Estd. 1989

SIR C R REDDY COLLEGE OF ENGINEERING

(AUTONOMOUS)

(SPONSORED BY SIR C R R EDUCATIONAL INSTITUTIONS, SOCIETY REGD. NO.: 10/1950)

VATLURU, ELURU-534007, ELURU DISTRICT, ANDHRA PRADESH, INDIA

Approved by AICTE, Accredited By NBA (UG: CSE, IT, ECE, EEE, ME), Affiliated To JNTUK, Kakinada

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I-Semester	POWER SYSTEM OPERATION & CONTROL	L-T-P 3-0-0	CREDITS : 3

Pre-requisite: Knowledge on Power Generation Engineering, Power Transmission Engineering.

Course Educational Objectives:

- To study the unit commitment problem for economic load dispatch.
- To study the load frequency control of single area and two area systems with and withoutcontrol.
- To study the effect of generation with limited energy supply.
- To study the effectiveness of interchange evaluation in interconnected power systems.

UNIT – 1

Unit commitment problem and optimal power flow solution: Unit commitment: Constraints in UCP,UC solution methods. Priority list method, introduction to Dynamic programming Approach. Optimal power flow: OPF without inequality constraints, inequality constraints on controlvariables and dependent variables.

UNIT – 2

Single area Load Frequency Control: Necessity of keeping frequency constant. Definition of control area, single area control, Block diagram representation of an isolated Power System, Steady State analysis, Dynamic response-Uncontrolled case. Proportional plus Integral control of single area and its block diagram representation, steady state response.

UNIT – 3

Two area Load Frequency Control: Load frequency control of two-area system, uncontrolled case and controlled case, tie-line bias control, steady state representation. Optimal two-area LF control- performance Index and optimal parameter adjustment. Load frequency control and Economic dispatch control.

UNIT – 4

Generation with limited Energy supply : Take-or-pay fuel supply contract, composite generation production cost function. Solution by gradient search techniques, Hard limits and slack variables, Fuel scheduling by linear programming.

UNIT – 5

Interchange Evaluation and Power Pools Economy Interchange: Economy interchange Evaluation, Interchange Evaluation with unit commitment, Multiple Interchange transactions, Other types of Interchange, power pools, transmission effects and issues.

Course Outcomes: At the end of the course, student will be able to

- Determine the unit commitment problem for economic load dispatch.
- Get the knowledge of load frequency control of single area system with and without control.
- Get the knowledge of load frequency control of two area system with and without control.
- Know the effect of generation with limited energy supply.
- Determine the interchange evaluation in interconnected power systems.

Text Books:

1. Power Generation, Operation and Control - by A.J.WoodandF.Wollenberg,Johnwiley& sonsInc. 1984.
2. Modern Power System Analysis - by I.J.Nagrath&D.P.Kothari, Tata McGraw-HillPublishing Company ltd, 2nd edition.

Reference Books:

1 Power system operation and control PSR Murthy B.S publication.

2 Electrical Energy Systems Theory - by O.I.Elgerd, Tata McGraw-Hill PublishingCompany Ltd, 2nd edition.

3 Reactive Power Control in Electric Systems - by TJE Miller, John Wiley & sons.

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I-Semester	ANALYSIS OF POWER ELECTRONIC CONVERTERS	L-T-P 3-0-0	CREDITS 3

Pre-Requisite: Power Electronics.

Course Educational Objectives:

- To understand the control principle of ac to ac conversion with suitable power semi -conductor devices.
- To have the knowledge of ac to dc conversion and different ac to dc converter topologies.
- To understand the effect of operation of controlled rectifiers on p.f. and improvement of p.f. with PFC converters
- To acquire the knowledge on dc-ac converters and to know the different controltechniques of dc-ac converters.
- To know multilevel inverter configuration to improve the quality of the inverter outputvoltage.

UNIT– 1

Overview of Switching Devices:

Power MOSFET, IGBT, GTO, GaN devices-static and dynamic characteristics, gate drive circuits forswitching devices.

UNIT– 2

AC-DC converters: Single phase fully controlled converters with RL load– Evaluation of input power factor and harmonic factor-Continuous and Discontinuous load current, Power factor improvements, Extinction angle control, symmetrical angle control, PWM control. Three Phase AC-DC Converters, fully controlled converters feeding RL load with continuous and discontinuous load current, Evaluation of input power factor and harmonic factor-three phase dual converters.

UNIT– 3

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– 4

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

UNIT– 5

Multi level inverters: Introduction, Multilevel Concept, Types of Multilevel Inverters- Diode-Clamped Multilevel Inverter, Principle of Operation, Features of Diode-Clamped Inverter, Improved Diode-Clamped Inverter- Flying-Capacitors Multilevel Inverter- Principle of Operation, 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.

Course Outcomes: At the end of the course, student will be able to

- Describe and analyze the operation of AC-DC converters.
- Analyze the operation of power factor correction converters.
- Analyze the operation of three phase inverters with PWM control.
- Study the principles of operation of multi- level inverters and their applications.

Text Books

1. Power Electronics: Converters, Applications, and Design- Ned Mohan, Tore M. Undeland,William P. Robbins, John Wiley& Sons, 2nd Edition, 2003.
2. Daniel W. Hart - McGraw-Hill,2011.

Reference Books:

1. Elements of Power Electronics – Philip T. Krein, Oxford University press, 2014.
2. Power Electronics: Converters, Applications, and Design- Ned Mohan, Tore M. Undeland,William P. Robbins, John Wiley& Sons, 2nd Edition, 2003.
3. Power Converter Circuits – William Shepherd & Li Zhang-Yes Dee CRC Press, 2004.

I-Semester	ELECTRICAL DISTRIBUTION AUTOMATION (ELECTIVE–I)	L-T-P 3 -0-0	CREDITS 3

Pre-requisite: Knowledge on basics of distribution systems, Compensation in electrical distribution systems, Circuit Analysis, concept of load modelling.

Course Educational Objectives:

- To learn the importance of economic distribution of electrical energy.
- To analyse the distribution networks for V-drops, P_{Loss} calculations and reactive power.
- To understand the co-ordination of protection devices.
- To impart knowledge of capacitive compensation/voltage control.
- To understand the principles of voltage control.

UNIT – 1

General : Introduction to Distribution systems, an overview of the role of computers in distribution system planning-Load modelling 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 – 2

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

UNIT – 3

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; types of coordination.

UNIT – 4

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.

UNIT – 5

Distribution automation functions: Electrical system automation, EMS functional scope, DMS functional scope functionality of DMS- Steady state and dynamic performance improvement; Geographic information systems-AM/FM functions and Database management; communication options, supervisory control and data acquisition: SCADA functions and system architecture; Synchrophasors and its application in power systems.

Course Outcomes: At the end of the course, student will be able to

- Analyse a distribution system.
- Design equipment for distribution system and sub-stations.
- Design protective systems and co-ordinate the devices.
- Understand of capacitive compensation.
- Understand of distribution automation.

Text Books:

1. "Electric Power Distribution System Engineering" by Turan Gonen, McGraw-Hill BookCompany,1986.

2. Distribution System Analysis and Automation, by Juan M. Gers, The Institution of Engineering and Technology, UK 2014.

Reference Books:

1. Electric Power Distribution-by A.S.Pabla, Tata McGraw-Hill Publishing Company, 4thedition, 1997.
2. Electrical Distribution V.Kamaraju-McGraw Hill
3. Handbook of Electrical Power Distribution – Gorti Ramamurthy-Universities press

I-Semester	RENEWABLE ENERGY TECHNOLOGIES (ELECTIVE–I)	L-T-P 3 -0-0	CREDITS : 3

Pre requisite: UG power Electronics.

Course Educational Objectives:

- To learn the technical challenges in renewable energy.
- To learn the basics of wind energy conversion & PV power generation.
- To learn the analysis of fuel cell system.

UNIT– 1

Introduction: Renewable Sources of Energy; Distributed Generation; Renewable Energy Economics - Calculation of Electricity Generation Costs; Demand-Side Management Options; Supply-Side Management Options; Control of renewable energy based power Systems

UNIT– 2

Induction Generators: Principles of Operation; Representation of Steady-State Operation; Power and Losses Generated - Self-Excited Induction Generator; Magnetizing Curves and Self-Excitation - Mathematical Description of the Self-Excitation Process; Interconnected and Stand-alone operation - Speed and Voltage Control.

UNIT– 3

Wind Power Plants: Site Selection; Evaluation of Wind Intensity; Topography; Purpose of the Energy Generation- General Classification of Wind Turbines; Rotor Turbines; Multiple-Blade Turbines; Drag Turbines; Lifting Turbines - Generators and Speed Control Used in Wind Power Energy; Analysis of Small wind energy conversion system.

UNIT– 4

Photovoltaic Power Plants: Solar Energy; Generation of Electricity by Photovoltaic Effect; Dependence of a PV Cell on Temperature and irradiance input-output Characteristics - Equivalent Models and Parameters for Photovoltaic Panels; MPPT schemes: P&O,INC, effect of partial shaded condition. Applications of Photovoltaic Solar Energy-Economical Analysis of Solar Energy

UNIT– 5

Fuel Cells: The Fuel Cell; Low- and High-Temperature Fuel Cells; Commercial and Manufacturing Issues - Constructional Features of Proton Exchange-Membrane Fuel Cells; Reformers; Electrolyser Systems; Advantages and Disadvantages of Fuel Cells - Fuel Cell Equivalent Circuit; Practical Determination of the Equivalent Model Parameters; Aspects of Hydrogen for storage

Course Outcomes: At the end of the course, student will be able to

- Understand various general aspects of renewable energy systems.
- Analyze and design induction generator for power generation from wind.
- Design MPPT controller for solar power utilization.
- Utilize fuel cell systems for power generation.

Text Books:

1. Felix A. Farret, M. Godoy Simo` es, Integration of Alternative Sources of Energy, John Wiley &Sons, 2006.
2. Remus Teodorescu, Marco Liserre, Pedro Rodríguez, Grid Converters for Photovoltaic and WindPower Systems, John Wiley & Sons, 2011.

Reference Books:

1. Gilbert M. Masters, Renewable and Efficient Electric Power Systems, John Wiley & Sons, 2004.

I-Semester	POWER SYSTEM DEREGULATION (ELECTIVE–I)	L-T-P 3 -0-0	CREDITS : 3

Pre-requisite: Knowledge on power systems.

Course Educational Objectives:

- To provide in-depth understanding of operation of deregulated electricity market systems.
- To examine typical issues in electricity markets and how these are handled world – widein various markets.
- To enable students to analyse various types of electricity market operational and controlissues using new mathematical models.

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; Effectof 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.

Course Outcomes: At the end of the course, student will be able to

- Understand of operation of deregulated electricity market systems
- Typical issues in electricity markets
- Analyse various types of electricity market operational and control issues using newmathematical models.
- Understand LMP’s wheeling transactions and congestion management.
- Analyse impact of ancillary services.

Text Books:

1. Power System Economics: Designing markets for electricity - S. Stoft, wiley.
2. Operation of restructured power systems - K. Bhattacharya, M.H.J. Bollen and J.E. Daalder, Springer.

Reference Books:

1. Power generation, operation and control, -J. Wood and B. F. Wollenberg, Wiley.
2. Market operations in electric power systems - M. Shahidehpour, H. Yaminand Z. Li,Wiley.
3. Fundamentals of power system economics - S. Kirschen and G. Strbac, Wiley.
4. Optimization principles: Practical Applications to the Operation and Marketsof the ElectricPower Industry - N. S. Rau, IEEE Press series on Power Engineeirng.
5. Competition and Choice in Electricity - Sally Hunt and Graham Shuttleworth

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I-Semester	HVDC TRANSMISSION (ELECTIVE–II)	L-T-P 3 -0-0	CREDITS 3

Pre-requisite: Knowledge on Power Electronics, Power Systems and High Voltage Engineering.

Course Educational Objectives:

- To learn various schemes of HVDC transmission.
- To learn about the basic HVDC transmission equipment.
- To learn the control of HVDC systems.
- To be exposed to the interaction between HVAC and HVDC system.
- To be exposed to the various protection schemes of HVDC engineering.

UNIT – 1

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

UNIT – 2

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 performance of diametrical connection with 6-pulse bridge circuit

UNIT – 3

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

UNIT – 4

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 – 5

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.

Course Outcomes: At the end of the course, student will be able to

- Understand the various schemes of HVDC transmission.
- Understand the basic HVDC transmission equipment.
- Understand the control of HVDC systems.
- Understand the interaction between HVAC and HVDC system.
- Understand the various protection schemes of HVDC engineering.
- Understand the various schemes of HVDC transmission.

Text Books:

1. S Kamakshaih and V Kamaraju: HVDC Transmission- MG hill.
2. K.R.Padiyar : High Voltage Direct current Transmission, Wiley Eastern Ltd., NewDelhi – 1992.

Reference Books:

1. E.W. Kimbark : Direct current Transmission, Wiley Inter Science – New York.
2. J.Arillaga : H.V.D.C.Transmission Peter Peregrinus ltd., London UK 1983
3. Vijay K Sood: HVDC and FACTS controllers:Applications of static converters inpower systems by, Kluwer Academic Press.

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I-Semester	ADVANCED POWER SYSTEMS PROTECTION (ELECTIVE–II)	L-T-P 3 -0-0	CREDITS3

Pre-requisite: Concepts of Power Electronics, Electronic circuits, STLD and basics of Relays andprotection.

Course Educational Objectives:

- To learn about classification and operation of static relays.
- To understand the basic principles and application of comparators.
- To learn about static version of different types of relays.
- To understand about numerical protection techniques.

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

PILOT Relaying schemes: Wire pilot protection: circulating current scheme – balanced voltage scheme – translay scheme – half wave comparison scheme - carrier current protection: phase comparison type – carrier aided distance protection – operational comparison of transfer trip and blocking schemes – optical fibre channels.

UNIT – 5

Microprocessor based relays and Numerical Protection: Introduction – over current relays – impedance relay – directional relay – reactance relay.

Numerical Protection: Introduction - numerical relay - numerical relaying algorithms - mann-morrison technique - Differential equation technique and discrete fourier transform technique - numerical over current protection - numerical distance protection.

Course Outcomes: At the end of the course, student will be able to

- Know the classifications and applications of static relays.
- Understand the application of comparators.
- Understand the static version of different types of relays.
- Understand the numerical protection techniques.

Text Books:

1. Power System Protection with Static Relays – by TSM Rao, TMH.
2. Power system protection & switchgear by Badri Ram & D N viswakarma, TMH.

Reference Books:

1. Protective Relaying Vol-II Warrington, Springer.
2. Art & Science of Protective Relaying - C R Mason, Willey.
3. Power System Stability KimbarkVol-II, Willey.
4. Electrical Power System Protection –C.Christopoulos and A.Wright- Springer
5. Protection & Switchgear –BhaveshBhalaja, R.PMaheshwari, NileshG.Chothani-Oxfordpublisher

I-Semester	POWER SYSTEM RELIABILITY (ELECTIVE–II)	L-T-P 3 -0-0	CREDITS3

Pre-requisite: Probability theory, power systems.

Course Educational Objectives:

- To get the basic understanding of network modelling and reliability.
- To get the basic understanding of Markov chains.
- To get the basic understanding of Reliability analysis of generation systems.
- To get the basic understanding ofDecomposition techniques

UNIT – 1

Basic probability theory – rules for combining probabilities of events – Bernoulli`s trials – probability density and distribution functions – binomial- distributions – expected value and standard deviation of binomial distribution.

UNIT – 2

Network Modelling and Reliability Analysis of Series, Parallel, Series-Parallel networks – complex networks – decomposition method Reliability functions F(t), R(t), h(t) and their relationship – exponential distributions – Expected value and standard deviation of exponential distribution – Bath tub curve – reliability analysis of series parallel networks using exponential distribution – reliability measures MTTF, MTTR,MTBF

UNIT – 3

Markov chains – concept of stochastic transitional probability Matrix, Evaluation of limiting stateProbabilities – Markov processes one component repairable system – time dependent probabilityevaluation using Laplace transform approach – evaluation of limiting state probabilities usingSTPM – two component repairable models – Frequency and duration concept – Evaluation offrequency of encountering state, mean cycle time, for one, two component repairable models –evaluation of cumulative probability and cumulative frequency of encountering merged states

UNIT – 4

Generation system reliability analysis – reliability model of a generation system – recursive relation for unit addition and removal – load modelling – merging of generation load model –

evaluation of transition rates for merged state model – cumulative Probability, cumulative frequency of failure evaluation – LOLP, LOLE.

UNIT – 5

Composite system reliability analysis decomposition method – distribution system reliability analysis – radial networks – weather effects on transmission lines – Evaluation of load and energy indices.

Course Outcomes: At the end of the course, student will be able to

- Understand reliability analysis applied to power systems.
- Understand Markov Chains and application to power systems.
- Perform stability analysis of generation systems.
- Understand decomposition techniques applied to power system.

Reference Books:

1. Reliability Evaluation of Engg. System – R.Billinton, R.N.Allan, Plenum Press, New York.
2. Reliability Modeling in Electric Power Systems - J. Endrenyi, John Wiley, 1978, Neewyork.
3. An Introduction to Realiability and Maintainability Engineering. Sharies E Ebeling, TATAMcGraw Hill – Edition.

I-Semester	RESEARCH METHODOLGY AND IPR	L-T-P 2-0-0	CREDITS 2

UNIT-I

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis,interpretation, Necessary instrumentations

UNIT-II

Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT-III

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT-IV

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT-V

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

REFERENCES:

1. Stuart Melville and Wayne Goddard, “Research methodology: an introduction for science &engineering students’”
2. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”
3. Ranjit Kumar, 2nd Edition, “Research Methodology: A Step by Step Guide for beginners”
4. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd,2007.
5. Mayall, “Industrial Design”, McGraw Hill, 1992.

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I-Semester	POWER SYSTEM SIMULATION LABORATORY – I	L-T-P 0-0-4	CREDITS 2

Pre-requisite: Electrical Power Systems

Course Educational Objectives:

- To understand the modelling of different transmission lines
- To understand the mathematical formulation of distribution system load flow
- To understand the configurations of transmission lines
- To understand the transients in transmission lines
- To understand the formation of Z- and Y-bus matrices

List of Experiments:

1. Performance analysis of short and medium transmission lines.
2. Performance analysis of long transmission lines.
3. Computation of sag of transmission lines for equal and unequal heights of towers.
4. Distribution load flow analysis.
5. Computation of B- co-efficient in economic load dispatch problem.
6. Computation of line parameters (R, L, C) for different configuration of 3-ϕ symmetricaltransmission lines.
7. Computation of line parameters (R, L, C) for different configuration of 3-ϕunsymmetrical transmission lines with and without transportation.
8. Computation reflection and refraction co-efficient of voltages and currents oftransmission line form different conditions.
9. Formation of Y-bus by direct inspection method.
10. Formations of Z-bus by building

algorithm.Course Outcomes: The student shall

be able to

1. Analyse the performance of thevarious transmission lines at different loading conditions
2. Perform the load flow study on distribution systems
3. Calculate the different line parameters of 3-phase symmetrical and unsymmetricaltransmission lines
4. Compute the reflection and refraction coefficients of voltages and currents in thetransmissions
5. Form the Z- and Y-bus matrices for the given power transmission system

I-Semester	POWER SYSTEMS LABORATORY	L-T-P 0 -0-4	CREDITS : 2

Course Educational Objectives:

To understand the experimental determination of various parameters used in power system area and to analyse the performance of transmission line with and without compensation.

List of Experiments:

1. Determination of Sequence Impendence of an Alternator by direct method.

2. Determination of Sequence impedance of an Alternator by fault Analysis.

3. Measurement of sequence impedance of a three phase transformer

   (a). by application of sequence voltage.　　(b). using fault analysis.

4. Power angle characteristics of a salient pole Synchronous Machine.

5. Poly-phase connection on three single phase transformers and measurement of phasedisplacement.

6.Determination of equivalent circuit of 3-winding Transformer.

7. Measurement of ABCD parameters on transmission line model.

8. Performance of long transmission line without compensation.

9. Study of Ferranti effect in long transmission line.

10. Performance of long transmission line with shunt compensation.

Course Outcomes:

After the Completion of lab they will understand procedure for determination of various parameters used in power system as well as performance of transmission line.

II-Semester	POWER SYSTEM DYNAMICS AND STABILITY	CATEGORY	L-T-P 3 -0-0	CREDITS3

Pre-requisite: Knowledge of synchronous machine, Power System Analysis

Course Educational Objectives:

- To study the model of synchronous machines.
- To study the stability studies of synchronous machines.
- To study the solution method of transient stability.
- To study the effect of different excitation systems.

UNIT – 1

System Dynamics: Synchronous machine model in state space from computer representation for excitation and governor system –modelling of loads and induction machines.

UNIT – 2

Steady state stability – steady state stability limit – Dynamics Stability limit – Dynamic stability analysis – State space representation of synchronous machine connected to infinite bus-time response – Stability by eigen value approach.

UNIT – 3

Digital Simulation of Transient Stability: Swing equation machine equations – Representation of loads – Alternate cycle solution method – Direct method of solution – Solution Techniques: Modified Euler method – Runge Kutta method – Concept of multi machine stability.

UNIT – 4

Effect of governor action and excite on power system stability effect of saturation, saliency & automatic voltage regulators on stability.

UNIT – 5

Excitation Systems : Rotating Self-excited Exciter with direct acting Rheostatic type voltage regulator – Rotating main and Pilot Exciters with Indirect Acting Rheostatic Type Voltage Regulator – Rotating Main Exciter, Rotating Amplifier and Static Voltage Regulator – Static excitation scheme – Brushless excitation system.

Course Outcomes: At the end of the course, student will be able to

- Determine the model of synchronous machines.
- Know the stability studies of synchronous machines.
- Get the knowledge of solution methods of transient stability.
- Know the effect of different excitation systems in power systems.

Text Books:

1. Power System Stability by Kimbark Vol. I&II, III, Willey.
2. Power System control and stability by Anderson and Fund, IEEE Press.

Reference Books:

1. Power systems stability and control by PRABHA KUNDUR, TMH.
2. Computer Applications to Power Systems–Glenn.W.Stagg& Ahmed. H.El.Abiad, TMH.
3. Computer Applications to Power Systems – M.A.Pai, TMH.
4. Power Systems Analysis & Stability – S.S.VadheraKhanna Publishers

II-Semester	REAL TIME CONTROL OF POWER SYSTEMS	L-T-P 3 -0-0	CREDITS :3

Pre-requisite: Power system operation and control.

Course Educational Objectives:

- To understand the importance of state estimation in power systems.
- To know the importance of security and contingency analysis.
- To understand SCADA, its objectives and its importance in power systems.
- To know the significance of voltage stability analysis.
- To know the applications of AI to power systems problems.

UNIT – 1:

State Estimation: Different types of State Estimations, Theory of WLS state estimation, sequential and non-sequential methods to process measurements. Bad data Observability, Bad data detection, identification and elimination.

UNIT – 2:

Security and Contingency Evaluation : Security concept, Security Analysis and monitoring, Contingency Analysis for Generator and line outages by iterative linear power flow method, Fast Decoupled model, and network sensitivity methods.

UNIT – 3:

Computer Control of Power Systems: Need for real time and computer control of power systems, operating states of a power system, SCADA - Supervisory control and Data Acquisition systems implementation considerations, energy control centres, software requirements for implementing the above functions.

UNIT – 4:

Voltage Stability, voltage collapse, and voltage security, relation of voltage stability to rotor angle stability. Voltage stability analysis Introduction to voltage stability analysis `P-V’ curves and `Q-V’ curves, voltage stability in mature power systems, long-term voltage stability, power flow analysis for voltage stability, voltage stability static indices.

UNIT – 5:

Synchrophasor Measurement units: Introduction, Phasor representation of sinusoids, a generic PMU, GPS, Phasor measurement systems, Communication options for PMUs, Functional requirements of PMUs and PDCs, Phasors for nominal frequency signals, types of frequency excursions in power systems, DFT estimation at off nominal frequency with a nominal frequency clock.

Course Outcomes: At the end of the course, student will be able to

- Understand state estimation, security and contingency evaluation.
- Understand about Supervisory control and data acquisition.
- Real time software application to state estimation.
- Understand application of AI in power system.

Text Books:

1. John J.Grainger and William D.Stevenson, Jr. : Power System Analysis, McGraw-Hill,1994, International Edition
2. Allen J.Wood and Bruce F.Wollenberg : Power Generation operation andcontrol, JohnWiley & Sons, 1984.
3. A.G.Phadka and J.S. Thorp, "Synchronized Phasor Measurements and TheirApplications", Springer, 2008

Reference Books:

1. R.N.Dhar : Computer Aided Power Systems Operation and Analysis, Tata McGraw Hill,1982
2. L.P.Singh : Advanced Power System Analysis and Dynamics, WileyEastern Ltd. 1986
3. PrabhaKundur : Power System Stability and Control -, McGraw Hill, 1994
4. P.D.Wasserman : `Neural Computing : Theory and Practice' Van Nostrand -Feinhold, NewYork.

II-Semester	EHVAC TRANSMISSION (ELECTIVE–III)	L-T-P 3 -0-0	CREDITS 3

Pre-requisite: Transmission line parameters and properties, Corona etc.

Course Educational Objectives:

- To calculate the transmission line parameters.
- To calculate the field effects on EHV and UHV AC lines.
- To have knowledge of corona, RI and audible noise in EHV and UHV lines.
- To have knowledge of voltage control and compensation problems in EHV and UHVtransmission systems.

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

Reactive power compensating systems: Introduction, SVC schemes, Harmonics injected into network by TCR, design of filters for suppressing harmonics injected into the system.

Course Outcomes: At the end of the course, student will be able to

- Calculate the transmission line parameters.
- Calculate the field effects on EHV and UHV AC lines.
- Determine the corona, RI and audible noise in EHV and UHV lines.
- Analyse voltage control and compensation problems in EHV and UHV transmissionsystems.
- Understand reactive power compensation using SVC and TCR

Text Books :

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

II-Semester	FLEXIBLE AC TRANSMISSION SYSTEMS (ELECTIVE–III)	L-T-P 3 -0-0	CREDITS: 3

Pre-requisite: Concepts on Power Electronics and Power Systems

Course Educational Objectives:

- To study the performance improvements of transmission system with FACTS.
- To study the effect of static shunt compensation.
- To study the effect of static series compensation.
- To study the effect of UPFC.

UNIT – 1

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

UNIT – 2

Basic concept of voltage and current source converters, comparison of current source converters with voltage source converters.

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 generation, switchingconverter type VAr generation, hybrid VAr generation.

UNIT – 3

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

UNIT – 4

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.

UNIT – 5

Unified Power Flow Controller: Basic operating principle, conventional transmission control capabilities, independent real and reactive power flow control, comparison of the UPFC to series compensators and phase angle regulators. Introduction to Inter line Power Flow Controller (IPFC)

Course Outcomes: At the end of the course, student will be able to

- Know the performance improvement of transmission system with FACTS.
- Get the knowledge of effect of static shunt and series compensation.
- Know the principle of operation and various controls of UPFC
- Determine an appropriate FACTS device for different types of applications.

Text Books:

1. "Understanding FACTS Devices" N.G.Hingorani and L.Guygi, IEEE Press. Indian Edition isavailable:--Standard Publications

Reference Books:

1. Sang.Y.HandJohn.A.T, "Flexible AC Transmission systems" IEEE Press (2006).
2. HVDC & FACTS Controllers: applications of static converters in power systems-Vijay K.Sood- Springer publishers

II-Semester	HYBRID ELECTRIC VEHICLES (ELECTIVE–III)	L-T-P 3 -0-0	CREDITS : 3

Pre-requisite: Knowledge of Power Electronics and Electric Drives

Course Educational Objectives:

To familiarize students with the concept of hybrid vehicles, types of electric drives used in hybrid vehicles and their control

UNIT– 1

Introduction:

History of hybrid vehicles, architectures of HEVs, series and parallel HEVs, complex HEVs.

UNIT– 2

Hybridization of Automobile:

Fundamentals of vehicle, components of conventional vehicle and propulsion load; Drive cycles and drive terrain; Concept of electric vehicle and hybrid electric vehicle; Plug-in hybrid vehicle, constituents of PHEV, comparison of HEV and PHEV; Fuel Cell vehicles and its constituents.

UNIT– 3

Plug-in Hybrid Electric Vehicle:

PHEVs and EREVs blended PHEVs, PHEV Architectures, equivalent electric range of blended PHEVs; Fuel economy of PHEVs, power management of PHEVs, end-of-life battery for electric power grid support, vehicle to grid technology, PHEV battery charging.

UNIT– 4

Power Electronics in HEVs:

Rectifiers used in HEVs, voltage ripples; Buck converter used in HEVs, non-isolated bidirectional DC-DC converter, regenerative braking, voltage source inverter, current source inverter, isolated bidirectional DC- DC converter, PWM rectifier in HEVs, EV and PHEV battery chargers.

UNIT– 5

Battery and Storage Systems

Energy Storage Parameters; Lead–Acid Batteries; Ultra capacitors; Flywheels - Superconducting Magnetic Storage System; Pumped Hydroelectric Energy Storage; Compressed Air Energy Storage - Storage Heat; Energy Storage as an Economic Resource

Course Outcomes: At the end of the course, student will be able to

- Know the concept of electric vehicles and hybrid electric vehicles.
- Familiar with different motors used for hybrid electric vehicles.
- Understand the power converters used in hybrid electric vehicles
- Know different batteries and other energy storage systems.

Text Books

1. Ali Emadi, Advanced Electric Drive Vehicles, CRC Press, 2014.
2. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.

Reference Books:

1. MehrdadEhsani, YimiGao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric andFuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
2. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.
3. H. Partab: Modern Electric Traction - DhanpatRai& Co, 2007.
4. Pistooa G., “Power Sources , Models, Sustanability, Infrstructure and the market”, Elsevier 2008
5. Mi Chris, Masrur A., and Gao D.W., “ Hybrid Electric Vehicle: Principles and Applications withPractical Perspectives” 1995.

II-Semester	GENERATION AND MEASUREMENT OF HIGH VOLTAGES (ELECTIVE–II)	L-T-P 3 -0-0	CREDITS 3

Pre-requisite: Basics of Electrical circuits, Electronics and measurements for testing purpose.

Course Educational Objectives:

- To study the numerical methods for analysing electrostatic field problems.
- To study the fundamental principles of generation of high voltage for testing.
- To study the methods for measurement of high AC ,DC and transient voltages.
- To Study the measurement techniques for high AC ,DC and impulse currents.

UNIT – 1

Electrostatic fields and field stress control : Electric fields in homogeneous Isotropic materialsand in multi dielectric media-Simple configurations-field stress control. Methods of computing electrostatic fields-conductive analogues-Impedance networks Numerical techniques-finite difference method-finite element method and charge simulation method.

UNIT – 2

Generation of High AC & DC Voltages:

Direct Voltages : AC to DC conversion methods, electrostatic generators, Cascaded Voltage Multipliers. Alternating Voltages : Cascading transformers-Resonant circuits and their applications, Teslacoil.

UNIT – 3

Generation of Impulse Voltages :

Impulse voltage specifications-Impulse generation circuits-Operation, construction and design of Impulse generators-Generation of switching and long duration impulses. Impulse Currents: Generation of high impulse currents and high current pulses.

UNIT – 4

Measurement of High AC & DC Voltages:

Measurement of High D.C. Voltages: Series resistance meters, voltage dividers and generating voltmeters. Measurement of High A.C. Voltages : Series impedance meters electrostatic voltmeters potential transformers and CVTS-voltage dividers and their applications.

UNIT – 5

Measurement of Peak Voltages :

Sphere gaps, uniform field gaps, rod gaps. Chubb-Fortesque method, passive and active rectifier circuits for voltage dividers. Measurement of Impulse Voltages: Voltage dividers and impulse measuring systems-generalized voltage measuring circuits-transfer characteristics of measuring circuits-L.V. Arms for voltage dividers-compensated dividers. Measurement of Impulse Currents: Resistive shunts-current transformers-Hall Generators and Faraday generators and their applications-Impulse Oscilloscopes.

Course Outcomes: At the end of the course, student will be able to

- Understand numerical computation of electrostatic problems.
- Understand the techniques of generation of high AC, DC and transient voltages.
- Measure high AC, DC and transient voltages.
- Measure high AC, DC and transient currents.

Text Books:

1. High Voltage Engineering – by E.Kuffel and W.S.Zaengl. Pergaman press Oxford, 1984.
2. High Voltage Engineering – by M.S.Naidu and V.Kamaraju, Mc.Graw-Hill Books Co.,New Delhi, 2nd edition, 1995.

Reference Books:

1. High Voltage Technology – LL Alston, Oxford University Press 1968.
2. High Voltage Measuring Techniques – A. Schwab MIT Press, Cambridge,USA, 1972.
3. Relevant I.S. and IEC Specifications.

II-Semester	Evolutionary Algorithms and Applications (ELECTIVE-III)	L-T-P 3 -0-0	CREDITS 3

Pre-Requisite: i) Optimization Techniques ii) Power System Operation

Course Educational Objectives:

- To distinguish between conventional optimization algorithms and evolutionary optimizationalgorithms.
- To apply genetic algorithm and particle swarm optimization algorithm to power systemoptimization problems.
- To analyse and apply Ant colony optimization algorithm and artificial Bee colony algorithm tooptimize the control parameters./power system optimization problems.
- To apply shuffled frog leaping algorithm and bat optimization algorithm to power systemoptimization problem.
- To apply multi-objective optimization algorithm to power system multi-objective problems.

UNIT– 1

Fundamentals of Soft Computing Techniques

Definition-Classification of optimization problems- Unconstrained and Constrained optimization Optimality conditions- Introduction to intelligent systems- Soft computing techniques- Conventional Computing versus Swarm Computing - Classification of meta-heuristic techniques - Single solution based and population based algorithms – Exploitation and exploration in population based algorithms -Properties of Swarm intelligent Systems - Application domain - Discrete and continuous problems - Singleobjective and multi-objective problems.

UNIT– 2

Genetic Algorithm and Particle Swarm Optimization

Genetic algorithms- Genetic Algorithm versus Conventional Optimization Techniques - Genetic representations and selection mechanisms; Genetic operators- different types of crossover and mutation operators -Bird flocking and Fish Schooling – anatomy of a particle- equations based on velocity and positions -PSO topologies - control parameters – GA and PSO algorithms for solving ELD problem without loss, Selective Harmonic Elimination in inverters and PI controller tuning.

UNIT– 3

Ant Colony Optimization and Artificial Bee Colony Algorithms

Biological ant colony system - Artificial ants and assumptions - Stigmergic communications - Pheromone updating- local-global - Pheromone evaporation - ant colony system- ACO models-Touring ant colony system-max min ant system - Concept of Elitist Ants-Task partitioning in honey bees - Balancing foragers and receivers - Artificial bee colony (ABC) algorithms-binary ABC algorithms – ACO and ABC algorithms for solving Economic Dispatch without loss and PI controller tuning.

UNIT– 4

Shuffled Frog-Leaping Algorithm and Bat Optimization Algorithm

Bat Algorithm- Echolocation of bats- Behaviour of microbats- Acoustics of Echolocation- Movement of Virtual Bats- Loudness and Pulse Emission- Shuffled frog algorithm-virtual population of frogscomparison of memes and genes -memeplex formation- memeplexupdation- BA and SFLA algorithms for solving ELD without loss and PI controller tuning.

UNIT– 5

Multi Objective Optimization

Multi-Objective optimization Introduction- Concept of Pareto optimality - Non-dominant sorting technique-Pareto fronts-best compromise solution-min-max method-NSGA-II algorithm and application togeneral two objective optimization problem.

Course Outcomes: At the end of the course, student will be able to

- State and formulate the optimization problem, without and with constraints, by using design variables from an engineering design problem.
- Apply classical optimization techniques to minimize or maximize a multi-variable objective function, without or with constraints, and arrive at an optimal solution.
- Formulate a mathematical model and apply linear programming technique by using Simplex method. Also extend the concept of dual Simplex method for optimal solutions.
- Apply gradient and non-gradient methods to nonlinear optimization problems and use interior or exterior penalty functions for the constraints to derive the optimal solutions.
- Apply Genetic algorithms for simple electrical problems and able to solve practical problems using PSO.

Text Books

1. Xin-She Yang, „Recent Advances in Swarm Intelligence and Evolutionary Computation‟, Springer International Publishing, Switzerland, 2015.
2. Kalyanmoy Deb „Multi-Objective Optimization using Evolutionary Algorithms‟, John Wiley &Sons, 2001.
3. James Kennedy and Russel E Eberheart, „Swarm Intelligence‟, The Morgan Kaufmann Series inEvolutionary Computation, 2001.

Reference Books:

1. Eric Bonabeau, Marco Dorigo and Guy Theraulaz, „Swarm Intelligence-From natural to ArtificialSystems‟, Oxford university Press, 1999.
2. David Goldberg, „Genetic Algorithms in Search, Optimization and Machine Learning‟, PearsonEducation, 2007.
3. Konstantinos E. Parsopoulos and Michael N. Vrahatis, „Particle Swarm Optimization and Intelligence: Advances and Applications‟, InformatIonscIence reference, IGI Global, , 2010.
4. N P Padhy, „Artificial Intelligence and Intelligent Systems‟, Oxford University Press, 2005.

Reference Papers:

1. "Shuffled frog-leaping algorithm: a memetic meta-heuristic for discrete optimization" by Muzaffareusuff, Kevin lansey and Fayzul pasha, Engineering Optimization, Taylor & Francis, Vol. 38, No. pp.129–154, March 2006.
2. "A New Metaheuristic Bat-Inspired Algorithm" by Xin-She Yang, Nature Inspired Cooperative Strategies for Optimization (NISCO 2010) (Eds. J. R. Gonzalez et al.), Studies inComputational Intelligence, Springer Berlin, 284, Springer, 65-74 (2010).
3. "Firefly Algorithms for Multimodal Optimization" Xin-She Yang, O. Watanabe and T. Zeugmann (Eds.), Springer-Verlag Berlin Heidelberg, pp. 169–178, 2009.

II-Semester	PROGRAMMABLE LOGIC CONTROLLERS & APPLICATIONS (ELECTIVE–IV)	L-T-P 3 -0-0	CREDITS 3

Pre-requisite: Knowledge on relay logic and digital electronics

Course Educational Objectives:

- To have knowledge on PLC.
- To acquire the knowledge on programming of PLC.
- To understand different PLC registers and their description.
- To have knowledge on data handling functions of PLC.
- To know how to handle analog signal and converting of A/D in PLC.

UNIT– 1

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– 2

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– 3

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– 4

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– 5

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.

Course Outcomes: At the end of the course, student will be able to

- Understand the PLCs and their I/O modules.
- Develop control algorithms to PLC using ladder logic etc.
- Manage PLC registers for effective utilization in different applications.
- Handle data functions and control of two axis and their axis robots with PLC.
- Design PID controller with PLC.

Text 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. Hackworthand F.D Hackworth Jr. – Pearson, 2004.

Reference Books:

1. Introduction to Programmable Logic Controllers- Gary Dunning-Cengage Learning.
2. Programmable Logic Controllers –W.Bolton-Elsevier publisher.

II-Semester	POWER SYSTEM SIMULATION LABORATORY-II	L-T-P 3 -0-0	CREDITS 3

Pre-requisite: Power systems

Course Educational Objectives:

The student should understand the modelling of various aspects of Power System analysis and develop the MATLAB programming.

List of Experiments

1. Load Flow Solution Using Gauss Siedel Method
2. Load Flow Solution Using Newton Raphson Method
3. Load Flow Solution Using Decoupled Method
4. Symmetrical Fault analysis using Z-bus
5. Unsymmetrical Fault analysis using Z-bus
6. Economic Load Dispatch with & without transmission losses
7. Transient Stability Analysis using modified Euler’s method.
8. Transient Stability Analysis using modified R-K method.
9. Transient Stability Analysis Using Point By Point Method
10. Load Frequency Control of Single Area Control & Two Area Control system with and without controllers.

Course Outcomes:

The student should analyze load flow solution obtained using GS and NR methods, symmetrical and unsymmetrical faults, Transient stability and load frequency deviation in single and two areasystems

Estd. 1989

SIR C R REDDY COLLEGE OF ENGINEERING

(AUTONOMOUS)

(SPONSORED BY SIR C R R EDUCATIONAL INSTITUTIONS, SOCIETY REGD. NO.: 10/1950)

VATLURU, ELURU-534007, ELURU DISTRICT, ANDHRA PRADESH, INDIA

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II-Semester	POWER CONVERTERS LABORATORY	L-T-P 3 -0-0	CREDITS 3

Pre-requisite: Fundamentals of Power Electronics

Course Educational Objectives: To study and understand the different converters and invertersfor single and three phase loads.

Any 10 of the following experiments are to be

conducted.List of experiments

1. Study of DC-DC non-isolated converters such as Buck & Boost converter.
2. Study of DC-DC Buck-Boost and Cuk converters.
3. Study of 1-ϕ dual converter.
4. Determination of input p.f. and harmonic factor for 1-ϕ semi- converter and 1-ϕ full-converter (Inductive load)
5. Study of p.f. improvement in 1-ϕ full-converter with symmetric and extinction anglecontrol.
6. Study of 1-ϕ square wave and sinusoidal PWM inverter.
7. Study of 3-ϕ inverter with 120^o and 180^o mode of operation.
8. Study of 3-ϕ sinusoidal PWM inverter.
9. Study of 3-level NPC inverter.
10. Study of 5-level cascaded H-bridge inverter.
11. Determination of input p.f. and harmonic factor for 3-ϕ full converter (Inductive load).
12. Determination of input p.f. and harmonic factor for 3-ϕ semi converter (Inductive load).
13. Study the characteristics of IGBT, MOSFET & GTO’s.
14. Design of gate drive circuits for IGBT & MOSFET’s.

Course Outcomes: Students are able to implement the converter and inverters in real time applications.

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II-Semester	MINI PROJECT WITH SEMINAR	L-T-P 0-0-4	CREDITS 2

Note:
It is recommended that a Supervisor/advisor should be allotted to each student at the end of thesemester-I or allot at the start of the semester-II

Syllabus content:

A Student has to select one paper published in any of the IEEE Transactions and simulate the same. The student has to present the progress of the work at the middle of the semester. At the end of the semester, the student has to present the results by explaining the idea of the topic, methodology, finding of the simulations. A Student should also submit a report of the entire work carried out under this course. The end semester presentation must be video recorded and preserved.