# COURSE STRUCTURE AND SYLLABUS

For

# M.Tech

## POWER ELECTRONICS AND ELECTRIC DRIVES

(*Applicable for batches admitted from 2016-17*)

# PRAGATI ENGINEERING COLLEGE

**(AUTONOMOUS)**

Permanently Affiliated to JNTUK, Kakinada, Accredited by NAAC with "A" Grade
Recognized by UGC 2(f) and 12(b) under UGC act, 1956
# 1-378, ADB Road, Surampalem – 533 437
Near Peddapuram, E.G.Dist, Andhra Pradesh

**PRAGATI ENGINEERING COLLEGE : SURAMPALEM**
**(Autonomous)**

## I Semester

| S.No. | Subject Code | Subject | L | T | C |
|---|---|---|---|---|---|
| 1 | 16051T01 | Electrical Machine Modeling & Analysis | 4 | - | 3 |
| 2 | 16051T02 | Analysis of Power Electronic Converters | 4 | - | 3 |
| 3 | 16051T03 | Electric Drives – I | 4 | | 3 |
| 4 | 16051T04 | Flexible AC Transmission Systems | 4 | - | 3 |
| 5 | **Elective I** | | 4 | - | 3 |
| | 16051D01 | 1. Modern Control Theory | | | |
| | 16051D02 | 2. Power Quality | | | |
| | 16051D03 | 3. Optimization Techniques | | | |
| 6 | **Elective II** | | 4 | - | 3 |
| | 16051D04 | 1. Energy Auditing, Conservation and Management | | | |
| | 16051D05 | 2. Artificial Intelligence Techniques | | | |
| | 16051D06 | 3. HVDC Transmission | | | |
| 7 | 16051L01 | Systems Simulation Lab | - | 4 | 2 |
| **Total Credits** | | | | | **20** |

## II Semester

| S.No. | Subject Code | Subject | L | T | C |
|---|---|---|---|---|---|
| 1 | 16052T05 | Switched Mode Power Conversion | 4 | - | 3 |
| 2 | 16052T06 | Electric Drives- II | 4 | - | 3 |
| 3 | 16052T07 | Digital Controllers | 4 | | 3 |
| 4 | 16052T08 | Custom Power devices | 4 | - | 3 |
| 5 | **Elective III** | | | - | 3 |
| | 16052D07 | 1. Renewable Energy Systems | | | |
| | 16052D08 | 2. Reactive Power Compensation & Management | | | |
| | 16052D09 | 3. Electrical Distribution Systems | | | |
| 6 | **Elective IV** | | | - | 3 |
| | 16052D10 | 1. Smart Grid | | | |
| | 16052D11 | 2. Special Machines | | | |
| | 16052D12 | 3. Programmable Logic Controllers & Applications | | | |
| 7 | 16052L02 | Power Converters & Drives Lab | - | 4 | 2 |
| **Total Credits** | | | | | **20** |

## III Semester

| S.No. | Subject Code | Subject | L | T | C |
|---|---|---|---|---|---|
| 1 | 16053S01 | Seminar – I | - | - | 2 |
| 2 | 16053P01 | Project Work – I | - | - | 18 |
| **Total Credits** | | | - | - | **20** |

## IV Semester

| S.No. | Subject Code | Subject | L | T | C |
|---|---|---|---|---|---|
| 1 | 16054S02 | Seminar – II | - | - | 2 |
| 2 | 16054P02 | Project Work – II | - | - | 18 |
| **Total Credits** | | | - | - | **20** |

**PRAGATI ENGINEERING COLLEGE : SURAMPALEM**
**(Autonomous)**

**M.Tech (PE&ED)**

| **I Year – I SEMESTER** | **L** | **P** | **C** |
|---|---|---|---|
| | **4** | **0** | **3** |

## ELECTRICAL MACHINE MODELING & ANALYSIS

**UNIT – I**

**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 áâ0) and two phase to three phase transformation áâ0 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.
4. http://www.motor-design.com/cmsAdmin/uploads/induction_motor_modelling.pdf

**PRAGATI ENGINEERING COLLEGE : SURAMPALEM**
**(Autonomous)**

**M.Tech (PE&ED)**

| **I Year – I SEMESTER** | **L** | **P** | **C** |
|---|---|---|---|
| | **4** | **0** | **3** |

## 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.
6. http://www.edrive.narod.ru/PE.pdf

**PRAGATI ENGINEERING COLLEGE : SURAMPALEM**
**(Autonomous)**

**M.Tech (PE&ED)**

| **I Year – I SEMESTER** | **L** | **P** | **C** |
|---|---|---|---|
| | **4** | **0** | **3** |

## 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.
5. www.iare.ac.in/sites/default/files/lecture_notes/sd%20lecture%20notes.pdf
6. http://shodganga.inflibnet.ac.in

**PRAGATI ENGINEERING COLLEGE : SURAMPALEM**
**(Autonomous)**

**M.Tech (PE&ED)**

| **I Year – I SEMESTER** | **L** | **P** | **C** |
|---|---|---|---|
| | **4** | **0** | **3** |

## FLEXIBLE AC TRANSMISSION SYSTEMS

**UNIT-I**

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

**UNIT-II**

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

**UNIT-III**

**Static shunt compensation :** Objectives of shunt compensation, midpoint voltage regulation, voltage instability prevention, improvement of transient stability, Power oscillation damping, methods of controllable var generation, variable impedance type static var generators, switching converter type var generators, hybrid var generators.

**UNIT-IV**

**SVC 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-IV**

**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
4. http://ethesis.nitrkl.ac.in/2243/1/Project_Thesis_Final.pdf
5. http://www.site.uottawa.ca/~rhabash/ELG4125FACTS.pdf

**PRAGATI ENGINEERING COLLEGE : SURAMPALEM**
**(Autonomous)**

**M.Tech (PE&ED)**

**I Year – I SEMESTER**

| L | P | C |
|---|---|---|
| 4 | 0 | 3 |

## MODERN CONTROL THEORY
## (ELECTIVE-I)

**UNIT –I**

**State Variable Analysis** The concept of state – State Equations for Dynamic systems – State diagram--- - Linear Continuous time model for physical systems – Existence and Uniqueness of Solutions to Continuous – Time State Equations – Solutions – Linear Time Invariant Continuous – Time State Equations – State transition matrix and it's properties

**UNIT – II**

**State Variable Techniques** General concept of Controllability - General concept of Observability Controllability tests for Continuous &Time Invariant systems - Observability tests for Continuous &Time Invariant systems - Controllability and Observability of state model in Jordan Canonical form - Controllability and Observability Canonical forms of State model – State feedback controller design through pole assignment.

**UNIT – III**

**Non Linear Systems – 1** Introduction – Non Linear Systems – Types of Non – Linearities – Saturation – Dead – Zone – Backlash – Jump Phenomenon etc; - Singular Points – Introduction to Linearization of nonlinear systems, properties of Non Linear Systems – Describing function – describing function analysis of nonlinear systems- Stability analysis of Non – Linear systems through describing functions.

**UNIT – IV**

**Non Linear Systems – 11** Introduction to phase – plane analysis, Method of Isoclines for Constructing Trajectories, singular points, phase – plane analysis of nonlinear control systems.

**UNIT – V**

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

**TEXTS BOOKS:**


1. Modern Control System Theory by M. Gopal – New Age International – 1984
2. Modern Control Engineering by Ogata. K – Prentice Hall – 1997
3. Nonlinear systems, Hassan K. Klalil, Prentice Hall, 1996
4. Modern control systems, Richard C. Dorf and Robert H. Bishop, 11th Edition, Pearson Edu, India, 2009
5. http://www.ece.rutgers.edu/~gajic/psfiles/chap5.pdf

**PRAGATI ENGINEERING COLLEGE : SURAMPALEM**
**(Autonomous)**

**M.Tech (PE&ED)**

| **I Year – I SEMESTER** | **L** | **P** | **C** |
|---|---|---|---|
| | **4** | **0** | **3** |

**POWER QUALITY**
**(ELECTIVE I)**

**UNIT-I**

**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-II**

**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-III**

**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-IV**

**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-V**

**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 by 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
7. www.tnb.com/eel/docs/furse/bs7671.pdf
8. http://prof.usb.ve/bueno/Libros/power_quality-0849310407.pdf

**PRAGATI ENGINEERING COLLEGE : SURAMPALEM**
**(Autonomous)**

**M.Tech (PE&ED)**

**I Year – I SEMESTER**

| L | P | C |
|---|---|---|
| 4 | 0 | 3 |

## OPTIMIZATION TECHNIQUES
## (ELECTIVE I)

**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.
5. www.slideplayer.com/slide/5028943/

**PRAGATI ENGINEERING COLLEGE : SURAMPALEM**
**(Autonomous)**

**M.Tech (PE&ED)**

| **I Year – I SEMESTER** | **L** | **P** | **C** |
|---|---|---|---|
| | **4** | **0** | **3** |

## ENERGY AUDITING , CONSERVATION & MANAGEMENT
## (ELECTIVE II)

**UNIT-I**

**Basic Principles of Energy Audit** 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-II**

**Energy Management –I** 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-III**

**Energy Efficient Motors and Lighting** 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, good lighting system design and practice, lighting control, lighting energy audit

**UNIT-IV**

**Power Factor Improvement and energy instruments** Power factor – methods of improvement , location of capacitors , Power factor with non-linear loads, effect of harmonics on p.f. , p.f motor controllers - Energy Instruments- watt meter, data loggers, thermocouples, pyrometers, lux meters, tongue testers ,application of PLC's

**UNIT-V**

**Economic Aspects and their computation** Economics Analysis- Depreciation Methods, time value of money, rate of return, present worth method, replacement analysis, lifecycle 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.

**REFERENCE BOOKS**


1. Energy management by W.R. Murphy & G. Mckay Butter worth, Heinemann publications.
2. Energy efficient electric motors by John .C. Andreas, Marcel DekkerInc Ltd-2nd edition, 1995-
3. Energy management by Paul o' Callaghan, Mc-graw Hill Book company-1st edition, 1998
4. Energy management hand book by W.C.Turner, John wiley and sons
5. Energy management and good lighting practice : fuel efficiency- booklet12-EEO
6. http://www.pdhonline.com/courses/e144/e144content.pdf

**PRAGATI ENGINEERING COLLEGE : SURAMPALEM**
**(Autonomous)**

**M.Tech (PE&ED)**

| **I Year – I SEMESTER** | **L** | **P** | **C** |
|---|---|---|---|
| | **4** | **0** | **3** |

## ARTIFICIAL INTELLIGENCE TECHNIQUES
## (ELECTIVE II)

**UNIT-I**

Introduction to artificial Intelligence systems ,concept of Artificial Neural Networks and its basic mathematical model, McCulloch-Pitts neuron model, simple perceptron, Adaline and Madaline, Multilayer Perceptron. Learning and Training the neural network.

**UNIT-II**

**Data Pre-Processing:** Scaling, Fourier transformation, principal- component analysis and wavelet transformations. Networks: Hopfield network, Self-organizing network and Recurrent network,Back propagation neural network: Architecture, algorithm and applications.

**UNIT-III**

**Genetic Algorithm:** Basic concept of Genetic algorithm and detail algorithmic steps, adjustment of free parameters,solution of typical control problems using genetic algorithm, Particle swarm optimization.

**UNIT-IV**

Introduction to crisp sets and fuzzy sets, basic fuzzy set operation, Fuzzy relations, membership function, defuzzication methods, fuzzy rule base, inference system, mamdani model and Takagi – sugeno fuzzy model, construction of an fuzzy logic control, fuzzy PD controller. Fuzzy modeling and control schemes for nonlinear systems. Self-organizing fuzzy logic control. Implementation of fuzzy logic controller using Matlab fuzzy-logic toolbox.

**UNIT-V**

Fuzzy logic applications: Design of Fuzzy PI controller for speed control of DC motor- Flux programming efficiency improvement of three phase induction motor.

Neural network applications:-PWM Controller-Selected harmonic elimination PWM-Space vector PWM-Vector controlled drive-feedback signal estimation-speed estimation and flux estimation of induction motor

**TEXT BOOKS**


1. Neural Networks: A comprehensive Foundation – Simon Haykins, Pearson Edition, 2003.
2. Fuzzy logic with Fuzzy Applications – T.J.Ross – Mc Graw Hill Inc, 1997.
3. Genetic Algorithms- David E Goldberg.
4. Modern Power Electronics and AC Drives –B.K.Bose-Pearson Publications
5. Artificial Intelligent based Electrical Machines and Drives- Peter Vas, Oxford University Press


**REFERENCES**


1. Neural Network Design-M.T.Hagan, H. B. Demuth and M. Beale, Indian reprint, 2008.
2. Fundamental of neural networks architectures, algorithms and applications- Laurene Fausett pearson publications
3. Principles of Neurocomputing for science and Engineering,- Fredric M.Ham and Ivica Kostanic,

McGraw Hill, 2001.
4. Principles of Neurocomputing for science and Engineering,- Fredric M.Ham and Ivica Kostanic, McGraw Hill, 2001.
5. Neural Network Fundamentals with Graphs, Algorithms and Applications, N.K. Bose and P.Liang, Mc-Graw Hill, Inc. 1996.
6. Intelligent System- Modeling, Optimization and Control- Yung C. Shin and Chengying Xu,CRC Press, 2009.
7. Soft computing & Intelligent Systems- Theory & Applications – N.K.Sinha and Modan M Gupta. Indian Edition, Elsevier, 2007.
8. Fuzzy logic Intelligence, Control, and Information- John Yen and Reza Langari, Pearson Education, Indian Edition, 2003.
9. Fuzzy Control and Fuzzy Systms, Witold Pedrycz, Overseas Press, Indian Edition, 2008.
10. http://www.eolss.net/sample-chapters/c18/e6-43-23-04.pdf
11. www.vssut.ac.in/lecture_notes/lecture1428643004.pdf

**PRAGATI ENGINEERING COLLEGE : SURAMPALEM**
**(Autonomous)**

**M.Tech (PE&ED)**

**I Year – I SEMESTER**

| L | P | C |
|---|---|---|
| 4 | 0 | 3 |

## H.V.D.C. TRANSMISSION
## (ELECTIVE II)

**UNIT –I**

Limitation of EHV AC Transmission .Advantages of HVDC Technical economical reliability aspects. H.V.D.C. Transmission: General considerations, Power Handling Capabilities of HVDC Lines, Basic Conversion principles, static converter configuration. Types of HVDC links-Apparatus and its purpose.

**UNIT-II**

Static Power Converters : 6-pulse bridge circuit and 12-pulse converters, converter station and Terminal equipment, commutation process, Rectifier and inverter operation, equivalent circuit for converter – special features of converter transformers. Comparison of the perform of diametrical connection with 6-pulse bridge circuit.

**UNIT-III**

Control of HVDC Converters and systems : constant current, constant extinction angle and constant Ignition angle control. Individual phase control and equidistant firing angle control, DC power flow control. Factors responsible for generation of Harmonics voltage and current harmonics effect of variation of á and µ. Filters Harmonic elimination.

**UNIT-IV**

Interaction between HV AC and DC systems – Voltage interaction, Harmonic instability problems and DC power modulation. Development of DC circuit Breakers, Multi-terminal DC links and systems; series, parallel and series parallel systems, their operation and control.

**UNIT-V**

Transient over voltages in HV DC systems : Over voltages due to disturbances on DC side, over voltages due to DC and AC side line faults. Converter faults and protection in HVDC Systems: Converter faults, over current protection - valve group, and DC line protection, circuit breakers. Over voltage PROTECTION OF CONVERTERS, SURGE ARRESTERS.

**REFERENCE BOOKS :**


1. K.R.Padiyar : High Voltage Direct current Transmission, Wiley EasternLtd., New Delhi – 1992.
2. E.W. Kimbark : Direct current Transmission, Wiley Inter Science – NewYork.
3. J.Arillaga : H.V.D.C.Transmission Peter Peregrinus ltd., London UK1983
4. E.Uhlman : Power Transmission by Direct Current, Springer Verlag, Berlin Helberg – 1985.
5. HVDC Transmission-S Kamakshaih and V Kamaraju MG hill.
6. http://nptel.ac.in/courses/108104013/

**PRAGATI ENGINEERING COLLEGE : SURAMPALEM**
**(Autonomous)**

**M.Tech (PE&ED)**

| **I Year – I SEMESTER** | **L** | **P** | **C** |
|---|---|---|---|
| | **-** | **4** | **2** |

## SYTEMS SIMULATION LAB

**Any 10 of the following experiments are to be conducted. List of experiments:**

1. Switching characteristics of Thyristor, MOSFET,IGBT using PSPICE Simulation
2. PSPICE Simulation of Single phase full converter using R-L load, R-L- E load with and without LC Filter.
3. PSPICE Simulation of Three phase full converter using R-L-E Load.
4. PSPICE Simulation of single phase AC Voltage controller with PWM control for RL load.
5. PSPICE Simulation of three phase AC Voltage controller using RL load.
6. PSPICE Simulation of single phase inverter with sinusoidal PWM control for R- load
7. PSPICE Simulation of Three phase inverter with Sinusoidal PWM control for R-Load.
8. PSPICE Simulation of dc-dc Boost converter.
9. Three phase converter fed DC motor using Matlab/Simulink
10. Development and Simulation of 3-phase PWM Inverter with sinusoidal pulse-width modulation using Matlab/Simulink
11. Characteristics of induction machines under balanced and symmetrical conditions for the following using Matlab/Simulink

    a. dq model in synchronous reference frame

    b. dq model in stator reference frame

    c. dq model in rotor reference frame
12. Volts/Hz closed-loop speed control of an induction motor drive using Matlab/Simulink.
13. Open-loop Volts/Hz control of a synchronous motor drive using Matlab/Simulink.
14. Speed control of a permanent magnet synchronous motor using Matlab/ Simulink.
15. Capacitor-start capacitor-run single-phase induction motor using Matlab/Simulink.
16. Single phase IGBT based fully controlled rectifier with PWM control using Matlab-Simpower blockset.
17. Three phase IGBT based ac voltage controller with PWM control using Matlab-Simpower blockset

**PRAGATI ENGINEERING COLLEGE : SURAMPALEM**
**(Autonomous)**

**M.Tech (PE&ED)**

| **I Year – II SEMESTER** | **L** | **P** | **C** |
|---|---|---|---|
| | **4** | **0** | **3** |

## SWITCHED MODE POWER CONVERSION

**UNIT-I**

**Non-isolated switch mode converters:** Control of DC-DC converters, Buck converters, Boost converters, Buck-Boost converter, CUK Converter, Converter realization with nonideal components.

**UNIT-II**

**Resonant converters:** Basic resonant circuit concepts, series resonant circuits, parallel resonant circuits, zero current switching Quasi-resonant buck converter, zero current switching Quasi-resonant boost converter, zero voltage switching Quasi-resonant buck converter, zero voltage switching Quasi-resonant boost converter

**UNIT-III**

**Isolated switch-mode converters:** Forwarded converter, flyback converter, Push-pull converter, half-bridge converter, full bridge converter

**UNIT-IV**

**Control schemes of switching converters:** Voltage-mode control, Current-mode control, control scheme for resonant converters, proportional integral controller.

**Magnetic design consideration:** Transformers design, DC inductor and capacitor design.

**UNIT-V**

**Modeling & Control design based on linearization:** Formulation of averaged models for buck and boost converters average circuits models, small –signal analysis and linearization.

**Control design based on linearization:** Transfer function of converters, control design, large signal issues in voltage-mode & current-mode control.

**REFERENCE BOOKS:**


1. Power Electronics – Issa Bataresh, Jhon willey publications,2004
2. Power switching converters-simon ang, alejandro olive, CRC Press (Taylor & franics group).
3. Elements of Power Electronics – Philip T. Krein, oxford university press.
4. Power Electronics: converters Applications & Design – Mohan, Undeland, Robbins- Wiley publications
5. www.peg.ee.iisc.ernet.in/people/faculty/vram/smpc/smpcbook.pdf

**PRAGATI ENGINEERING COLLEGE : SURAMPALEM**
**(Autonomous)**

**M.Tech (PE&ED)**

**I Year – II SEMESTER**

| L | P | C |
|---|---|---|
| 4 | 0 | 3 |

## 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,Undeland and 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

9. "Fundamentals of electric drives", G. K. Dubey, Narosi Publishing House
10. http://ethesis.nitrkl.ac.in/5016/1/109EE0039.pdf

**PRAGATI ENGINEERING COLLEGE : SURAMPALEM**
**(Autonomous)**

**M.Tech (PE&ED)**

**I Year – II SEMESTER**

| L | P | C |
|---|---|---|
| 4 | 0 | 3 |

## DIGITAL CONTROLLERS

**UNIT-I**

**PIC MICROCONTROLLERS** PIC Microcontrollers: Overview and Features, PIC 16C6X/7X, FSR(File Selection Register) [Indirect Data Memory Address Pointer], PIC Reset Actions, PIC Oscillator Connections, PIC Memory Organizations, PIC PIC 16C6X/7X Instructions, Addressing Modes, I/O Ports, Interrupts in PIC 16C61/
71, PIC 16C61/71 Timers, PIC 16C71 Analog-to-Digital Converter (ADC).

**UNIT - II**

**INTRODUCTION TO DSP** Introduction to the C2xx DSP core and code generation, The components of the C2xx DSP core, Mapping external devices to the C2xx core , peripherals and Peripheral Interface, System configuration registers , Memory , Types of Physical Memory, memory Addressing Modes , Assembly Programming using C2xx DSP, Instruction Set, Software Tools.

**UNIT - III**

**I/O & CONTROL REGISTERS** Pin Multiplexing (MUX) and General Purpose I/O Overview, Multiplexing and General Purpose I/O Control Registers .Introduction to Interrupts, Interrupt Hierarchy, Interrupt Control Registers, Initializing and Servicing Interrupts in Software.

**UNIT - IV**

**ADC & EVENT MANAGER** ADC Overview , Operation of the ADC in the DSP , Overview of the Event manager (EV) , Event Manager Interrupts , General Purpose (GP) Timers , Compare UNITs, Capture UNITs And Quadrature Enclosed Pulse (QEP) Circuitry , General Event Manager Information.

**UNIT - V**

**FPGA** Introduction to Field Programmable Gate Arrays – CPLD Vs FPGA – Types of FPGA , Xilinx XC3000 series , Configurable logic Blocks (CLB), Input/Output Block (IOB) – Programmable Interconnect Point (PIP) – Xilinx 4000 series – HDL programming – overview of Spartan 3E and Virtex II pro FPGA boards- case study.

**REFERENCES**


1. Microcontrollers-Theory and Applications by Ajay V Deshmukh, McGraw Hills.
2. Microcontrollers by Kennith J ayala, Thomson publishers.
3. Microprocessor and Microcontrollers by Prof C.R.Sarma.
4. Hamid.A.Toliyat and Steven G.Campbell " DSP Based Electro Mechanical Motion Control " CRC Press New York , 2004.
5. XC 3000 series datasheets ( version 3.1). Xilinx,Inc.,USA, 1998.
6. Wayne Wolf," FPGA based system design ", Prentice hall, 2004
7. http://cs.hadassah.ac.il/staff/martin/embedded/slide04-1.pdf
8. www.nptel.ac.in/courses/108105057/Pdf/Lesson-20.pdf

**PRAGATI ENGINEERING COLLEGE : SURAMPALEM**
**(Autonomous)**

**M.Tech (PE&ED)**

**I Year – II SEMESTER**

| L | P | C |
|---|---|---|
| 4 | 0 | 3 |

## CUSTOM POWER DEVICES

**UNIT-I**

**Introduction** Custom Power and Custom Power Devices - power quality variations in distribution circuits –Voltage Sags, Swells, and Interruptions - System Faults – Over voltages and Under voltages - Voltage Flicker - Harmonic Distortion - Voltage Notching - Transient Disturbances - Characteristics of Voltage Sags.

**UNIT-II**

**Overview of Custom Power Devices** Reactive Power and Harmonic Compensation Devices - Compensation Devices for Voltage Sags and Momentary Interruptions - Backup Energy Supply Devices - Battery UPS – Super Conducting Magnetic Energy Storage systems - Flywheel – Voltage Source Converter - Multi-level converters.

**UNIT-III**

**Reactive Power and Harmonic Compensation Devices** Var control devices - Static Var Compensator – Topologies - Direct Connected Static Var Compensation for Distribution Systems – Static Series Compensator - Static Shunt Compensator (DSTATCOM) - Interaction with Distribution Equipment and System - Installation Considerations.

**UNIT-IV**

**High-Speed Source Transfer Switches, Solid State Limiting, And Breaking Devices:** Source Transfer Switch - Static Source Transfer Switch (SSTS),- Hybrid source transfer switch – High-speed mechanical source transfer switch - Solid state current limiter - Solid state breaker.

**UNIT-V**

**Application of Custom Power Devices in Power Systems** P-Q theory – Control of P and Q – Dynamic Voltage Restorer (DVR) – Operation and control – Interline Power Flow Controller (IPFC) – Operation and control – Unified Power Quality Conditioner (UPQC) – Operation and control. Recent custom power devices.

**TEXT BOOKS**


1. Guidebook on Custom Power Devices, Technical Report, Published byEPRI, Nov 2000
2. Power Quality Enhancement Using Custom Power Devices – Power Electronics and Power Systems, Gerard Ledwich, Arindam Ghosh, Kluwer Academic Publishers, 2002.


**REFERENCES**


1. Power Quality, C. Shankaran, CRC Press, 2001.
2. Instantaneous power theory and application to power conditioning, H. Akagi et.al., IEEE Press, 2007.

3. Custom Power Devices - An Introduction, Arindam Ghosh and Gerard Ledwich, Springer, 2002.
4. A Review of Compensating Type Custom Power Devices for Power Quality Improvement, Yash Pal et.al., Joint International Conference on Power System Technology and IEEE Power India Conference, 2008. POWERCON 2008.
5. http://www.academia.edu/11090463/ Custom Power Devices For Power Quality Improvement A Review

**PRAGATI ENGINEERING COLLEGE : SURAMPALEM**
**(Autonomous)**

**M.Tech (PE&ED)**

**I Year – II SEMESTER**

| L | P | C |
|---|---|---|
| 4 | 0 | 3 |

## RENEWABLE ENERGY SYSTEMS
## (ELECTIVE-III)

**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 – Sitting – 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

8. http://www.cs.kumamoto-u.ac.jp/epslab/APSF/sub5.html

**PRAGATI ENGINEERING COLLEGE : SURAMPALEM**
**(Autonomous)**

**M.Tech (PE&ED)**

| **I Year – II SEMESTER** | **L** | **P** | **C** |
|---|---|---|---|
| | **4** | **0** | **3** |

## REACTIVE POWER COMPENSATION & MANAGEMENT
## (ELECTIVE III)

**UNIT-I**

**Load Compensation** Objectives and specifications – reactive power characteristics – inductive and capacitive approximate biasing – Load compensator as a voltage regulator – phase balancing and power factor correction of unsymmetrical loads- examples.

**UNIT-II**

**Reactive power compensation in transmission system:** Steady state - Uncompensated line – types of compensation – Passive shunt and series and dynamic shunt compensation – examples

Transient state - Characteristic time periods – passive shunt compensation – static compensations- series capacitor compensation

–compensation using synchronous condensers – examples

**UNIT-III**

**Reactive power coordination:** Objective – Mathematical modeling – Operation planning – transmission benefits – Basic concepts of quality of power supply – disturbances- steady –state variations – effects of under voltages – frequency – Harmonics, radio frequency and electromagnetic interferences

**UNIT-IV**

**Distribution side Reactive power Management:** System losses –loss reduction methods – examples – Reactive power planning – objectives

– Economics Planning capacitor placement – retrofitting of capacitor banks

**User side reactive power management:** KVAR requirements for domestic appliances – Purpose of using capacitors – selection of capacitors – deciding factors – types of available capacitor, characteristics and Limitations

**UNIT-V**

**Reactive power management in electric traction systems and are furnaces:** Typical layout of traction systems – reactive power control requirements – distribution transformers- Electric arc furnaces – basic operations- furnaces transformer –filter requirements – remedial measures – power factor of an arc furnace

**REFERENCE BOOKS:**


1. Reactive power control in Electric power systems by T.J.E.Miller, John Wiley and sons, 1982
2. Reactive power Management by D.M.Tagare,Tata McGraw Hill,2004
3. http://ethesis.nitrkl.ac.in/2243/1/Project_Thesis_Final.pdf

**PRAGATI ENGINEERING COLLEGE : SURAMPALEM**
**(Autonomous)**

**M.Tech (PE&ED)**

**I Year – II SEMESTER**

| L | P | C |
|---|---|---|
| 4 | 0 | 3 |

## ELECTRICAL DISTRIBUTION SYSTEMS
## (ELECTIVE-III)

**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. Power Distribution-by A.S.Pabla, Tata Mc Graw-Hill Publishing Company, 4th edition, 1997.
3. Electrical Distribution V.Kamaraju-Mc Graw Hill
4. http://www.tech.mtu.edu/~avsergue/EET3390/Lectures/CHAPTER6.pdf

**PRAGATI ENGINEERING COLLEGE : SURAMPALEM**
**(Autonomous)**

**M.Tech (PE&ED)**

**I Year – II SEMESTER**

| L | P | C |
|---|---|---|
| 4 | 0 | 3 |

## SMART GRID
## (ELECTIVE – IV)

**UNIT-I**

**Introduction to Smart Grid:** Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Functions of Smart Grid, Opportunities & Barriers of Smart Grid, Difference between conventional
& smart grid, Concept of Resilient & Self Healing Grid, Present development & International policies on Smart Grid. Case study of Smart Grid.

**UNIT-II**

**Smart Grid Technologies: Part 1:** Introduction to Smart Meters, Real Time Prizing, Smart Appliances, Automatic Meter Reading(AMR), Outage Management System(OMS), Plug in Hybrid Electric Vehicles(PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation, Phase Shifting Transformers.

**UNIT-III**

**Smart Grid Technologies: Part 2:** Smart Substations, Substation Automation, Feeder Automation. Geographic Information System(GIS), Intelligent Electronic Devices(IED) & their application for monitoring
& protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System(WAMS), Phase Measurement Unit(PMU).

**UNIT-IV**

**Microgrids and Distributed Energy Resources:** Concept of microgrid, need & applications of microgrid, formation of microgrid, Issues of interconnection, protection & control of microgrid. Plastic & Organic solar cells, Thin film solar cells, Variable speed wind generators, fuelcells, microturbines, Captive power plants, Integration of renewable energy sources.

**UNIT-V**

**Power Quality Management in Smart Grid:** Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power
Quality monitoring, Power Quality Audit.

**Information and Communication Technology for Smart Grid:** Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighborhood Area Network (NAN), Wide Area Network (WAN).

**TEXT BOOKS:**


1. Ali Keyhani, Mohammad N. Marwali, Min Dai "Integration of Green and Renewable Energy in Electric Power Systems", Wiley

2. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response",CRC Press

3. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama,"Smart Grid: Technology and Applications", Wiley
4. Jean Claude Sabonnadière, Nouredine Hadjsaïd, "Smart Grids", Wiley Blackwell 19
5. Peter S. Fox Penner, "Smart Power: Climate Changes, the Smart Grid, and the Future of Electric Utilities", Island Press; 1 edition 8 Jun 2010
6. S. Chowdhury, S. P. Chowdhury, P. Crossley, "Microgrids and Active Distribution Networks." Institution of Engineering and Technology, 30 Jun 2009
7. Stuart Borlase, "Smart Grids (Power Engineering)", CRC Press

**REFERENCE BOOKS:**

1. Andres Carvallo, John Cooper, "The Advanced Smart Grid: Edge Power Driving Sustainability: 1", Artech House Publishers July 2011

2. James Northcote, Green, Robert G. Wilson "Control and Automation of Electric Power Distribution Systems (Power Engineering)", CRC Press

3. Mladen Kezunovic, Mark G. Adamiak, Alexander P. Apostolov, Jeffrey George Gilbert "Substation Automation (Power Electronics and Power Systems)", Springer
4. R. C. Dugan, Mark F. McGranghan, Surya Santoso, H. Wayne Beaty, "Electrical Power System Quality", 2nd Edition, McGraw Hill Publication
5. Yang Xiao, "Communication and Networking in Smart Grids", CRC Press
6. https://www.engineering.unsw.edu.au/electrical.../sites/.../GSOE9141_S12015.pdf
7. http:// iauctb.ac.ir /Files

**PRAGATI ENGINEERING COLLEGE : SURAMPALEM**
**(Autonomous)**

**M.Tech (PE&ED)**

**I Year – II SEMESTER**

| L | P | C |
|---|---|---|
| 4 | 0 | 3 |

## SPECIAL MACHINES
## (ELECTIVE IV)

**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**

**Permanent Magnet Synchronous Motors (PMSM) and Switched Reluctance Motors (SRM)**

**PMSM:** Power electronic controllers, Torque speed characteristics, Self control, Vector control, Current control.

**SRM:** Constructional features, Principle of operation. Torque equation, Characteristics, Control Techniques, Drive concept.

**UNIT-III**

**Permanent Magnet Brushless DC Motors** Concept of electronic commutation, Hall sensors, Optical sensors, back emf detection, Multiphase Brushless motor, Square wave permanent magnet brushless motor drives, Torque and emf equation, Torque-speed characteristics, Speed control by microcontroller.

**UNIT-IV**

**Servomotors and AC Tachometers** Servomotor – Types – Constructional features – Principle of Operation – Characteristics - Control – Microprocessor based applications.

**AC Tachometers:** Permanent magnet ac tachometer, AC induction tachometer, Schematic diagrams, Operating principle.

**UNIT-V**

**Linear Motors** 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

**REFERENCES**


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. Special Electrical Machines-K.Venkataratnam- University press.
5. Floyd E Saner,"Servo Motor Applications", Pittman USA, 1993.

6. Kenjo, T and Naganori, S "Permanent Magnet and brushless DC motors", Clarendon Press, Oxford, 1989.

7. Generalized Theory of Electrical Machines – P.S.Bimbra-Khanna publications-5th edition- 1995.

*8.* www.nct-tech.edu.lk/Download/Technology%20Zone/Stepping%20Motors.pdf

**PRAGATI ENGINEERING COLLEGE : SURAMPALEM**
**(Autonomous)**

**M.Tech (PE&ED)**

| **I Year – II SEMESTER** | **L** | **P** | **C** |
|---|---|---|---|
| | **4** | **0** | **3** |

## PROGAMMABLE LOGIC CONTROLLERS & APPLICATIONS
## (ELECTIVE IV)

**UNIT-I**

**PLC Basics:** PLC system, I/O modules and interfacing, CPU processor, programming equipment, programming formats, construction of PLC ladder diagrams, devices connected to I/O modules.

**UNIT-II**

**PLC Programming:** Input instructions, outputs, operational procedures, programming examples using contacts and coils. Drill press operation. Digital logic gates, programming in the Boolean algebra system, conversion examples. Ladder diagrams for process control: Ladder diagrams and sequence listings, ladder diagram construction and flow chart for spray process system.

**UNIT-III**

**PLC Registers:** Characteristics of Registers, module addressing, holding registers, input registers, output registers. PLC Functions: Timer functions and Industrial applications, counters, counter function industrial applications, Arithmetic functions, Number comparison functions, number conversion functions.

**UNIT-IV**

**Data Handling functions:** SKIP, Master control Relay, Jump, Move, FIFO, FAL, ONS, CLR and Sweep functions and their applications. Bit Pattern and changing a bit shift register, sequence functions and applications, controlling of two axis and three axis Robots with PLC, Matrix functions.

**UNIT-V**

**Analog PLC operation:** Analog modules and systems, Analog signal processing, multi bit data processing, analog output application examples, PID principles, position indicator with PID control, PID modules, PID tuning, PID functions.

**REFERENCE BOOKS:**


1. Programmable Logic Controllers – Principle and Applications by John W. Webb and Ronald A. Reiss, Fifth Edition, PHI
2. Programmable Logic Controllers – Programming Method and Applications by JR. Hackworth and F.D Hackworth Jr. – Pearson, 2004.
3. Introduction to Programmable Logic Controllers- Gary Dunning- Cengage Learning.
4. Programmable Logic Controllers –W.Bolton-Elsevier publisher
5. https://www.ia.omron.com/data_pdf/guide/26/plc_tg_fi.pdf
5. http://ieeebooks.blogspot.in/2009/06/plc-programmable-logic-controller.html

**PRAGATI ENGINEERING COLLEGE : SURAMPALEM**
**(Autonomous)**

**M.Tech (PE&ED)**

| **I Year – II SEMESTER** | **L** | **P** | **C** |
|---|---|---|---|
| | **-** | **4** | **2** |

## POWER CONVERTERS AND DRIVES LAB

**List of experiments**

1. Operation of 3- phase Full-Converter on R & R-L load.
2. Performance & speed control of D.C. drive using 3-phase full Converter.
3. Performance & Operation of a four quadrant Chopper on D.C. Drive
4. Performance & Operation of a 3-phase A.C. Voltage controller on motor load.
5. Single Phase IGBT based PWM Inverter on R & R-L load
6. Operation of 3-phase IGBT based PWM Inverter on R & R-L load.
7. Performance & speed control of 3 phase slip ring Induction motor by Static Rotor Resistance controller.
8. Three phase PWM Pulse generation using PIC Micro controller
9. PIC Microcontroller based speed control of three phase Induction Motor
10. DSP based V/F Control of 3 phase Induction motor..