SCHEME & SYLLABUS

M. Tech (Electrical Engineering)

Full-time

Department of Electrical Engineering

UIET

Sant Baba Bhag Singh University

2018

Index

Course Scheme M. Tech (Electrical Engineering) Full-time

SEMESTER I

I. Theory Subjects (including Non- Credit Courses)

S. No.	Type	Subject Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credit Hours
1	PC	EE501-18	Advance Electrical Machines	4:0:0	4:0:0	4	4
2	PC	EE503-EE	Power System Analysis & Design	4:0:0	4:0:0	4	4
3	PC	EE505-18	Advanced Power Electronics	4:0:0	4:0:0	4	4
4	PC	EE507-18	Digital Control System	4:0:0	4:0:0	4	4
5	PC	EE509-18	Renewable Energy Resources	4:0:0	4:0:0	4	4

II. Practical Subjects

S. No.	Type	Subject Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credit Hours
1	PC	EE511-18	Power System Software Lab-I	0:0:2	0:0:1	2	1

Total Contact Hours:22
Total credit Hours:21

SEMESTER II

I. Theory Subjects (including Non- Credit Courses)

S. No.	Type	Subject Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credit Hours
1	PC	MAT523	Advanced Engineering Mathematics	4:0:0	4:0:0	4	4
2	PC	EE502-18	Energy Efficient Machines	4:0:0	4:0:0	4	4
3	PC	EE504-18	Power System Operation and Control	4:0:0	4:0:0	4	4
4	PE		Professional Elective-I	4:0:0	4:0:0	4	4
5	PE		Professional Elective-II	4:0:0	4:0:0	4	4

II. Practical Subjects

S. No.	Type	Subject Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credit Hours
1	PC	EE506-18	Seminar	0:0:2	0:0:1	2	1
2	PC	EE508-18	Special Problem	0:0:2	0:0:1	2	1

III. Professional Elective-II

S. No.	Type	Subject Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credit Hours
1	PE	EE510-18	EHVAC & HVDC Transmission System	4:0:0	4:0:0	4	4
2	PE	EE512-18	Advanced Relaying & Protection	4:0:0	4:0:0	4	4
3	PE	EE514-18	Optimization Techniques	4:0:0	4:0:0	4	4

IV. Professional Elective-III

S. No.	Type	Subject Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credit Hours
1	PE	EE516-18	Industrial Drives & Automation	4:0:0	4:0:0	4	4
2	PE	EE518-18	Modelling and Dynamics of Electrical Machines	4:0:0	4:0:0	4	4
3	PE	EE520-18	Neural Networks & Fuzzy Logic	4:0:0	4:0:0	4	4

*The seminar will be studied and presented by the student on the topic of any latest technology in their relevant field. The complete knowledge of the latest technology is expected from the student. A Report and presentation will be submitted at the end of semester.

**Special Problem: (Term paper/Review/research paper etc)-The students are required to do literature survey on the topics related to the theory subjects taken during the semester. Every student will prepare a detailed report on the selected topics and will present the findings of the report in front of the examination board.

Total Contact Hours: 24
Total credit Hours: 22

SEMESTER III

I. Theory Subjects (including Non- Credit Courses)

S. No.	Type	Subject Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credit Hours
1	PE		Professional Elective -III	5:0:0	5:0:0	5	5
2	PE		Professional Elective -IV	5:0:0	5:0:0	5	5

II. Practical Subjects

S. No.	Type	Subject Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credit Hours
1	PC	EE613-18	Master Research	0:0:10	0:0:5	10	5

III. Professional Elective-II

S. No.	Type	Subject Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credit Hours
1	PE	EE601-18	Load and Energy Management	5:0:0	5:0:0	5	5
2	PE	EE603-18	Real Time Instrumentation	5:0:0	5:0:0	5	5
3	PE	EE605-18	Power System Dynamics & Stability	5:0:0	5:0:0	5	5

IV. Professional Elective-III

S. No.	Type	Subject Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credit Hours
1	PE	EE607-18	Organization and Finance in Power sector	5:0:0	5:0:0	5	5
2	PE	EE609-18	Power System Reliability	5:0:0	5:0:0	5	5
3	PE	EE611-18	Power System Planning	5:0:0	5:0:0	5	5

Total Contact Hours: 20
Total credit Hours: 15

Course Code	EE501-18
Course Title	Advance Electrical Machines
Type of Course	PC
L T P	4:0:0
Credits	4
Course Prerequisites	Electrical Machines
Course Objectives (CO)	Construct equivalent circuit of poly phase synchronous machines, analyze the harmonics in waveforms, Understand the parameters related to steady state analysis of cylindrical and salient pole synchronous machines.

SYLLABUS

UNIT-I: Mathematical: Basic Synchronous machine parameters, Voltage Flux linkage and inductance relations, Park's transformation–its physical concept, equations of performance. Phasor equations and phasor diagrams, Power-angle characteristics, cylindrical rotor and Salient pole machines, Short circuit ratio.

UNIT-II: Three phase short-circuits, Armature and field transients, Transient torque, Sudden reactive loading and Unloading, Transient Analysis-a qualitative approach , Reactance and Time-Constants from equivalent circuits, Measurement of reactance, Transient Power-angle characteristics, The basic electro mechanical equation, Linearized Analysis, Large Angular/oscillation, Non-linear analysis.

UNIT-III: Multi-Circuit Transformers: General theory, Equivalent circuits, Three winding transformer as a multi-circuit transformers, Determination of parameters, In-rush current phenomena, Qualitative approach, Analytical approach, In-rush current in 3-phase transformers.

UNIT-IV: Harmonics in Single–phase transformers, Harmonics in three-phase transformers, Disadvantages of harmonics, Suppression of harmonics. Single-phase load on three-phase transformers, Single-Phasing in 3-phase transformers, Effect of using tertiary winding.

RECOMMENDED BOOKS

S. No	Name	Author(S)	Publisher
1	Power System Stability	E.W. Kim bark	Wiley
2	Electric Machinery	Fitzgerald A.E., Kingsley C. and Umans S.D.,	Mc Graw Hill
3.	Generalized theory of electrical Machines	Bimbra, P.S.,	Khanna Publications

Course Code	EE503-18
Course Title	Power system analysis and design
Type of Course	PC
L T P	4:0:0
Credits	4
Course Prerequisites	Power Systems
Course Objectives (CO)	Construct network matrices by singular and non-singular transformation and bus impedance matrices by algorithmic approach. Develop mathematical model and find solution of optimal power flow problems. Investigate state of a power system by power flow analysis as well as state estimation.

SYLLABUS

UNIT-I: Incidence and network matrices, formation of network matrices by singular and non-singular transformation.

UNIT-II: Formation of single phase bus impedance matrix using algorithmic approach including the effect of mutually coupled elements.

UNIT-III: Review of power flow without and with tap changing and phase shifting transformers, power flow analysis with series and shunt compensating devices, power flow for radial distribution network.

UNIT-IV: Optimal power flow problem formulation and solution techniques. Factors effecting power system security, short circuit and contingency analysis, network sensitivity using load flow, correcting the generation dispatch by using sensitivity method and linear programming. State estimation from on line measurements, method of least squares, the line power flow state estimation.

RECOMMENDED BOOKS

S. No	Name	Author(S)	Publisher
1	Computer Methods in Power System Analysis	G.N. Stagg and A. H.EI- Abiad	Mc Graw– Hill
2	Analysis of Faulted Power System	P.M. Anderson	IEEE Press Book
3.	Computer Techniques in Power Systems Analysis	M.A. Pai	Tata McGraw Hill

Course Code	EE505-18
Course Title	Advanced Power Electronics
Type of Course	PC
L T P	4:0:0
Credits	4
Course Prerequisites	Power Electronics
Course Objectives (CO)	1. Understand the operation of advanced power electronic circuit topologies. 2. Understand the control strategies involved.

SYLLABUS

UNIT-I: Power Electronic Systems, Power Semiconductor switches, Basic electrical and magnetic circuit concepts, Temperature Control and Heat Sinks: Control of semiconductor device temperatures, Heat transfer by conduction, Heat sinks, Heat transfer by radiation and convection

UNIT-II: Switching dc Power Supplies: Introduction, Comparison of Linear power supplies and switching power supplies, dc-dc converters with electrical isolation, Control of SMPS, Power supply protection, Electrical isolation in the feedback loop, Designing to meet power supply specifications, Power Conditioners and Uninterrupted Power Supplies: Introduction, Power line disturbances, Power Conditioners, Uninterrupted Power Supplies (UPS).

UNIT-III: Electric Utility Applications: Introduction, HVDC, Static Var Compensators, Interconnection of Renewable Energy Sources and Energy storage Systems to the Utility Grid.

UNIT-IV : Snubber Circuits: Types of Snubber circuits, needs of Snubber circuit with diode, thyristor and transistors, Turn-off Snubber, over voltage snubber, turn on snubber, Snubber for bridge circuit configurations, GTO Snubber circuit.

Design Consideration, De-coupled drive circuits, electrically isolated drive circuits, cascade connected drive circuits, Power device protection in drive circuits, circuit layout considerations.

RECOMMENDED BOOKS

S. No	Name	Author(S)	Publisher
1	Power Electronics Handbook	Rashid M.H	Elsevier Press (Academic Press Series).
2	Power electronics: converters, Applications and Design	Mohan, Undeland and Robbins	John Wiley and Sons.
3.	The Power Thyristor and its Applications	Finney D	McGraw Hill

Course Code	EE507-18
Course Title	Digital Control System
Type of Course	PC
L T P	4:0:0
Credits	4
Course Prerequisites	Control systems
Course Objectives (CO)	1. Understand Digital Control Systems. 2. Apply knowledge to find Time Response of Digital Control Systems. 3. Analyse the stability of Digital Control Systems

SYLLABUS

UNIT-I: Configuration of the basic Digital Control Systems, types of sampling operations, Sample and Hold operations, Sampling theorem, Basic discrete time signals. Z-Transforms, Properties of Z-Transform, Inverse Z-Transforms, Pulse Transfer Function, Difference equations, Z-Transform method for solving the difference equations, Block diagram and signal flow graph analysis, Time response of digital control systems.

UNIT-II: Mapping between s-plane and z-plane, stability methods: Modified Routh Criterion Jury's method, modified Schur-Cohn criterion.

UNIT-III: Digital temperature control System, Digital position control system, stepping motors and their control, Design of Digital compensator using frequency response plots.

UNIT-IV: Review of state variable methods, state variable description of digital control systems, conversion of state variable models to pulse transfer function and vice versa, solution of state difference equations, controllability and observability.

RECOMMENDED BOOKS

S. No	Name	Author(S)	Publisher
1	Digital Control and State Variable Methods	Gopal M	Tata McGraw-Hill
2	Control System Engg	Nagrath I.J. & Gopal M	John Wiley & sons.
3.	Control System Analysis and Design	Aggarwal K.K	Khanna Publisher

Course Code	EE509-18
Course Title	Renewable Energy Resources
Type of Course	PC
L T P	4:0:0
Credits	4
Course Prerequisites	Energy resources
Course Objectives (CO)	1. To create awareness among the students about the different types of renewable energy resources and emphasize its importance 2. To facilitate the students to achieve a clear conceptual understanding of technical and commercial aspects of Wind and Alternative Sources of Energy. 3. To enable the students to develop managerial skills to assess feasibility of alternative approaches and drive strategies regarding Wind and Alternative Sources of Energy.

SYLLABUS

UNIT-I: Renewable energy sources, Energy and Global Climate Change energy parameters, atmospheric aspects of electric energy generation, Impact of renewable energy generation on environment, Electromagnetic Radiation from Extra High Voltage Overhead lines.

UNIT-II: Solar Radiation and its Measurement, Solar Thermal Energy Collectors, Solar Thermal Energy Conversion Systems, Solar Photovoltaic System. Wind turbines and rotors, Modes of Wind Power Generation, Estimation of Wind Energy Potential, Selection of Optimum Wind Energy Generator (WEG), Economics of Wind Farms

UNIT-III: Structure of the Earth's Interior, Geothermal Sites, Geothermal Field, Geothermal Resources, Geothermal Electric Power Plant. Development of a Tidal Power Scheme, Grid Interfacing of Tidal Power, Principle of Wave Energy plant, Wave Energy Conversion Machines.

UNIT-IV: Principle of Operation of Fuel Cell, Fuel Processor, Fuel Cell Types, Energy Output of a Fuel Cell, Efficiency, and EMF of a Fuel Cell, Operating Characteristics of Fuel Cells, Thermal Efficiency of a Fuel Cell. Hydrogen Production, Hydrogen storage, Development of Hydrogen Cartridge, Gas Hydrate. Hybrid Systems and its types, Electric and Hybrid Electric Vehicles, Hydrogen-Powered-Electric Vehicles.

RECOMMENDED BOOKS

S. No	Name	Author(S)	Publisher
1	Renewable energy sources and emerging technologies	Kothari DP, Singal KC and Ranjan Rakesh	Prentice Hall (India)
2	Non-Conventional Sources of Energy	G.D. Rai	Khanna Publishers
3.	Renewable energy Systems	Mittal KM	Wheelar Publishing, New Delhi, 1997

Course Code	EE511-18
Course Title	Power System Software Lab-I
Type of Course	P C
L T P	0:0:2
Credits	1
Course Prerequisites	Power system bus bar design
Course Objectives (CO)	The student will be able to development of algorithms & flowcharts and digital simulation of power system analysis using ETAP/ MATLAB software

SYLLABUS

Development of algorithms, flowcharts and digital simulation of the following using ETAP/MATLAB Software package:

1. Z-bus and Y-bus formulation
2. Load flow studies
3. Fault analysis
4. Transient stability studies

RECOMMENDED BOOKS			
S. No	**Name**	**Author(S)**	**Publisher**
1	Computer Methods in Power System Analysis	G.N. Stagg and A. H.EI- Abiad	Mc Graw– Hill
2	Computer Aided Power Systems Analysis	George L .Kusic	Prentice Hall
3.	Computer Techniques in Power Systems Analysis	M.A. Pai,	Tata McGraw Hill

Course Code	EE502-18
Course Title	Energy Efficient Machines
Type of Course	PC
L T P	4:0:0
Credits	4
Course Prerequisites	Electrical Machines
Course Objectives (CO)	Know-How of energy efficient machinery systems, energy losses and their management.

SYLLABUS

UNIT-I: Energy efficient machines, energy cost and two part tariff, energy conservation in industries and agricultural sector -a necessity, introduction to energy management and energy audit system. Review of induction motor characteristics.

UNIT-II: Standard motor efficiency, energy efficient motors, efficiency determination methods, Direct Measurement method, Loss segregation method, Comparison, motor efficiency labeling, energy efficient motor standards.

UNIT-III: The power factor in sinusoidal systems, power factor improvement, and power factor with nonlinear loads, Harmonics and the power factor. Varying duty applications, Voltage variation, Voltage Unbalance, over motoring, Poly-phase induction motors supplied by adjustable frequency power supplies.

UNIT-IV: Energy Conservation, adjustable speed systems, Application of adjustable speed systems to fans, pumps and constant torque loads.

RECOMMENDED BOOKS

S. No	Name	Author(S)	Publisher
1	Energy efficient electric motors,	Andreas John C.,	Marcel Dekker Inc. 1992.
2	Electric Energy Utilization and Conservation.	Tripathi S.C.,	Tata McGraw-Hill 1991.
3.	Handbook of Modem Electronics and Electrical Engineering,	Belove Charles,	John Wiley and Sons.

Course Code	EE504-18
Course Title	Power System Operation & Control
Type of Course	PC
L T P	4:0:0
Credits	4
Course Prerequisites	Power System
Course Objectives (CO)	1. To demonstrate economic operation of power systems, hydrothermal scheduling. 2. Solve the unit Commitment problem with various constraints 3. Discuss single area and two area load frequency control.

SYLLABUS

UNIT-I:

Characteristics of power generation units(thermal, nuclear, hydro, pumped hydro), variation in thermal unit characteristics with multiple valves, Economic dispatch with and without line losses, lambda iteration method, gradient method, Economic dispatch without line losses, economic dispatch with line losses, lambda iteration method, gradient method, Newton's method, base point and participation factors.

UNIT-II

Introduction to long range and short range hydro scheduling, Types of short range scheduling problem, Scheduling energy. The short term hydro-thermal scheduling problems and its solution by Lambda-Gamma iteration method and gradient method.

UNIT-III:

Constraints in unit commitment, priority list method, Dynamic programming method and Lagrange relaxation methods.

UNIT-IV:

Load frequency control, single area system, multi-area system, tie line control. Take or pay fuel supply contract, composite generation production cost function, gradient search techniques.

RECOMMENDED BOOKS

S. No	Name	Author(S)	Publisher
1	Power generation operation and control	Wood A.J,	Wollenberg B.F
2	Modern Power System Analysis	Kothari D.P. and Nagrath I.J	Tata McGraw-Hill Publishing Company Ltd., New Delhi
3.	Power System Optimization,	Kothari D.P. and Dhillon J.S.	Prentice-Hall of India Pvt. Ltd. New Delhi

Course Code	EE510-18
Course Title	EHVAC & HVDC Transmission System
Type of Course	PE
L T P	4:0:0
Credits	4
Course Prerequisites	Power System
Course Objectives (CO)	1. Mould students to acquire knowledge about EHV AC HVDC transmission Systems its control aspects. 2. Understand about the over voltage and effects on power systems.

SYLLABUS

UNIT-I:

Comparison of EHV AC and DC transmission, description of DC transmission systems, modern trends in AC and DC transmission. Limitations of extra-long AC transmission, Voltage profile and voltage gradient of conductor, Electrostatic field of transmission line, Reactive Power planning and control, traveling and standing waves, EHV cable transmission system.

UNIT-II

Converter configurations and their characteristics, DC link control, converter control characteristics; Monopolar operation, converter with and without overlap, smoothing reactors, transients in DC line, converter faults and protection, HVDC Breakers.

UNIT-III:

Corona and corona loss due to EHV AC and HVDC, Radio and TV interference due to EHV AC and HVDC systems, methods to reduce noise, radio and TV interference.

UNIT-IV:

Component models, solution of DC load flow, per unit system for DC quantities, solution techniques of AC-DC power flow equations, Parallel operation of HVDC/AC systems, Multi terminal systems.

RECOMMENDED BOOKS

S. No	Name	Author(S)	Publisher
1	HVDC Power Transmission Systems,	Padiyar K.R.,	Wiley Eastern Ltd., New Delhi
2	EHV AC Transmission Engineering,	Begamudre R.D.	Wiley Eastern Press
3.	Direct Current Transmission, Vol-I,	Kim bark E.,	John-Wiley and sons, NY

Course Code	EE512-18
Course Title	Advanced Relaying and Protection
Type of Course	PE
L T P	4:0:0
Credits	4
Course Prerequisites	Power System
Course Objectives (CO)	To acquaint the students with various aspects and tools used in the protection of power systems.

SYLLABUS

UNIT-I:

Relay terminology, Definitions, Classification, electromechanical, static and digital-numerical relays. Design-factors affecting performance of a protection scheme for various faults, Instrument transformers for protection.

UNIT-II

Over Current Relay-Instantaneous/Inverse Time –IDMT Characteristics; Directional Relays; Differential Relays- Restraining Characteristics; Distance Relays: Types- Characteristics. Generator, Transformer, Transmission Systems, Bus bars, Motors; Pilot wire and Carrier Current Schemes.

UNIT-III:

Ground faults and protection; Load shedding and frequency relaying; Out of step relaying; Re- closing and synchronizing.

UNIT-IV:

Digital signal processing – Digital filtering in protection relay – digital data transmission – Numeric relay hardware – relay algorithm – distance relays – direction comparison relays – differential relays – software considerations – numeric relay testing –concept of modern coordinated control system. SCADA based protection systems, Testing of Relays.

RECOMMENDED BOOKS

S. No	Name	**Author(S)**	**Publisher**
1	The art and science of protective relaying	Mason C.R	John Wiley &sons, 2002
2	Protective relaying for power generation systems	Reimert Donald	Taylor & Francis-CRC press 2006
3.	Numerical distance protection	Gerhard Ziegler	Siemens, 2nd edition, 2006

Course Code	EE514-18
Course Title	Optimization Techniques
Type of Course	PE
L T P	4:0:0
Credits	4
Course Prerequisites	Optimization
Course Objectives (CO)	1. To acquaint the students with Operation research models using optimization techniques based upon the fundamentals of engineering mathematics 2. Formulation of mathematical models for quantitative analysis of managerial problems in industry

SYLLABUS

UNIT-I:

Statement of an optimization problem, Classification of optimization problems, Optimization techniques, Engg. applications of optimization. Single variable optimization, Multivariable optimization with no constraints, Multivariable optimization with equality constraints, Multivariable optimization with in equality constraints.

UNIT-II

Standard form of linear programming ,Graphical solution, Simplex method, Two phase simplex method, Computer implementation of the simplex method, Duality theory. North-West Corner rule, Least cost method, Vogel approximation method, testing for optimality.

UNIT-III:

Unimodal function, Dichotomous search, Fibonacci search, Quadratic interpolation method, Cubic interpolation method. Random search method, Steepest descent method, Conjugate gradient method, Variable metric method.

UNIT-IV:

Interior Penalty function method, Exterior penalty function method.

RECOMMENDED BOOKS

S. No	Name	Author(S)	Publisher
1.	Optimization : Theory and applications	S.S. Rao	Wiley Eastern Ltd.
2.	Engg. optimization Methods & applications	G.V. Reklaitis	Wiley.

Course Code	EE516-18
Course Title	Industrial Drives & Automation
Type of Course	PE
L T P	4:0:0
Credits	4
Course Prerequisites	
Course Objectives (CO)	The course is designed to give a solid grounding of fundamental concepts of industrial automation systems and their control.

SYLLABUS

UNIT-I:

Definition, Types of loads, steady state and transient stability of Drive, state of art of power lectronics and drives, selection of motor rating.

UNIT-II:

Review of braking and speed control of D.C. motors, multi-quadrant operation, and loss minimization in adjustable speed drives. Mathematical modeling of dc drives, stability analysis, modern control techniques: variable structure, adaptive control.

UNIT-III:

Review of braking and speed control of induction motors. Constant V/F, constant air gap flux, controlled voltage, controlled current and controlled slip operation, vector control, Mathematical modeling of induction motor drives, transient response and stability analysis Introduction to cycloconverter fed induction motor drive.

UNIT-IV:

Adjustable frequency operation, voltage fed drive, current fed self-controlled drive.

Introduction, various components of automation, different sensors used in automation, PLC introduction and ladder programming, industrial application of automation, sensor less vector control and DTC drive, Recent trends in automation and case studies.

RECOMMENDED BOOKS

S. No	Name	Author(S)	Publisher
1	Thyristor Controlled DC Drives,	Sen. P.C.,	Wiley, New York.
2	Power Semiconductor Controlled Drive,	Dubey G.K.,	Prentice Hall, New Jersey
3.	Power Electronics and AC Drives,	Bose B.K.,	Prentice Hall, New Jersey

Course Code	EE518-18
Course Title	Modelling and Dynamics of Electrical Machines
Type of Course	PE
L T P	5:0:0
Credits	5
Course Prerequisites	Electrical machines
Course Objectives (CO)	To aquatint the students with the principles of modeling and analysis of electrical machines

SYLLABUS

UNIT-I:

Challenges in computer simulations, Mechanics of simulation, solution techniques for time domain analysis, introduction of widely used circuit- oriented simulators like pspice, MATLAB, PSIM, equation solvers, simulation of power electronics circuits and converters.

UNIT-II:

Concept, constraints and considerations; modeling and performance simulation methods, concept of reference frame, generalized transformation, formulation of dynamic equations of a generalized machine in arbitrary reference frame.

UNIT-III:

Ideal machine; dynamic equation; transfer function and block diagram; linear analysis of D.C. generators; effects of saturation; analysis and performance under disturbances. Switching and surge voltage transients in transformers. Transients and dynamics; basic electro mechanical equations; linearized and non-linearized analysis; operation on harmonic supplies; unbalanced operation.

UNIT-IV:

Coupled circuit viewpoint; approximate physical picture; equivalent circuit under transient conditions and its applications; synchronous motor operation with variable/fixed load torque and excitation; equal-area criterion for the study of transient stability.

RECOMMENDED BOOKS

S. No	Name	Author(S)	Publisher
1	Electric Machinery	Krause P.C	McGraw Hill
2	Power System Stability Vol 3 Synchronous Machine	Kimbark E.W	John Wiley and Sons
3.	Synchronous machines, Theory and Performance	Concordia C	John Wiley and Sons.

Course Code	EE520-18
Course Title	Neural Network and Fuzzy Logic
Type of Course	PE
L T P	5:0:0
Credits	5
Course Prerequisites	Neural network
Course Objectives (CO)	After the completion of course the students will 1. Get the exposure to Artificial Neural Networks & Fuzzy Logic. 2. Reveal different applications of these models to solve engineering and other problems

SYLLABUS

UNIT-I: Neural networks characteristics, History of development in neural networks principles, artificial neural net terminology , Model of a neuron, Topology, Learning, types of learning, Supervised, Unsupervised, Re-enforcement learning. Knowledge representation and acquisition.

UNIT-II:
Basic Hop filed model, Basic learning laws, Unsupervised learning, Competitive learning, K-means clustering algorithm ,Kohonen's feature maps.

UNIT-III:
Radial basis function neural networks, Basic learning laws in RBF nets, Recurrent back propagation, Introduction to counter propagation networks, CMAC network and ART networks. Application of neural nets such as pattern recognition, Optimization, Associative memories, speech and decision-making. VLSI implementation of neural networks.

UNIT-IV:
Basic concepts of fuzzy logic, Fuzzy vs. Crisp set, Linguistic variable, Membership functions, Operations of fuzzy sets, Fuzzy IF-THEN rules, Variable inference techniques, De-Fuzzification ,Basic fuzzy inference algorithm, Fuzzy system design, FKBC & PID control , Antilock Breaking system(ABS), Industrial applications.

RECOMMENDED BOOKS

S. No	Name	Author(S)	Publisher
1	Electric Machinery	Krause P.C	McGraw Hill
2	Power System Stability Vol 3 Synchronous Machine	Kimbark E.W	John Wiley and Sons
3.	Synchronous machines, Theory and Performance	Concordia C	John Wiley and Sons.

Course Code	EE601-18
Course Title	Load and energy management
Type of Course	PE
L T P	5:0:0
Credits	5
Course Prerequisites	
Course Objectives (CO)	To provide students with a general awareness on 1. the importance of energy, its management and forecasting 2. the importance and strategies of load management

SYLLABUS

UNIT-I:

Classification and characterization of loads, Approaches to load forecasting, Forecasting methodology, Energy forecasting, Peak demand forecasting, Non-weather sensitive forecast and Weather sensitive forecast, Total forecast, Annual and monthly peak demand forecasts. Applications of state estimation to load forecasting

UNIT-II:

Introduction to Load management. Electric energy production and delivery system structure (EEPDS). Design alternatives for EEPD systems. Communication/control techniques for load management. Tariff structure and load management, principles of macro and microeconomics and energy pricing strategies, Assessing the impacts of load management

UNIT-III:

Static and dynamic analysis of energy demand, elements of energy demand forecasting, methodologies and models for energy demand forecasting, techno-economic approach in energy demand forecasting..

UNIT-IV:

Energy management strategy, symbiotic relation between information, energy models and decision making, case studies like industrial energy forecasting, transportation energy forecasting, residential, commercial and agricultural energy forecasting

RECOMMENDED BOOKS

S. No	Name	Author(S)	Publisher
1	Technological Forecasting for Decision Making	Martino J	Elsevier Press, New York.
2	Demand Forecasting in the Electric Utility Industry	Gellings C.W. and Penn Well P.E	Fairmount Press
3.	Forecasting Methods and Applications,	Makridakis S	Wiley

Course Code	EE603-18
Course Title	Real time instrumentation
Type of Course	PE
L T P	5:0:0
Credits	5
Course Prerequisites	
Course Objectives (CO)	Real Time Instrumentation aims to equip students with the necessary and additional computing and hardware skills to be able to work with, and design real time computer systems which are connected as instrumentation and control devices to other electrical and mechanical circuits.

SYLLABUS

UNIT-I:

Static and Dynamic characteristics, Error analysis; transducers and sensors; their characteristics and parameters; role of instrumentation in monitoring, control and industrial automation.

UNIT-II:

Amplifiers, multiplexers and dividers, timer multiplexers, Signal converters, ADC and DAC, Signal conditioning, digital signal conditioning, transmission of digital signals, Telemetry methods and errors, PLCC, AM, FM, PAM, PWM, PCM Techniques.

UNIT-III:

Role of dedicated computers, analog and digital control, computer systems for real time applications, distributed and supervisory control, SCADA and its organization and structure, centralized, hierarchical and decentralized control schemes, man machine interface, energy management system.

UNIT-IV:

Instrumentation and conditioning of drive signals, data acquisition of drive system, energy management system for AGC, VAR Control, state estimation, security monitoring, economic dispatch, on line load management. Power system digital relaying, Power plant instrumentation.

RECOMMENDED BOOKS

S. No	Name	Author(S)	Publisher
1	Power System Control Technology	Torsten Cegrell	PHI, India
2	Power generation operation and control	Wood A. J. and Wollenberg B	John Wiley
3.	Instrumentation for Engineering Management	Cerni R.H and Foster L.E	John Wiley and Sons

Course Code	EE605-18
Course Title	Power System Dynamics and Stability
Type of Course	PE
L T P	5:0:0
Credits	5
Course Prerequisites	
Course Objectives (CO)	The course aims to provide advanced knowledge about dynamic behaviour, stability and control in electric power systems. This will give specialised insight and understanding of the theoretical foundations behind the physical phenomena that are necessary for modelling and control of power systems.

SYLLABUS

UNIT-I:

Angular Stability, Transient stability, steady state stability, dynamic stability, Small Signal, Voltage Stability. Generators (Non-linear and linear models using d-q transformation, power capability curve); Excitation System (IEEE standard models); Turbine and Speed governing System; Loads (Induction motors and composite loads)

UNIT-II:

Single Machine - Infinite Bus System; Equal Area Criterion; Multi-machine Stability; Network Reduction and Numerical Integration Methods; Methods of Improvement.

UNIT-III:

Eigen Value and Participation Factor Analysis; Single machine - Infinite Bus and Multi machine Simulation; Effect of Excitation System and AVR; Improvement of Damping - Power System Stabilizer and SVS supplementary controls. Sub Synchronous Resonance (SSR) Phenomenon; Counter measures to SSR problems

UNIT-IV:

P-V and Q-V curves, Impact of Load and Tap-changer Dynamics; Static Analysis, Sensitivity and Continuation Methods; Dynamic Simulation, Introduction to Bifurcation Analysis; Proximity Indices, Methods to enhance Stability Margin.

RECOMMENDED BOOKS

S. No	Name	Author(S)	Publisher
1	Power System Voltage Stability	Taylor C.W	McGraw Hill
2	Power System Control and Stability	Anderson P.M. and Foud A. A	IEEE Press
3.	Power System Stability	Kim bark E	Vol. I, II and III, IEEE Press

Course Code	EE607-18
Course Title	Organization and Finance in Power Sector
Type of Course	PE
L T P	5:0:0
Credits	5
Course Prerequisites	
Course Objectives (CO)	To help the students to develop cognizance of the importance of financing in power sector

SYLLABUS

UNIT-I:
Organization and Management; The management process; Managerial skills and Managerial performance; Policy and Objectives of a Power Utility; The Goal of a Firm. Balance Sheet, Income Statements and Cash Report; Depreciation; Interest charges during
construction; Financial Statement Analysis.

UNIT-II:
Interest and compounding; Measure of price - public versus private perspective; Economic evaluation of investment proposal; Internal Rate of return, Pay-Back Period

UNIT-III:

Generating system costs; Basic concept of cost levelization; Levelized bus bar cost. Functional structure;Divisional Structure; Matrix structure; Hybrid structure

UNIT-IV:
Main concerns of electric utilities; Performance of electric utilities; Power Sector changes; Dynamic, spot and real time pricing; Regulatory aspects - towards deregulation; System Planning under Evolving Utility Structures Computerized Management Game.

RECOMMENDED BOOKS

S. No	Name	Author(S)	Publisher
1	Management	Bartol K. M. and David C	Martin McGraw-Hill, INC
2	Brigham Essential of Managerial Finance	Weston J.F	Dryden Press
3.	Least-Cost Electric Utility Planning	Stoll	John Wiley

Course Code	EE609-18
Course Title	Power System Reliability
Type of Course	PE
L T P	5:0:0
Credits	5
Course Prerequisites	
Course Objectives (CO)	The course gives the students knowledge on how to use reliability analysis as a tool for decision support during design, operation and maintenance of electric power systems. The application studies are focused on electrical distribution systems.

SYLLABUS

UNIT-I:

Review of probability concepts, probability distributions, applications of binomial distribution to engineering problems, probability distribution in reliability evaluation, reliability indices, network modeling and evaluation of simple and complex networks, system reliability evaluation using probability distributions, frequency and load duration techniques, key indices of power system reliability and their calculations.

UNIT-II:

Concept of loss of load probability (LOLP), Energy demand, EDNS (Energy demand not served),

Evaluation of these indices for isolated systems, generation system, reliability analysis using the frequency and duration techniques.

UNIT-III:

Evaluation of LOLP and EDNS, indices for an isolated transmission system, interconnected system reliability, bulk power system reliability.

UNIT-IV:

Reliability analysis of radial systems with switching.

RECOMMENDED BOOKS

S. No	Name	Author(S)	Publisher
1	Power System Reliability Calculation,	Billinton R	MIT Press, USA
2	Reliability Modeling in Electric Power System	Endreyni,	John Wiley, New York

Course Code	EE-609-18
Course Title	Power System Planning
Type of Course	PE
L T P	5:0:0
Credits	5
Course Prerequisites	
Course Objectives (CO)	• Use the tools required to analyze and evaluate an electric power system for generation planning and load forecasting • Execute production costing analysis and long term generation expansion plans in a deregulated environment

SYLLABUS

UNIT-I:

Power System planning, objective, stages in planning and design, Key indices of power system reliability and their calculations, Linkage between reliability and capacity planning.

UNIT-II:

Probabilistic models of generating units, growth rate, Rate of generation capacity, Outage performance and system evaluation of loss of load and loss of energy indices, Power supply availability assessment. Multi area reliability analysis, Power pool operation and power exchange energy contracts, quantification of economic and reliability benefits of pool operation.

UNIT-III:

Electricity consumption pattern, Peak demand and energy forecasting by trend and economic projection methods. Formulation of least cost optimization problem involving capital, operation and maintenance costs of candidate units of different types.

UNIT-IV:

Traditional generation expansion planning models, integrated resource planning models, production cost simulation models.

RECOMMENDED BOOKS

S. No	Name	Author(S)	Publisher
1	Power System Planning	Wallach Y	McGraw Hill International
2	Power System Planning	Sullivan P	McGraw Hill International
3	Electric Power System Planning	Dasari, S.	IBT Publishers, New Delhi.