ESTD: 1980

SAGI RAMA KRISHNAM RAJU ENGINEERING COLLEGE (AUTONOMOUS)
(Affiliated to JNTUK, Kakinada), (Recognised by AICTE, New Delhi)
Accredited by NAAC with 'A' Grade, All UG Programmes are Accredited by NBA
Recognised as Scientific and Industrial Research Organisation
CHINNA AMIRAM (P.O):: BHIMAVARAM :: W.G.Dt., A.P., INDIA :: PIN: 534 204

SCHEME OF INSTRUCTION & EXAMINATION
(Regulation R17)
IV/IV B.TECH
(With effect from **2017-2018**Admitted Batch onwards**)**
ELECTRICAL AND ELECTRONICS ENGINEERING
(Accredited by NBA)

I-SEMESTER

Code No.	Name of the Subject	Credits	Lect Hrs	Tutorial Hrs	Lab Hrs	Contact Hrs/ Week	Internal Marks	External Marks	Total Marks
B17 EE 4101	Electric Drives	3	3	1	-	4	30	70	100
B17 EE 4102	Power System Operation & Control	3	3	1	-	4	30	70	100
B17 EE 4103	Electric Vehicles	3	3	1	-	4	30	70	100
#ELE-I	Elective-I	3	3	1	-	4	30	70	100
#ELE-II	Elective-II	3	3	1	-	4	30	70	100
B17 EE 4110	Power Electronics Lab	2	-	-	3	3	50	50	100
B17 EE 4111	Power System Simulation Lab	2	-	-	3	3	50	50	100
Total		**19**	**15**	**5**	**6**	**26**	**250**	**450**	**700**

#ELE-I	B17 EE 4104	Operations Research
	B17 EE 4105	Flexible AC Transmission Systems
	B17 EE 4106	Integration of Distributed Generation
#ELE-II	B17 EE 4107	High Voltage Engineering
	B17 EE 4108	Electric Power Quality
	B17 EE 4109	Energy Management & Auditing

Code: B17EE4101

ELECTRIC DRIVES

Lecture	**: 3 Hours**	**Int. Marks**	**: 30**
Tutorial	**: 1 Hour**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

Course Objectives:

1. To impart knowledge about fundamentals of Electric drives and control.
2. Operational strategies of dc and ac motor drives and quadrant operations.
3. It covers in detail the basic and advanced speed control techniques using power electronic converters that are used in industry.
4. Understand the operation of Rectifier and Chopper fed DC drives.
5. Describes the slip power recovery schemes in induction motors and operation of AC drives.

Course outcomes:

S.No	Out Come: Students will be able to	Knowledge Level	PO'S
1	Discriminate the speed control, starting and braking of AC and DC Drives using conventional techniques.	K4	PO1, PO2
2	Analyze the operation of Rectifier fed DC Drives	K4	PO1, PO2
3	Analyze the operation of Chopper fed DC Drives	K4	PO1, PO2
4	Apply and analyze the voltage and frequency control techniques to induction motor drive and slip power recovery schemes	K3, K4	PO1, PO2
5	Analyze the operation of synchronous motor drives and special drives	K4	PO1, PO2

SYLLABUS

UNIT-I

INTRODUCTION TO DRIVES

Definition, Advantages and applications of drives, Components of electric drive system, Difference between DC and AC drives, Multi quadrant operation of drive, Review of Speed control methods of DC motors and Induction motors, Starting methods of synchronous motor, Electric Braking.

UNIT-II

RECTIFIER CONTROLLED FED DC DRIVES

Single Phase Fully controlled converters connected to DC separately excited motor and DC series motor – Continuous & Discontinuous current operation – voltage and current waveforms – Speed Torque expressions – Speed Torque Characteristics.

UNIT-III

CHOPPER CONTROLLED FED DC DRIVES

Chopper controlled DC separately excited motor and DC series motor – Continuous current operation – voltage and current waveforms – Speed Torque expressions – Speed Torque characteristics, Closed loop control of DC drive (Only Block Diagram)

UNIT-IV

CONTROL OF INDUCTION MOTORS

Variable voltage control of Induction motor by AC voltage controller, Variable frequency control of Induction motor by cycloconverter – waveforms – Speed Torque characteristics, Slip power recovery schemes – Static Kramer Drive – Static Scherbius Drive.

UNIT-V

SYNCHRONOUS MACHINE AND SPCIAL DRIVES

Introduction to Synchronous motor drives- True synchronous & Self-control modes of operation of synchronous motor drives.

Principle & operation of brushless dc motor,Stepper motors, PMSM, Switched Reluctance Motor.

Text Books:

1. Fundamentals of Electrical Drives by G.K.Dubey, Second Edition, 2002.
2. Power Electronics: Circuits, Devices and Applications by M.H.Rashid, Third Edition, 2009.

Reference Books:

1. Power Electronics by M.D.Singh and K.B.Khanchandani, Second Edition, 2017.
2. Modern Power Electronics and AC Drives by Bimal K Bose, 2005.
3. Thyristor Control of Electric Drives by Vedam Subramanyam, Tata McGraw-Hill Publications, 2008.

Code: B17EE4102

POWER SYSTEM OPERATION AND CONTROL

Lecture	**: 3 Hours**	**Int. Marks**	**: 30**
Tutorial	**: 1 Hour**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

Course Objectives:

1 To understand the concepts of economical operation using thermal plants and also combined hydro- thermal plants.
2 To understand the concepts of optimal unit commitment problem and power flow problem along with the solution.
3 To study the Single area and Two-area system under steady state response and dynamic of both controlled and uncontrolled case study.
4 To understand the reactive power control by voltage and compensation of transmission lines
5 To Study the stability enhancement methods, preventive control and power system security.

Course outcomes:

S.No	Out Come: Students will be able to	Knowledge Level	PO'S
1	**Compute** the economic load scheduling for Thermal and Hydro-thermal plants.	K4	PO2
2	**Solve** and **analyze** the unit commitment and optimal power flow problems.	K3, K4	PO2
3	**Analyze** the frequency deviations of single area and two area power systems.	K4	PO2
4	**Apply** the compensation techniques for the reactive power control in transmission system.	K3	PO1
5	**Apply** the knowledge of engineering fundamentals to assess the power system security.	K3	PO1

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UNIT-I

OPTIMAL SYSTEM OPERATION:

Optimal operation of Generators in Thermal power stations, Heat rate curve, Cost Curve, Incremental fuel and Production costs, Input–output characteristics. Optimum generation allocation with & without transmission line losses, Loss Coefficients, General transmission line loss formula. Optimal scheduling of Hydrothermal System: Short term hydrothermal scheduling problem.

UNIT-II

UNIT COMMITMENT & OPTIMAL POWER FLOW:

Optimal unit commitment problem, Need for unit commitment, Constraints in unit commitment, Cost function formulation, Solution methods using Priority list method & Dynamic programming. Optimal Power Flow: Problem formulation & Solution of OPF by Gradient Method.

UNIT-III

AUTOMATIC LOAD FREQUENCY CONTROL

Frequency control: Load-Frequency Control Concepts, Load frequency Control of a Single Area System modeling, Steady state & Dynamic response of uncontrolled & controlled cases, Load Frequency Control and Economic Dispatch Control, Two-area system modeling - Static analysis of uncontrolled case, Tie line with frequency bias control of two-area system.

UNIT-IV

REACTIVE POWER CONTROL:

Overview of Reactive Power control Reactive Power compensation in transmission systems. Advantages and disadvantages of different types of compensating equipment for transmission systems. Load compensation, Specifications of load compensator. Uncompensated and compensated transmission lines: Shunt and series compensation, Need for FACTS controllers.

UNIT-V

EMERGENCY CONTROL AND POWER SYSTEM SECURITY:

Concepts, Preventive and Emergency Control, Coherent Area Dynamics, Stability Enhancement Methods, Long Term Frequency Dynamics, Average System Frequency, Centre of Inertia. System state classification, Linear sensitivity factors, Contingency analysis

Text Books:

1. Power System Engineering By I.G. Nagarath& D.P. Kothari, Fouth edition, Tata McGraw Hill Publications
2. Electric Energy Systems Theory-An Introduction by Olle I. Elgerd, second edition Tata McGraw Hill publication.
3. Power system operation and control by P.S.R.Murthy, second edition B.S Publication.
4. Power System stability & control, PrabhaKundur,TMH, 3rd edition.

Reference Books:

1. Advanced power system operation and control by Allen.J.wood and B.F. Wollenberg, second edition, John wiley&sonspulication Inc. 1984.
2. Advanced Power System Analysis and Dynamics by L.P. Singh, Third Edition, Wiley Eastern Limited publications.
3. Power System Analysis by HadiSadat,ThirdEdition,TataMcGraw Hill publication.
4. Power System Analysis and Design by J.Duncan Glover and M.S.Sarma, Thompson, 3rd Edition
5. Power System Analysis by Grainger and Stevenson, Tata McGraw Hill.

Code: B17EE4103

ELECTRIC VEHICLES

Lecture	**: 3 Hours**	**Int. Marks**	**: 30**
Tutorial	**: 1 Hour**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

Course Objectives:

1. To study the introductory concepts of EVs and dynamic modeling equations of EVs
2. To study the various configurations of EVs and HEVs and power train components.
3. To study the drive systems of EVs and their control
4. To study Various Energy storage systems for EVs and understand their characteristics.
5. To understand the charging technology in EVs and EVs utilization in real time infrastructures.

Course outcomes:

S.No	Out Come: Students will be able to	Knowledge Level	PO'S
1	**Analyze** and understand dynamic modelling and design considerations of electrical vehicles.	K4	PO2, PO7
2	**Analyze** and understandthe architecture of electric vehicles and power train components.	K4	PO2
3	**Evaluate** Battery performance parameters for EVs and understand other energy storage methods for EVs.	K4	PO2, PO7
4	**Analyze** and understand the electric drives using power electronic converters for EVs.	K4	PO2
5	**Develop** the chargers for EVs and integrate EVs into grid	K4	PO3, PO6

SYLLABUS

UNIT-I

INTRODUCTION TO ELECTRIC VEHICLES AND MODELLING

Introduction to Electric Vehicles (EV), Hybrid Electric Vehicles (HEV), EV History, EV Advantages, Performance of EVs,Comparisons of EV with Internal Combustion Engine vehicles, Vehicle Dynamics modelling with tractive effort and Design Considerations.

UNIT-II

ARCHITECTURE OF EV's AND POWER TRAIN COMPONENTS

Architecture of EV's and HEV's – Plug-in Hybrid Electric Vehicles (PHEV) , Fuel cell EV, Power train components of EVs--EV Transmission Configurations, Transmission Components,Ideal Gearbox: Steady State Model, andEV Motor Sizing,

UNIT-III

ENERGY SOURCES AND STORAGE FOR EV

Battery Basics, Different types, Battery Parameters, Battery modelling, importance of Lead Acid Batteries and Lithium Batteries, Battery Management system,Fuel cell,Super Capacitors, Ultra capacitors,Fly Wheel, Hydrogen Storage Systems.

UNIT-IV

ELECTRIC VEHICLE DRIVE SYSTEMS& CONTROL

DC Motor Drives, AC Motor Drives, Permanent Magnetic BLDC Motor Drives, SRM Drives, Electric Drive Components of EVs-- Power Converters and Drive Controller.

UNIT-V

CHARGING TECHNOLOGY IN EV AND GRID CONNECTION.

Introduction to charging mechanism, Various Charging Algorithms for EVs,EVs in infrastructure system, Integration of EVs in smart grid

Text books:

1. Iqbal Husain, "Electric and Hybrid Vehicles Design Fundamentals", CRC Press, Taylor & Francis Group, 2011.
2. Ali Emadi, MehrdadEhsani, John M.Miller , "Vehicular Electric Power Systems", Special Indian Edition, Marcel Dekker, Inc 2010.
3. Y. Gao, S. Gay and A. Emadi,Modern Electric, Hybrid Electric, and Fuel CellVehicles, CRC Press, 2005.
4. John G. Hayes and A. Goodarzi, "Electric Powertrain - Energy Systems, Power electronics and drives for Hybrid, electric and fuel cell vehicles "Wiley Publication.

Reference Books:

1. Bimal K Bose, "Modern Power Electronics and AC Drives", Pearson Education, Asia, 2002.
2. Gopal K Dubey, "Power Semiconductor controlled Drives", Prentice Hall Inc, New Yersy, 1989.

Reference Links:

1. https://nptel.ac.in/courses/108/103/108103009/
2. https://nptel.ac.in/courses/108/102/108102121/
3. https://swayam.gov.in/nd1_noc20_ee99/preview

Code: B17EE4104

OPERATIONS RESEARCH
(Elective-I)

Lecture	**: 3 Hours**	**Int. Marks**	**: 30**
Tutorial	**: 1 Hour**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

Course Objectives:

1 Students should evaluate how to formulate different objective functions and should understand how to associate the evidential support and scientific base for Managers, Engineers and practitioners to take several decisions.
2 Relate OR methodologies for different agencies and also how to examine different approaches to solve problems related to transportation and assignment problems.
3 Should apply different logics for project management.

Course outcomes:

S.No	Out Come: Students will be able to	Knowledge Level	PO'S
1	**Model** and **solve** different optimization problems mathematically.	K3,K4	PO1, PO2
2	**Apply** traditional approaches to minimize transportation cost.	K3	PO1
3	**Apply** Hungarian method to solve the optimal solution for assignment problems.	K3	PO1
4	**Apply** the Linear Programming methods for CPM and PERT problems	K3	PO1
5	**Outline** the optimal solution by **applying** dominance and max-min principle in game theory.	K3,K4	PO1, PO2

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UNIT-I

Introduction to Operations Research

Applications of OR, Optimization, Mathematical Model- Linear Programming Problem, Requirements for a LP Problem, Examples on the Application of LPP, Graphical Solution of 2-Variable LP Problems, General Mathematical Formulation for LPP, Canonical and Standard Forms of LP Problem, Simplex Method, Simple Problems on Simplex Methods, Big-M Method**.**

UNIT-II

Transportation Problem

Matrix Terminology, Definition and Mathematical Representation of Transportation Model, Formulation and Solution of Transportation Models (Basic Feasible Solution by North-West Corner Method, Least Cost Entry Method. Vogel's Approximation Method)

UNIT-III

Assignment Problem

Matrix Terminology, Definition of Assignment Model, Comparison with Transportation Model, Mathematical Representation of Assignment Model, Formulation and Solution of Assignment Models.

UNIT-IV

PERT and CPM Network

Introduction, Phases of Project Scheduling, Network Logic, Numbering the Events (Fulkerson's Rule), Measure of Activity, Forward Pass and Backward Pass Computations, Slack Critical Path.

UNIT-V

Game Theory

Useful Terminology, Rules for Game Theory, Saddle Point, Pure Strategy, Mini-Max, Maxi-Min Principle, Reduce Game by Dominance, Graphical solution, Mixed Strategies, 2x2 Games Without Saddle Point.

Text Books:

1. "Operations research-an introduction' by H.Taha, 10th Edition, Prentice Hall of India Pvt. Ltd.
2. "Engineering Optimization-Theory & Practice" By S.S. Rao, 4th Edition, New Age International (P) Ltd.

Reference Books:

1. "Operations research – an introduction" by P.K.Gupta&D.S.Hira, Seventh Revised Ediotion, S.Chnd& Co. Ltd.

Code: B17EE4105

FLEXIBLE AC TRANSMISSION SYSTEMS
(Elective-I)

Lecture	**: 3 Hours**	**Int. Marks**	**: 30**
Tutorial	**: 1 Hour**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

Course Objectives:

1 Understand the needs of power systems and utility networks where installation of FACTS Controllers/Devices becomes essential.

2 Understand the importance of controllable parameters and benefits of FACTS controllers.

Course outcomes:

S.No	Out Come: Students will be able to	Knowledge Level	PO'S
1	**Interpret** the importance of reactive power and its compensation in transmission lines.	K3	**PO1**
2	**Summarize** the characteristics of TCR, TSR, FC-TCR and TSC.	K4	**PO2**
3	**Examine** the functional operation of SVC, STATCOM, TCSC & SSSC and their comparison.	K4	**PO3**
4	**Inspect** SVC &STATCOM for their applications in improvement of transient stability, Steady-State Power-Transfer Capacity, and SSR mitigation.	K4	**PO2**
5	**Inspect** TCSC & SSSC for their applications in improvement of system stability limit**,** system damping, Power flow control, and SSR mitigation.	K4	**PO2**

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UNIT-I: INTRODUCTION

Basic types of FACTS controllers–shunt and series controllers, Reactive Power, Uncompensated Transmission Lines, Passive Compensation, Conventional Reactive Power Compensator-Synchronous Condenser.

Thyristor-Controlled Reactor (TCR), Thyristor-Switched Reactor (TSR), Fixed Capacitor–Thyristor-Controlled Reactor (FC–TCR), Thyristor-Switched Capacitor (TSC).

UNIT-II: STATIC VAR COMPENSATOR (SVC) AND APPLICATIONS:

Voltage control by SVC – Advantages of slope in dynamic characteristics – Influence of SVC on system voltage – Design of SVC voltage regulator.

Applications: Increase in Steady-State Power-Transfer Capacity, Enhancement of transient stability.

UNIT-III: STATCOM AND APPLICATIONS:

Static Synchronous Compensator (STATCOM) – Principle of operation – V-I Characteristics, Harmonic Performance, Steady-State Model.

Applications: Sub-Synchronous Resonance (SSR) Mitigation.

UNIT-IV:

THYRISTOR CONTROLLED SERIES CAPACITOR (TCSC) AND APPLICATIONS:

Operation of the TCSC – Different modes of operation – Analysis of the TCSC Modelling ofTCSC – Variable reactance model.

Applications: Improvement of the system stability limit, Enhancement of system damping-Principle of Damping, Bang-Bang Control, Sub-Synchronous Resonance (SSR) Mitigation.

UNIT-V:

STATIC SYNCHRONOUS SERIES COMPENSATOR (SSSC) AND APPLICATIONS:

Operation of SSSC and Control System.

Applications: Power flow control and Sub-Synchronous Resonance (SSR) Mitigation.

Text Books:

1. R. Mohan Mathur, Rajiv K. Varma, "Thyristor – Based Facts Controllers for Electrical Transmission Systems", IEEE Press and John Wiley & Sons, Inc,2002.
2. Narain G. Hingorani, "Understanding FACTS -Concepts and Technology of Flexible AC Transmission Systems", Standard Publishers Distributors, Delhi- 110 006,2011.

Reference Books:

1. K. R. Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International(P)Limited, Publishers, New Delhi,2008.
2. A.T. John, "Flexible A.C. Transmission Systems", Institution of Electrical and Electronics Engineers (IEEE)1999.
3. V.K. Sood, HVDC and FACTS controllers – Applications of Static Converters in Power System, APRIL 2004, Kluwer Academic Publishers, 2004.

Web Links:

1. https://nptel.ac.in/courses/108/107/108107114/
2. http://npti.gov.in/flexible-ac-transmission-system

Code: B17EE4106

INTEGRATION OF DISTRIBUTED GENERATION
(Elective-I)

Lecture	**: 3 Hours**	**Int. Marks**	**: 30**
Tutorial	**: 1 Hour**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

Course Objectives:

1 To familiarize power generation by alternate energy sources like wind ,solar power and their location
2 To Discuss the effects of integration of distributed generation on the performance the system.
3 To Discuss the overloading, Voltage fluctuations and Power Quality problems in the integration of DG's

Course outcomes:

S.No	Out Come: Students will be able to	Knowledge Level	PO'S
1	**Explain** energy generation by Wind Power, Solar Power, Combined Heat-and-Power, Hydropower, Tidal Power, Wave Power, Geothermal Power, Thermal Power Plants and interface with grid	**K3**	**PO1**
2	**Illustrate** the impact of Integration of DG's to Power System and their issues	**K3**	**PO1**
3	**Demonstrate** the Overloading of DG's and losses	**K3**	**PO1**
4	**Discriminate** Voltage magnitude variations of DG's and their compensation	**K4**	**PO2**
5	**Identify** Harmonics of different frequencies related to Power Quality disturbances.	**K4**	**PO2**

SYLLABUS

UNIT–I

Distributed Generation: Introduction,Sources of Energy - Wind Power, Solar Power, Combined Heat-and-Power, Hydropower, Tidal Power, Wave Power, Geothermal Power, Thermal Power Plants, Interface with the Grid**.**

UNIT–II

Power System Performance: Impact of Distributed Generation on the Power System, Aims of the Power System, Hosting Capacity Approach, Power Quality, Voltage Quality and Design of Distributed Generation, Hosting Capacity Approach for Events, Increasing the Hosting Capacity.

UNIT–III

Overloading andLosses:Impact of Distributed Generation, Overloading: Radial Distribution Networks, Overloading: Redundancy and Meshed Operation, Losses, Increasing the Hosting Capacity.

UNIT–IV

Voltage Magnitude Variations: Impact of Distributed Generation, Voltage Margin and Hosting Capacity, Design of Distribution Feeders, A Numerical Approach to Voltage Variations, Tap Changers with Line-Drop Compensation.

UNIT–V

Power Quality Disturbances: Impact of Distributed Generation, Fast Voltage Fluctuations, Voltage Unbalance, Low-Frequency Harmonics, High-Frequency Distortion, Voltage Dips, Increasing the Hosting Capacity.

Text books:

1. "Integration ofDistributedGeneration in thePower System" by Math Bollen, Wiley publications 2011.

Code: B17EE4107

HIGH VOLTAGE ENGINEERING
(Elective-II)

Lecture	**: 3 Hours**	**Int. Marks**	**: 30**
Tutorial	**: 1 Hour**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

Course Objectives:

1. To understand electric field distribution and computation in different configuration of electrode systems.
2. To understand HV breakdown phenomena in gases, liquids and solids dielectrics.
3. To acquaint with the generating principle of operation and design of HVDC, AC and Impulse voltages and currents.
4. To acquaint with methods to measure high AC, DC and Impulse voltages and currents.
5. To analyze the insulating characteristics of dielectric materials and various testing techniques of HV equipments and industrial applications.

Course outcomes:

S.No	Out Come: Students will be able to	Knowledge Level	PO'S
1	**Apply the knowledge to estimate the** performance of different configurations of electrode systems subjected to high voltage.	K3	PO1
2	**Interpret** the breakdown behavior of all types of dielectric materials.	K3	PO1
3	**Apply the knowledge to comprehend** generation of High AC, DC and Impulse voltages and currents.	K3	PO1
4	**Apply** methods to measure High AC, DC and Impulse voltages and currents.	K3	PO1
5	**Analyze** the techniques of testing various equipment's used in HV engineering and industrial applications.	K4	PO2

SYLLABUS

UNIT-I

Introduction to High Voltage Technology

Electric Field Stresses – Uniform and non–uniform field configuration of electrodes – Estimation and control of electric Stress – Numerical methods for electric field computation.

UNIT-II

Break down phenomenon in gaseous, liquid and solid insulation

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 liquid – Intrinsic breakdown – Electromechanical breakdown – Thermal breakdown –Breakdown of solid dielectrics in practice – Breakdown in composite dielectrics used in practice.

UNIT-III

Generation of High voltages and currents

Generation of high DC voltages – Generation of high alternating voltages – Generation of impulse voltages – Generation of impulse currents – Tripping and control of impulse generators.

UNIT-IV

Measurement of high voltages and high currents

Measurement of high AC, DC and Impulse voltages – and measurement of high currents – direct, alternating and Impulse.

UNIT-V

High Voltage testing of Electrical apparatus

Measurement of DC resistivity – Measurement of dielectric constant and loss factor – Partial discharge measurements. Impulse testing of HV Transformers, Power Frequency tests- over voltage tests on insulators.

Industrial Applications to High Voltage Engineering

Electro Static applications – Electro static precipitator, Electro static separator, Electro static coating, pulsed power engineering.

Text Books:

1. High Voltage Engineering by M.S.Naidu and V. Kamaraju – TMH Publications, 3rd Edition
2. High Voltage Engineering: Fundamentals by E.Kuffel, W.S.Zaengl, J.Kuffel by Elsevier,2nd Edition.
3. High Voltage Engineering and Technology by Ryan, IET Publishers.

Reference Books:

1. High Voltage Engineering by C.L.Wadhwa, New Age Internationals (P) Limited, 1997.
2. High Voltage Insulation Engineering by Ravindra Arora, Wolfgang Mosch, New Age International (P) Limited,1995.

Code: B17EE4108

ELECTRIC POWER QUALITY
(Elective-II)

Lecture	**: 3 Hours**	**Int. Marks**	**: 30**
Tutorial	**: 1 Hour**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

Course Objectives:

1 To learn different types of power quality phenomena.
2 To identify sources for voltage sag, voltage swell, interruptions, transients, long duration over voltages and harmonics in a power system.
3 To describe power quality terms and study power quality standards.
4 To learn the principle of voltage regulation and power factor improvement methods.
5 To explain the relationship between distributed generation and power quality
6 To learn different types of power quality phenomena.
7 To identify sources for voltage sag, voltage swell, interruptions, transients, long duration over voltages and harmonics in a power system.

Course outcomes:

S.No	Out Come: Students will be able to	Knowledge Level	PO'S
1	**Differentiate** between different types of power quality problems.	**K4**	**PO1, PO2**
2	**Explain** and **Analyze** power quality terms and power quality standards	**K4**	**PO1, PO2**
3	**Analyze** and evaluate the causes and effects of harmonic distortion.	**K4**	**PO1, PO2**
4	**Explain** the principle of voltage regulation and apply power factor improvement methods.	**K4**	**PO1, PO2**
5	**Analyze** the impact of distributed generation on power quality	**K4**	**PO1, PO2**

SYLLABUS

UNIT–I:

INTRODUCTION

Overview of power quality – Concern about the power quality – General classes of power quality and voltage quality problems – Transients – Long–duration voltage variations –Short–duration voltage variations – Voltage unbalance – Waveform distortion – Voltage fluctuation – Power frequency variations

UNIT–II:

VOLTAGE IMPERFECTIONS IN POWER SYSTEMS

Power quality terms – Voltage sags – Voltage swells and interruptions – Sources of voltage sag, swell and interruptions – Nonlinear loads – IEEE and IEC standards. Source of transient over voltages – Principles of over voltage protection – Devices for over voltage protection –Utility capacitor switching transients.

UNIT–III

HARMONIC DISTORTION AND SOLUTIONS

Voltage distortion vs. Current distortion – Harmonics vs. Transients – Harmonic indices –Sources of harmonics – Effect of harmonic distortion – Impact of capacitors, transformers, motors and meters – Point of common coupling – Passive and active filtering – Numerical problems.

UNIT– IV

VOLTAGE REGULATION AND POWER FACTOR IMPROVEMENT:

Principles of regulating the voltage – Device for voltage regulation – Utility voltage regulator application – Capacitor for voltage regulation – End–user capacitor application – Regulating utility voltage with distributed resources – Flicker – Power factor penalty – Static VAR compensations for power factor improvement

UNIT–V

DISTRIBUTED GENERATION AND POWER QUALITY

Resurgence of distributed generation – DG technologies – Interface to the utility system – Power quality issues and operating conflicts – DG on low voltage distribution networks. Interconnection standards - Wiring and Grounding - Typical Wiring and Grounding Problems - Solution to Wiring and grounding Problems

Text Books:

1. Electrical Power Systems Quality, Dugan R C, McGranaghan M F, Santoso S, and Beaty H W, Second Edition, McGraw–Hill, 2012, 3rd edition.E
2. lectric power quality problems –M.H.J.Bollen IEEE series-Wiley India publications,2011.

Reference Books:

1. Power Quality Primer, Kennedy B W, First Edition, McGraw–Hill, 2000.
2. Understanding Power Quality Problems: Voltage Sags and Interruptions, Bollen M HJ, First Edition, IEEE Press; 2000.
3. Power System Harmonics, Arrillaga J and Watson N R, Second Edition, John Wiley & Sons, 2003.
4. Electric Power Quality control Techniques, W. E. Kazibwe and M. H. Sendaula,Van Nostrad Reinhold, New York.
5. Power Quality c.shankaran, CRC Press, 2001.
6. Harmonics and Power Systems –Franciso C.DE LA Rosa–CRC Press (Taylor &Francis)
7. Power Quality in Power systems and Electrical Machines–EwaldF.fuchs,Mohammad A.S. Masoum–Elsevier

Code: B17EE4109

ENERGY MANAGEMENT AND AUDITING
(Elective-II)

Lecture	**: 3 Hours**	**Int. Marks**	**: 30**
Tutorial	**: 1 Hour**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

Course Objectives:

1. To understand energy efficiency, scope, conservation and technologies.
2. To familiarize with energy efficient lighting systems.
3. To estimate/calculate power factor of systems and propose suitable compensation techniques.
4. To acquaint with the economical aspects of energy.
5. To calculate life cycle costing analysis and return on investment on energy efficient technologies.

Course outcomes:

S.No	Out Come: Students will be able to	Knowledge Level	PO'S
1	**Illustrate** the energy audit, conservation, management and various technologies.	K3	PO1
2	**Analyze** and **design** the energy efficient lighting systems.	K4	PO2, PO3
3	**Calculate** power factor and suggest location and compensation techniques.	K4	PO2
4	**Analyze** the economic aspects of energy using different methods.	K4	PO1, PO2
5	**Compute** the economic aspects by applying life cycle costing and return on investment.	K3	PO1

SYLLABUS

UNIT–I
BASIC PRINCIPLES OF ENERGY AUDIT AND MANAGEMENT

Energy audit – Definitions – Concept – Types of audit – Energy index – Cost index – Pie charts – Sankey diagrams – Load profiles – Energy conservation schemes and energy saving potential – Numerical problems – Principles of energy management – Initiating, planning, controlling, promoting, monitoring, reporting – Energy manager – Qualities and functions – Language – Questionnaire – Check list for top management.

UNIT–II
LIGHTING

Modification of existing systems – Replacement of existing systems – Priorities**:** Definition of terms and units – Luminous efficiency – Polar curve – Calculation of illumination level – Illumination of inclined surface to beam– Luminance or brightness – Types of lamps – Types of lighting – Electric lighting fittings (luminaries) – Flood lighting – White light LED and conducting Polymers – Energy conservation measures.

UNIT–III

POWER FACTOR AND ENERGY INSTRUMENTS

Power factor – Methods of improvement – Location of capacitors – Power factor with non linear loads – Effect of harmonics on Power factor – Numerical problems. Energy Instruments – Watt–hour meter – Data loggers– Thermocouples – Pyrometers – Lux meters – Tong testers – Power analyzer.

UNIT–IV

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 (basic concepts).

UNIT–V

COMPUTATION OF ECONOMIC ASPECTS

Calculation of simple payback method – Net present worth method – Power factor correction – Lighting – Applications of life cycle costing analysis – Return on investment.

Text Books:

1. Energy management by W.R. Murphy & G. Mckay Butter worth, Elsevier publications. 2012
2. Energy efficient electric motors by John .C. Andreas, Marcel Dekker Inc Ltd–2nd edition, 1995.

Reference Books:

1. Electric Energy Utilization and Conservation by S C Tripathy, Tata McGraw hill publishing company Ltd. New Delhi.
2. Energy management by Paul o' Callaghan, Mc–Graw Hill Book company–1st edition, 1998.
3. Energy management hand book by W.C.Turner, John Wiley and sons.
4. Energy management and conservation –k v Sharma and pvenkataseshaiah-I K International Publishing House pvt.ltd,2011.

Code: B17EE4110

POWER ELECTRONICS LAB

		Int. Marks	**: 50**
Practical	**: 3 Hours**	**Ext. Marks**	**: 50**
Exam	**: 3 Hrs.**	**Credits**	**: 2**

Course Objectives:

1 To conduct experiments on power semiconductor devices to study its characteristics.
2 To conduct experiments to convert power with different converters.

Course outcomes:

S.No	Out Come: Students will be able to	Knowledge Level	PO'S
1	**Apply** power electronic circuits for different loads and triggering methods.	K4	PO2, PO9
2	**Compare** the characteristics of power semiconductor devices	K3	PO1, PO9
3	**Analyze** the operation of controlled rectifiers and choppers	K4	PO2, PO9
4	**Analyze** the operation of AC voltage controllers and Cycloconverter	K4	PO2, PO9
5	**Analyze** the operation of inverters	K4	PO2, PO9

List of experiments:

1. Study the Characteristics of SCR, IGBT and MOSFET
2. Design of Gate Drive Circuit for IGBT & MOSFET
3. Compare the R and RC triggering circuit for various firing angle.
4. Construct a Single Phase Semi Converter for R and RL Loads.
5. Control the Speed of DC Motor Using Single Phase Full Converter with and without Free Wheeling Diode.
6. Construct a Single Phase AC Voltage Controller for R and RL Loads.
7. Study of Single Phase Cycloconverter for different frequency divisions.
8. Study of Impulse Commutated Chopper for various duty cycles.
9. Construct a single phase dual converter with and without circulating current mode of operation.
10. Study of Three Phase Inverter with 120º and 180º Mode of operation.

Add on Experiments:

1. Obtain the Three Level AC voltage from DC input using NPC Inverter.
2. Obtain the Five Level AC voltage from DC input using Cascaded Multi Level Inverter.
3. Study of Three Phase Full Converter with R-Load
4. Study of Three Phase Semi Converter with R-Load
5. Study of Three Phase AC Voltage Controller with R-Load
6. Study of Three Phase Sinusoidal PWM Inverter.

Textbooks:

1. P.S.Bhimbra , Power Electronics, Khanna publications. Fifth edition.
2. M. H. Rashid, Power Electronics: Circuits, Devices and Applications, – Prentice Hall of India, 2nd edition, 1998.

Code: B17EE4111

POWR SYSTEM SIMULATION LAB

		Int. Marks	**: 50**
Practical	**: 3 Hours**	**Ext. Marks**	**: 50**
Exam	**: 3 Hrs.**	**Credits**	**: 2**

Course Objectives:

1 To obtain the time domain response for the various networks and load flows of the power systems by using matlab programming software.

2 To obtain the load frequency response and other responses of the power systems by using Simulink software.

Course outcomes:

S.No	Out Come: Students will be able to	Knowledge Level	PO'S
1	Acquire knowledge to write the matlab program for the Ybus, Load flows, Economic Load Dispatch considering with and without losses.	K4	PO3, PO5, PO9
2	**Construct** the Simulink models for the simulation of transient and steady state stabilities in power systems, load frequency control of single and two-area system using MATLAB/ SIMULINK software.	K4	PO2, PO5, PO9
3	Attain proficiency in usage of MATLAB/SIMULINK software tool.	K4	PO5, PO9

List of experiments:

1. Linear electrical systems
2. Iterative solutions for non-linear equations
3. Y-bus formation by direct inspection method
4. Power flow solution by gauss-seidel method
5. Economic load dispatch
6. PID control of automatic voltage regulator
7. Load frequency control of an isolated power system using state feedback
8. Automatic generation control in a two-area system
9. Transient stability using swing curve
10. Symmetrical components

Add on Experiments:

1. Load frequency control of a two-area systems with tie line biased control
2. Linear quadratic regulator state feedback for single area load frequency control

Reference Textbooks:

1. Power System Analysis Haadi Saadat IInd edition, McGraw-Hill College1998
2. Modern *Power System Analysis*. Front Cover · D. P. *Kothari*, I. J. Nagrath. Tata McGraw-Hill Education, 2003.

SCHEME OF INSTRUCTION & EXAMINATION

(Regulation R17)

IV/IV B.TECH

(With effect from **2017-2018**Admitted Batch onwards**)**

ELECTRICAL AND ELECTRONICS ENGINEERING

(Accredited by NBA)

II-SEMESTER

Code No.	Name of the Subject	Cr.	Lect Hrs	Tut. Hrs	Lab Hrs	Contact Hrs/ Week	Int. Marks	Ext. Marks	Total Marks
B17 EE 4201	Electrical Machine Design	3	3	1	--	4	30	70	100
#ELE-III	Elective-III	3	3	1	--	4	30	70	100
B17 EE 4205	Power System Protection Lab	2	--	--	3	3	50	50	100
B17 EE 4206	Seminar	2	--	--	--	--	50	--	50
B17 EE 4207	Project Work	10	--	--	3	3	60	140	200
Total		**20**	**6**	**2**	**6**	**14**	**220**	**330**	**550**

#ELE-III	B17 EE 4202	Electrical Distribution Systems
	B17 EE 4203	Utilization of Electrical Energy & Traction
	B17 EE 4204	HVDC Transmission

Code: B17EE4201

ELECTRICAL MACHINE DESIGN

Lecture	**: 3 Hours**	**Int. Marks**	**: 30**
Tutorial	**: 1 Hour**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

Course Objectives:

1 Understand the concept of magnetic circuits, temperature rise in electrical machines
2 Understand the concept of transformers design & their windings
3 Examine various losses in DC machines& their classification
4 Understand the design procedures of Induction Machines & Classification
5 Understand design procedures of synchronous machine and induction machines.

Course outcomes:

S.No	Out Come: Students will be able to	Knowledge Level	PO'S
1	**Illustrate** the design of rating, magnetic circuits, limitations, heating and cooling aspects of DC & AC machines.	K3	PO1
2	**Design** the armature, field winding and main dimensions of DC Machine.	K4	PO3
3	**Design** of core, windings, insulation, cooling and dimensions of single phase and three phase transformers.	K4	PO3
4	**Design** number of turns, air gap length, conductor size, stator and rotor dimensions of AC Machines.	K4	PO3
5	**Select** the number of slots, poles and develop winding diagrams for AC Machines.	K4	PO3

SYLLABUS

UNIT-I

Fundamental Aspects Of Electrical Machine Design:

Design of Machines, Design Factors, Limitations in Design, Basic Principles, specification, Ratings, Magnetic Circuits, magnetization curves, heating, cooling, temperature rise with short term rating.

UNIT-II

D.C Machine:

Construction details, Armature, windings, Commutator, Design of output equation, Selection of No. of poles, Magnetic circuit and Magnetization curve.

UNIT-III

Transformer:

Classification of Transformers, core construction, types of winding and design, cooling and insulation, Output of Transformer, output equation, ratio of iron loss to copper loss, relation between core area and weight of iron and copper, optimum design.

UNIT-IV

Three phase Induction Machine:

Stator, stator frames, rotor, rotor windings, comparison of squirrel cage and wound rotors, slip rings, design of output equation, main dimensions, stator winding, design of squirrel cage rotor and wound rotor.

UNIT-V

Three phase Synchronous Machine:

Output equation, main dimensions for salient and non-salient pole machines, armature windings and design, selection of stator slots, air gap length, design of rotor for salient pole and turbo alternators.

Textbooks:

1. Sawhney AK, "Electrical Machine Design", Dhanpat Rai & Sons, 4th edition.

Reference Books:

1. Clayton A.E., "The performance and design of D.C. Machines", Pitman (ELBS),1st edition.
2. Say MG, "The performance and design of A.C. Machines", Pitman (ELBS), 3rd edition.

Code: B17EE4202

ELECTRICAL DISTRIBUTION SYSTEMS
(Elective-III)

Lecture	**: 3 Hours**	**Int. Marks**	**: 30**
Tutorial	**: 1 Hour**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

Course Objectives:

1 To distinguish between transmission and distribution systems
2 To understand design considerations of feeders
3 To compute voltage drop and power loss in feeders
4 To understand protection of distribution systems
5 To examine the power factor improvement and voltage control

Course outcomes:

S.No	Out Come: Students will be able to	Knowledge Level	PO'S
1	**Apply** engineering fundamentals to obtain different loadmodelings and their characteristics.	K3	PO1, PO2
2	**Identify** the optimal location of substation and **Design** a radial and loop type distribution feeder.	K4	PO2, PO3
3	**Compute** voltage drop and power loss in a distribution system under uniform and non-uniform distribution loads.	K4	PO2
4	**Identify** the types of faults in distribution system and select suitable protection schemes.	K4	PO2
5	**Design** a suitable capacitor for power factor correction and voltage compensation in a distribution system.	K4	PO3

SYLLABUS

UNIT – I

GENERAL CONCEPTS:

Introduction to distribution systems, Load modelling and characteristics – Coincidence factor– Contribution factor loss factor – Relationship between the load factor and loss factor –Classification of loads (Residential, commercial, Agricultural and Industrial).

UNIT – II

SUBSTATIONS:

Location of substations**:** Rating of distribution substation – Service area with 'n' primary feeders – Benefits and methods of optimal location of substations..

DISTRIBUTION FEEDERS:

Design Considerations of distribution feeders**:** Radial and loop types of primary feeders –Voltage levels – Feeder loading – Basic design practice of the secondary distribution system.

UNIT – III

SYSTEM ANALYSIS:

Voltage drop and power–loss calculations**:** Derivation for voltage drop and power loss in lines – Uniformly distributed loads and non-uniformly distributed loads – Numerical problems - Three phase balanced primary lines.

UNIT – IV

PROTECTION:

Objectives of distribution system protection – Types of common faults and procedure for fault calculations for distribution system – Protective devices**:** Principle of operation of fuses– Circuit reclosures – Line sectionalizers and circuit breakers.

UNIT – V

COMPENSATION FOR POWER FACTOR IMPROVEMENT:

Capacitive compensation for power factor control – Different types of power capacitors –shunt and series capacitors – Effect of shunt capacitors (Fixed and switched) – Power factor correction – Capacitor allocation – Economic justification – Procedure to determine the best capacitor location – Numerical problems.

VOLTAGE CONTROL:

Voltage Control**:** Equipment for voltage control – Effect of series capacitors – Effect of AVB/AVR – Line drop compensation – Numerical problems.

Text Book:

1. "Electric Power Distribution system, Engineering" - 3rd Edition by TuranGonen, CRC Press,2015.

Reference Books:

1. "Electrical Distribution Systems"- 2nd Edition by Dale R.Patrick and Stephen W.Fardo, CRC press,2009.
2. "Electric Power Distribution" - 4th Edition by A.S. Pabla, Tata McGraw–hill Publishing company,1997.
3. "Electrical Power Distribution Systems"- 1st Edition by V.Kamaraju, Right Publishers,2009.

Web links:

1. https://nptel.ac.in/courses/108/107/108107112/

Code: B17EE4203

UTILIZATION OF ELECTRICAL ENERGY AND TRACTION
(Elective-III)

Lecture	**: 3 Hours**	**Int. Marks**	**: 30**
Tutorial	**: 1 Hour**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

Course Objectives:

1 To study various electric heating and electric welding methods used in industries.
2 To study the basic principles of illumination and types of light schemes.
3 To study working principle of air-conditioning and Refrigeration.
4 To study the concepts of Electrolysis processes.
5 To study the basic principles of electric traction and speed time curves.

Course outcomes:

S.No	Out Come: Students will be able to	Knowledge Level	PO'S
1	**Identify** different heating and welding methods for industrial applications.	K3	PO1
2	**Employ** different lamps and **analyze** lighting schemes for illumination of residential, commercial and industrial environments.	K4	PO1, PO2
3	**Illustrate** the speed control and braking of traction motors by applying basic principles.	K3	PO1
4	**Analyze** electric traction systems under braking and acceleration conditions.	K4	PO2
5	**Analyze** electrolytic processing techniques used in industries and **Apply** the knowledge of electric wiring to air-conditioning and Refrigeration systems.	K4	PO1, PO2

SYLLABUS

UNIT-I

ELECTRIC HEATING & ELECTRIC WELDING:

Advantages and methods of electric heating, resistance heating, induction heating, and dielectric heating. Electric welding, resistance and arc welding, electric welding equipment, comparison between A.C. and D.C. Welding.

UNIT-II

ILLUMINATION :

Introduction, terms used in illumination, laws of illumination, polar curves, photometry, Measurement of MSCP by integrating sphere, Illumination for different purposes. sources of light : Discharge lamps, MV and SV lamps comparison between tungsten filament lamps and fluorescent tubes, Basic principles of light control, Types and design of lighting and flood lighting.

UNIT-III

ELECTRIC TRACTION - I

System of electric traction and track electrification. Special features of traction motor, methods of electric braking – plugging, rheostatic braking and regenerative braking. Mechanics of train movement. Speed-time curves for different services – trapezoidal and quadrilateral speed time curves and its applications.

UNIT-IV

ELECTRIC TRACTION - II

Calculations of tractive effort, power, specific energy consumption for given run, effect of varying acceleration and braking retardation, adhesive weight and braking retardation adhesive weight and coefficient of adhesion.

UNIT-V

ELECTROLYTIC PROCESS & ELECTRIC CIRCUITS USED IN REFREGERATION, AIR CONDITIONING, WATER COOLERS

Laws of electrolysis, process of electro-deposition - clearing, operation, deposition of metals, polishing and buffing , Factors affecting electro-deposition, Principle of galvanizing & anodizing and its applications, Electroplating of non-conducting materials , Principle of air conditioning, vapour pressure, refrigeration cycle, eco-friendly refrigerants. Description of Electrical circuit used in a) Refrigerator, b) Air-conditioner, and c) Water cooler

Text Books:

1. Art & Science of Utilization of electrical Energy – by Partab, Dhanpat Rai & Sons.
2. H. Partab, " Modern Electric Traction" Dhanpat Rai & Sons.
3. C.L. Wadhwa, " Generation, Distribution and Utilization of Electrical Energy" New Age International Publications.

Reference Books:

1. Utilization, Generation and Conservation of Electrical Energy Sunil S Rao Khanna Publishers 1st Edition, 2011.
2. Utilization of Electric Power and Electric Traction G.C. Garg Khanna Publishers 9th Edition, 2014

Code: B17EE4204

HVDC TRANSMISSION
(Elective-III)

Lecture	**: 3 Hours**	**Int. Marks**	**: 30**
Tutorial	**: 1 Hour**	**Ext. Marks**	**: 70**
Exam	**: 3 Hrs.**	**Credits**	**: 3**

Course Objectives:

1 To impart the knowledge about working for various converters used in HVDC transmission.
2 To impart the knowledge about controlling of power flow in HVDC transmission systems.
3 To impart the knowledge about protection of HVDC transmission systems during various faults

Course outcomes:

S.No	Out Come: Students will be able to	Knowledge Level	PO'S
1	**Apply** engineering fundamentals to understand operation of basic converters and links used in HVDC transmission system.	K3	PO1
2	**Analyze** 6-pulse and 12-pulse converters and used in HVDC Transmission.	K4	PO2
3	**Analyze** different types of harmonics produced by HVDC converters and **Suggest** suitable filters to eliminate the harmonics.	K4	PO2
4	**Analyze** voltage Interactions problems between HVDC and HVAC systems and the control for MTDC systems	K4	PO2
5	**Analyze** about different types of faults will occur and techniques to protect equipment used in HVDC transmission systems	K4	PO2

SYLLABUS

UNIT-I:
H.V.D.C. Transmission:
Limitation of EHV AC Transmission, Advantages of HVDC: Technical economical and reliability aspects. HVDC Transmission: General considerations, Power Handling Capabilities of HVDC Lines, Basic Conversion principles, static converter configuration. Types of HVDC Links-Apparatus and its purpose

UNIT-II
Static Power Converters:
6-pulse bridge circuit and 12-pulse converters, converter station and Terminal equipment, commutation process, Rectifier and inverter operation, equivalent circuit for converter – special features of converter transformers. Comparison of the performance of diametrical connection with 6-pulse bridgecircuit

UNIT-III

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

UNIT-IV

Interaction between HV AC and DC systems – Voltage interaction, Harmonic instability problems and DC power modulation. Development of DC circuit Breakers, Multi-terminal DC links and systems; series, parallel and series parallel systems, their operation and control.

UNIT-V

Transient over voltages in HV DC systems: Over voltages due to disturbances on DC side, over voltages due to DC and AC sideline faults. Converter faults and protection in HVDC Systems: Converter faults, over current protection - valve group, and DC line protection, circuit breakers. Over voltage protection of converters, surge arresters.

Text Books:

1. S Kamakshaih and V Kamaraju: HVDC Transmission- MGhill.2011 1st edition
2. K.R.Padiyar : High Voltage Direct current Transmission, Third Edition Wiley Eastern Ltd.,New Delhi – 1992.

Reference Books:

1. E.W. Kimbark : Direct current Transmission, Wiley Inter Science – NewYork.volume -1 1971
2. J.Arillaga : H.V.D.C.Transmission Peter Peregrinus ltd., London UK19832nd edition

Code: B17EE4205

POWER SYSTEM PROTECTION LAB

		Int. Marks	**: 50**
Lab	**: 3 Hours**	**Ext. Marks**	**: 50**
Exam	**: 3 Hrs.**	**Credits**	**: 2**

Course Objectives:

1 To study the operation of various protective relays.
2 To understand the behavior of performance of synchronous machine.
3 To study the parameters of transmission line and transformer.
4 To determine the dielectric strength of insulating oil.

Course outcomes:

S.No	Out Come: Students will be able to	Knowledge Level	PO'S
1	**Examine** different protection relays.	K4	PO2, PO9
2	**Analyze** the performance of synchronous machine by using synchronous reactance and power angle curve.	K4	PO2, PO9
3	**Determine** the parameters of transmission line and three phase transformers.	K3	PO1, PO9
4	**Compute** the dielectric strength of insulating oil	K3	PO1, PO9

List of experiments

1. Obtain positive, negative and zero sequence impedances of a 3-phase transformer.
2. Obtain the sequence impedance of alternator by fault analysis.
3. Obtain power angle characteristics of a salient pole synchronous machine by knowing direct and quadrature axis reactance.
4. Determine the dielectric strength of insulating oil.
5. Obtain the equivalent circuit of a 3-winding transformer.
6. Obtain the ABCD parameters of transmission line.
7. To plot the IDMT characteristics of electromagnetic over current relay.
8. To plot the DMT and IDMT characteristics of static overvoltage and under voltage relays.
9. To test the operation of Differential relay for Protection of transformer.
10. To test the characteristics of Negative sequence current relay with phase reversal fault simulation.

Reference Books:

1. "Electrical Power Systems" by C. L. Wadhwa, New Age International, 2009.
2. "Power System Protection" by Paul M Anderson, Wiely, 1998.

Code: B17 EE 4206

SEMINAR

Lecture	**: --**	**Int.Marks**	**: 50**
Tutorial	**: --**	**Ext. Marks**	**: --**
Exam	**: --**	**Credits**	**: 2**

For the seminar, each student has to be evaluated based on the presentation of any latest topic with report of 10-15 pages and a PPT of minimum 10 slides. The student shall collect the information on a specialized topic and prepare a technical report, showing his understanding over the topic, and submit to the department, which shall be evaluated by the Departmental committee consisting of Head of the department, seminar supervisor and a senior faculty member.

NOTE: Minimum of 50 % of marks is required to pass in seminar. If a student fails to get those minimum marks he/she has to again present the same topic within 2 weeks from the date of earlier presentation.

Code: B17 EE 4207

PROJECT WORK

Lab	**: 3 Hrs.**	**Int.Marks**	**: 60**
Tutorial	**: --**	**Ext. Marks**	**: 140**
Exam	**: --**	**Credits**	**: 10**

Course Outcomes: At the end of the Project Work students will be able to

S.No	Out Come	Knowledge Level
1	Identify a current problem through literature/field/case studies	K3
2	Identify the background objectives and methodology for solving the same.	K3
3	Design a technology/ process for solving the problem.	K6
4	Develop a technology/ process for solving the problem.	K6
5	Evaluate that technology/ process at the laboratory level.	K5

Format for Preparation of Project Thesis for B. Tech:

1. Arrangement Of Contents: The sequence in which the project report material should be arranged and bound should be as follows:

1. Cover Page & Title Page .
2. Bonafide Certificate
3. Abstract.
4. Table of Contents
5. List of Tables
6. List of Figures
7. List of Symbols, Abbreviations and Nomenclature
8. Chapters
9. Appendices
10. References

*The table and figures shall be introduced in the appropriate places.

Note:

Out of a total of 200 marks for the project work, 60 marks shall be for Internal Evaluation and 140 marks for the end semester examination. The end semester examination (VivaVoce) shall be conducted by the committee. The committee consists of an external examiner, Head of the Department and Supervisor of the Project. The evaluation of project work shall be conducted at the end of the IV year. The Internal Evaluation shall be on the basis of two seminars given by each student on the topic of his project and evaluated by an internal committee.