Course Scheme & Syllabus

For

M. Tech. in Electrical Engineering

1^{st} TO 4^{th} SEMESTER

Session 2018-19
## Scheme of Courses
### M. Tech. in Electrical Engineering
#### Semester-1

<table>
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<tr>
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<th>Course Code</th>
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**L: Lectures  T: Tutorial  P: Practical  Cr: Credits**

## Scheme of Courses
### M. Tech. in Electrical Engineering
#### Semester-2

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**L: Lectures  T: Tutorial  P: Practical  Cr: Credits**
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**M. Tech. in Electrical Engineering**
**Semester-3**

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L: Lectures  T: Tutorial  P: Practical  Cr: Credits

### Scheme of Courses
**M. Tech. in Electrical Engineering**
**Semester-4**

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Detailed Syllabus
Course Title: Research Methodology  
Course Code: MGT551  
Course Objective: The course is designed to introduce the students to research methodology and application of research techniques and procedures. The primary goal of this course is to develop a sound understanding of research methods.  
Learning Outcomes: The students will be able to apply the various research methods by using computerized data analysis softwares to solve the real life problems.

### Unit – A

- **Introduction to Research**: Meaning of Research, Objectives of Research, Types of Research, Research Approaches, Significance of Research, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India.  
- **Defining the Research Problem**: What is a Research Problem?, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem  

### Unit – B

- **Sampling design and Procedures**: Sample or Census, The Sampling Design Process, A Classification of Sampling Techniques, Choosing Nonprobability Versus Probability Sampling, Uses of Non probability Versus Probability Sampling.  
- **Measurement and Scaling**: Non-comparative Scaling Techniques, Continuous Rating Scale, Itemized Rating Scale, Non-comparative Itemized Rating Scale Decisions, Multi-item Scales, Scale Evaluation, Choosing a Scaling Technique.  
- **Methods of Data Collection**: Collection of Primary Data, Observation Method, Interview Method, Collection of Data through Questionnaires, Collection of Data through Schedules, Some Other Methods of Data Collection, Collection of Secondary Data, Selection of Appropriate Method for Data Collection.  
- **Questionnaire & form design**: questionnaire & observation forms, questionnaire design process.

### Unit – C
• **Data preparation:** editing, coding, transcribing  
  1 Hours

• **Data analysis:** tests of significance based on t, f and z distribution and chi-square test; cross tabulation  
  3 hours

• **Multiple Regression:** Overview of Multiple Regression, Statistics Associated with Multiple Regression, Conducting Multiple Regression, Stepwise Regression, Multicollinearity  
  3 hours

• **Discriminant Analysis:** Discriminant Analysis Model, Statistics Associated with Discriminant Analysis, Conducting Discriminant Analysis  
  4 hours

• **Conjoint Analysis:** Basic Concepts in Conjoint Analysis, Statistics Associated with Conjoint Analysis, Conducting Conjoint Analysis, Assumptions & Limitations of Conjoint Analysis, Hybrid Conjoint Analysis  
  4 hours

**Unit – D**

• **Multi Dimensional Scaling:** Basic Concepts in Multidimensional Scaling (MDS), Statistics Associated with MDS, Conducting Multidimensional Scaling, Selecting an MDS Procedure, Deciding on the Number of Dimensions, Labeling the Dimensions & Interpreting the Configuration, Assessing Reliability and Validity, Assumptions & Limitations of MDS, Scaling Preference Data  
  3 hours

• **Correspondence Analysis:** Relationship between MDS, FA, & DA  
  2 hours

• **Factor Analysis:** Factor Analysis Model, Statistics Associated with Factor Analysis, Conducting Factor Analysis, Applications of Common Factor Analysis  
  3 hours

• **Cluster Analysis:** Statistics Associated with Cluster Analysis, Conducting Cluster Analysis, Applications of Non-hierarchical Clustering, Clustering Variables.  
  5 hours

• **Research Report Writing:** Contents of Report, Executive Summary, Bibliography format. Presentation of Report.  
  2 hours

**Total 45 hours**

**Suggested Books:**

Course Title: Modern Power System Analysis  
Paper Code: ELE501A

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Course Objective: The main portion of the course will refer to modelling of power systems, short circuit calculations, and load flow algorithms and methods. Students will learn how to apply these fields with theory topics such as voltage regulation, VAR control, and relay setting and coordination.

Unit-A  

Unit-B  
**Reactive Power compensation and voltage control Methods:** Mathematical Relation between Reactive power and system voltage, Generators and consumers of Reactive power, Variation of voltage as a function of distance of line. Working of shunt capacitor, series capacitor, synchronous capacitor, tap changing transformer, detail comparison between shunt and series capacitors. Static VAR compensation.

Unit-C  

Unit-D  
**Deregulation:** Motivation of restructuring of power system, electricity market entities and model, benefits of deregulation, international scenario, operation in power market, power pools, transmission networks and electricity markets, principle of ATC determination,
methods of static ATC determination, ATC calculation using MATLAB, cost component of transmission components.

**Suggested Books:**

Unit –A


Unit –B

**Modelling of Power System Components:** Introduction, Review of Per Unit Three-Phase Quantities, Modelling & Equivalent Circuit: Synchronous Machine, Two winding transformer, Power System stabilizer (PSS), Governor, Exciter, Transmission Line (Short, Medium & Long), Modelling of Power Network.


Unit –C

**Power System Compensation using FACT Devices:** Introduction, Reactive Power requirement of an uncompensated line, concept of surge impedance loading, operation of transmission line at no load and heavy loading, FACTS: SVC, STATCOM, TCSC, UPFC.

Unit-D

**Power Quality:** Introduction, Theory of Harmonics, Characteristics of Harmonics in Power System, Causes of Harmonics in power systems, Effect of harmonic distortion on power systems, Mitigation of power system harmonics.

**Suggested Books:**

4. Benjamin C. Kuo, Automatic Control system, Prentice Hall of India Pvt Ltd.
Course Title: Advanced Electric Drives
Paper Code: ELE503A

Unit-A

**Study of Motor Drives:** Electrical Drives, Advantages of Electrical Drives, Electrical Motors, Power Modulators, Choice of electrical Drives, Fundamentals of Torque Equations, Speed Torque Conventions and Operation, Components of Load Torques, Nature and Classification of Load Torques, Control of Electrical Drives, Braking of electric motors, starting of electric motors.

Unit-B

**Dynamics and Steady State Performance of DC/AC Drives:** Basic elements of electric drives, dynamic conditions of drive system, Closed Loop Control of Drives, DC Choppers, methods for controlling choppers, Chopper Controlled DC Drives, ratings of choppers and their general applications, three phase inverters and their voltage control, cycloconverters, AC voltage controller Controlled Rectifier Fed DC Drives.

Unit-C

**Control techniques for Electrical Drives:** Control of induction motor, synchronous motor drives. Block diagram representation of an electric drive system, signal flow representation, transfer function, transient response of close loop drive system, frequency response approach, stability of controlled drives, compensation and the use of controllers to improve the performance.

Unit D

**Drives for Specific Applications:** Drive Considerations for Textile Mills, Steel Rolling Mills, Cranes and Hoist Drives, Cement Mills, Sugar Mills, Machine Tools, Paper Mills, Coal Mines, Centrifugal Pumps. Microprocessors and Control of Electrical Drives: Dedicated Hardware Systems versus Microprocessor Control, Application Areas and
Functions of Microprocessors in Drive Technology, Control of DC Drives using Microprocessors.

**Suggested Books:**

Course Objectives: The objective of the course is to enable the students to understand the Operation and Control Strategies used in Electric Power Systems.

Unit-A

Introduction: Structure of power systems, operating stages, Power system control centre and real time computer control, SCADA system Level decomposition in power system, Power system security, Various operational stages of power system, Power system voltage stability, Preventive and Emergency control, Indian Electricity Grid Code, Co-ordination between different agencies in India.

Unit-B


Unit-C

Multi-control Area system: Introduction, pool operation, two area system, Modelling the tie line, static and dynamic response of two area systems, Tie line bias control, state-space representation of two area systems .Generation allocation. Modern implementation of AGC Scheme, Effect of GRC and speed governor dead-based on AGC

Excitation systems: Introduction, Elements of excitation systems .Types of Excitation systems, Digital Excitation system modelling

Unit-D

Automatic Voltage Control: Schematic diagram and block diagram representation, different types of Excitation systems & their controllers. Voltage and Reactive Power control: Concept of voltage control, methods of voltage control-control by tap changing transformer. Shunt Compensation, series compensation, phase angle compensation

Optimum operating strategies: introduction Generation Mix, Characteristic of steam and Hydro-electric units, optimum economic dispatch-neglecting Loss and with Transmission Loss, Computational steps, Derivation of Loss formula, calculation from jacobian matarix equation, Economic Dispatch for hydrothermal Plants short term hydrothermal scheduling, Hydraulic co-ordination, Reactive power scheduling.

Suggested Books:

Course Title: Electrical Power System Laboratory  
Paper Code: ELE505A

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**List of Experiments**

1. Introduction to power word simulator
2. Design a two bus, two generator & two load network.
3. Design five bus, two generator & four load network.
4. Design a three bus, two generator & one load network. Also find the solution using Ybus.
5. Design a six bus, three generator & three load network to find the solution using Ybus.
6. Develop MATLAB program for YBUS formation.
7. Develop MATLAB program for G-S Load Flow Analysis.
10. Develop MATLAB program for Short Circuit Analysis.
Course Title: Power System Dynamics Laboratory
Paper Code: ELE506A

List of Experiments

1. Introduction to MATLAB environment
2. Introduction to MATLAB Simulink
3. Create a program to calculate machine parameters using MATLAB
4. Create a program to calculate SVC using MATLAB
5. Create a program to calculate TVSC using MATLAB
6. Create a program to calculate K-constants using MATLAB
7. Power Flow Analysis using Power Flow Analysis Tool (P-SAT)
8. Create a program to calculate Eigen values using MATLAB
10. Determination of Sequence Impedances of a Cylindrical Rotor Synchronous Machine
11. Fault Analysis:
   
   Single Line to Ground fault (L-G).
   Line to Line fault (L-L).
   Double Line to Ground fault (L-L-G).
   Triple Line to Ground fault (L-L-L-G).

13. Determination of Sequence Impedances of Three Phase Transformer
14. To Study the characteristics of Over Current Relays
   
   IDMT Electromagnetic Relay (7051 A).
   Microprocessor based Relay (7051 B)
15. To Study the characteristics of Percentage biased Differential Relay.
   
   Electromagnetic Relay (7054 A).
   Static Relay (7054 B).
16. To Study the characteristics of Over Voltage Relay.

   i. Electromagnetic Relay (7053 A).
   ii. Microprocessor based Relay (7053 B).

17. Characteristics of Under Voltage (UV) and Negative sequence Relays
   i. UV Electromagnetic Relay (7052 A).
   ii. UV Microprocessor based Relay (7052 B).
   iii. Static Negative Sequence Relay (7055 B).

22. Differential protection on Single Phase Transformer.
Objective: The objective of the course is to enable the students to understand the Economic Operation of Generating Units and Their scheduling along with Hydro-Thermal, Wind-Thermal and Unit Commitment used in Electric Power Systems.

Unit-A


Unit-B

Economic Load Dispatch Of Thermal Generating Units: Generator operating cost, Optimal generation scheduling, Loss Coefficient Calculations, Classical ELD problem with and without transmission loss, its various constraints and concept of lagrangian multiplier. Economic Load Dispatch Based on penalty factors.

Unit-C


Wind-Thermal Scheduling: Introduction, wind potential in India, and Future Scope, ELD problem formulations and solutions technique for wind-thermal system.

Unit-D

Multi-objective Generation Scheduling: Multi-objective optimization, Weighting Method, Min-Max Method, utility function Method, Fuzzy Set theory in power system, Multi-objective Problem Formulations, the Surrogate Worth Trade –Off Function (SWT)

Unit Commitment: Introduction, significance various soft and hard constraints in unit commitment, thermal unit constraints Hydro-constraints, unit commitment solution methods: Exhaustive Enumeration-priority list method, Dynamic programming method, Lambda Relaxations method etc., Introduction to Multi-Objective Unit Commitment Problem

Suggested Texts:

Course Title: Design of Electrical Machines

Paper Code: ELE514A

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Course Objective: The objective of the course is to enable the students to understand the concepts related to Designing and Testing of various Electrical Machines i.e. Transformer, Induction Motor, Synchronous machines.

Unit-A

Design of Transformers: Review of Constructional details of Transformers, core & shell types, Distribution & power transformers, Core & core materials, windings, Cooling of transformers, tank, transformer oil, cooling tubes conservators & breathers

Output equation, EMF per turn ratio of iron loss to copper loss, Yoke design for single phase & 3 phase transformers, Window dimensions, winding design, Transformer oil & specifications & insulation details, Tank & cooling tubes design, Resistance, leakage reactance of winding calculation of no load current, equivalent circuit, performance characteristics

Unit-B

Design of Three phase Induction Motor: Review of Three phase induction motors, No load current, magnetizing current, loss component short circuit current, Resistance, leakage reactance equivalent circuit, Use of circle diagram to obtain performance figures, Calculation of torque, maximum torque, maximum output, Output equation, specific electric & magnetic loadings efficiency & power factor, Design of main dimensions, Stator core & winding design, Calculation of air-gap length, Design of squirrel cage rotor, rotor bar currents, elimination of harmonic torques, rotor slot insulation, endring currents, area of end ring, Design of wound motor rotor, Rotor slot design, rotor stampings

Unit-C
**Single Phase Induction Motors Design:** Review of Single phase Induction Motors, Types & constructional details, construction of stator, stator windings, rotor, starting switches, electrolytic capacitor, Output equation, specific loadings, Main dimensions, Relative sizes of single phase & 3-phase induction motors, Design of stator, main winding, starting winding, nos, of stator slots, size of stator slot, stator teeth, stator core length of mean turn & air gap length, Design of rotor, numbers of rotor slots, Area of rotor bars, area of end rings, rotor core & teeth, rotor resistance MMF for air gap, saturation factor, Iron, friction & windage losses, Rotor resistance, leakage reactance calculations, Equivalent circuit, running performance, pull-out torque, Design of auxiliary winding for capacitor start/run motors, Length of mean turn, starting torque

**Unit-D**

**Design of synchronous machine (Smooth cylindrical rotor):** Review of construction of water wheel & turbo alternators, Different parts & materials used for different parts, Choice of electric & magnetic loadings, Output equation, Determinate of diameter & length, Length of air-gap & main dimensions, effect of short circuit ratio on machine performance, Rotor design

**Design of synchronous machine (Salient pole rotor):** Design of salient pole rotor, Sectional area & type of pole, pole height, damper winding, Design of field winding, Direct & quadrature axis synchronous reactance, MMF for magnetic circuit, Estimating full load field mmf, Design of turbo-generator, Estimation of length of air-gap.

**Suggested Books:**

2. Mittle V. N., Design of Electrical Machine (DC & AC), Standard Publishers & Distributors, Delhi,
Course Title: Power System Planning and Reliability

Paper Code: ELE621A

Course Objective:
The objective of the course is to enable the students to understand the concepts related to Power System Planning and Reliability of Power System.

Unit-A

Introduction: Hierarchy of modern power system planning, Brief description about short term and long term planning, Introduction to Reliability Engineering: Definition of reliability, Probabilistic reliability, Repairable and non-repairable items, the pattern of failures with time (non-repairable and repairable items).

Generation Expansion Planning: fundamentals, Economic analysis, planning including maintenance scheduling.

Unit-B


Reliability Mathematics: The general reliability function, The exponential distribution, Mean time to failure and repair, series and parallel systems, Markov processes, System reliability using network and state space method.

Unit-C


Unit-D

Spinning Generating Capacity Reliability Evaluation: Introduction, Spinning capacity evaluation, Derated capacity levels.

Transmission System Reliability Evaluation: Average interruption rate method, the frequency and duration approach, Stormy and normal weather effects, The Markov processes approach, System studies.

Suggested Books:


Course Title: Computer Aided Design of Electrical Machines
Paper Code: ELE651

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Course Objective:
The objective of the course is to enable the students to understand the concepts related to Computer Aided Design of Electrical Machines

Unit-A
Introduction
Computer aided design of electrical machines - Conventional design procedures - Analysis and synthesis methods - Limitations - Need for field analysis based design.

Unit-B
Mathematical Formulation of Field Problems

Unit-C
Philosophy of FEM

Unit-D
CAD Packages
Suggested Books:


9. User Manuals of Software Packages like MAGNET, ANSOFT & ANSYS.
Course Title: Power System Transients

Paper Code: ELE652

Course Objective: To understand generation of switching and lighting transients, their propagation, reflection and refraction on the grid and their impact on the grid equipment. To develop a basic understanding of the transient effect of lightning, faults, and switching on power systems. Provide a basic understanding of the principles used to protect power system equipment from transients. Introduce the student to the software used to analyze power system transients.

Unit-A

Introduction and Survey: Source of transients, various types of power systems transients, effect of transients on power systems, importance of study of transients in planning.


Unit-B

Lightning Transients: Causes of over voltage, lightning phenomenon, charge formation in the clouds, rate of charging of thunder clouds, mechanisms of lighting strokes, characteristics of lightning strokes; factors contributing to good line design, protection afforded by ground wires, tower footing resistance. Interaction between lightning and power system: Mathematical model for lightning.
Unit-C

Travelling Waves On Transmission Line Computation Of Transients

Computation of transients: Transient response of systems with series and shunt lumped parameters and distributed lines. Travelling wave concept: step response, Bewely’s lattice diagram, standing waves and natural frequencies, reflection and refraction of travelling waves.

Unit-D

Transients In Integrated Power System: The short line and kilometric fault, distribution of voltage in a power system: Line dropping and load rejection; voltage transients on closing and reclosing lines; over voltage induced by faults; switching surges on integrated system; EMTP for transient computation.

Suggested Books:

Course Title: Advanced Power Electronics and Drives

Paper Code: ELE517

Course Objective:
The objective of the course is to enable the students to understand the basic concepts related to Analysis of power electronics converter.

Unit-A

Single Phase AC voltage Controllers
Review of Power Electronics Devices, Single Phase AC Voltage Controllers with RL and RLE loads-ac voltage controller’s with PWM control-Effects of source and load inductances–synchronous tap changers–Application- numerical problems

Three Phase AC Voltage Controllers
Three Phase AC Voltage controllers-Analysis of Controllers with star and delta connected resistive, resistive –inductive loads-Effects of source and load inductances–Application- numerical problems.

Unit-B

Single phase ac-dc converters
Single phase Half controlled and Fully controlled Converters with RL load– Evaluation of input power factor and harmonic factor-Continuous and Discontinuous load current-Power factor improvements-Extinction angle control-symmetrical angle control-PWM single phase sinusoidal PWM-Single phase series converters- numerical problems

Three Phase ac-dc Converters
Three Phase ac-dc Converters- Half controlled and fully controlled Converters with RL load– Evaluation of input power factor and harmonic factor-Continuous and Discontinuous load current-three phase dual converters-Power factor improvements-three phase PWM-twelve pulse converters- numerical problems

Unit-C

Power Factor Correction Converters
Single-phase single stage boost power factor corrected rectifier, power circuit principle of
operation, and steady state- analysis, three phase boost PFC converter

**Single phase PWM Inverters**

Principle of operation-Voltage control of single phase inverters - sinusoidal PWM – modified PWM – phase displacement Control – Trapezoidal, staircase, stepped, harmonic injection and delta modulation – numerical problems

**Unit-D**

**Three Phase PWM Inverters**

Voltage Control of Three-Phase Inverters- Sinusoidal PWM- 60° PWM- Third Harmonic PWM- Space Vector Modulation- Comparison of PWM Techniques-current source inverters-Variable dc link inverter - numerical problems

**Multi level inverters**


**Introduction to AC Drives**-IGBT/IGCT based AC Drive for Induction Motors- Single/Four Quadrant operations in AC Drives-AC Drives options, features, systems & configurations-AC Drives Braking Methods -AC Drives selections & applications -AC Drives for Synchronous Motors

**Suggested Books:**


Course Title: HVDC/EHVAC Transmission
Paper Code: ELE513

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Course Objective:
The objective of the course is to enable the students to understand the concepts related to HVDC/EHVAC Transmission.

Unit-A

Overview: Comparison of EHV AC and DC transmission, description of DC transmission systems, modern trends in AC and DC transmission.

EHV AC Systems: 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-B

Static Var System: Reactive VAR requirements, Static VAR systems, SVC in power systems, design concepts and analysis for system dynamic performance, voltage support, damping and reactive support.

HVDC System: 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-C

Corona and Interference: 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.

Harmonic Filters: Generation of harmonics, design of AC filters, DC filters

Unit-D

Power flow analysis in AC/DC systems: 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.

Suggested Books:
Course Title: Automatic Control of DC drives
Paper Code: ELE670

Objective:
The objective of the course is to enable the students to understand the basic concepts related to automatic speed control of DC machines.

Unit-A

Speed Torque characteristics of DC Motors
Separately excited DC motors, Shunt motor, series motor and compound motor

Controlled Bridge Rectifier (1-Φ) with DC Motor Load
Separately excited DC motors with rectified single phase supply- single phase semi converter and single phase full converter for continuous and discontinuous modes of operation – power and power factor.

Unit-B

Controlled Bridge Rectifier (3-Φ) with DC Motor Load
Three phase semi converter and three phase full converter for continuous and discontinuous modes of operation – power and power factor – Addition of Free wheeling diode – Three phase double converter.

Three phase naturally commutated bridge circuit as a rectifier or as an inverter
Three phase controlled bridge rectifier with passive load impedance, resistive load and ideal supply – Highly inductive load and ideal supply for load side and supply side quantities, shunt capacitor compensation, three phase controlled bridge rectifier inverter.

Unit-C

Closed loop control of phase controlled DC motor Drives
Open loop Transfer function of DC Motor drive- Closed loop Transfer function of DC Motor drive – Phase-Locked loop control.

Chopper controlled DC motor drives
Principle of operation of the chopper – Four quadrant chopper circuit – Chopper for inversion – Chopper with other power devices – model of the chopper – input to the chopper – Steady state analysis of chopper controlled DC motor drives – rating of the devices.

Unit-D

Closed loop control of chopper fed DC motor Drives
Speed controlled drive system – current control loop – pulse width modulated current controller – hysteresis current controller – modeling of current controller – design of current controller

Simulation of DC motor Drives
Dynamic simulations of the speed controlled DC motor drives – Speed feedback speed controller – command current generator – current controller.

REFERENCES
2. Power Electronic Circuits, Devices and Applications – M. H. Rashid – PHI.
Course Title: Special Electrical Machines  
Paper Code: ELEE663

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UNIT-A

Poly-phase AC Machines: Construction and performance of double cage and deep bar three phase induction motors; e.m.f. injection in rotor circuit of slip ring induction motor, concept of constant torque and constant power controls, static slip power recovery control schemes (constant torque and constant power)

UNIT-B

Single phase Induction Motors: Construction, starting characteristics and applications of split phase, capacitor start, capacitor run, capacitor start capacitor-run and shaded pole motors.

Two Phase AC Servomotors: Construction, torque-speed characteristics, performance and applications.

UNIT-C

Stepper Motors: Principle of operation, variable reluctance, permanent magnet and hybrid stepper motors, characteristics, drive circuits and applications.

Switched Reluctance Motors: Construction; principle of operation; torque production, modes of operation, drive circuits.

UNIT-D

Permanent Magnet Machines: Types of permanent magnets and their magnetization characteristics, demagnetizing effect, permanent magnet dc motors, sinusoidal PM ac motors, brushless dc motors and their important features and applications, PCB motors.

Single phase synchronous motor: construction, operating principle and characteristics of reluctance and hysteresis motors; introduction to permanent magnet generators.

Single Phase Commutator Motors: Construction, principle of operation, characteristics of universal and repulsion motors; Linear Induction Motors. Construction, principle of operation, Linear force, and applications.

Suggested Books:

5. Say M.G., Alternating current Machines Pitman & Sons
Course Title: Flexible AC Transmission Systems
Paper Code: ELE653

Course Objective:

The objective of the course is to enable the students to understand the basic Fundamentals of FACT devices.

UNIT-A

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-B

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.

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-C

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-D

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.

Suggested Books:

Course Title: Power Station Design
Paper Code: ELE654

UNIT-A

Introduction: Electric energy demand and growth in India, electric energy sources.

Thermal Power Plant: Site selection, general layout and operation of plant, detailed description and use of different parts.

Hydro Electric Plants: Classifications, location and site selection, detailed description of various components, general layout and operation of Plants, brief description of impulse, reaction, Kaplan and Francis turbines, advantages & disadvantages, hydro-potential in India

UNIT-B

Nuclear Power Plant: Location, site selection, general layout and operation of plant. Brief description of different types of reactors Moderator material, fissile materials, control of nuclear reactors, disposal of nuclear waste material, shielding.

Gas Turbine Plant: Operational principle of gas turbine plant & its efficiency, fuels, open and closed-cycle plants, regeneration, inter-cooling and reheating, role and applications.

Diesel Plants: Diesel plant layout, components & their functions, its performance, role and applications

UNIT-C

Sub-stations Layout: Types of substations, bus-bar arrangements, typical layout of substation.

Power Plant Economics and Tariffs: Load curve, load duration curve, different factors related to plants and consumers, Cost of electrical energy, depreciation, generation cost, effect of Load factor on unit cost. Fixed and operating cost of different plants, role of load diversity in power system economy. Objectives and forms of Tariff; Causes and effects of low power factor, advantages of power factor improvement, different methods for power factor improvements.

UNIT-D


Non Conventional Energy Sources: Power Crisis, future energy demand, role of Private sectors in energy management, MHD generation: Working principle, open and closed cycles, MHD systems, advantages, parameters governing power output.

Solar power plant: Conversion of solar heat to electricity, Solar energy collectors, Photovoltaic cell, power generation, future prospects of solar energy use.

Wind Energy: Windmills, power output with combined operation of wind turbine generation and isolated generating system, technical choices & economic size.

Geothermal Energy: Earth energy, heat extraction, vapor turbine cycle, difficulties & disadvantages.

Tidal energy: Tidal phenomenon, tidal barrage, tidal power Schemes.


Suggested Books:
Course Title: High Voltage Engineering  
Paper Code: ELE655  

UNIT-A  
Introduction To High Volatge Engineering: Electric Field Stresses, Gas / Vacuum as Insulator, Liquid Dielectrics, Solids and Composites, Estimation and Control of Electric Stress, Numerical methods for electric field computation, Surge voltages, their distribution and control, Applications of insulating materials in transformers, rotating machines, circuit breakers, cable power capacitors and bushings.  

UNIT- B  
Break Down In Dielectric Materials: Gases as insulating media, collision process, Ionization process, Townsend’s criteria of breakdown in gases, Paschen’s law. Liquid as Insulator, pure and commercial liquids, breakdown in pure and commercial liquids. Intrinsic breakdown, electromechanical breakdown, thermal breakdown, breakdown of solid dielectrics in practice, Breakdown in composite dielectrics, solid dielectrics used in practice.  

UNIT-C  

UNIT-D  
Over Voltages & Insulation Co-Ordination: Natural causes for over voltages – Lightning phenomenon, Overvoltage due to switching surges, system faults and other abnormal conditions, Principles of Insulation Coordination on High voltage and Extra High Voltage power systems.  
Suggested Books:

5. Mazen Abdel Salam, Hussein Anis, Ahdan El-Morshedy, Roshdy Radwan, Marcel Dekker, High Voltage Engineering, Theory and Practice
Course Title: Power system Reliability

Objective: To develop a basic understanding of the reliability analysis for generation, distribution used for Electrical power system optimization.

Unit-A:
Generating system reliability analysis: Generation system model, capacity outage probability tables, recursive relation for capacitive model building, sequential addition method, unit removal, evaluation of loss of load and energy indices

Unit-B:
Bulk power system reliability evaluation: Basic configuration, conditional probability approach, system and load point reliability indices, weather effects on transmission lines, weighted average rate and markov model, common mode failures.

Unit-C:
Inter connected system reliability analysis: Probability array method, two inter connected systems with independent loads, effects of limited and unlimited tie capacity, imperfect tie, two connected systems with correlated loads, expression for cumulative probability and cumulative frequency

Unit-D:
Distribution system reliability analysis (radial configuration): Basic techniques, radial networks, evaluation of basic reliability indices, performance indices, load point and system reliability indices, customer oriented, loss and energy oriented indices.

Suggested Texts:
Course Title: Power System Optimization Laboratory
Paper Code: ELE516

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Course Objective: This course provides a practical aspect of various optimization algorithm.

Learning Outcomes: After the completion of this course the participants would gain the knowledge of

List of Experiments

To solve Load Flow Analysis, Economic Load Dispatch, Hydro-Thermal Generation Scheduling and Short Term Unit Commitment Problem using Various Optimization Algorithm such as:

1. Particle Swarm Optimization (PSO)
2. Ant Colony Optimization (ACO)
3. Genetic Algorithm (GA)
4. Pattern Search Algorithm (PSA)
5. Min-Max Algorithm
6. Grey Wolf Optimizer (GWO)
7. Gravitational Search Algorithm (GSA)
8. Guided Gravitation Search Algorithm (GGSA)
9. Binary Gravitational Search Algorithm (BGSA)
10. Hybrid PSO-GSA Algorithm etc.
11. Ant Lion Optimizer
12. Moth Flame Optimizer
13. Dragonfly Optimizer
14. Multi Verse Optimizer
Course Title: Seminar
Paper Code: ELE550

Institution: DAV UNIVERSITY, JALANDHAR

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**Course Objectives:** To assess the debating capability of the student to present a technical topic. Also to impart training to a student to face audience and present his ideas and thus creating in him self esteem and courage that are essential for an engineer.

Individual students are required to choose a topic of their interest from energy related engineering topics preferably from outside the M.Tech syllabus and give a seminar on that topic about 30 minutes followed by a 10 minutes session for discussion/question and answers. A committee consisting of at least three faculty members (preferably specialized in Electrical Engineering) shall assess the presentation of the seminar and award marks to the students. Each student shall submit two copies of a write up of his / her seminar topic. One copy shall be returned to the student after duly certifying it by the Chairman of the assessing committee and the other will be kept in the departmental library. Internal continuous assessment marks are awarded based on the relevance of the topic, presentation skill, quality of the report and participation.

**Note:**

(i) The seminar topic selected by the student must be approved by the authorized faculty of the department at least two weeks in advance.

(ii) Each student has to submit to the department a seminar report at least three days before the day of seminar.

(iii) Each student has to make the Power Point presentation with multi-media projector.
Course Title: Energy Auditing, Conservation and Management

Paper Code: ELE659

UNIT-A

**Basic Principles Of Energy Audit:** Energy audit- definitions, concept, types of audit, energy index, cost index, pie charts, Sankey diagrams, load profiles, Energy conservation schemes - Energy audit of industries- energy saving potential, energy audit of process industry, thermal power station, building energy audit.

UNIT-B

**Energy Management:** Principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting- Energy manger, Qualities and functions, language, Questionnaire – check list for top management.

**Energy Efficient Motors:** Energy efficient motors, factors affecting efficiency, loss distribution, constructional details, characteristics - variable speed, variable duty cycle systems, RMS hp, voltage variation-voltage unbalance- over motoring- motor energy audit

UNIT-C

**Power Factor Improvement, Lighting And Energy Instruments:** Power factor – methods of improvement, location of capacitors, Pf with non linear loads, effect of harmonics on power factor, power factor motor controllers - Good lighting system design and practice, lighting control, lighting energy audit - Energy Instruments- wattmeter, data loggers, thermocouples, pyrometers, lux meters, tongue testers, application of PLC’s.

UNIT-D

**Economic Aspects And Analysis:** Economics Analysis-Depreciation Methods, time value of money, rate of return, present worth method, replacement analysis, life cycle costing analysis- Energy efficient motors- calculation of simple payback method, net present worth method-Power factor correction, lighting - Applications of life cycle costing analysis, return on investment.

**Suggested Books:**

3. Turner W.C., Energy management hand book John wiley and sons
5. Energy management and good lighting practice: fuel efficiency- booklet12-EEO.
Objective: To develop a basic understanding of the organisation and finance in Power System. Provide a basic understanding of the finance, investment proposals, industry status and trends

Unit-A

MANAGEMENT AND ITS GOALS:
Organization and Management; The management process; Managerial skills and Managerial performance; Policy and Objectives of a Power Utility; The Goal of a Firm.

UTILITY FINANCIAL ACCOUNTING: Balance Sheet, Income Statements and Cash Report; Depreciation; Interest charges during construction; Financial Statement Analysis.

Unit-B

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

LEVELIZED COSTS OF GENERATION:
Generating system costs; Basic concept of cost levelization; Levelized bus bar cost.

Unit-C

ELECTRICITY TARIFFS: Traditional Approach; Long-run Marginal costs; General Principles of Tariff Construction; Objectives of tariff.

UTILITY ORGANIZATION: Functional structure; Divisional Structure; Matrix structure; Hybrid structure.

Unit-D

INDUSTRY STATUS AND TRENDS: 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.
BOOKS RECOMMENDED:

Course Title: Distribution Automation

Paper Code: ELE661

Objective: To develop a basic understanding of the Electrical Distribution Automation in Power System. Provide a basic understanding of the principle and implementation of Distribution Automation and their technical benefits.

Unit-A

Distribution Automation And The Utility System: Intro to Distribution Automation (DA), control system interfaces, control and data requirements, centralized (Vs) decentralized control, DA System (DAS), DA Hardware, DAS software.

Unit-B

Distribution Automation Functions: DA capabilities, Automation system computer facilities, management processes, Information management, system reliability management, system efficiency management, voltage management.

Unit-C

Communication Systems For DA: DA communication requirements, Cost effectiveness, Data rate Requirements, Two way capability, Ability to communicate during outages and faults, Ease of operation and maintenance, Conforming to the architecture of data flow, Communication systems used in DA.

Unit-D


Suggested Texts:


UNIT-A

Photo voltaic power generation, spectral distribution of energy in solar radiation, solar cell configurations, voltage developed by solar cell, photo current and load current, practical solar cell performance, commercial photo voltaic systems, test specifications for PV systems, applications of super conducting materials in electrical equipment systems.

UNIT-B


UNIT-C

Tides and tidal power stations, modes of operation, tidal project examples, turbines and generators for tidal power generation. Wave energy conversion: properties of waves and power content, vertex motion of Waves, device applications. Types of ocean thermal energy conversion systems Application of OTEC systems examples

UNIT-D

Miscellaneous energy conversion systems: coal gasification and liquefaction, biomass conversion, geothermal energy, thermo electric energy conversion, principles of EMF generation, description of fuel cells, Co-generation and energy storage, combined cycle co-generation, energy storage. Global energy position and environmental effects: energy units, global energy position.

Types of fuel cells, H2-O2 Fuel cells, Application of fuel cells – Batteries, Description of batteries, Battery application for large power. Environmental effects of energy conversion systems, pollution from coal and preventive measures steam stations and pollution, pollution free energy systems.

Suggested Books:

Course Title: Dissertation Part-1
Paper Code: ELE600

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**Course Objectives:** To improve the professional competency and research aptitude by touching the areas which otherwise not covered by theory or laboratory classes. The dissertation work aims to develop the work practice in students to apply theoretical and practical tools/techniques to solve real life problems related to industry and current research.

The dissertation work can be a design project / experimental project and or computer simulation project on engineering or any of the topics related with Electrical Engineering. The dissertation work is allotted individually on different topics. The students shall be encouraged to do their dissertation work in the parent institute itself. If found essential, they may be permitted to continue their dissertation work outside the parent institute as per regulations of M.Tech of DAV University, Jalandhar. Department will constitute an Evaluation Committee to review the dissertation work. The Evaluation committee consists of at least three faculty members of which internal supervisor and another expert in the specified area of the project shall be two essential members. The student is required to undertake the Dissertation Part-1 during the third semester and the same is continued in the 4th semester.(Dissertation Part-2).

Dissertation-I consists of preliminary thesis/dissertation work, two reviews of the work and the submission of preliminary report. First review would highlight the topic, objectives, methodology and expected results. Second review evaluates the progress of the work, preliminary report and scope of the work, which is to be completed in the 4th semester.
Course Title: Dissertation Part-2
Paper Code: ELE700

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**Course Objectives:** To improve the professional competency and research aptitude by touching the areas which otherwise not covered by theory or laboratory classes. The dissertation work-II aims to develop the work practice in students to apply theoretical and practical tools/techniques to solve real life problems related to industry and current research.

Dissertation-II is a continuation of Dissertation Part-I started in the 3rd semester of M.Tech. Before the end of the 4th semester, there will be three Dissertation Seminars to be held every month end as decided by Research Degree Committee. In the Dissertation Seminar-I, progress of the Dissertation work done is to be assessed regarding Research Gaps in existing Literatures. In the Dissertation Seminar-II, The assessment regarding Problem Formulation will be carried out. In the Dissertation Seminar-III, the complete assessment (quality, quantum and authenticity) of the Dissertation is to be evaluated. The reviews should be conducted by supervisor and Evaluation committee. This would be a pre qualifying exercise for the students for getting approval for the submission of the Dissertation. At least two research papers are to be prepared for possible publication in Referred Journal/Science Index Journals, out of which one research paper should have impact factor more than Unity.

The research papers are to be submitted along with the dissertation. The final evaluation of the project will be external evaluation.