francis -2004

REFERENCE BOOKS:

1. Gyugyi, L., B. R. Pelly, *Static Power Frequency Changers*, Wiley, New York.
2. Rashid M.H., *Power Electronics Circuits, Devices and Applications*, Prentice Hall India, Third Edition, New Delhi, 2004
3. Ali Emadi, AlirezaKhaligh, ZhongNie, Young Joo Lee, *Integrated Power Electronic Converters and Digital Control*", CRC press
4. Simon Ang, Alejandro Oliva, *Power-Switching Converters*, Second Edition, CRC Press, Taylor & Francis Group, 2010
5. Marian.K.Kazimierczuk and DariuszCzarkowski, *Resonant Power Converter*, John Wiley & Sons limited, 2011

PART - 3

KONERU LAKSHMAIAH EDUCATION FOUNDATION
Pre-Ph.D. Examination

SMART GRID TECHNOLOGIES
SYLLABUS

THE SMART GRID: Introduction – Necessity of smart grid – Definition – Early smart grid initiatives – overview of the technologies required for the smart grid-Information and communication technologies, Sensing measurement, control and automation technologies, Power electronics and energy storage.

DATA COMMUNICATION: Introduction – dedicated and shared communication channels – switching techniques – communication channels- layered architecture and protocols; Communication technologies for the smart grid: Introduction –communication technologies – standards for information exchange.

INFORMATION SECURITY FOR THE SMART GRID: Introduction – Encryption and Decryption: Symmetric Key encryption, Public key encryption - Authentication – Digital signature: Secret key signature, Public key signature, Message digest – cyber security standards.

SMART METERING AND DEMAND SIDE INTEGRATION: Introduction – smart metering – smart meters – Communication infra structure and protocols for smart metering - Demand side integration.

INTRODUCTION TO SMART GRID APPLICATIONS: Introduction – voltage and VAR control and optimization – fault detection, isolation and restoration (FDIR) – Demand response (DR) – Distributed energy resources (DERs) – wide area monitoring, control and protection (WAMCP).

Text Books:

1. JanakaEkanayake ,KithsiriLiyanage , Jianzhong Wu , Nick Jenkins, *Smart Grid: Technology and Applications,* first Edition, John Wiley & sons Limited (2012).
2. Lars T. Berger and Krzysztof Iniewski, *Smart Grid: Applications, communication and security,* first Edition ,John Wiley & sons Limited;(2012).

Reference Books:

James Momoh, *Smart grid: Fundamental of Design and analysis*, John Wiley & sons Limited IEEE Press (2012).

KONERU LAKSHMAIAH EDUCATION FOUNDATION
Pre-Ph.D. Examination

BATERY MANAGEMENT SYSTEM FOR ELECTRIC VEHICLES
SYLLABUS

COMPONENTS OF BATTERY MANAGEMENT SYSTEMS: Lithium-ion cellterminology, major functions provided by a battery-management system and their purpose - Identify the major components of a lithium-ion cell and their purpose - Understand how a battery-management system "measures" current, temperature, and isolation.

FUNCTIONS OF BATTERY MANAGEMENT SYSTEMS: Identify electronic components that can provide protection and specify a minimum set of protections needed - Compute stored energy in a battery pack - List the manufacturing steps of different types of lithium-ion cells and possible failure modes.

STATIC MODELLING OF BATTERY: Static modelling of battery: static model parameters of the battery, lab test to determine the parameters of battery model, static equivalent circuit determination.

DYNAMIC MODELLING OF BATTERY: Dynamic modelling of battery, parameters affecting the dynamic model, lab test to determine the dynamic model parameters, dynamic equivalent circuit determination.

Text books:

1. L.Plett , Gregory, *Battery management systems: Battery Modeling,* Artech house, 2015.
2. Gregory L.Plett, *Battery management systems: Equivalent circuit methods,* Artech house, 2015.

Reference books:

1. Chris Mi, M. AbdulMasrur and David Wenzhong Gao, *Hybrid Electric vehicles-Principles and Applications with practical perspectives*, Wiley Publications,*1* edition 2011
2. Gianfranco Pistoia, *Electric and Hybrid Vehicles power sources, models, sustainability, infrastructure and the market,* Elsevier 1 edition 2010.
3. Iqbal Hussain, *Electric and Hybrid Vehicles Design Fundamentals,* CRC Press2nd edition, 2010.

KONERU LAKSHMAIAH EDUCATION FOUNDATION
Pre-Ph.D. Examination

POWER QUALITY
SYLLABUS

INTRODUCTION: Power or voltage quality, terms and definitions: short duration voltage variations, Interruptions – Voltage sag – Swell – Surges – Harmonics – Voltage fluctuations. Long duration voltage variations: Over voltage – Under voltage – Sustained interruptions, Transients: Impulse transients – Oscillatory transient, Power quality terms.

LONG INTERRUPTIONS: Definition – Interruptions – Causes of long interruptions – Origin of interruptions – Limits for the interruptions frequency – Limits for the interruption duration.

SHORT INTERRUPTIONS: Definition, origin of short interruptions, basic principle, fuse saving, voltage magnitude events due to re-closing, voltage during the interruption, monitoring of short interruptions, difference between medium and low voltage systems. Multiple events, single phase tripping – voltage and current during fault period, voltage and current at post fault period, stochastic prediction of short interruptions.

VOLTAGE SAG ANALYSIS: Voltage sag magnitude – Monitoring - Theoretical calculations – Examples - Sag magnitude in non-radial systems, Voltage calculation in meshed systems, Voltage sag duration, Fault clearing time – Magnitude duration plots- Measurement of sag duration, Magnitude and Phase angle jumps for three phase unbalanced sags – Phase to phase fault – Single phase faults – Two phase to ground faults – High impedance fault – Meshed systems.

MITIGATION OF INTERRUPTIONS AND VOLTAGE SAGS: Overview of mitigation methods – From fault to trip, Reducing the number of faults, Reducing the fault clearing time changing the power system, Installing mitigation equipment, Improving equipment immunity, Different events and mitigation methods. System equipment interface – Voltage source converter, series voltage controller, Shunt voltage controller, combined shunt and series controller. Typical wiring and grounding problems.

Text books:

1. Math H J Bollen, *Understanding Power Quality Problems: voltage sags and interruptions*, Wiley-IEEE Press, 1999.
2. Roger C Dugan, Surya Santoso, Mark F. Mc Granaghan, H. Wayne Beaty, *Electrical power system squality*, Third edition, 2012, TMH.

Reference Books:

1. Angelo Baggini, *Hand book of power quality*, Wiley publications, 2008.
2. Edward F Fuchr, Mohammad A S Masoum, *Power Quality in Power System and Electrical Machine*, 1st Edition, Elsevier,2008

KONERU LAKSHMAIAH EDUCATION FOUNDATION
Pre-Ph.D. Examination

ADAPTIVE CONTROL SYSTEMS
SYLLABUS

ELEMENTS OF PROBABILITY THEORY: definition of probability and random variable, probability functions, expected value, mean and covariance, independence and correlation, Gaussian distribution and its properties. **STOCHASTIC PROCESSES AND SYSTEM MODELS:** Elements of the theory of stochastic processes, mean value function and covariance kernel, independent and correlated stochastic processes, stationery and non sequence model, Gaussian white process.

NON PARAMETRIC METHODS & PARAMETRIC METHODS: Nonparametric methods: Transient analysis-frequency analysis-Correlation analysis-Spectral analysis.Liner Regression: The Lease square estimate-best liner unbiased estimation under linear constraints-Prediction error methods: Description of Prediction error methods-Optimal Prediction –relationships between Prediction error methods and other identification methods theoretical analysis.

ADAPTIVE CONTROL SCHEMES: Introduction – users- Definitions-auto tuning-types of adaptive control-gain scheduling controller-model reference adaptive control schemes – self tuning controller. MRAC and STC: Approaches – The Gradient approach – Lyapunov functions – Passivity theory – pole placement method Minimum variance control – Predictive control.

ADAPTIVE CONTROL AND APPLICATION: Stability – Convergence – Robustness – Application of adaptive control, direct model reference adaptive control. Introduction: Basic approaches to adaptive control. Applications of adaptive control. Identification: Error formulations linear in the parameters. Direct adaptive control: Linear error equations with dynamics. Gradient and pseudo-gradient algorithms. Strictly positive real transfer functions. Kalman-Yacubovitch-Popov lemma.Passivity theory.

TEXT BOOKS:

1. Dan Simon, *Optimal State Estimation*, Wiley Intersience, 2006.
2. S. Sastry and M. Bodson, *Adaptive Control: Stability, Convergence, and Robustness*, Prentice-Hall, 1989.

REFERENCE BOOKS:

1. K.J. Astrom and B. Wittenmark, *Adaptive Control*, Addison-Wesley, 2nd edition, 1995.
2. I.D. Landau, R. Lozano, and M. M'Saad, *Adaptive Control*, Springer Verlag, London, 1998.
3. Meditch, *Stochastic Optimal Linear Estimation and Control*, Mc-Graw Hill Company, 1969.
4. K.S. Narendra and A.M. Annaswamy, *Stable Adaptive Systems*, Prentice-Hall, 1989.
5. P.E. Wellstead& M.B. Zarrop, *Self-Tuning Systems: Control and Signal Processing*, J. Wiley & Sons, Chichester, England, 1991

KONERU LAKSHMAIAH EDUCATION FOUNDATION
Pre-Ph.D. Examination

DIGITAL PROTECTION OF POWER SYSTEMS
SYLLABUS

PROTECTION OF POWER SYSTEM EQUIPMENT: summation transformer, phase-sequence current segregating network.Load shedding and frequency relays; Out of step relaying; Re-closing and synchronizing - adaptive protection – integrated protection and control.

DIGITAL PROTECTION: Developments in computer relaying – mathematical basis for protective relaying algorithms, Fourier Transforms – Discrete Fourier transforms –Walsh - Hadamard, Haar - wavelet transforms, digital relaying algorithms,.

MICROPROCESSOR BASED PROTECTION RELAYS: Working principles of μP based over current, directional, distance, current differential relays and frequency relays - microprocessor implementation of digital distance relaying algorithms.

MODERN TRENDS IN PROTECTION: New developments in relaying principles –travelling wave propagation – types of travelling wave relays- AI based numerical protection – FPGA based relays.

TEXT BOOKS:

1. Badri Ram & DN Viswakarma, *Power System Protection & Switch Gear*, Tata McGraw Hill Publishing Company Limited, New Delhi (1995).

REFERENCE BOOKS:

1. T.S.MadhavaRao, *Power System Protection – Static relays*, TMH, 2010.
2. A.T.Johns and S.K.Salman, *Digital Protection for Power Systems,* 1995.
3. A.G.Phake, James S.Thorp, *Computer Relaying for power Systems*, John–Wiley and sons
4. J.Lewis Blackburn, *Protective relaying principles and applications,* Marcel & Dekker

KONERU LAKSHMAIAH EDUCATION FOUNDATION
Pre-Ph.D. Examination

AI TECHNIQUES IN POWER SYSTEMS
SYLLABUS

ARTIFICIAL NEURAL NETWORKS: Introduction Models of Neuron Network – Architectures –Hebbian learning –Supervised learning – Unsupervised learning – Reinforcement learning.

ANN PARADIGMS: Multi – layer perceptron using Back propagation Algorithm (BPA) –Radial Basis Function Network –Hopfield Network – Application to Load forecasting.

FUZZY LOGIC: Introduction – Fuzzy versus crisp – Fuzzy sets – Membership function – Basic Fuzzy set operations –Fuzzy Inference – Fuzzy Rule based system–Defuzzification methods – Application to Load Frequency Control.

GENETIC ALGORITHMS: Introduction–Encoding – Fitness Function–Reproduction operators–Genetic Modeling – Genetic operators–Cross over – Single site cross over – Two point cross over – Multi point cross over – Uniform cross over –Mutation operator – Elitism - Generational cycle – convergence of Genetic Algorithm – Application to economic dispatch.

Text Books:

1. S.Rajasekaran and G.A.V.Pai Neural Networks, *Fuzzy Logic & Genetic Algorithms*, PHI, New Delhi, 2003.
2. Rober J. Schalkoff, *Artificial Neural Networks,* Tata McGraw Hill Edition, 2011

Reference Books:

1. James A freeman, David M Skapura, *Neural Networks,* Addison – Wesley, an imprint of Pearson Education, II Edition , 2000
2. S N Sivanandam, S sumathi, S. N deepa, *Introduction to Neural Networks using Matlab 6.0,* Tata Mc Graw Hill Publishing Company Private Limited, 2006
3. K Sundareswaran, *Fuzzy Logic Systems,* Jaico Publishing House, 2005

KONERU LAKSHMAIAH EDUCATION FOUNDATION
Pre-Ph.D. Examination

ADVANCED ELECTRICAL DRIVES
SYLLABUS

FIELD ORIENTED CONTROL OF INDUCTION MOTOR DRIVES: Field oriented control of induction machines – Theory – DC drive analogy – Direct and Indirect methods – Flux vector estimation - Direct torque control of Induction Machines – Torque expression with stator and rotor fluxes, DTC control strategy.

SENSORLESS VECTOR CONTROL OF INDUCTION MOTOR: Slip and Speed Estimation at Low performance, Rotor Angle and Flux-linkage Estimation at high performance -rotor Speed Estimation Scheme- estimators using rotor slot harmonics, Model Reference adaptive systems, Extended Kalman Filter.

CONTROL OF SYNCHRONOUS MOTOR DRIVES: Self control-margin angle control-torque control-power factor control-Brushless excitation systems - SRM Structure-Stator Excitation-techniques of sensor less operation-convertor topologies-SRM Waveforms-SRM drive design factors-Torque controlled SRM-Torque Ripple-Instantaneous Torque control -using current controllers-flux controllers.

CONTROL OF BLDC MOTOR DRIVES: principle of operation of BLDC Machine, Sensing and logic switching scheme, BLDM as Variable Speed Synchronous motor-methods of reducing Torque pulsations -Three-phase full wave Brushless dc motor -Sinusoidal type of Brushless dc motor - current controlled Brushless dc motor Servo drive.

Text Books:

1. R. Krishnan, *Electric Motor Drives Modeling, Analysis & control,* - Pearson Education
2. B. K. Bose, *Modern Power Electronics and AC Drives,* Pearson Publications
3. Peter Vas, *Sensorless Vector Direct Torque control,* Oxford University Press

References books:

1. B. K. Bose , *Modern Power Electronics and AC Drives,* Pearson Publications-
2. MD Murphy & FG Turn Bull, *Power Electronics control of AC motors,* Pergman Press -1st edition-1998
3. W.Leonhard, *Control of Electrical Drives,* Narosa Publishing House, 1992
4. VedamSubramanyam, *Electric Drives – Concepts and Applications,* Tata McGraw-Hill publishing company Ltd., New Delhi, 2002