JNTUH COLLEGE OF ENGINEERING HYDERABAD
(AUTONOMOUS)
M.Tech. (ELECTRICAL POWER ENGINEERING) – Full Time w.e.f. 2018-19
(R18) COURSE STRUCTURE

I Semester			**L**	**T**	**P**	**Credits**
Sr.N	**Core/Elective**	**Course Name**				
1.	Core 1	Power System Analysis	3	0	0	3
2.	Core 2	Economic Operation of Power Systems	3	0	0	3
3.	PE1	1. HVDC Transmission 2. Renewable Energy Systems 3. Smart Grid Technologies 4. Modern Control Thoery	3	0	0	3
4.	PE2	1. Electrical Power Distribution System 2. Reactive Power Compensation and Management 3. Mathematical Methods for Power Engineering 4. Hybrid Electric Vehicles	3	0	0	3
5.		Research Methodology and IPR	2	0	0	2
6.	Lab1	Power Systems Computation Lab-I	0	0	4	2
7.	Lab 2	Advanced Power Systems Lab	0	0	4	2
8.	Audit-I	Audit I	2	0	0	0
		Total Credits				**18**

II Semester			**L**	**T**	**P**	**Credits**
Sr.N	**Core/Elective**	**Course Name**				
1.	Core3	Digital Protection of Power System	3	0	0	3
2.	Core4	Power System Dynamics	3	0	0	3
3.	PE3	1. Restructured Power Systems 2. EHV AC Transmission 3. Swarm Intelligence Techniques in Power Systems 4. Industrial Load Modelling and Control	3	0	0	3
4.	PE4	1. AI Techniques in Power Systems 2. Power Quality 3. Power Apparatus Design 4. Power System Reliability and Planning	3	0	0	3
5.		Mini Project with Seminar	0	0	4	2
6.	Lab3	Power Systems Computation Lab-II	0	0	4	2
7.	Lab4	Power System Protection Lab	0	0	4	2
8.	Audit-II	Audit II	2	0	0	0
		Total Credits				**18**

III Semester			L	T	P	Credits
Sr.N	**Core/Elective**	**Course Name**				
1.	PE5	1. Power System Transients 2. Flexible AC Transmission Systems 3. Gas Insulated Systems 4. SCADA System and Applications	3	0	0	3
2.	OE	1. Business Anlytics 2. Industrial Safety 3. Operations Research 4. Cost Mangement of Engineering Projects 5. Composite Materials 6. Energy from Waste	3	0	0	3
3.	Major Project	Phase-I Dissertation	0	0	20	10
		Total Credits				**16**

IV Semester			L	T	P	Credits
Sr.N	**Core/Elective**	**Course Name**				
1.	Major Project	Phase-II Dissertation	0	0	32	16
		Total Credits				**16**

Total Credits : 68

Audit Course I&II

1. English for Research Paper Writing
2. Disaster Management
3. Sanskrit for Technical Knowledge
4. Value Education
5.Constiotution of India
6. Pedagogy Studies
7. Stress Mangement by Yoga
8. Personality Development through Life Enlightenment Skills

POWER SYSTEM ANALYSIS
(Core 1)

M.Tech. EPE, I Sem

L	T	P	C
3	0	0	3

Prerequisite: Computer Methods in Power Systems

Course Objectives: Students will be able to

- Build the Nodal admittance and Nodal impedance matrices of a practical network.
- Study various methods of load flow and their advantages and disadvantages.
- Understand how to analyze various types of faults in power system.
- Understand power system security concepts and study the methods to rank the contingencies.
- Understand need of state estimation and study simple algorithms for state estimation.

Course Outcomes: Students will be able to:

- To build/construct Y_{BUS} and Z_{BUS} of any practical network.
- calculate voltage phasors at all buses, given the data using various methods of load flow.
- calculate fault currents in each phase.
- Rank various contingencies according to their severity.
- Estimate the bus voltage phasors given various quantities viz. power flow, voltages, taps , CB status etc.

UNIT-I: NETWORK MATRICES

Introduction, Bus Admittance Matrix, Network Solution, Network Reduction(Kron Reduction), Y_{BUS} structure and manipulation.Bus Impedance matrix, Methods to determine columns of Z_{BUS}.

UNIT-II: LOAD FLOW STUDIES

Overview of Gauss-Siedel, Newton-Raphson load flow methods,fast decoupled method, convergence properties, sparsity techniques, handling Qmax violations in constant matrix, inclusion in frequency effects,
AVR in load flow, handling of discrete variable in load flow.

UNIT-III: FAULT CALCULATIONS

Symmetrical faults-Fault calculations using ZBUS - Fault calculations usingZBUS equivalent circuits, Selection of circuit breakers,Unsymmetrical faults - Problems onvarious types of faults.

UNIT-IV: CONTINGENCY ANALYSIS

Security Analysis: Security state diagram, contingency analysis, generator shift distribution factors, line outage distribution factor, multiple line outages, overload index ranking

UNIT-V: STATE ESTIMATION

Sources of errors in measurements, Virtual and Pseudo measurements, Observability concepts,Tracking state Estimation, Weighted Least Square method,Bad Data detection and estimation.

TEXT BOOKS:

1. J.J. Grainger &W.D.Stevenson, "Power system analysis ", McGraw Hill ,2003.
2. A. R. Bergen & Vijay Vittal , "Power System Analysis" ,Pearson , 2000.

REFERENCES:

1. L.P. Singh , "Advanced Power System Analysis and Dynamics", New Age International, 2006.
2. G.L. Kusic, "Computer aided power system analysis" ,Prentice Hall India, 1986.
3. A.J. Wood, " Power generation, operation and control" , John Wiley, 1994.
4. P.M. Anderson, "Faulted power system analysis" , IEEE Press , 1995.

ECONOMIC OPERATION OF POWER SYSTEMS
(Core 2)

M.Tech. EPE, I Sem

L	T	P	C
3	0	0	3

Prerequisite: Electrical Power Systems

Course Objectives: Students will be able to:

- formulate and derive the necessary conditions for economical load scheduling problem.
- understand various constraints, problem formulation and methods to solve the unit commitment problem.
- understand the constraints related to hydel power plants, problem formulation and solution techniques for hydro-thermal scheduling problem.
- understand the necessity, factors governing the frequency control and analyze the uncontrolled and controlled LFC system.
- understand the basic difference between ELS and OPF problem, formulation of the OPF problem and solution techniques.

Course Outcomes:

- Student can solve the economic load scheduling with and without network losses both in classical method and iterative methods.
- Student can solve the unit commitment problem using priority-list method and forward-dynamic method.
- should able to solve hydro-thermal scheduling problem for short-term and long-term range.
- should able to analyze the single area and two area systems for frequency deviation under sudden change in load.
- should able to solve the OPF problem using ac and dc load flow methods.

UNIT-I: ECONOMIC LOAD SCHEDULING

Characteristics of Steam Turbine, Variations in steam unit characteristics, Economic dispatch with piecewise linear cost functions, Lambda Iterative method, LP method, Economic dispatch under composite generation production cost function, Base point and Participation factors, Thermal system Dispatching with Network losses considered.

UNIT-II: UNIT COMMITMENT

Unit Commitment – Definition – Constraints in Unit Commitment–Unit Commitment solution methods – Priority–List Methods – Dynamic Programming Solution.

UNIT-III: HYDRO THERMAL SCHEDULING

Characteristics of Hydroelectric units, Introduction to Hydrothermal coordination, Long-Range and Short-Range Hydro-Scheduling, Hydroelectric plant models, Hydrothermal scheduling with storage limitations, Dynamic programming solution to hydrothermal scheduling.

UNIT-IV: LOAD FREQUENCY CONTROL

Control of generation – models of power system elements – single area and two area block diagrams – generation control with PID controllers – implementation of Automatic Generation control (AGC) – AGC features.

UNIT-V: OPTIMAL POWER FLOW

Introduction to Optimal power flow problem, OPF calculations combining economic dispatch and power flow, OPF using DC power flow, Algorithms for solution of the ACOPF, Optimal Reactive Power Dispatch.

TEXT BOOKS:

1. J.J. Grainger &W.D.Stevenson, "Power system analysis ", McGraw Hill ,2003
2. Allen J. Wood, Bruce F. Wollenberg, Gerald B. Sheblé-Power Generation, Operation and Control-Wiley-Interscience (2013)

REFERENCES:

1. Olle l. Elgerd, "Electric Energy Systems Theory an Introduction", TMH, 2nd Edition, 1983.

HVDC TRANSMISSION
(PE-1)

M.Tech. EPE, I Sem

L	T	P	C
3	0	0	3

Prerequisite: Power Systems and Power Electronics

Course Objectives: Students will be able to:

- Understand state of the art HVDC technology.
- Learn the Methods to carry out modeling and analysis of HVDC system frontier-area power
  flow regulation.

Course Outcomes: Students will be able to:

- To expose the students to the state of the art HVDC technology.
- Knowledge of modelling and analysis of HVDC system for inter-area power flow regulation.
- Able to analyze the converter and dc grid faults and methods to mitigate them.
- understand the HVDC converter reactive power requirements and identifying the necessary means to address those issues.

UNIT-I: GENERAL ASPECTS OF DC TRANSMISSION

Evolution of HVDC transmission, Comparison of HVDC and HVAC systems, Types of DC links, Components of a HVDC system, Valve characteristics, Properties of converter circuits, assumptions,single phase and Three-phase Converters, Pulse number, choice of best circuit for HVDC converters.

UNIT-II: ANALYSIS OF BRIDGE CONVERTER

Analysis of simple rectifier circuits, Required features of rectification circuits for HVDC transmission.

Analysis of HVDC converter: Different modes of converter operation, Output voltage waveforms and DC voltage in rectification, Output voltage waveforms and DC in inverter operation, Thyristor/Valve voltages. Equivalent electrical circuit.

UNIT-III: DC LINK CONTROL

Grid control, basic means of control, power reversal, limitations of manual control,Constant current versus Constant Voltage, Desired features of control.

Actual control characteristics: Constant-minimum-ignition-angle control,Constant-current control, Constant-extinction-angle control. Stability of control, tap-changer control**,**Power control and current limits, frequency control.

UNIT-IV: CONVERTER FAULTS & PROTECTION

Converter mal-operations, Commutation failure, Starting and shutting down the converter bridge, Converter protection.

UNIT-V: REACTIVE POWER MANAGEMENT & AC-DC POWER FLOW ANALYSIS

Smoothing reactor and DC Lines,Reactive power requirements,Harmonic analysis,Filter design,Power flow Analysis in AC/DC systems – Modelling of DC links – solutions of AC-DC Power flow.

TEXT BOOKS:

1. J. Arrillaga, “High Voltage Direct Transmission”, Peter Peregrinus Ltd. London, 1983.
2. K. R. Padiyar, “HVDC Power Transmission Systems”, Wiley Eastern Ltd., 1990.

REFERENCES:

1. E. W. Kimbark, “Direct Current Transmission”, Vol. I, Wiley Interscience, 1971.
2. Erich Uhlmann, “Power Transmission by Direct Current”, B.S. Publications, 2004.
3. SN Singh, “*Electric Power Generation, Transmission and Distribution*, PHI, New Delhi 2nd edition, 2008.
4. V. Kamaraju, ”HVDC Transmission” Tata McGraw-Hill Education Pvt Ltd,New delhi,2011.

RENEWABLE ENERGY SYSTEMS
(PE-1)

M.Tech. EPE, I Sem

L	T	P	C
3	0	0	3

Prerequisite: Power Systems and Electrical Machines

Course Objectives: Students will be able to
- To learn various renewable energy sources
- To gain understanding of integrated operation of renewable energy sources
- To understand Power Electronics Interface with the Grid

Course Outcomes: Students will be able to
- Knowledge about renewable energy
- Understand the working of distributed generation system in autonomous/grid connected modes

UNIT- I: SOLAR ENERGY SYSTEMS:
Introduction – solar radiation - solar thermal energy conversion - Flat plate collector - concentric collectors- solar pond - central receiver system- solar pumping - Solar photovoltaic systems - characteristics of PV cell- Photo voltaic modules - Types of Photo voltaic systems.

UNIT-II: WIND ENERGY AND BIO GAS:
Basics of wind energy - classification of turbines - wind characteristics - energy extraction - Betz limit - Modes of wind power generation- Bio Mass energy conversion - Anaerobic Digestion - Aerobic Digestion - Gasification-Bio Gas Plants.

UNIT-III: OCEAN ENERGY CONVERSION:
Tidal Energy generation - characteristics of Tides - Power generation schemes - Components in Tidal power plant- Wave Energy - Principle of wave energy plant - Wave energy conversion machines - Ocean Thermal Energy conversion - Principle - cycles of operation - Types of OTEC plants - Applications

UNIT-IV: GEO-THERMAL ENERGY AND FUEL CELLS:
HYBRID ENERGY SYSTEMS:
Geothermal Energy - Structure of Earth's interior - Geothermal fields, gradient, resources - Geothermal power generation - Fuel cells – Introduction - Principle of operation - Types of **FUEL CELLS** - State of art fuel cells-energy output of a fuel cell - operating characteristics of fuel cells - thermal efficiency - Need for Hybrid systems - Types of Hybrid systems.

UNIT-V: ENERGY SYSTEMS AND GRIDS
Introduction, Energy systems, Distribution technologies, Energy storage for grid electricity, Social and environmental aspects of energy supply and storage.

Electricity grids(networks), DC grids, Special challenges and opportunities for renewable electricity, Power Electronic Interface with the Grid

TEXT BOOKS:

1. D.P.Kothari, K.C.Singal, R.Ranjan, "Renewable Energy Resources and emerging technologies"- PHI 2/e 2011.
2. John Twidell and Tony Weir ,"Renewable Energy Resources" - 2nd edition, CRC Press.
3. Rakosh Das Begamudre, "Energy conversion systems"- New Age International Publishers, New Delhi - 2000.
4. "Energy conversion systems" by Rakosh das Begamudre, New age International publishers, New Delhi - 2000.
5. "Renewable Energy Resources" by John Twidell and Tony Weir, 2nd Edition, Fspon & Co.

REFERENCES:

1. "Understanding Renewable Energy Systems", by Volker Quaschning, 2005, UK.
2. "Renewable Energy Systems-Advanced Conversion, Technologies & Applications" by Faner Lin Luo Honer Ye, CRC press, Taylor & Francis group.

SMART GRID TECHNOLOGIES
(PE-1)

M.Tech. EPE, I Sem

L	T	P	C
3	0	0	3

Prerequisite: Power Systems

Course Objectives: Students will be able to

- Understand concept of smart grid and its advantages over conventional grid
- Know smart metering techniques
- Learn wide area measurement techniques
- Understanding the problems associated with integration of distributed generation & its solution through smart grid.

Course Outcomes: Students will be able to

- Appreciate the difference between smart grid & conventional grid
- Apply smart metering concepts to industrial and commercial installations
- Formulate solutions in the areas of smart substations,distributed generation and wide area measurements
- Come up with smart grid solutions using modern communication technologies

UNIT-I:

Introduction to Smart Grid, Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Concept of Robust & Self Healing Grid Present development & International policies in Smart Grid

UNIT-II:

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, Smart Substations, Substation Automation, Feeder Automation .

UNIT-III:

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:

Concept of micro-grid, need & applications of micro-grid, formation of micro-grid, Issues of interconnection, protection & control of micro-grid, Plastic & Organic solar cells, Thin film solar cells, Variable speed wind generators, fuel-cells, micro-turbines, Captive power plants, Integration of renewable energy sources

UNIT-V:

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. Advanced Metering Infrastructure (AMI) and Various Communication means and IP based Protocols.

TEXT BOOKS:

1. Ali Keyhani, “Design of smart power grid renewable energy systems”, Wiley IEEE, 2011
2. Clark W. Gellings, “The Smart Grid: Enabling Energy Efficiency and Demand Response”, CRC
Press , 2009

REFERENCES:

1. JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, “Smart Grid: Technology and Applications”,
   Wiley 2012
2. Stuart Borlase, “Smart Grid: Infrastructure, Technology and solutions “ CRC Press
3. A.G.Phadke, “Synchronized Phasor Measurement and their Applications”, Springer

MODERN CONTROL THEORY
(PE-1)

M.Tech. EPE, I Sem

L	T	P	C
3	0	0	3

Prerequisite: Control Systems

Course Objectives:

- To explain the concepts of basics and modern control system for the real time analysis and design of control systems.
- To explain the concepts of state variables analysis.
- To study and analyze non linear systems.
- To analyze the concept of stability for nonlinear systems and their categorization.
- To apply the comprehensive knowledge of optimal theory for Control Systems.

Course Outcomes: Upon completion of this course, students should be able to:

- Various terms of basic and modern control system for the real time analysis and design of control systems.
- To perform state variables analysis for any real time system.
- Apply the concept of optimal control to any system.
- Able to examine a system for its stability, controllability and observability.
- Implement basic principles and techniques in designing linear control systems.
- Formulate and solve deterministic optimal control problems in terms of performance indices.
- Apply knowledge of control theory for practical implementations in engineering and network analysis.

UNIT I: Mathematical Preliminaries and State Variable Analysis:
Fields, Vectors and Vector Spaces – Linear combinations and Bases – Linear Transformations and Matrices – Scalar Product and Norms – Eigen values, Eigen Vectors and a Canonical form representation of Linear systems – The concept of state – State space model of Dynamic systems – Time invariance and Linearity – Non uniqueness of state model – State diagrams for Continuous-Time State models - Existence and Uniqueness of Solutions to Continuous-Time State Equations – Solutions of Linear Time Invariant Continuous-Time State Equations – State transition matrix and it's properties. Complete solution of state space model due to zero input and due to zero state.

UNIT II: Controllability and Observability:
General concept of controllability – Controllability tests, different state transformations such as diagonalization, Jordon canonical forms and Controllability canonical forms for Continuous-Time Invariant Systems – General concept of Observability – Observability tests for Continuous-Time Invariant Systems – Observability of different State transformation forms.

UNIT III: State Feedback Controllers and Observers:
State feedback controller design through Pole Assignment, using Ackkermans formula– State observers: Full order and Reduced order observers.

UNIT IV: Non-Linear Systems:
Introduction – Non Linear Systems - Types of Non-Linearities – Saturation – Dead-Zone - Backlash – Jump Phenomenon etc; Linearization of nonlinear systems, Singular Points and its types– Describing function–describing function of different types of nonlinear elements, – Stability analysis of Non-Linear systems through describing functions. Introduction to phase-plane analysis, Method of Isoclines for Constructing Trajectories, Stability analysis of nonlinear systems based on phase-plane method.

UNIT V: Stability Analysis:
Stability in the sense of Lyapunov, Lyapunov's stability and Lypanov'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.

TEXT BOOKS :
1. M.Gopal, Modern Control System Theory, New Age International - 1984
2. Ogata. K, Modern Control Engineering, Prentice Hall - 1997

REFERENCES:
1. N K Sinha, Control Systems, New Age International – 3rd edition.
2. Donald E.Kirk, Optimal Control Theory an Introduction, Prentice - Hall Network series - First edition.

ELECTRICAL POWER DISTRIBUTION SYSTEM
(PE-2)

M.Tech. EPE, I Sem

L	T	P	C
3	0	0	3

Prerequisite: Power Systems

Course Objectives: Students will be able to

- Learning about power distribution system
- Learning of SCADA System
- Understanding Distribution Automation

Course Outcomes: Students will be able to

- Knowledge of power distribution system
- Study of Distribution automation and its application in practice
- To learn SCADA system

UNIT-I:

Distribution of Power, Management, Power Loads, Load Forecasting Short-term & Long-term, Power System Loading, Technological Forecasting.

UNIT-II:

Advantages of Distribution Management System (D.M.S.) Distribution Automation: Definition, Restoration / Reconfiguration of Distribution Network, Different Methods and Constraints, Power Factor Correction

UNIT-III:

Interconnection of Distribution, Control & Communication Systems, Remote Metering, Automatic Meter Reading and its implementation. SCADA: Introduction, Block Diagram, SCADA Applied To Distribution Automation. Common Functions of SCADA, Advantages of Distribution Automation through SCADA

UNIT-IV:

Calculation of Optimum Number of Switches, Capacitors, Optimum Switching Device Placement in Radial, Distribution Systems, Sectionalizing Switches – Types, Benefits, Bellman's Optimality Principle, Remote Terminal Units, Energy efficiency in electrical distribution & Monitoring

UNIT-V:

Maintenance of Automated Distribution Systems, Difficulties in Implementing Distribution. Automation in Actual Practice, Urban/Rural Distribution, Energy Management, AI techniques applied to Distribution Automation

TEXT BOOKS:

1. A.S. Pabla, " Electric Power Distribution", Tata McGraw Hill Publishing Co. Ltd., Fourth Edition.
2. M.K. Khedkar, G.M. Dhole, "A Text Book of Electrical power Distribution Automation",
   University Science Press, New Delhi

REFERENCES:

1. Anthony J Panseni, "Electrical Distribution Engineering", CRC Press
2. James Momoh, "Electric Power Distribution, automation, protection & control", CRC Press

REACTIVE POWER COMPENSATION AND MANAGEMENT
(PE-2)

M.Tech. EPE, I Sem

L	T	P	C
3	0	0	3

Prerequisite: Power Systems

Course Objectives:

- To identify the necessity of reactive power compensation
- To describe load compensation
- To select various types of reactive power compensation in transmission systems
- To illustrate reactive power coordination system
- To characterize distribution side and utility side reactive power management.

Course Outcomes:

Upon the completion of this course, the student will be able to

- Distinguish the importance of load compensation in symmetrical as well as un symmetrical loads
- Observe various compensation methods in transmission lines
- Construct model for reactive power coordination
- Distinguish demand side reactive power management & user side reactive power management

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: STEADY–STATE REACTIVE POWER COMPENSATION IN TRANSMISSION SYSTEM

Uncompensated line – types of compensation – Passive shunt and series and dynamic shunt compensation – examples.

TRANSIENT STATE REACTIVE POWER COMPENSATION IN TRANSMISSION SYSTEMS:

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: DEMAND SIDE MANAGEMENT

Load patterns – basic methods load shaping – power tariffs- KVAR based tariffs penalties for voltage flickers and Harmonic voltage levels

DISTRIBUTION SIDE REACTIVE POWER MANAGEMENT:
System losses –loss reduction methods – examples – Reactive power planning – objectives – Economics Planning capacitor placement – retrofitting of capacitor banks

UNIT-V: 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
Reactive power management in electric traction systems and arc 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

TEXT 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.

REFERENCES:
1. Wolfgang Hofmann, Jurgen Schlabbach, Wolfgang Just "Reactive Power Compensation: A Practical Guide, April, 2012, Wiley publication.

MATHEMATICAL METHODS FOR POWER ENGINEERING
(PE-2)

M.Tech. EPE, I Sem

L	T	P	C
3	0	0	3

Prerequisite: Mathamatices

Course Objectives: Students will be able to

- To understand the relevance of mathematical methods to solve engineering problems.
- To understand how to apply these methods for a given engineering problem.

Course Outcomes: Students will be able to

- Knowledge about vector spaces, linear transformation, eigenvalues and eigenvectors of linear operators
- To learn about linear programming problems and understanding the simplex method for solving linear programming problems in various fields of science and technology
- Acquire knowledge about nonlinear programming and various techniques used for solving constrained and unconstrained nonlinear programming problems
- Understanding the concept of random variables, functions of random variable and their probability distribution
- Understand stochastic processes and their classification

UNIT-I:
Vector spaces, Linear transformations, Matrix representation of linear transformation, Eigen values and Eigen vectors of linear operator

UNIT-II:
Linear Programming Problems, Simplex Method, Duality, Non Linear Programming problems

UNIT-III:
Unconstrained Problems, Search methods, Constrained Problems

UNIT-IV:
Lagrange method, Kuhn-Tucker conditions, Random Variables, Distributions

UNIT-V:
Independent Random Variables, Marginal and Conditional distributions, Elements of stochastic processes

TEXT BOOKS:

1. Kenneth Hoffman and Ray Kunze, “Linear Algebra”, 2nd Edition, PHI, 1992
2. Erwin Kreyszig, “Introductory Functional Analysis with Applications”, John Wiley & Sons, 2004

REFERENCES:

1. Irwin Miller and Marylees Miller, John E. Freund's "Mathematical Statistics", 6th Edn, PHI, 2002
2. J. Medhi, "Stochastic Processes", New Age International, New Delhi., 1994
3. A Papoulis, "Probability, Random Variables and Stochastic Processes", 3rd Edition, McGraw Hill, 2002
4. John B Thomas, "An Introduction to Applied Probability and Random Processes", John Wiley, 2000
5. Hillier F S and Liebermann G J, "Introduction to Operations Research", 7th Edition, McGraw Hill, 2001
6. Simmons D M, "Non Linear Programming for Operations Research", PHI, 1975

HYBRID ELECTRIC VEHICLES
(PE-2)

M.Tech. EPE, I Sem

L	T	P	C
3	0	0	3

Prerequisite: Power Systems, Electrical Machines and Power Electronics

Course Objectives: Students will be able to

- To understand upcoming technology of hybrid system
- To understand different aspects of drives application
- Learning the electric Traction

Course Outcomes: Students will be able to

- Acquire knowledge about fundamental concepts, principles, analysis and design of hybrid and
  electric vehicles.
- To learn electric drive in vehicles / traction.

UNIT-I:
History of hybrid and electric vehicles, Social and environmental importance of hybrid and electric vehicles, Impact of modern drive-trains on energy supplies, Basics of vehicle performance, vehicle power source characterizationTransmission characteristics, Mathematical models to describe vehicle performance

UNIT-II:
Basic concept of hybrid traction, Introduction to various hybrid drive-train topologies,Power flow control in hybrid drive-train topologies, Fuel efficiency analysis.

UNIT-III:
Introduction to electric components used in hybrid and electric Vehicles, Configuration and control of DC Motor drives, Configuration and control of Introduction Motor drives configuration and control of Permanent Magnet Motor drives Configuration and control of Switch Reluctance, Motor drives, drive system efficiency

UNIT-IV:
Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics Selecting the energy storage technology, Communications, supporting subsystems

UNIT-V:
Introduction to energy management and their strategies used in hybrid and electric vehicle, Classification of different energy management strategies Comparison of different energy management strategies Implementation issues of energy strategies

TEXT BOOKS:

1.Sira -Ramirez, R. Silva Ortigoza, “Control Design Techniques in Power Electronics Devices”, Springer.
2. Siew-Chong Tan, Yuk-Ming Lai, Chi Kong Tse, “Sliding mode control of switching Power Converters”

REFERENCES:

1.Iqbal Hussein, Electric and Hybrid Vehicles: Design fundamentals, CRC Press, 2003.
2.Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
3.James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.
4.Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

RESEARCH METHODOLOGY AND IPR

M.Tech. EPE, I Sem

L	T	P	C
2	0	0	2

Prerequisite: None

Course Objectives:

- To understand the research problem
- To know the literature studies, plagiarism and ethics
- To get the knowledge about technical writing
- To analyze the nature of intellectual property rights and new developments
- To know the patent rights

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

- Understand research problem formulation.
- Analyze research related information
- Follow research ethics
- Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
- Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

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

UNIT-III:

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-IV:

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-V:

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

TEXT BOOKS:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science &
   engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"

REFERENCES:

1. Ranjit Kumar, 2nd Edition , "Research Methodology: A Step by Step Guide for beginners"
2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
3. Mayall , "Industrial Design", McGraw Hill, 1992.
4. Niebel , "Product Design", McGraw Hill, 1974.
5. Asimov , "Introduction to Design", Prentice Hall, 1962.
6. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
7. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

POWER SYSTEMS COMPUTATION LAB-I
(Lab1)

M.Tech. EPE, I Sem

L	T	P	C
0	0	4	2

Prerequisite: power systems

Course Objectives: Students will be able to:

- Construction of Y-bus, z-bus for a n-bus system.
- Analyze various Load flow studies .
- Steady state, transient stability analysis.
- Economic load dispatch problem.
- Unitcommitment problem.
- State estimation of power system.

Course Outcomes: Students will be able to:

- Construct Y-bus and Z-bus
- Compare the different load flow methods
- Analyze the different stability analysis of variety of power systems
- Understood Economic load dispatch and Unitcommitment problems.
- Understood State estimation of power system.

1. Develop Program for Y_{BUS} formation by direct inspection method.
2. Develop Program for Y_{BUS} formation by Singular Transformation method.
3. Develop Program for G-S Load Flow Algorithm.
4. Develop Program for N-R Load Flow Algorithm in Polar Coordinates.
5. Develop Program for FDLF Algorithm.
6. Develop Program for DC load Flow Algorithm.
7. Develop Program for Z_{BUS} Building Algorithm.
8. Develop Program for Short Circuit Analysis using Z_{BUS} Algorithm.
9. Develop Program for Transient Stability Analysis for Single Machine connected to Infinite Bus
10. Develop Program for Economic Load Dispacth Problem using Lambda Iterative Method.
11. Develop Program for Unit Commitment Problem using Forward Dynamic Programming Method.
12. Develop Program for State Estimation of Power System.

Note: From the above list minimum 10 experiments are to be conducted using suitable software.

ADVANCED POWER SYSTEMS LAB
(Lab2)

M.Tech. EPE, I Sem

L	T	P	C
0	0	4	2

Prerequisite:power systems and FACTS

Course Objectives: Students will be able to:

- Determine transmission line parameters
- Determine transmission line regulation and efficiency
- Determine various fault calculations
- Perform load and line compesation

Course Outcomes: Students will be able to:

- Calculate transmission line parameters
- Calculate transmission line regulation and efficiency
- Calculate various fault parameters
- Compare system parameters with and with out compenasation

1. Determination of Line Parameters R, L and C.
2. Determination of T/L efficiency and Regulation for a given load.
3. Analysis of Ferranti effect on Transmission Lines under light loadings.
4. Determination of ABDC parameters of a given Transmission Line Network.
5. Fault Analysis:
   - I. Single Line to Ground fault (L-G).
   - II. Line to Line fault (L-L).
   - III. Double Line to Ground fault (L-L-G).
   - IV. Triple Line to Ground fault (L-L-L-G).
6. Analysis of Uncompensated lines and their voltage profiles.
7. Shunt compensation of Transmission lines (Capacitor/Reactors)
8. Load Compensation analysis
9. Line Compensation using FACTS devices.
10. Analysis of Transmission lines under Surge Impedance Loading.
11. Determination of Sequence impedance of Transmission Line and SIL analysis.

DIGITAL PROTECTION OF POWER SYSTEM
(Core3)

M.Tech. EPE, II Sem

L	T	P	C
3	0	0	3

Prerequisite: Power System Protection

Course Objectives: Students will be able to:

- Study of numerical relays.
- Developing mathematical approach towards protection.
- Study of algorithms for numerical protection.

Course Outcomes: Students will be able to:

- Learn the importance of Digital Relays.
- Apply Mathematical approach towards protection.
- Learn to develop various Protection algorithms.

UNIT-I: Mathematical Background to Digital Protection

Overview of static relays, Transmission line protection, Transformer protection, Need for Digital protection. Performance and operational characteristics of Digital protection, Basic structure of Digital relays, Finite difference techniques, Interpolation formulas, Numerical differentiation, Curve fitting and smoothing, Fourier analysis, Walsh function analysis,Relationship between Fourier and Walsh coefficients.

UNIT-II: Basic Elements of Digital Protection

Basic components of a digital relay, Signal conditioning subsystems, Conversion subsystem, Digital relay subsystem, The digital relay as a unit.

UNIT-III: Digital Relaying Algorithms-I

Sinusoidal-Wave-Based algorithms: Sample and first-derivative methods, First and second-derivative methods, Two-sample technique, Three-sample technique, An early relaying scheme.

Fourier analysis based algorithms: Full cycle window algorithm, Fractional-cycle window algorithms, Fourier-transform based algorithm.Walsh-function-based algorithms.

UNIT-IV: Digital Relaying Algorithms-II

Least squares based methods: Integral LSQ fit, Power series LSQ fit, Multi-variable series LSQ technique, Determination of measured impedance estimates.

Differential equation based techniques: Representation of transmission lines with capacitance neglected, Differential equation protection with selected limits, Simultaneous differential equation techniques.

Travelling-wave based protection: Fundamentals of Travelling-wave based protection, Bergeron's-equation based protection scheme, Ultra-high-speed polarity comparison scheme, Ultra-high-speed wave differential scheme, Discrimination function based scheme, Superimposed component trajectory based scheme.

UNIT-V: Digital protection of Transformers and Transmission lines

Principles of transformer protection, Digital protection of Transformer using: FIR filter based algorithm, Least squares curve fitting based algorithms, Fourier-based algorithm, Flux-restrained current differential relay.

Digital Line differential protection: Current-based differential schemes, Composite voltage- and current-based scheme.

TEXT BOOKS:

1. A.G. Phadke and J. S. Thorp, "Computer Relaying for Power Systems", Wiley/Research studies
   Press, 2009.
2. A.T. Johns and S. K. Salman, "Digital Protection of Power Systems", IEEE Press,1999.

REFERENCES:

1. Gerhard Zeigler, "Numerical Distance Protection", Siemens Publicis Corporate Publishing, 2006.
2. S.R.Bhide "Digital Power System Protection" PHI Learning Pvt.Ltd.2014.

POWER SYSTEM DYNAMICS
(Core4)

M.Tech. EPE, II Sem

L	T	P	C
3	0	0	3

Prerequisite: Power Systems and Electrical Machines

Course Objectives: Students will be able to:

- Development of mathematical models for synchronous machine, Exciter, Governor and Prime mover.
- Study of power system dynamic phenomena and the effects of exciter and governor control.
- Methods to improve dynamic stability.

Course Outcomes: Students will be able to:

- Understand the modeling of synchronous machine in details
- Understand the modeling of Exciter and Governor control
- Carry out simulation studies of power system dynamics using MATLAB-SIMULINK, MI
  POWER
- Carry out stability analysis with and without power system stabilizer (PSS)

UNIT-I:POWER SYSTEM STABILITY: A CLASSICAL APPROACH

Introduction, Requirements of a Reliable Electrical Power Service, Swing Equation, Power-Angle Curve, Stability analysis of SMIB system, Equal area criteria, Classical Model of a Multimachine System, Shortcomings of the Classical Model, Block Diagram of One Machine, *System Response to Small Disturbances:* Types of Problems Studied, The Unregulated Synchronous Machine, Modes of Oscillation of an Unregulated Multimachine System, Regulated Synchronous Machine.

UNIT-II: SYNCHRONOUS MACHINE MODELING-I

Introduction, Park's Transformation, Flux Linkage Equations, Voltage Equations, Formulation of State-Space Equations, Current Formulation, Per Unit Conversion, Normalizing the Voltage and Torque Equations, Equivalent Circuit of a Synchronous Machine, The Flux Linkage State-Space Model, Load Equations, Sub-transient and Transient Inductances and Time Constants, Simplified Models of the Synchronous Machine, Turbine Generator Dynamic Models.

UNIT-III: SYNCHRONOUS MACHINE MODELING-II

Steady state equations and phasor diagrams, Determining steady state conditions, Evaluation of Initial conditions, Determination of machine parameters, Digital simulation of Synchronous machines, Linearization and Simplified Linear model and state-space representation of simplified model.

UNIT-IV: EXCITATION AND PRIME MOVER CONTROL

Simplified view of excitation control, control configurations, typical excitation configurations, excitation control system definitions, voltage regulator, exciter buildup, excitation system response, state-space description of the excitation system, computer representation of excitation systems, Typical system constants, and the effects of excitation on generator power limits, transient stability and dynamic stability of the power system, Prime mover control: Hydraulic turbines and governing systems, Steam turbines and governing systems.

UNIT-V: SMALL SIGNAL STABILITY ANALYSIS

Fundamental concepts of stability of dynamic systems, Eigenproperties of the state matrix, Small-signal stability of a single-machine infinite bus system, Effects of excitation system, Power system stabilizer, System state matrix with amortisseurs, Characteristics of small-signal stability problems.

TEXT BOOKS:

1. P. M. Anderson & A. A. Fouad "Power System Control and Stability", Galgotia , New Delhi,
   1981
2. J Machowski, J Bialek& J. R W. Bumby, "Power System Dynamics and Stability", John Wiley &Sons, 1997

REFERENCES:

1. P.Kundur, "Power System Stability and Control", McGraw Hill Inc., 1994.
2. 4.E.W. Kimbark, "Power system stability", Vol. I & III, John Wiley & Sons, New York 2002
3. L. Leonard Grigsby (Ed.); "Power System Stability and Control", Second edition, CRC Press,
   2007

RESTRUCTURED POWER SYSTEMS
(PE-3)

M.Tech. EPE, II Sem

L	T	P	C
3	0	0	3

Prerequisite: Power Systems

Course Objectives: Students will be able to

- Understand what is meant by restructuring of the electricity market
- Understand the need behind requirement for deregulation of the electricity market
- Understand the money, power & information flow in a deregulated power system

Course Outcomes: Students will be able to

- Describe various types of regulations in power systems.
- Identify the need of regulation and deregulation.
- Define and describe the Technical and Non-technical issues in Deregulated Power Industry.
- Identify and give examples of existing electricity markets.
- 5.Classify different market mechanisms and summarize the role of various entities in the market.

UNIT-I:
Fundamentals of restructured system, Market architecture, Load elasticity,Social welfare maximization

UNIT-II:
OPF: Role in vertically integrated systems and in restructured markets, congestion management

UNIT-III:
Optimal bidding, Risk assessment, Hedging,Transmission pricing,Tracing of power

UNIT-IV:
Ancillary services,Standard market design,Distributed generation in restructured markets

UNIT-V:
Developments in India, IT applications in restructured markets, Working of restructured power systems**,** PJM, Recent trends in Restructuring

TEXT BOOKS:

1. LorrinPhilipson, H. Lee Willis, “Understanding electric utilities and de-regulation”, Marcel Dekker Pub.,1998.
2. Steven Stoft, “Power system economics: designing markets for electricity”, John Wiley and Sons, 2002.

REFERENCES:

1. Kankar Bhattacharya, Jaap E. Daadler, Math H.J. Boolen, “Operation of restructured power systems”, Kluwer Academic Pub., 2001.
2. Mohammad Shahidehpour, MuwaffaqAlomoush, “Restructured electrical power systems: operation, trading and volatility”, Marcel Dekker.

EHV AC TRANSMISSION
(PE-3)

M.Tech. EPE, II Sem

L	T	P	C
3	0	0	3

Prerequisite: Power Systems

Course objectives:

- To identify the different aspects of Extra High Voltage A.C and DC Transmission design and analysis
- To understand the importance of modern developments of EHV and UHV transmission systems.
- To demonstrate EHV AC transmission system components, protection and insulation level for over voltages.

Course Outcomes: Upon the completion of this course, the student will be able to

- Understand the importance of EHV AC transmission
- Estimate choice of voltage for transmission, line losses and power handling capability of EHV Transmission.
- Analyse by applying the statistical procedures for line designs, scientific and engineering principles in power systems.

UNIT- I:

E.H.V.A.C. Transmission line trends and preliminary aspect standard transmission voltages – Estimation at line and ground parameters-Bundle conductor systems-Inductance and Capacitance of E.H.V. lines – positive, negative and zero sequence impedance – Line Parameters for Modes of Propagation.

UNIT- II:

Electrostatic field and voltage gradients – calculations of electrostatic field of AC lines – effect of high electrostatic field on biological organisms and human beings - surface voltage gradients and maximum gradients of actual transmission lines – voltage gradients on sub conductor.

UNIT- III:

Electrostatic induction in unenergized lines – measurement of field and voltage gradients for three phase single and double circuit lines – unenergized lines. Power Frequency Voltage control and over-voltages in EHV lines: No load voltage – charging currents at power frequency-voltage control – shunt and series compensation – static VAR compensation.

UNIT - IV:

Corona in E.H.V. lines – Corona loss formulae- attention of traveling waves due to Corona – Audio noise due to Corona, its generation, characteristic and limits. Measurements of audio noise radio interference due to Corona - properties of radio noise – frequency spectrum of RI fields – Measurements of RI and RIV.

UNIT- V:

Design of EHV lines based on steady state and transient limits - EHV cables and their characteristics.

TEXT BOOKS:

1. R. D. Begamudre, "EHVAC Transmission Engineering", New Age International (p) Ltd. 3rd Edition.
2. K.R. Padiyar, "HVDC Power Transmission Systems" New Age International (p) Ltd. 2nd revised Edition, 2012.

REFERENCES:

1. S. Rao "EHVAC and HVDC Transmission Engineering. Practice" Khanna publishers.
2. Arrillaga. J "High Voltage Direct Current Transmission" 2nd Edition (London) Peter Peregrines, IEE, 1998.
3. Padiyar.K.R, "FACTS Controllers in Power Transmission and Distribution" New Age International Publishers, 2007.
4. Hingorani H G and Gyugyi. L "Understanding FACTS-Concepts and Technology of Flexible AC Transmission Systems" New York, IEEE Press, 2000.

SWARM INTELLIGENCE TECHNIQUES IN POWER SYSTEMS
(PE-3)

M.Tech. EPE, II Sem

L	T	P	C
3	0	0	3

Prerequisite: Artificial Intellegence Techniques in Electrical Engineering

Course Objectives: Students will be able to:

- Understand Evolutionary algorithms like GA,PSO,ANT COLONY and BEE COLONY etc.
- Apply these Evolutionary algorithms to solve power systems problems
- Also able to understand solution of Multi-Objective optimization using these algorithms

Course Outcomes: Upon the completion of this course, the student will be able to

- Discriminate the capabilities of bio-inspired system and conventional methods in solving optimization problems.
- Examine the importance of exploration and exploitation swarm intelligent system to attain near global optimal solution.
- Distinguish the functioning of various swarm intelligent systems.
- Employ various bio-inspired algorithms for power systems engineering applications.

UNIT-I: 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-single objective and multi-objective problems.

UNIT-II: 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 problems.

UNIT-III: 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 elastic 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 of thermal units.

UNIT-IV: SHUFFLED FROG-LEAPING ALGORITHM and BAT OPTIMIZATION ALGORITHM

Bat algorithm-Echolocation of bats-Behaviour of micro bats-Acoustics of echolocation-Movement of Virtual bats-Loudness and pulse Emission-Shuffled frog algorithm-virtual population of frogs-comparison of memes and genes-memeplex formation-memeplex updation-BA and SFLA algorithms for solving ELD and optimal placement and sizing of the DG problem.

UNIT-V: 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 applications to power systems

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.

REFERENCES:

1. James Kennedy and Russel E Eberheart, 'Swarm Intelligence', The Morgan Kaufmann Series in Evolutionary Computation, 2001.
2. Eric Bonabeau, Marco Dorigo and Guy Theraulaz, 'Swarm Intelligence-From natural to Artificial Systems', Oxford university Press, 1999.
3. David Goldberg, 'Genetic Algorithms in Search, Optimization and Machine Learning', Pearson Education, 2007.
4. Konstantinos E. Parsopoulos and Michael N. Vrahatis, ' Particle Swarm Optimization and Intelligence: Advances and Applications', Information Science reference, IGI Global, 2010.
5. 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 Muzaffar eusuff, Kevin lansey and Fayzul pasha, Engineering Optimization, Taylor & Francis, Vol. 38, No. 2, 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 in Computational 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.

INDUSTRIAL LOAD MODELLING AND CONTROL
(PE-3)

M.Tech. EPE, II Sem

L	T	P	C
3	0	0	3

Prerequisite: Power Systems

Course Objectives: Students will be able to
- To understand the energy demand scenario
- To understand the modeling of load and its ease to study load demand industrially
- To know Electricity pricing models
- Study Reactive power management in Industries

Course Outcomes: Students will be able to
- Knowledge about load control techniques in industries and its application.
- Different types of industrial processes and optimize the process using tools like LINDO and LINGO.
- Apply load management to reduce demand of electricity during peak time.
- Apply different energy saving opportunities in industries.

UNIT-I:
Electric Energy Scenario-Demand Side Management-Industrial Load Management. Load Curves-Load Shaping Objectives-Methodologies. Barriers; Classification of Industrial Loads- Continuous and Batch processes -Load Modeling.

UNIT-II:
Direct load control- Interruptible load control. Bottom up approach- scheduling-Formulation of loadmodels- Optimization and control algorithms - Case studies. Reactive power management in industries-controls-power quality impacts, application of filters, Energy saving in industries.

UNIT-III:
Cooling and heating loads- load profiling- Modeling. Cool storage-Types- Control strategies. Optimal operation-Problem formulation- Case studies.

UNIT-IV:
Captive power units- Operating and control strategies- Power Pooling- Operation models. Energy banking-Industrial Cogeneration

UNIT-V:
Selection of Schemes Optimal Operating Strategies. Peak load saving-Constraints-Problem formulation Case study. Integrated Load management for Industries

TEXT BOOKS:
1. C.O. Bjork “Industrial Load Management - Theory, Practice and Simulations", Elsevier, the Netherlands,1989.
2. C.W. Gellings and S.N. Talukdar, “Load management concepts,” IEEE Press, New York, 1986,
pp. 3-28.

REFERENCES:

1. Y. Manichaikul and F.C. Schweppe ," Physically based Industrial load", IEEE Trans. on PAS, April 1981.
2. H. G. Stoll, "Least cost Electricity Utility Planning", Wiley Interscience Publication, USA, 1989.
3. I.J.Nagarath and D.P.Kothari, .Modern Power System Engineering., Tata McGraw Hill publishers, New Delhi, 1995.
4. IEEE Bronze Book- "Recommended Practice for Energy Conservation and cost effective planningin Industrial facilities", IEEE Inc, USA.

AI TECHNIQUES IN POWER SYSTEMS
(PE-4)

M.Tech. EPE, II Sem

L	T	P	C
3	0	0	3

Prerequisite: Artificial Intellegence Techniques in Electrical Engineering

Course Objectives: Students will be able to
- Understanding fuzzy logic, ANN
- Understanding GA & EP

Course Outcomes: Students will be able to
- Learn the concepts of biological foundations of artificial neural networks
- Learn Feedback networks and radial basis function networks and fuzzy logics
- Identifications of fuzzy and neural network
- Acquire the knowledge of GA

UNIT-I:
Biological foundations to intelligent Systems, Artificial Neural Networks, Single layer and Multilayer Feed Forward NN, LMS and Back Propagation Algorithm, Feedback networks and Radial Basis Function Networks.

UNIT-II:
Fuzzy Logic, Knowledge Representation and Inference Mechanism, Defuzzification Methods. Fuzzy Neural Networks and their learning methods

UNIT-III:
System Identification using Fuzzy and Neural Network.

UNIT-IV:
Genetic algorithm, Reproduction cross over, mutation, Introduction to evolutionary program.

UNIT-V:
Applications of above mentioned techniques to practical problems

TEXT BOOKS:
1. J M Zurada , “An Introduction to ANN”,Jaico Publishing House
2. Simon Haykins, “Neural Networks”, Prentice Hall

REFERENCES:
1. Timothy Ross, “Fuzzy Logic with Engg.Applications”, McGraw. Hill
2. Driankov, Dimitra, “An Introduction to Fuzzy Control”, Narosa Publication
3. Golding, “Genetic Algorithms”, Addison-Wesley Publishing Com

POWER QUALITY
(PE-4)

M.Tech. EPE, II Sem

L	T	P	C
3	0	0	3

Prerequisite: Power Systems and Power Electronics

Course Objectives:

- To know different terms of power quality.
- To illustrate power quality issues for short and long interruptions.
- To construct study of characterization of voltage sag magnitude and three phase unbalanced voltage sag.
- To know the behavior of power electronics loads, induction motors, synchronous motor etc. by the power quality issues
- To know mitigation of power quality problems by using VSI converters.

Course Outcomes: Upon the completion of this course, the student will be able to

- Know the severity of power quality problems in distribution system;
- Understand the concept of voltage sag transformation from up-stream (higher voltages) to down-stream (lower voltage)
- Compute the power quality improvement by using various mitigating custom power devices.

UNIT-I: INTRODUCTION

Introduction of the Power Quality (PQ) problem: Terms used in PQ - Voltage, Sag, Swell, Surges, Harmonics, over voltages, spikes, Voltage fluctuations, Transients, Interruption, overview of power quality phenomenon, Remedies to improve power quality, power quality monitoring.

UNIT-II: LONG & SHORT INTERRUPTIONS

Interruptions – Definition – Difference between failures, outage, Interruptions – causes of Long Interruptions – Origin of Interruptions – Limits for the Interruption frequency – Limits for the interruption duration – costs of Interruption – Overview of Reliability evaluation to power quality, comparison of observations and reliability evaluation.

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

UNIT III: SINGLE-PHASE & THREE-PHASE VOLTAGE SAG CHARACTERIZATION

Voltage sag – definition, causes of voltage sag, voltage sag magnitude, and monitoring, theoretical calculation of voltage sag magnitude, voltage sag calculation in non-radial systems, meshed systems, and voltage sag duration.

Three phase faults, phase angle jumps, magnitude and phase angle jumps for three phase unbalanced sags, load influence on voltage sags.

UNIT-IV: POWER QUALITY CONSIDERATIONS IN INDUSTRIAL POWER SYSTEMS

Voltage sag – equipment behavior of Power electronic loads, induction motors, synchronous motors, computers, consumer electronics, adjustable speed AC drives and its operation. Mitigation of AC Drives, adjustable speed DC drives and its operation, mitigation methods of DC drives.

UNIT-V: MITIGATION OF INTERRUPTIONS & VOLTAGE SAGS

Overview of mitigation methods – from fault to trip, reducing the number of faults, reducing the fault clearing time changing the power system, installing mitigation equipment, improving equipment immunity, different events and mitigation methods. System equipment interface – voltage source converter, series voltage controller, shunt controller, combined shunt and series controller.

Power Quality and EMC Standards:

Introduction to standardization, IEC Electromagnetic compatibility standards, European voltage characteristics standards, PQ surveys.

TEXT BOOKS:

1. Math H J Bollen "Understanding Power Quality Problems", IEEE Press.
2. R.C. Dugan, M.F. McGranaghan and H.W. Beaty, "Electric Power Systems Quality." New York: McGraw-Hill.1996

REFERENCES:

1. G.T. Heydt, 'Electric Power Quality', 2nd Edition. (West Lafayette, IN, Stars in a Circle Publications, 1994).
2. Power Quality VAR Compensation in Power Systems, R. Sastry Vedam Mulukutla S.Sarma,CRC Press.
3. A Ghosh, G. Ledwich, Power Quality Enhancement Using Custom Power Devices. Kluwer Academic, 2002

POWER APPARATUS DESIGN
(PE-4)

M.Tech. EPE, II Sem

L	T	P	C
3	0	0	3

Prerequisite: Electrical Machines

Course Objectives: Students will be able to

- Study the modelling analysis of rotating machine.
- Learning electromagnetic energy conversion
- To know about rating of machines.

Course Outcomes:

- To give a systematic approach for modeling and analysis of all rotating machines under both transient and steady state conditions with the dimensions and material used.
- Ability to model and design all types of rotation machines including special machines.

UNIT-I:
Principles of Design of Machines -Specific loadings, choice of magnetic and electric loadings,Real and apparent flux densities, temperature rise calculation, Separation of main dimension for DC machines, Induction machines and synchronous machines, Design of Transformers-General considerations, output equation, emf per turn, choice of flux density and current density, main dimensions, leakage reactance and conductor size, design of tank and cooling.

UNIT-II:
Specific loadings, choice of magnetic and electric loadings Real and apparent flux - densities, temperature rise calculation,Separation of main dimension for DC machines,Induction machines and synchronous machines,Heating and cooling of machines, types of ventilation, continuous and intermittent rating.

UNIT-III:
General considerations, output equation, emf per turn, choice of flux density and current density, main dimensions, leakage reactance and conductor size, design of tank and cooling tubes,Calculation of losses, efficiency and regulation, Forces winding during short circuit.

UNIT-IV:
General considerations, output equation, Choice of specific electric and magnetic loadings, efficiency, power factor, Number of slots in stator and rotor,Elimination of harmonic torques.

UNIT-V:
Design of stator and rotor winding, slot leakage flux, Leakage reactance, equivalent resistance of squirrel cage rotor, Magnetizing current, efficiency from design data. Types of alternators, comparison, specific loadings, output co-efficient, design of main dimensions Introduction to Computer Aided Electrical Machine Design Energy efficient machines.

TEXT BOOKS:

1. Clayton A.E, "The Performance and Design of D.C. Machines", Sir I. Pitman & sons, Ltd.
2. M.G. Say, "The Performance and Design of A.C. Machines ", Pitman

REFERENCES:

1. Sawhney A.K, "A course in Electrical Machine Design", DhanpatRai & Sons, 5th Edition

POWER SYSTEM RELIABILITY AND PLANNING
(PE-4)

M.Tech. EPE, II Sem

L	T	P	C
3	0	0	3

Prerequisite: Reliability Engineering

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

- To describe the generation system model and recursive relation for capacitive model building
- To explain the equivalent transitional rates, cumulative probability and cumulative frequency
- To develop the understanding of risk, system and load point reliability indices
- To explain the basic and performance reliability indices

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

- Understand the importance of maintaining reliability of power system components.
- Apply the probabilistic methods for evaluating the reliability of generation and transmission systems.
- Assess the different models of system components in reliability studies.
- Assess the reliability of single area and multi area systems.

UNIT-I:
Basic Reliability Concepts:
The general reliability function. The exponential distribution – Mean time to failures – series and parallel systems. Markov process – continuous Markov process – Recursive techniques – Simple series and parallel system models.

UNIT-II:
Generating Capacity – Basic Probability Methods:
The generation system model – Loss of load indices – Capacity expansion analysis – scheduled outages. Load forecast uncertainty Loss of energy indices. The frequency and duration method.

UNIT-III:
Transmission Systems Reliability Evaluation:
Radial configuration – Conditional probability approach – Network configurations – State selection.

UNIT-IV:
Generation Planning:
Comparative economic assessment of individual generation projects – Investigation and simulation models – Heuristic and linear programming models – Probabilistic generator and load models.

UNIT-V:

Transmission and Distribution Planning:

Deterministic contingency analysis – Probabilistic transmission system – reliability analysis. Reliability calculations for single area and multi–area power systems. Network configuration design–consisting of schemes – security criteria configuration synthesis.

TEXT BOOKS:

1. Roy Billinton and Ronald Allan Pitam: Reliability Evaluation of Power Systems,1996.
2. R.L. Sullivan: Power System Planning, McGraw Hill International, 1977.

REFERENCES:

1. Wheel Wright and Makridakis: Forecasting methods and Applications, John Wiley, 1992.
2. J. Endremyl: Reliability Modelling in Electric Power Systems, John Wiley, 2005.

POWER SYSTEMS COMPUTATION LAB-II
(Lab-3)

M.Tech. EPE, II Sem

L	T	P	C
0	0	4	2

Prerequisite:power systems and Artificial Neural Networks

Course Objectives: Students will be able to:

- Known Neural network tool box
- Know the various Evolutionary Algorithms
- Apply various Evolutionary Algorithms to power system problems

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

- Understood Neural network and fuzszy logic tool box
- Understood various Evolutionary Algorithms
- Solved power system problems by applying various Evolutionary Algorithms

1. Load Flow analysis using Neural Network
2. State Estimations using Neural Network
3. Contingency Analysis using Neural Network
4. Power system Security using Neural Network
5. Fuzzy Logic based AGC – Single area system – Two area system
6. Fuzzy Logic based small signal stability analysis
7. Economic Dispatch of Thermal Units using ANN
8. Economic Dispatch of Thermal Units using GA
9. Unit commitment problem by using GA
10. Unit commitment problem by using PSO
11. Optimal location and sizing of capacitor in distribution system using PSO
12. Security constrained optimal power dispatch using GA
13. Optimal Reactive power dispatch using PSO

POWER SYSTEM PROTECTION LAB
(Lab4)

M.Tech. EPE, II Sem

L	T	P	C
0	0	4	2

Prerequisite: Power systems protection

Course Objectives: Upon successful completion of the lab students will be familiar with:
- Different types of Faults occurring in power systems
- Characteristics of different types of relays
- Protection schemes

Course Outcomes: At the end of the course, the student should be able to:
- Calculate various faults
- Analyze the various time-current characteristics of protective relays
- Know the Performance and Testing of various electrical models and systems

1. Characteristics of Electromechanical Non-Directional over current relay
2. Characteristics of Electromechanical Directional Over Current Relay
3. Characteristics of Electromechanical differential protection relay
4. Characteristics of Numerical Distance relay
5. Characteristics of Integrated Numerical under Voltage Relay
6. Characteristics of Numerical over current Relay
7. Zones protection characteristics of distance Relay
8. Differential protection on Single Phase Transformer
9. Performance and Testing of Feeder Protection System
10. Performance and Testing of Generator Protection System.

POWER SYSTEM TRANSIENTS
(PE-5)

M.Tech. EPE, III Sem

L	T	P	C
3	0	0	3

Prerequisite: Power Systems

Course Objectives: Students will be able to:

- Learn the reasons for occurrence of transients in a power system.
- Understand the change in parameters like voltage & frequency during transients.
- To know about the lightning phenomenon and its effect on power system.

Course Outcomes: Students will be able to:

- Knowledge of various transients that could occur in power system and their mathematical formulation.
- Ability to design various protective devices in power system for protecting equipment and
  Personnel.
- Coordinating the insulation of various equipments in power system.
- Modelling the power system for transient analysis.

UNIT-I:
Fundamental circuit analysis of electrical transients,Laplace Transform method of solving simple Switching transients, Damping circuits -Abnormal switching transients, Three-phase circuits and transients,Computation of power system transients

UNIT-II:
Principle of digital computation – Matrix method of solution,Modal analysis- Z transform- Computation using EMTP,Lightning, switching and temporary over voltages, Lightning,Physical phenomena of lightning.

UNIT-III:
Interaction between lightning and power system,Influence of tower footing resistance and Earth Resistance, Switching: Short line or kilometric fault, Energizing transients - closing and re-closing of lines, line dropping, load rejection – over voltages induced by faults

UNIT-IV:
Switching HVDC line, Travelling waves on transmission line, Circuits with distributed Parameters, Wave Equation, Reflection, Refraction, Behaviour of Travelling waves at the lineTerminations, Lattice Diagrams, Attenuation and Distortion factors, Multi-conductor system and Velocity wave.

UNIT-V:
Insulation co-ordination: Principle of insulation co-ordination in Air Insulated substation (AIS) and Gas Insulated Substation (GIS) Coordination between insulation and protection level, Statistical approach. Protective devices**,** Protection of system against over voltages**,** lightning arresters, substation earthling

TEXT BOOKS:

1. Allan Greenwood, “Electrical Transients in Power System”, Wiley & Sons Inc. New York, 1991
2. Harold A Peterson: Transient in Power Systems, McGraw Hill, 1966.

REFERENCES:

1. Kuffel and Abdullah: High Voltage Engineering, PHI, 2000.
2. Rakesh D. Begamudre: EHV AC Transmission Engineering, PHI, 2006.

FLEXIBLE AC TRANSMISSION SYSTEMS
(PE-5)

M.Tech. EPE, III Sem

L	T	P	C
3	0	0	3

Prerequisite: Power Electronics and Power Systems

Course Objectives:

- To understand uncompensated lines and their behavior under heavy loading conditions.
- To understand the concept and importance controllable parameters of FACTS controllers.
- To emphasize the objectives of Shunt compensation, and basic operation of SVC and STATCOM.
- To analyze the functioning of series controllers like GCSC, TSSC and TCSC

Course Outcomes:

Upon the completion of this course, the student will be able to

- Choose proper controller for the specific application based on system requirements
- Understand various systems thoroughly and their requirements
- Interpret the control circuits of Shunt Controllers SVC & STATCOM for various functions viz. Transient stability Enhancement, voltage instability prevention and power oscillation damping
- Detect the Power and control circuits of Series Controllers GCSC, TSSC and TCSC

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, mid-point 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 compensator control.

UNIT-V: STATIC SERIES COMPENSATORS

Concept of series capacitive compensation, improvement of transient stability, power oscillation damping, and functional requirements of 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 BOOKS:

1. Hingorani H G and Gyugyi. L " Understanding FACTS-Concepts and Technology of Flexible AC Transmission Systems" New York, IEEE Press, 2000.
2. Padiyar.K.R, " FACTS Controllers in Power Transmission and Distribution" New Age Int. Publishers, 2007

REFERENCES:

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

GAS INSULATED SYSTEMS
(PE-5)

M.Tech. EPE, III Sem

L	T	P	C
3	0	0	3

Prerequisite: Switch Gear and Protection

Course objectives:

- To know the GIS concepts and principles
- To distinguish Air Insulated and Gas insulated Substations
- To demonstrate the design and constructional aspects of GIS
- To analyze transient phenomenon, problems and diagnostic methods in GIS

Course Outcomes: Upon the completion of this course, the student will be able to

- Know the advantages of GIS systems over air insulated systems
- Observe constructional design features of GIS design
- Discriminate the problems and design diagnostic methods of GIS

UNIT–I: INTRODUCTION TO GIS AND PROPERTIES OF SF_6

Characteristics of GIS- Introduction to SF_6 - Physical properties-Chemical properties - Electrical properties-Specification of SF_6 gas for GIS application - Handling of SF_6 gas before use - Safe handling of Sf_6 gas in electrical equipment - Equipment for handling the SF_6 Gas - SF_6 and environment.

UNIT–II: LAYOUT OF GIS STATIONS

Advancement of GIS station - Comparison with Air Insulated Substation - Economics of GIS - User Requirements for GIS - Main Features for GIS - Planning and Installation components of a GIS station.

UNIT–III: DESIGN AND CONSTRUCTION OF GIS STATION

Introduction - Rating of GIS components - Design Features - Estimation of different types of Electrical Stresses -Design Aspects of GIS components - Insulation Design for Components - Insulation Design for GIS - Thermal Considerations in the Design of GIS - Effect of very Fast Transient Over-voltages (VFTO) on the GIS design - Insulation Coordination systems - Gas handling and Monitoring System Design.

UNIT-IV: FAST TRANSIENT PHENOMENA IN GIS

Introduction - Disconnector Switching in Relation to Very fast Transients-Origin of VFTO-Propagation and Mechanism of VFTO-VFTO Characteristics- Effects of VFTO-Testing of GIS for VFTO.

UNIT–V: SPECIAL PROBLEMS IN GIS AND GIS DIAGNOSTICS

Introduction - particles their effects and their control- Insulating Spacers and their Reliability - SF_6 Gas Decomposition - Characteristics of imperfections in insulation - Insulation Diagnostic methods - PD Measurement and UHF Method.

TEXT BOOKS:

1. M. S. Naidu,” Gas Insulated Substations”- IK International Publishing House.
2. Hermann J. Koch, “Gas Insulated Substations”, June 2014, Wiley - IEEE Press.

REFERENCES:

1. Olivier Gallot-Lavellee, “Dielectric materials and Electrostatics” , Wiley - IEEE Press.
2. Jaun Martinez, “Dielectric Materials for Electrical Engineering”, Wiley - IEEE Press.

SCADA SYSTEM AND APPLICATIONS
(PE-5)

M.Tech. EPE, III Sem

L	T	P	C
3	0	0	3

Prerequisite: None

Course Objectives: Students will be able to:

- To understand what is meant by SCADA and its functions.
- To know SCADA communication.
- To get an insight into its application**.**

Course Outcomes: Students will be able to:

- Describe the basic tasks of Supervisory Control Systems (SCADA) as well as their typical
  Applications.
- Acquire knowledge about SCADA architecture, various advantages and disadvantages of each
  System.
- Knowledge about single unified standard architecture IEC 61850.
- To learn about SCADA system components: remote terminal units, PLCs, intelligent
  electronic devices, HMI systems, SCADA server.
- Learn and understand about SCADA applications in transmission and distribution sector,
  industries etc.

UNIT–I:
Introduction to SCADA, Data acquisition systems, Evolution of SCADA, Communication technologies.
Monitoring and supervisory functions, SCADA applications in Utility Automation, Industries SCADA.

UNIT–II:
Industries SCADA System Components, Schemes- Remote Terminal Unit (RTU), Intelligent Electronic Devices(IED), Programmable Logic Controller (PLC), Communication Network, SCADA Server, SCADA/HMI Systems.

UNIT–III:
SCADA Architecture**,** Various SCADA architectures, advantages and disadvantages of each System,single unified standard architecture -IEC 61850.

UNIT–IV:
SCADA Communication,various industrial communication technologies,wired and wireless methods and fiber optics,Open standard communication protocols.

UNIT–V:
SCADA Applications: Utility applications**,**Transmission and Distribution sector operations, monitoring, analysis and improvement**,**Industries - oil, gas and water,Case studies, Implementation, Simulation Exercises.

TEXT BOOKS:

1. Stuart A. Boyer: "SCADA-Supervisory Control and Data Acquisition", Instrument Society of America Publications,USA,2004.
2. Gordon Clarke, Deon Reynders: "Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems", Newnes Publications, Oxford, UK,2004.

REFERENCES:

1. William T. Shaw, "Cybersecurity for SCADA systems", PennWell Books, 2006.
2. David Bailey, Edwin Wright, "Practical SCADA for industry", Newnes, 2003.
3. Michael Wiebe, "A guide to utility automation: AMR, SCADA, and IT systems for electric power", PennWell 1999.

BUSINESS ANLYTICS
(OE1)

M.Tech. EPE, III Sem

L	T	P	C
3	0	0	3

Prerequisite: None

Course objectives:

- Understand the role of business analytics within an organization.
- Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
- To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
- To become familiar with processes needed to develop, report, and analyze business data.
- Use decision-making tools/Operations research techniques.
- Mange business process using analytical and management tools.
- Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

Course Outcomes:

- Students will demonstrate knowledge of data analytics.
- Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
- Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.
- Students will demonstrate the ability to translate data into clear, actionable insights.

UNIT-I:

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

UNIT-II:

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

UNIT-III:

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

UNIT-IV:

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

UNIT-V:

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making. Recent Trends in : Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

TEXT BOOKS:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

INDUSTRIAL SAFETY
(OE-2)

M.Tech. EPE, III Sem

L	T	P	C
3	0	0	3

Prerequisite: None

Course objectives:
Course Outcomes:

UNIT-I:
Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT-II:
Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT-III:
Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT-IV:
Fault tracing: Fault tracing-concept and importance, decision treeconcept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic,automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT-V:
Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.

TEXT BOOKS/ REFERENCES:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

OPERATIONS RESEARCH
(OE-3)

M.Tech. EPE, III Sem

L	T	P	C
3	0	0	3

Prerequisite: None

Course objectives:

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

- Students should able to apply the dynamic programming to solve problems of discreet and continuous variables.
- Students should able to apply the concept of non-linear programming
- Students should able to carry out sensitivity analysis
- Student should able to model the real world problem and simulate it.

UNIT-I:
Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

UNIT-II:
Formulation of a LPP - Graphical solution revised simplex method - duality theory – dual simplex method - sensitivity analysis - parametric programming

UNIT-III:
Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem – max flow problem - CPM/PERT

UNIT-IV:
Scheduling and sequencing - single server and multiple server models – deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

UNIT-V:
Competitive Models,Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

TEXT BOOKS/ REFERENCES:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

COST MANGEMENT OF ENGINEERING PROJECTS
(OE-4)

M.Tech. EPE, III Sem

L	T	P	C
3	0	0	3

Prerequisite: None

Course objectives:

Course Outcomes:

UNIT-I:
Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

UNIT-II:
Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

UNIT-III:
Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints.

UNIT-IV:
Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

UNIT-V:
Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

TEXT BOOKS/ REFERENCES:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

COMPOSITE MATERIALS
(OE-5)

M.Tech. EPE, III Sem

L	T	P	C
3	0	0	3

Prerequisite: None

Course objectives:

Course Outcomes:

UNIT–I:
INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT – II:
REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

UNIT – III:
Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT–IV:
Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT – V:
Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TEXT BOOKS/ REFERENCES:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.
3. Hand Book of Composite Materials-ed-Lubin.
4. Composite Materials – K.K.Chawla.
5. Composite Materials Science and Applications – Deborah D.L. Chung.
6. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W.Tasi.

ENERGY FROM WASTE
(OE-6)

M.Tech. EPE, III Sem

L	T	P	C
3	0	0	3

Prerequisite: None

Course objectives:

Course Outcomes:

UNIT-I:
Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNIT-II:
Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT-III:
Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT-IV:
Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT-V:
Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

TEXT BOOKS/ REFERENCES:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

ENGLISH FOR RESEARCH PAPER WRITING
(Audit-I &II)

M.Tech. EPE, I Sem

L	T	P	C
2	0	0	0

Prerequisite: None

Course objectives: Students will be able to:

- Understand that how to improve your writing skills and level of readability
- Learn about what to write in each section
- Understand the skills needed when writing a Title Ensure the good quality of paper at very first-time submission

Course Outcomes:

UNIT-I:
Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT-II:
Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

UNIT-III:
Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

UNIT-IV:
key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,

UNIT-V:
skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT-VI:
useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

TEXT BOOKS/ REFERENCES:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book .
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

DISASTER MANAGEMENT
(Audit-I &II)

M.Tech. EPE, I Sem

L	T	P	C
2	0	0	0

Prerequisite: None

Course Objectives: Students will be able to

- learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- critically understand the strengths and weaknesses of disaster management approaches,
- planning and programming in different countries, particularly their home country or the countries they work in

Course Outcomes:

UNIT-I:
Introduction:
Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.

UNIT-II:
Repercussions Of Disasters And Hazards:
Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT-III:
Disaster Prone Areas In India:
Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics

UNIT-IV:
Disaster Preparedness And Management:
Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

UNIT-V:
Risk Assessment Disaster Risk:
Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co- Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.

UNIT-VI:

Disaster Mitigation:

Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

TEXT BOOKS/ REFERENCES:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, Pardeep Et.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L. , Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi.

SANSKRIT FOR TECHNICAL KNOWLEDGE
(Audit-I &II)

M.Tech. EPE, I Sem

L	T	P	C
2	0	0	0

Prerequisite: None

Course Objectives:

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- Learning of Sanskrit to improve brain functioning
- Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
- The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

Course Outcomes:

Students will be able to

- Understanding basic Sanskrit language
- Ancient Sanskrit literature about science & technology can be understood
- Being a logical language will help to develop logic in students

UNIT-I:

Alphabets in Sanskrit,

UNIT-II:

Past/Present/Future Tense,Simple Sentences

UNIT-III:

Order, Introduction of roots,

UNIT-IV:

Technical information about Sanskrit Literature

UNIT-V:

Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

TEXT BOOKS/ REFERENCES:

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

VALUE EDUCATION
(Audit-I &II)

M.Tech. EPE, I Sem

L	T	P	C
2	0	0	0

Prerequisite: None

Course Objectives: Students will be able to
- Understand value of education and self- development
- Imbibe good values in students
- Let the should know about the importance of character

Course outcomes: Students will be able to
- Knowledge of self-development
- Learn the importance of Human values
- Developing the overall personality

UNIT-I:
Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles.Value judgements

UNIT-II:
Importance of cultivation of values.Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness.Honesty, Humanity. Power of faith, National Unity. Patriotism.Love for nature ,Discipline

UNIT-III:
Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline, Punctuality, Love and Kindness.

UNIT-IV:
Avoid fault Thinking.Free from anger, Dignity of labour.Universal brotherhood and religious tolerance.True friendship.Happiness Vs suffering, love for truth.Aware of self-destructive habits.Association and Cooperation.Doing best for saving nature

UNIT-V:
Character and Competence –Holy books vs Blind faith.Self-management and Good health.Science of reincarnation, Equality, Nonviolence ,Humility, Role of Women.All religions and same message.Mind your Mind, Self-control. Honesty, Studying effectively

TEXT BOOKS/ REFERENCES:
1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

CONSTIOTUTION OF INDIA
(Audit-I &II)

M.Tech. EPE, I Sem

L	T	P	C
2	0	0	0

Prerequisite: None

Course Objectives: Students will be able to:

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Course Outcomes: Students will be able to:

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

UNIT-I:
History of Making of the Indian Constitution: History Drafting Committee, (Composition & Working)

UNIT-II:
Philosophy of the Indian Constitution: Preamble**,** Salient Features

UNIT-III:
Contours of Constitutional Rights & Duties: Fundamental Rights Right to Equality**,** Right to Freedom**,** Right against Exploitation**,** Right to Freedom of Religion**,** Cultural and Educational Rights**,** Right to Constitutional Remedies, Directive Principles of State Policy**,** Fundamental Duties.

UNIT-IV:
Organs of Governance: Parliament**,** Composition**,** Qualifications and Disqualifications**,** Powers and Functions**,** Executive**,** President**,** Governor**,** Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualification, Powers and Functions

UNIT-V:
Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation.Pachayati raj: Introduction, PRI: Zila Pachayat.Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments),Village level: Role of Elected and Appointed officials, Importance of grass root democracy

UNIT-VI:

Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

TEXT BOOKS/ REFERENCES:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

PEDAGOGY STUDIES
(Audit-I &II)

M.Tech. EPE, I Sem

L	T	P	C
2	0	0	0

Prerequisite: None

Course Objectives: Students will be able to:

- Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

Course Outcomes: Students will be able to understand:

- What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

UNIT-I:

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions**.** Overview of methodology and Searching.

UNIT-II:

Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

UNIT-III:

Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies.How can teacher education (curriculum and practicum) and the scho curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT-IV:

Professional development: alignment with classroom practices and followup support, Peer support, Support from the head teacher and the community.Curriculum and assessment, Barriers to learning: limited resources and large class sizes

UNIT-V:

Research gaps and future directions: Research design**,** Contexts**,** Pedagogy**,** Teacher education**,** Curriculum and assessment**,** Dissemination and research impact.

TEXT BOOKS/ REFERENCES:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.

3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

STRESS MANGEMENT BY YOGA
(Audit-I &II)

M.Tech. EPE, I Sem

L	T	P	C
2	0	0	0

Prerequisite: None

Course Objectives:

- To achieve overall health of body and mind
- To overcome stress

Course Outcomes:

Students will be able to:

- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

UNIT-I:

Definitions of Eight parts of yog. (Ashtanga)

UNIT-II:

Yam and Niyam.

UNIT-III:

Do`s and Don't's in life.

i) Ahinsa, satya, astheya, bramhacharya and aparigraha

ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

UNIT-IV:

Asan and Pranayam

UNIT-V:

i) Various yog poses and their benefits for mind & body

ii)Regularization of breathing techniques and its effects-Types of pranayam

TEXT BOOKS/ REFERENCES:

1. 'Yogic Asanas for Group Tarining-Part-I" : Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS
(Audit-I &II)

M.Tech. EPE, I Sem

L	T	P	C
2	0	0	0

Prerequisite: None

Course Objectives:

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

Course Outcomes: Students will be able to

- Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
- The person who has studied Geeta will lead the nation and mankind to peace and prosperity
- Study of Neetishatakam will help in developing versatile personality of students

UNIT-I:

Neetisatakam-Holistic development of personality

- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)

UNIT-II:

Neetisatakam-Holistic development of personality

- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's)

UNIT-III:

Approach to day to day work and duties.

- Shrimad Bhagwad Geeta : Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
- Chapter 18-Verses 45, 46, 48.

UNIT-IV:

Statements of basic knowledge.

- Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68
- Chapter 12 -Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad Bhagwad Geeta:

UNIT-V:

- Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4-Verses 18, 38,39
- Chapter18 – Verses 37,38,63

TEXT BOOKS/ REFERENCES:

1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata.
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.