DAV UNIVERSITY
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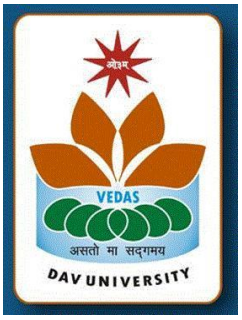

Course Scheme & Syllabus

For

M. Tech. in Electrical Engineering

1st TO 4th SEMESTER

Session 2020-21

Scheme of Courses
M. Tech. in Electrical Engineering
Semester-1

Semester	Course Code	Course Title	L	T	P	Cr	Nature of Course
1	MGT551	Research Methodology	4	0	0	4	Core
1	ELE501A	Modern Power System Analysis	4	0	0	4	Core
1	ELE502A	Power System Dynamics	4	0	0	4	Core
1	ELE503A	Advanced Electric Drives	4	0	0	4	Core
1	ELE504	Power System Operation and Control	4	0	0	4	Core
1	ELE505A	Electrical Power System Laboratory	0	0	4	2	Core (Lab)
1	ELE506A	Power System Dynamics Laboratory	0	0	4	2	Core (Lab)
			20	**0**	**8**	**24**	

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

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

Semester	Course Code	Course Title	L	T	P	Cr	Nature of Course
2	ELE511	Power System Optimization	3	0	0	3	Core
2		Discipline Specific Elective -1	4	0	0	4	DSE-1
2		Discipline Specific Elective -2	4	0	0	4	DSE-2
2		Discipline Specific Elective -3	4	0	0	4	DSE-3
2		Generic Elective -1	4	0	0	4	GE-1
2	ELE516	Power System Optimization Laboratory	0	0	2	1	Core (Lab)
2	ELE550	Seminar	0	0	4	2	Seminar
			19	**0**	**6**	**22**	

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

Scheme of Courses
M. Tech. in Electrical Engineering
Semester-3

Semester	Course Code	Course Title	L	T	P	Cr	Nature of Course
3		Discipline Specific Elective -4	4	0	0	4	DSE-4
3		Generic Elective -2	4	0	0	4	GE-2 Dissertation
3	ELE600	Dissertation Part - 1	0	0	0	8	Part - 1
			8	**0**	**0**	**16**	

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

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

Semester	Course Code	Course Title	L	T	P	Cr	Nature of Course
4	ELE700	Dissertation Part - 2	0	0	0	12	
			0	0	0	**12**	

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

DSE-1	Course Code	Course Title	L	T	P	Cr.
	ELE514A	Design of Electrical Machines	4	0	0	4
	ELE621A	Power System Planning and Reliability	4	0	0	4
	ELE651	Computer Aided Design of Electrical Machines	4	0	0	4
	ELE652	Power System Transients	4	0	0	4

DSE-2	Course Code	Course Title	L	T	P	Cr.
	ELE517	Advanced Power Electronics and Drives	4	0	0	4
	ELE513	HVDC/EHVAC Transmission	4	0	0	4
	ELE670	Automatic Control of DC drives	4	0	0	4
	ELE663	Special Electrical Machines	4	0	0	4

DSE-3	Course Code	Course Title	L	T	P	Cr.
	ELE653	Flexible AC Transmission Systems	4	0	0	4
	ELE654	Power Station Design	4	0	0	4
	ELE655	High Voltage Engineering	4	0	0	4
	ELE658	Power System Reliability	4	0	0	4

DSE-4	Course Code	Course Title	L	T	P	Cr.
	ELE659	Energy Auditing, Conservation and Management	4	0	0	4
	ELE660	Organization and Finance in Power Sector	4	0	0	4
	ELE661	Distribution Automation	4	0	0	4
	ELE662	Renewable Energy Resources	4	0	0	4

Generic Elective Basket

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S. No	Course Code	Course Title	L	T	P	Cr.
1	ELE901	Renewable Energy Sources	4	0	0	4
2	ELE902	Energy Audit and Management	4	0	0	4
3	CHL901	Analytical Techniques	4	0	0	4
4	CHL902	Pollution Abatrment and Control Equipment's	4	0	0	4
5	MEC901	Methods Engineering and Ergonomics	4	0	0	4
6	MEC902	Power Plant Engineering	4	0	0	4
7	CSE901	Soft Computing	4	0	0	4
8	CSE902	Mobile Communications	4	0	0	4
9	ECE901	Smart Sensors	4	0	0	4
10	ECE902	Silicon Chip Technology	4	0	0	4
11	CIV901	Transportation Engineering	4	0	0	4
12	CIV902	Water Resource Engineering	4	0	0	4
13	MGT 551	Business Strategy	4	0	0	4
14	MGT 552	Principles of Marketing	4	0	0	4

Detailed Syllabus

Course Title: Research Methodology
Course Code: MGT551

L	T	P	Credits
4	0	0	4

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. **2 hour**

- **Defining the Research Problem**: What is a Research Problem?, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem **1 hour**

- **Research Design**: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, factors affecting RDs, Relation among RDs, Developing a Research Plan. **2 hour**

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. **2 hours**

- **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. **3 hours**

- **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. **3 hours**

- **Questionnaire & form design**: questionnaire & observation forms, questionnaire design process. **2 hours**

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 Regressio**n: 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 hour**
• **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 hour**
Total	**45 hours**

Suggested Books:

1. Bajpai Naval, *Business Research Methods*, Pearson Publications.
2. Malhotra, Naresh K. (2007), *Marketing Research: An Applied Orientation*, 5th Edition. Pearson/Prentice-Hall.

3. Proctor Tony, *Essentials of Marketing Research*, Prentice Hall, 4th Edition
4. Beri G. C., *Marketing research*, Mcgrawhill, 4th Edition
5. C.R Kothari, *Research Methodology*, New Age Publishers.

Course Title: Modern Power System Analysis

Paper Code: ELE501A

L	T	P	Credits
4	0	0	4

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

Power System Analysis: Introduction, Structure of Power Systems, Modelling of Power System Components, One Line Diagram, Network Modelling, Formation of Bus Admittance Matrix, Singular Transformation Method, Formation of Bus Admittance Matrix using Power World Simulator, Solution Techniques. **(14 Hours)**

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. **(14 Hours)**

Unit-C

Power System Security and Stability: Introduction, Classification of power system stability, Transient stability, Power Angle Stability, power angel equation for two machine and salient pole machine, Reactive Power Control and Voltage Stability, Small Signal Stability, Small Signal Stability Analysis in Multi-machine Power System, Power System Stabilizer in Multi-machine small signal stability problem, Different aspects of voltage stability, analysis of voltage stability indices , swing equation, equal area criteria, solution of swing equation, multi-machine transient stability, factors affecting power system stability, contingency analysis, AC power flow security analysis, concentric relaxation, Bounding area method. **(13 Hours)**

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. **(13 Hours)**

Suggested Books:

1. Venkatesh, P., "Electrical Power system: Analysis, Security and Deregulation", PHI Publications.
2. Chakrabarti A., “Power system dynamics and simulation”, PHI Publications.

Ray, “Electrical Power Systems: Concepts, Theory and Practice”, PHI Publications.

3.

Course Title: Power System Dynamics
Paper Code: ELE502A

L	T	P	Credits
4	0	0	4

Unit –A

Introduction General basic concept of Power System Stability, States of operation & System Security, System Dynamics Problems, Review of Classical Model, System Model, Analysis of Steady State Stability & Transient Stability, Introduction to Steady State Operation of Uncompensated Power Transmission Lines. Review of Transmission Lines Parameters. **(13 Hours)**

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.

Three Phase Modelling: Modelling of three phase single circuit transmission line, Modelling of Pair of Three-Phase Mutually Coupled Transmission Lines, Modelling of Shut Capacitor/Inductor, Modelling of Series capacitor, modelling of an Induction Motor, Combined Shunt-Series Connected Controllers, Interphase Power Controller, Modelling of Load. **(14 Hours)**

Unit –C

Power System Compensation using FACT Devices: Introduction, Reactive Power requirement of an uncompensated line, concept of surge impedance loading, and operation of transmission line at no load and heavy loading, FACTS: SVC, STATCOM, TCSC, UPFC. **(14 Hours)**

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. **(14 Hours)**

Suggested Books:

1. K. R. Padiyar, “Power System Dynamics – Stability & Control”, BS Publications.

2. Chakrabarti Abhijit, "Power System Dynamics and Simulation", Prentice Hall of India Pvt. Ltd, 2013.
3. Bergen A.R., Vittal V., "Power System Analysis", Pearson LPE, 2009.
4. Benjamin C. Kuo, "Automatic Control system", Prentice Hall of India Pvt Ltd.
5. Kundur Prabha, "Power System Stability and Control", Tata McGraw Hill.

Course Title: Advanced Electric Drives
Paper Code: ELE503A

L	T	P	Credits	
4	0	0	4	

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. **(14 Hours)**

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. **(13 Hours)**

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. **(13 Hours)**

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. **(13 Hours)**

Suggested Books:

1. Subramanyam Vedam , “Electric Drives-Concepts and Applications”, Second Edition, Tata McGraw Hill Publication.

2. Nagrath. I. J. & Kothari. D.P, “Electrical Machines”, Tata Mc-Graw-Hill.

3. Pillai.S.K ,“A first course on Electric drives”, Wiley Eastern Limited.

4. Singh M.D., Khanchandani K.B., "Power Electronics", Tata Mc Graw-Hill.

5. Krishnan R., “Electric Motor Drives: Modelling, Analysis, And Control”, PHI Publications.

Course Title: Power System Operation and Control
Paper Code: ELE504

L	T	P	Credits
4	0	0	4

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. **(13 Hours)**

Unit-B

Load frequency control: introduction, types of speed governing system and modelling. Mechanical, Electro-hydraulic. Digital electro-hydraulic system. Turbine Modelling. Generator load modelling, steady state and dynamic response of ALFC loop, the secondary ALFC loop, integral control. **(13 Hours)**

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. **(14 Hours)**

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 matrix equation, Economic Dispatch for hydrothermal Plants short term hydrothermal scheduling, Hydraulic co-ordination, Reactive power scheduling.

(13 Hours)

Suggested Books:

1. Kothari D.P. & Nagrath I.J., “Modern Power System Analysis”, Tata Mc Graw Hill, 3rd Edition.
2. Elgerd O.I., “Electric Energy System Theory”, Tata McGraw Hill.
3. Wood J. & Wollenburg B.F., “Power Generation, Operation and Control”, John Wiley & Sons.
4. Dhillon, J. S., and Kothari, D. P., "Power system optimization." *New Delhi: PHI* , 2004.

5. Kundur P., “Power System Stability and Control”, Mc Graw Hill.
6. Nagsarkar T. K. &.Sukhiza M.S, “Power System Analysis”, Oxford University Press
7. Murty P.S.R., “Operation and control in Power Systems”, B.S. Publications.
8. Hingorani N. G & Gyugyi L., “Understanding FACTs Concepts and Technology of Flexible AC Transmission Systems”
9. Rashid M.H., “Power Electronics: Circuits, devices and Applications”, Prentice Hall of India, 3rd Edition.

Course Title: Electrical Power System Laboratory
Paper Code: ELE505A

L	T	P	Credits	
0	0	4	2	

List of Experiments

1. Introduction to power word simulator
2. Design a two bus, two generator & two load networks.
3. Design five bus, two generator & four load network.
4. Design a three bus, two generator & one load networks. Also find the solution using Ybus.
5. Design a six bus, three generator &three load networks to find the solution using Ybus.
6. Develop MATLAB program for YBUS formation.
7. Develop MATLAB program for G-S Load Flow Analysis.
8. Develop MATLAB program for N-R Load Flow Analysis.
9. Develop MATLAB program for FDLF Load Flow Analysis.
10. Develop MATLAB program for Short Circuit Analysis.
11. Transient Stability Analysis for Single Machine connected to Infinite Bus by Point by Point

    Method.
12. Develop PSPICE Program for Generation System Reliability Analysis.
13. Develop PSPICE Program for Distribution System Reliability Analysis.

Paper Code: ELE506A

L	T	P	Credits
0	0	4	2

Course Title: Power System Dynamics Laboratory

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
9. Determination of Equivalent circuit of a 3-Winding Transformer.
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).
12. Determination of Sub-transient reactance's of a Salient Pole Synchronous Machine.
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).

18. Performance and Testing of Generator Protection System.
19. Performance and Testing of Transformer Protection System.
20. Performance and Testing of Feeder Protection System.
21. Performance and Testing of Transmission Line Model.
22. Differential protection on Single Phase Transformer.

Course Title: Power System Optimization
Paper Code: ELE511

L	T	P	Credits
3	0	0	3

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.

(12Hours)

Unit-A

Introduction: Load flow studies, Types of Buses, YBUS, ZBUS Formulation, static load flow equations Computation of Line Flows, Modelling of Regulating Transformer. Gauss Seidal, Newton- Raphson & Fast Decoupled Method for PV and PQ Buses.

(10Hours)

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.

(11Hours)

Unit-C

Optimal Hydrothermal Scheduling: Introduction, Hydro plant performance model, Short range and Long Range Generation Scheduling. Discharge from short range fixed head hydrothermal scheduling problem .short range hydro thermal scheduling problem with Newton rap son method.

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

(10Hours)

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

(12Hours)

Suggested Texts:

1. Dhillon, J. S., and Kothari, D. P., "Power system optimization." *New Delhi: PHI*, 2004.
2. Zhu, Jizhong. “Optimization of power system operation”. Vol. 49. John Wiley & Sons, 2009.
3. Momoh, James A. “Electric power system applications of optimization”. CRC Press, 2000.

Course Title: Design of Electrical Machines

Paper Code: ELE514A

L	T	P	Credits
4	0	0	4

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 trans formers, 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. **(14 hours)**

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. **(14 hours)**

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, 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. **(14 hours)**

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.

(14 hours)

Suggested Books:

1. Swahney A. K., "A course in Electrical Machine Design", Dhanpat Rai & Sons, Delhi.
2. Mittle V. N., "Design of Electrical Machine (DC & AC)", Standard Publishers & Distributors, Delhi,
3. M G Say, "Performance & Design of AC Machine"
4. Deshpande M. V., "Design & Testing of Electrical Machine", 2nd edition, A H Wheeler & Co, Allahabad.
5. Agarwal , R. K., "Principles of Electrical Machine Design", S K Kataria & Sons, Delhi.

L	T	P	Credits
4	0	0	4

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. **(14 Hours)**

Unit-B

Network Expansion Planning: Introduction, Heuristic methods, Mathematical optimization methods.

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. **(14 Hours)**

Unit-C

Static Generating Capacity Reliability Evaluation: Introduction, Capacity outage Probability tables, Loss of load probability (LOLP) method.Loss of energy probability (LOLE) method, Frequency and duration approach. **(13 Hours)**

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. **(12 Hours)**

Suggested Books:

1. R. Billinton, Gordon "Power System Reliability Evaluations",Breach Science Publishers, New York
2. X, Wang and J.R. McDonald "Modern Power System Planning" , McGraw-Hill Book Company.

3. J. Endrenyi “Reliability Modeling in Electric Power Systems”, John Wiley & Sons, New York.
4. Patrick D.T. O'Connor “Practical Reliability Engineering”, John Wiley & Sons, (Asia) Pvt. Ltd., Singapore.
5. I. Ryabinin “Reliability of Engineering Systems - Principles and Analysis”, MIR Publishers, Moscow.

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

L	T	P	Credits
4	0	0	4

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.

(14 Hours)

Unit-B

Mathematical Formulation of Field Problems

Development of torque/force - Electromagnetic Field Equations - Magnetic Vector/Scalar potential - Electrical Vector/Scalar potential - Stored energy in field problems – Inductances - Laplace and Poisson's Equations - Energy functional - Principle of energy conversion. **(14 Hours)**

Unit-C

Philosophy of FEM

Mathematical Models - Differential/Integral equations - Finite Difference method – Finite Element Method - Energy minimization - Variational method - 2D Field problems - Discretisation- Shape functions - Stiffness matrix - Solution techniques. **(14 Hours)**

Unit-D

CAD Packages

Elements of a CAD System - Pre-processing - Modelling - Meshing -Material properties - Boundary Conditions - Setting up solution - Post processing. Design Applications- Design of Solenoid Actuator - Induction Motor - Switched Reluctance Motor – Synchronous Machines. **(14 Hours)**

Suggested Books:

1. Salon S. J., "Finite Element Analysis of Electrical Machines", Kluwer Academic Publishers, London, 1995.
2. Chee-Mun Ong, "Dynamic Simulations of Electric Machinery: Using MATLAB/SIMULINK", Prentice Hall, 1998.
3. Vlado Ostovic, "Computer Aided Analysis of Electric Machines", Prentice Hall International (UK) Ltd, 1994.
4. Silvester and Ferrari, "Finite Elements for Electrical Engineer", Cambridge University Press, 1983.
5. Hoole S.R.H., "Computer-Aided, Analysis and Design of Electromagnetic Devices", Elsevier, New York, Amsterdam, London, 1989.
6. Lowther D.A., Silvester P. P., "Computer Aided Design in Magnetics", Springer Verlag, New York.
7. Ramamoorthy M., "Computer Aided Design of Electrical Equipments", Affiliated East West Press.
8. Trowbridge C.W., "An Introduction to Computer Aided Electromagnetic Analysis", Vector Field Ltd.
9. User Manuals of Software Packages like MAGNET, ANSOFT& ANSYS.

Course Title: Power System Transients

Paper Code: ELE652

L	T	P	Credits
4	0	0	4

Course Objective: To understand generation of switching and lighting transients, their propagation, reflection and refraction a on the grid ad 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 analyse 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.

Switching Transients: Introduction, circuit closing transients: RL circuit with sine wave drive, double frequency transients, observations in RLC circuit and basic transforms of the RLC circuit. Resistance switching: Equivalent circuit for the resistance switching problems, equivalent circuit for interrupting the resistor current. Load switching: Equivalent circuit, waveforms for transient voltage across the load, switch; normal and abnormal switching transients. Current suppression, current chopping, effective equivalent circuit. Capacitance switching, effect of source regulation, capacitance switching with a restrike, with multiple restrikes, illustration for multiple restriking transients, ferro resonance. **(14 Hours)**

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. **(14 Hours)**

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.

(14 Hours)

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; EMTPfor transient computation. **(14 Hours)**

Suggested Books:

1. Greenwood Allan, 'Electrical Transients in Power Systems', Wiley Interscience, New York, 2nd edition 1991.
2. Begamudre R.D., 'Extra High Voltage AC Transmission Engineering', Wiley Eastern Limited, 1986.
1. Naidu M.S. and Kamaraju V., 'High Voltage Engineering', Tata McGraw Hill, 2nd edition, 2000.

Course Title: Advanced Power Electronics and Drives

Paper Code: ELE517

L	T	P	Credits	
4	0	0	4	

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. **(14 Hours)**

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. **(14 Hours)**

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 **(14Hours)**

Unit-D

Three Phase PWM Inverters

Voltage Control of Three-Phase Inverters- Sinusoidal PWM- 60^0 PWM- Third Harmonic PWM- Space Vector Modulation- Comparison of PWM Techniques-current source inverters-Variable dc link inverter - numerical problems

Multi-level inverters

Introduction, Multilevel Concept, Types of Multilevel Inverters- Diode-Clamped Multilevel Inverter, Principle of Operation, Features of Diode-Clamped Inverter, Improved Diode-Clamped Inverter- Flying-Capacitors Multilevel Inverter- Principle of Operation, Features of Flying-Capacitors Inverter- Cascaded Multilevel Inverter-Principle of Operation- Features of Cascaded Inverter- Switching Device Currents-DC-Link Capacitor Voltage Balancing- Features of Multilevel Inverters- Comparisons of Multilevel Converters

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. **(14 Hours)**

Suggested Books:

1. Rashid Md. H., "Power Electronics, Pearson Education", 3rd Edition, First Indian Reprint- 2008

2. Ned Mohan, Tore M. Undelan and William P. Robbins, "Power Electronics", John Wiley & Sons, 2nd Edition

Course Title: HVDC/EHVAC Transmission

Paper Code: ELE513

L	T	P	Credits
4	0	0	4

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.

(14 Hours)

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.

(14 Hours)

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.

(14 Hours)

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:

1. Padiyar K.R., “HVDC Power Transmission Systems”, Wiley Eastern Ltd., New Delhi.
2. Kimbark E.," Direct Current Transmission", Vol-I, John-Wiley & sons, NY
3. Arrillaga J., “HVDC Transmission”, IEE Press, London.
4. Begamudre R.D., “EHV AC Transmission Engineering”, Wiley Eastern Press.
5. Arrillaga J. and Smith B.C., “AC-DC Power System Analysis”, IEE Press, London.

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

L	T	P	Credits
4	0	0	4

Unit-A

Speed Torque characteristics of DCMotors

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.

(14 Hours)

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 Freewheeling diode – Three phase double converter.

Three phase naturally commutated bridge circuit as a rectifier or as an inverter

Three phase-controlled bridge rectifiers 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 inverters.

(14 Hours)

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.

(14 Hours)

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 – modelling 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.

(14 Hours)

REFERENCES

1. Shepherd, Hulley, Liang "Power Electronics and Motor Control" — II Edition, Cambridge University Press
2. M. H. Rashid "Power Electronic Circuits, Devices and Applications" — PHI.
3. R. Krishnan "Electric Motor Drives Modeling, Analysis and Control", Prentice Hall India.
4. G. K. Dubey "Fundamentals of Electric Drives" Narosa Publications – 1995.

Course Title: Special Electrical Machines
Paper Code: ELEE663

L	T	P	Credits	
4	0	0	4	

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).

(14Hours)

UNIT-B

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

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

(14Hours)

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.

(14Hours)

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.

(14Hours)

Suggested Books:

1. Bimbhra P.S. , "Generalized Theory of Electrical Machines", Khanna Publishers.
2. Sen P.C., "Principles of Electrical Machines and Power Electronics", John willey & Sons, 2001
3. Dubey G.K., "Fundamentals of Electric Drives", Narosa Publishing House, 2001
4. Veinott Cyril G. , "Fractional and Sub-fractional horse power electric motors", McGraw Hill International, 1987

5. Say M.G., “Alternating current Machines”, Pitman & Sons

Course Title: Flexible AC Transmission Systems
Paper Code: ELE653

L	T	P	Credits
4	0	0	4

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. **(14Hours)**

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. **(14Hours)**

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. **(14Hours)**

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. **(14Hours)**

Suggested Books:

1. Hingorani N.G. and Guygi L., "Understanding FACTS Devices".IEEEPressPublications2000

Course Title: Power Station Design
Paper Code: ELE654

L	T	P	Credits	Marks
4	0	0	4	100

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

(14 Hours)

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

(14 Hours)

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.

(14 Hours)

UNIT-D

Economic Operation of Power Systems: Characteristics of steam and hydro-plants, Constraints in operation, Economic load scheduling of thermal plants Neglecting and considering transmission Losses, Penalty factor, loss coefficients, Incremental transmission loss. Hydrothermal Scheduling

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.
Ocean Thermal Energy: Introduction, energy conversion, problems.

(14 Hours)

Suggested Books:

1. Gupta B.R., "Generation of Electrical Energy", S. Chand Publication.
2. Soni, Gupta & Bhatnagar, "A text book on Power System Engg.", Dhanpat Rai & Co.
3. Murthy P.S.R., "Operation and control of Power System" BS Publications, Hyderabad.
4. Stevenson W. D., "Elements of Power System Analysis", McGraw Hill.
5. Uppal S. L., "Electrical Power", Khanna Publishers.

DAV UNIVERSITY, JALANDHAR

Course Title: High Voltage Engineering

Paper Code: ELE655

L	T	P	Credits
4	0	0	4

UNIT-A

Introduction To High Voltage 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. **(14 Hours)**

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. **(14 Hours)**

UNIT-C

Generation & Measurement Of high Voltages & Currents: Generation of High Direct Current Voltages, Generation of High alternating voltages, Generation of Impulse Voltages, Generation of Impulse currents, Tripping and control of impulse generators. Measurement of High Direct Current voltages, Measurement of High Voltages alternating and impulse, Measurement of High Currents-direct, alternating and Impulse, Oscilloscope for impulse voltage and current measurements. **(14 Hours)**

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.

Testing Of Materials & Electrical Apparatus: Measurement of D.C Resistivity, Measurement of Dielectric Constant and loss factor, Partial discharge measurements. Testing of Insulators and bushings, Testing of Isolators and circuit breakers, testing of cables, Testing of Transformers, Testing of Surge Arresters, and Radio Interference measurements. **(14 Hours)**

Suggested Books:

1. Naidu M.S. and Kamaraju V., 3rd Edition , "High Voltage Engineering", TMH Publications.
2. E.Kuffel, W.S.Zaengl, J.Kuffel, "High Voltage Engineering: Fundamentals", 2nd Edition, Elsevier.
3. Wadhwa C.L., "High Voltage Engineering", New Age Internationals (P) Limited, 1997.
4. Arora Ravindra, Mosch Wolfgang, "High Voltage Insulation Engineering", New Age International (P) Limited, 1995.
5. Mazen Abdel Salam, Hussein Anis, Ahdan El-Morshedy, Roshdy Radwan , Marcel Dekker, "High Voltage Engineering", Theory and Practice

L	T	P	Credits
4	0	0	4

Course Title: Power system Reliability

Paper Code: ELE658

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:

1. Reliability Evaluation of Power Systems by Roy Billinton and Ronald N. Allan, Plenum press, New York and London (Second Edition), 1996.

2. Reliability Modeling in Electric Power Systems by J. Endrenyi, John Wiley and Sons, 1978. (First Edition)

Course Title: Power System Optimization Laboratory
Paper Code: ELE516

L	T	P	Credits
0	0	2	1

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

DAV UNIVERSITY, JALANDHAR

Course Title: Seminar
Paper Code: ELE550

L	T	P	Credits
0	0	3	2

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.

DAV UNIVERSITY, JALANDHAR

Course Title: Energy Auditing, Conservation and Management

Paper Code: ELE659

L	T	P	Credits
4	0	0	4

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. (**14 Hours)**

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. (**14 Hours)**

UNIT-C

Power Factor Improvement, Lighting And Energy Instruments: Power factor – methods of improvement, location of capacitors, Pf with nonlinear 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. (**14 Hours)**

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 .

(14 Hours)

Suggested Books:

1. Murphy W.R. and Butterworth, G. Mckay, "Energy management", Heinemann publications.

2. John. C. Andreas, “Energy efficient electric Motors”, Marcel Dekker Inc Ltd-2nd edition, 1995.
3. Turner W.C., “Energy management hand book”, John wiley and sons
4. Callaghan Paul o’, “Energy management”, 1st edition,Mc-Graw Hill Book company, 1998.
5. “Energy management and good lighting practice: fuel efficiency”, booklet12-EEO.

DAV UNIVERSITY, JALANDHAR

Course Title: ORGANIZATION AND FINANCE IN POWER SECTOR

Paper Code: ELE660

L	T	P	Credits
4	0	0	4

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. (**14 Hours)**

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 laterization; Levelized bus bar cost. (**14 Hours)**

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. **(14 Hours)**

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. (**14 Hours)**

BOOKS RECOMMENDED:

1.Bartol K. M. and David .,"Management"., Martin McGraw-Hill, INC. 2.Bartol K. M. and David C., Management, Martin McGraw-Hill, INC. 3.Weston J.F., Brigham Essential of ManagerialFinance, Dryden Press. 4.Stoll, Least-Cost Electric Utility Planning, John Wiley.

5.Stickney C.P. and Weil R.L., Financial Accounting, Dryden Press.
6.Berrie T.W., Electricity Economics and Planning, IEE Power Series.

7.Levy H. and Sarnat M., Capital Investment and Financial Decisions, Prentice Hall.

DAV UNIVERSITY, JALANDHAR

Course Title: Distribution Automation

L	T	P	Credits
4	0	0	4

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. **(14 Hours)**

Unit-B

Distribution Automation Functions: DA capabilities, Automation system computer facilities, management processes, Information management, system reliability management, system efficiency management, voltage management. (**14 Hours)**

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. (**14 Hours)**

Unit-D

Technical Benefits: Capital deferred savings, O&M savings, Interruption related savings, Customer related savings, Operational savings, improved operation, Function & Potential benefits, Guidelines for formulation of estimating equations Parameters required, economic impact areas, Resources for determining benefits impact on distribution system, integration of benefits into economic evaluation. **(14 Hours)**

Suggested Texts:

1. Northcote Green Robert, Wilson James, "Control and Automation of Electrical Distribution Systems",., CRC Press.

2. Khedkar M. K., Dhole G.M., "Electric Power Distribution Automation", University Science press.

DAV UNIVERSITY, JALANDHAR

Course Title: Renewable Energy Resources

L	T	P	Credits
4	0	0	4

Paper Code: ELE662

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. **(14 Hours)**

UNIT-B

Principles of MHD power generation, ideal MHD generator performance, practical MHD generator, MHD technology. Wind Energy conversion: Power from wind, properties of air and wind, types of wind Turbines, operating characteristics. (**14 Hours)**

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 (**14 Hours)**

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. (**14 Hours)**

Suggested Books:

1. Begamudre Rakosh Das, “Energy conversion systems”, New age International publishers, New Delhi - 2000.
2. Twidell John and Weir Tony, “Renewable Energy Resources” , 2nd Edition, Fspon & Co.

DAV UNIVERSITY, JALANDHAR

Course Title: Dissertation Part-1
Paper Code: ELE600

L	T	P	Credits
0	0	0	8

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 4^{th} 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 4^{th} semester.

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Course Title: Dissertation Part-2
Paper Code: ELE700

L	T	P	Credits
0	0	0	12

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-1 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.

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