JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

COURSE STRUCTURE & SYLLABUS for M.Tech EEE Common for

High Voltage Engineering (HVE),
Power Systems with emphasis on H. V. Engineering (PSHVE) &
High Voltage and Power Systems Engineering (HVPSE)

Programme

(Applicable for batches admitted from 2019-2020)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

COURSE STRUCTURE

I Semester

S.No	Course No	Category	Course Name	P.Os	L	T	P	C	Marks
1		PC	Generation and Measurement of High Voltages		3	0	0	3	100
2		PC	Dielectrics and Insulation Engineering		3	0	0	3	100
3		PE	Program Elective – I I. Artificial Intelligence Techniques II. HVDC Transmission III. Breakdown Phenomenon in Electrical Insulation		3	0	0	3	100
4		PE	Program Elective – II i. High Voltage Power Apparatus and Diagnostics ii. Collision Phenomena in Plasma Science iii. Advanced Electro Magnetic Fields		3	0	0	3	100
5			Research Methodology and IPR		2	0	0	2	100
6			Simulation Laboratory – I		0	0	4	2	100
7			High Voltage Laboratory		0	0	4	2	100
8			Audit Course – I		2	0	0	0	100
					16	0	8	18	800

II Semester

S.No	Course No	Category	Course Name	P.Os	L	T	P	C	Marks
1		PC	High Voltage Testing Techniques		3	0	0	3	100
2		PC	Surge Phenomenon & Insulation Coordination		3	0	0	3	100
3		PE	Program Elective – III i.Partial Discharge in HV Equipment **ii.**Gas Insulated Systems and Substations iii. Pulse Power Engineering		3	0	0	3	100
4		PE	Program Elective – IV i.Flexible AC Transmission Systems ii.EHVAC Transmission iii.Smart Grid Technologies		3	0	0	3	100
5			Simulation Laboratory – II		0	0	4	2	100
6			Power Systems Laboratory		0	0	4	2	100
7			Mini Project with Seminar		0	0	4	2	100
8			Audit Course – II		2	0	0	0	100
					14	0	12	18	800

III Semester

S.No	Course No	Category	Course Name	P.Os	L	T	P	C	Marks
1		PE	Program Elective –V i. Industrial Safety ii. Power Quality iii. Power System Transients		3	0	0	3	100
2		OE	Open Elective i. Operations Research ii. Energy Audit Conservation & Management iii. Composite Materials		3	0	0	3	100
3			Dissertation Phase - I **(to be continued and evaluated next semester)**		0	0	20	10	---
					6	0	20	16	200

IV Semester

S.No	Course No	Category	Course Name	T	P	C	Marks
1			Dissertation Phase-II **(continued from III semester)**	0	32	16	100
				0	32	16	100

Audit course 1 & 2

a. English for Research Paper Writing
b. Disaster Management
c. Sanskrit for Technical Knowledge
d. Value Education
e. Constitution of India
f. Pedagogy Studies
g. Stress Management by Yoga
h. Personality Development through Life Enlightenment Skills.

I-Semester	GENERATION AND MEASUREMENT OF HIGH VOLTAGES	CATEGORY	L-T-P 3 -0-0	CREDITS 3

Pre-requisite:Basics of Electrical circuits, Electronics and measurements for testing purpose.

Course Educational Objectives:

1. To study the numerical methods for analyzing electrostatic field problems.
2. To study the fundamental principles of generation of high voltages for testing
3. To study the fundamental principles of generation of high impulse voltages for testing.
4. To study the methods for measurement of high AC, DC and transient voltages.
5. To Study the measurement techniques for high AC, DC and impulse currents.

UNIT – 1

Electrostatic fields and field stress control : Electric fields in homogeneous Isotropic materials and in multi dielectric media-Simple configurations-field stress control. Methods of computing electrostatic fields-conductive analogues-Impedance networks Numerical techniques-finite difference method-finite element method and charge simulation method

UNIT – 2

Generation of High AC & DC Voltages:

Direct Voltages: AC to DC conversion methods, electrostatic generators, Cascaded Voltage Multipliers.

Alternating Voltages: Cascading transformers-Resonant circuits and their applications, Tesla coil.

UNIT – 3

Generation of Impulse Voltages :

Impulse voltage specifications-Impulse generation circuits-Operation, construction and design of Impulse generators-Generation of switching and long duration impulses.

Impulse Currents: Generation of high impulse currents and high current pulses

UNIT – 4

Measurement of High AC & DC Voltages :

Measurement of High D.C. Voltages: Series resistance meters, voltage dividers and generating voltmeters.

Measurement of High A.C. Voltages : Series impedance meters electrostatic voltmeters potential transformers and CVTS-voltage dividers and their applications.

UNIT – 5

Measurement of Peak Voltages :

Sphere gaps, uniform field gaps, rod gaps, Chubb-Fortesque method, Passive and active rectifier circuits for voltage dividers.

Measurement of Impulse Voltages: Voltage dividers and impulse measuring systems-generalized voltage measuring circuits-transfer characteristics of measuring circuits-L.V. Arms for voltage dividers-compensated dividers

Measurement of Impulse Currents: Resistive shunts-current transformers-Hall Generators and Faraday generators and their applications-Impulse Oscilloscopes

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

1. Understand numerical computation of electrostatic problems.
2. Understand the techniques of generation of high AC, DC and transient voltages.
3. Measure high AC, DC and transient voltages.
4. Measure high AC, DC and transient currents.

Text Books:

1. High Voltage Engineering – by E.Kuffel and W.S.Zaengl. Pergaman press Oxford, 1984.
2. High Voltage Engineering – by M.S.Naidu and V.Kamaraju, Mc.Graw-Hill Books Co., New Delhi, 2nd edition, 1995.

Reference Books:

1. High Voltage Technology – LL Alston, Oxford University Press 1968.
2. High Voltage Measuring Techniques – A. Schwab MIT Press, Cambridge, USA, 1972.
3. Relevant I.S. and IEC Specifications.

I-Semester	DIELECTRICS AND INSULATION ENGINEERING	CATEGORY	L-T-P 3-0-0	CREDITS 3

Pre-requisite:Concepts of High voltage engineering and basic physics.

Course Educational Objectives:

- To study and unstained the dielectric phenomena in insulating materials
- To understand the electrical properties of insulating materials.
- To understand the electrical breakdown phenomena in gaseous and vacuum insulation
- To understand the electrical breakdown phenomena in liquid and solid insulation
- To understand the design &application of insulating materials in different electrical apparatus.

UNIT – 1

Dielectrics and Insulating Materials: Review of Dielectric Phenomenon: Complex permittivity – Polarization - Relaxation and resonant models. Solid, Liquid and Gaseous insulating materials-Physical, Thermal & Electrical properties-Classification of Insulating Materials.

UNIT – 2

Solid Insulating Materials: Organic Fiber materials Ceramics & Synthetic polymers and their applications.

Liquid Insulating Materials: Insulating oils, their properties and applications.

Gaseous Insulating Materials: Air and SF_6- applications in electrical apparatus.

UNIT – 3

Breakdown phenomenon in gaseous and vacuum insulation: Insulation and decay processes-transition from self-sustained discharges to breakdown-Townsend and streamer discharge, Paschen's law, Penning effect-Time lags-Surge breakdown voltage-Breakdown in non-uniform fields-Vacuum insulation and vacuum breakdown.

UNIT – 4

Breakdown Phenomenon in Liquid and Solid Insulation: Pure and commercial liquids-suspended particle and bubble theories-stressed oil volume theory-Breakdown in solid insulation: Intrinsic breakdown-Treeing and tracking phenomenon-Thermal breakdown—Breakdown in composite dielectrics.

UNIT – 5

Insulation design: Insulation design for power cables, capacitors, bushings, switchgear, transformers and rotating machines-resents trends.

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

- Distinguish between dielectrics and insulating materials.
- Understand the Properties of insulating materials.
- Analyze Electrical breakdown in gas and vacuum insulation.
- Analyze Electrical breakdown in liquid and solid insulation.
- Understand the insulation design in electrical power apparatus.

Text Books:

1. High Voltage Engineering – by M.S.Naidu and V.Kamaraju, Tata McGraw-Hill Books Co., New Delhi, 2nd edition, 1995.
2. Insulating Materials-by Dekker, S.Chanda & Co

Reference Books:

1. High Voltage Engineering – by E.Kuffel and W.S. Zaegnl, Pergamon press, Oxford, 1984.
2. Electrical Engineering Materials – B. Tareev, M.I.R. Publications, MOSCOW.
3. Physics of Dielectrics - B. Tareev, M.I.R. Publications, MOSCOW
4. High Voltage Technology - LL Alston, Oxford University Press 1968.
5. Insulation Engineering- by Arora ,John Wiley & Sons
6. Dielectrics and waves-by Vonhipple, John Wiley & Sons

I-Semester	ARTIFICIAL INTELLIGENT TECHNIQUES (ELECTIVE–I)	CATEGORY	L-T-P 3 -0-0	CREDITS 3

Pre–requisite: Fundamentals of Neural networks and Fuzzy Logic.

Course Educational Objectives:

- To have knowledge on concept of neural network.
- To know different types of neural networks and training algorithms.
- To understand the concept of genetic algorithm and its application in optimization.
- To have the knowledge on fuzzy logic and design of fuzzy logic controllers.
- To know the applications of AI Techniques in electrical engineering.

UNIT– 1

Introduction

Artificial Neural Networks (ANN) – definition and fundamental concepts – Biological neural networks – Artificial neuron – activation functions – setting of weights – typical architectures – biases and thresholds – learning/training laws and algorithms. Perceptron – architectures, ADALINE and MADLINE – linear separability- XOR function.

UNIT– 2

ANN Paradigms

ADALINE – feed forward networks – Back Propagation algorithm- number of hidden layers – gradient decent algorithm – Radial Basis Function (RBF) network. Kohonen'sself organizing map (SOM), Learning Vector Quantization (LVQ) and its types – Functional Link Networks (FLN) – Bidirectional Associative Memory (BAM) – Hopfield Neural Network.

UNIT– 3

Classical and Fuzzy Sets

Introduction to classical sets- properties, Operations and relations; Fuzzy sets, Membership, Operations, Properties, Fuzzy relations, Cardinalities, Membership functions.

UNIT– 4

FUZZY LOGIC CONTROLLER (FLC)

Fuzzy logic system components: Fuzzification, Inference engine (development of rule base and decision making system), Defuzzification to crisp sets- Defuzzification methods.

UNIT– 5

Application of AI Techniques

Speed control of DC motors using fuzzy logic –load flow studies using back propagation algorithm, single area and two area load frequency control using fuzzy logic.

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

- Differentiate between Algorithmic based methods and knowledge based methods.
- Use appropriate AI framework for solving power system problems.
- To design fuzzy logic controllers for power engineering applications.

Text Books:

1. Introduction to Artificial Neural Systems - Jacek M. Zurada, Jaico Publishing House, 1997.
2. Fuzzy logic with Fuzzy Applications – T.J Ross – McGraw Hill Inc, 1997.

Reference Books:

1. Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications by Rajasekaran and G.A.VijayalakshmiPai – PHI Publication.
2. Modern power Electronics and AC Drives – B.K.Bose -Prentice Hall, 2002
3. Genetic Algorithms- David E Goldberg. Pearson publications.
5. Introduction to Neural Networks using MATLAB 6.0 by S N Sivanandam, SSumathi,S N Deepa TMGH
6. Introduction to Fuzzy Logic using MATLAB by S N Sivanandam, SSumathi,S N Deepa Springer, 2007.

I-Semester	HVDC TRANSMISSION (ELECTIVE–I)	CATEGORY	L-T-P 3 -0-0	CREDITS 3

Prerequisites: Knowledge on Power Electronics, Power Systems and High Voltage Engineering

Course Educational Objectives:

- To learn various schemes of HVDC transmission.
- To learn about the basic HVDC transmission equipment.
- To learn the control of HVDC systems.
- To be exposed to the interaction between HVAC and HVDC system.
- To be exposed to the various protection schemes of HVDC engineering.

UNIT – 1

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 – 2

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 bridge circuit

UNIT – 3

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 – 4

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 – 5

Transient over voltages in HV DC systems : Over voltages due to disturbances on DC side, over voltages due to DC and AC side line 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.

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

- Understand the various schemes of HVDC transmission.
- Understand the basic HVDC transmission equipment.
- Understand the control of HVDC systems.
- Understand the interaction between HVAC and HVDC system.
- Understand the various protection schemes of HVDC engineering.
- Understand the various schemes of HVDC transmission.

Text Books:

1. S Kamakshaih and V Kamaraju: HVDC Transmission- MG hill.
2. K.R.Padiyar : High Voltage Direct current Transmission, Wiley Eastern Ltd., New Delhi – 1992.

Reference Books:

1. E.W. Kimbark : Direct current Transmission, Wiley Inter Science – New York.
2. J.Arillaga : H.V.D.C.Transmission Peter Peregrinus ltd., London UK 1983
3. Vijay K Sood: HVDC and FACTS controllers: Applications of static converters in power systems by, Kluwer Academic Press.

I-Semester	BREAKDOWN PHENOMENON IN ELECTRICAL INSULATION (ELECTIVE-I)	CATEGORY	L-T-P 3-0-0	CREDITS 3

Pre-requisite:Basic physics, conduction phenomena in dielectrics.

Course Educational Objectives:

- To Understand the fundamental behavior of gases in electric fields.
- To Understand the Ionization phenomena in gases.
- To understand the self-sustained discharges and breakdown in large gaps
- To Understand the Breakdown phenomena in liquid and solid dielectrics.
- To Understand the Breakdown phenomena in vacuum.

UNIT – 1

Fundamentals of Electrical Breakdown Phenomena in Gases:

Review of gas laws-mean free path of a particle-velocity distribution of swarm of molecules-Expression for mean free path (λ)-Distribution of free paths-Bohr's model of an atom .calculation of radius of Bohr's orbit Energy of an electron-Ionization energy of an atom calculation of frequency of emitted radiation.

UNIT – 2

Ionization in Gases:

Methods of ionization in gases-Ionization by collision-types of inelastic collisions – collision cross sections.

Behavior of charged particles in a gas in electric fields of low (E/P)-drift velocity –mobility conditions for low (E/P).

Electrical Breakdown in Uniform Fields:

Voltage-current relationship is gaseous gap (small gaps)-condition for high (E/P)-Townsend's first Ionization coefficient (α) - (α/p) is a function of (E/P)-Experimental determination of (α) – Penning effect

UNIT – 3

Self-sustained discharge:

β-process and its limitations cathode process –methods of liberating secondary electrons – Townsend's second ionization coefficient -γ -process . Condition for electric spark breakdown. Secondary emission by gas produced photons – Meta stables-Role of solid contaminants. Electron Attachment, electronegative gases (SF_6etc).

Measurement of 'γ'- Paschen's law –expression for Minimum Breakdown voltage and minimum (Pd_{min}) - limitations of Paschen's law.

Breakdown of long gaps: Streamer Mechanism- Explanation for positive streamer. Estimation of space charge fields (Es) - Anode directed streamer - comparison between Townsend and streamer mechanism. Breakdown in non-uniform fields –corona discharges - difference between DC and AC corona. Effect of polarity on break down of point-plane gaps.

UNIT – 4

Breakdown in Solids and Liquid Insulations:

Types of Breakdown: Intrinsic Breakdown – Electronic Breakdown – Streamer Breakdown – Electromechanical Breakdown –Thermal Breakdown -treeing and tracking. Electro – Chemical Breakdown – BD due to thermal discharges.

Breakdown in liquids dielectrics:
Pure and commercial liquids – Breakdown tests – Pre-breakdown currents and breakdown in pure liquids – breakdown in commercial liquids –Suspended particle theory, cavitation and bubble mechanism. Thermal breakdown – Stressed oil – Volume Theory.

UNIT – 5

Breakdown in Vacuum Insulation:
Pre-Breakdown currents – Steady currents –Micro discharges-Factors affecting the Breakdown like electrode separation - electrode conditioning - electrode material –Surface condition surface contamination - electrode area and configurations –effect of electrode temperature – frequency of applied voltage – pressure - recovery strength of vacuum gap. Practical Exchange theory –electron beam Hypothesis – Clump mechanism- transition in breakdown mechanisms – criteria for B.D - effect of solids dielectrics in vacuum and liquids.

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

- Understand the fundamental process of conduction in gases.
- Understand ionization and breakdown phenomena in gases.
- Understand breakdown phenomena in liquid and solid dielectrics.
- Understand breakdown phenomena in vacuum.

Text Books:

1. Fundamentals of gaseous ionization and plasma electronics by Essam Nassar, John Wiley, New York (1974).

References Books:

1. High voltage & electrical insulation by RavindraArora , John willy and sons.
2. High voltage technology –L.L.Alston -Oxford Press (1968).
3. High voltage Engineering Fundamentals E. Kuffel, W. S. Zaengl,andJ. Kuffel oxford (2002).
4. High voltage Engineering, M.S.Naidu and V.Kamaraju (5th edition) McGraw Hill Publishing Co., New Delhi (2011).

I-Semester	HIGH VOLTAGE POWER APPARATUS AND DIAGNOSTICS (ELECTIVE-II)	CATEGORY	L-T-P 3-0-0	CREDITS 3

Pre-requisite: To know about power transformers, Degree of polymerization, dissolved gas analysis, Fourier Transformer and frequency response analysis of transformers.

Course Educational Objectives:

- To study about components of power transformer, types of insulation material, overvoltage due to lightning impulse & faults.
- To study the measurement of resistivity and capacitance of transformer oil, method of measurement of tan delta and analysis to detect ageing.
- To study the concept of moisture in transformer oil and paper and partial discharges detection methods within transformer volume.
- To study the degree of polymerization and to determine tan delta and capacitance in transformer bushing.
- To Study the concept of Fourier Transformer with regard to configuration of winding, frequency response analysis of transformer winding.

UNIT – 1

Introduction to power transformer, important components of power transformer, winding configuration, various types of insulation material, cooling of winding. Reasons of failure of transformer, overvoltage due to switching operation, over-voltage due to lightning impulse, over voltage due to fault, high level of partial discharges, over fluxing.

UNIT – 2

Tan delta, capacitance in transformer winding, method of measurement of tan delta and capacitance in transformer, Tan delta, resistivity and capacitance of transformer oil, bushing capacitance ,tan delta and resistivity, on-site measurement, analysis to detect ageing and likely failure

UNIT – 3

Moisture in transformer oil and paper, ageing effect of paper, insulation resistance, Method of measurement of polarization, polarization value, method of moisture reduction, winding resistance, Influence with regard to life of transformer. Partial Discharges in transformer, causes of partial discharges, concept of partial discharges, acoustic method of measurement of partial discharges, discharges in oil, discharges in paper, method of reduction of partial discharges, analysis and detection of partial discharge sites within transformer volume.

UNIT – 4

Degree of polymerization (DP) of transformer paper, effect of DP on life of transformer, effect of transformer temperature on degree of polymerization, furfural content in oil insulation, inter – relationship between degree of polymerization and furfural content, reduction of degree of polymerization in transformer paper. Dissolved gas analysis in transformer oil, various gas product in transformer oil, tolerable level of gases in transformer onload , detection of important gases in transformer, causes of various gases, likely reason of gases with reference to high temperature and partial discharges.

UNIT – 5

Fourier Transform and frequency response analysis of transformer winding, concept of Fourier Transformer with regard to configuration of winding, comparison of frequency response of LV , HV and tapping winding, concept of winding movement on the basis of frequency comparison, turn failure.

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

- Learn power transformer, types of insulation material.
- Measurement of tan delta and capacitance of transformer oil.
- Know the concept of moisture in transformer oil and paper and partial discharges.
- Know degree of polymerization.
- Know concept of Fourier Transformer and frequency response analysis of transformer winding.

Text Book:

1. Transformer, Bharat Heavy Electricals Limited (Bhopal), Second edition 2003,First Edition 1987 Tata Mc.Graw-Hhill Publishing Company Ltd. McGraw –Hill office Page 1- 602

Reference book

1 Seminar on fault finding and life assessment of power transformers Proceedings 25-26 April2008 New Delhi, Organized by Central Board of Irrigation and Power, New Delhi in association with Omicron India.

2.Transformer Engineering, Bluem and Boission, Wiley international publication

I-Semester	COLLISION PHENOMENA IN PLASMA SCIENCE (ELECTIVE-II)	CATEGORY	L-T-P 3-0-0	CREDITS 3

Pre-requisite:Introduction to plasma physics and quantum physics.

Course Educational Objectives:

- To Understand the Plasmas and their characterizations
- To Understand the Charged particle motion in electromagnetic fields.
- To Understand the Electron Avalanche mechanisms.

UNIT – 1

Ionization, Deionization and Electron Emission :Ionization and plasma conductivity, Production of charged particles, Ionization by cosmic rays, Thermal ionization. The free path, excited states, metastable states. Diffusion, Recombination, Negative ions. Photoelectric emission, Thermionic emission, Field emission.

UNIT – 2

Behavior of charged particles in a gas in electric fields of low E/P and high E/P, Definition and significance of mobility, Forces between ions and molecules, Diffusion under low fields, Electron drift velocity.

UNIT – 3

What is high E/P? Coefficient of ionization by electron collision, evaluation of$\propto$, electron avalanche, effect of the cathode, Ionization coefficient in alternating fields.

The Self-Sustaining Discharge Breakdown Mechanisms: Ionization by positive-ion collision, Cathode processes, space-charge field of an avalanche. Critical avalanche size,

UNIT – 4

Townsend mechanism and its limitations, Streamer formation. The transition between the breakdown mechanisms, The effect of electron attachment.

Partial Breakdown and Breakdown Under Alternating Fields: Electron current, positive-ion current, total current, characteristic time, effect of space charge, Anode coronas, Cathode coronas.

UNIT – 5

The Glow and Plasma: General description, The cathode zone, Negative glow and Faraday dark space, positive column, Anode region, other effects.

Definition of plasma, Debye length, scope of known plasmas, Plasma oscillations, high-temperature plasmas, Plasma diagnostics

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

- Analyze the collision phenomena in different materials.
- Calculate the forces between ions and molecules.
- Evaluate the ‘α’
- Analyze transition from Streamer to Townsend mechanisms of breakdown.
- Electric glow discharge and plasma glow discharge.

Text Book:

1. Fundamentals of Gaseous Ionization And Plasma Electronics by Essam Nasser, John Willey & Sons, Printed in America, 1971.

I-Semester	ADVANCED ELECTRO MAGNETIC FIELDS (ELECTIVE-II)	CATEGORY	L-T-P 3-0-0	CREDITS 3

Pre-requisite:To know the elements of Electromagnetic and electro static field theory along with the behavior of conductors in an electric field.

Course Educational Objectives:

- To know the analytical calculations of electric fieldsin different charge configurations
- To know calculations of electric fields in transmission lines
- To know the numerical methods for calculating electrical fields
- To understand the behavior of conductors and dielectrics in electric fields
- To understand the calculation of magnetic fields in time varying fields

UNIT – 1

Electrostatics:

Electrostatic Fields – Coulomb's Law – Electric Field Intensity (EFI) – EFI due to a line and a surface charge – Work done in moving a point charge in an electrostatic field – Electric Potential – Properties of potential function – Potential gradient – Gauss's law – Application of Gauss's Law – Maxwell's first law, div .(D)=ρv – Laplace's and Poisson's equations – Solution of Laplace's equation in one variable.

UNIT – 2

Electric fields-1

Introduction, Analytical calculation of space-charge-free fields, simple geometries, transmission conductors to ground, fields in multidielectric media, experimental analogs for space-space-charge-free fields, electrolytic tank, semi conducting paper analog, resistive-mesh analog.

UNIT – 3

Electric fields-2

Analytical Calculations of Fields With Space Charges, Numerical Computation of Fields With Space Charges, Finite Element Technique, Finite Element Technique Combined With The Method Of Characteristics, Charge-Simulation Technique Combined With The Method Of Residues, Electric Stress Control And Optimization, Electric Stress Control, Electric Stress Optimization

UNIT – 4

Conductors &Dielectrics:

Behavior of conductors in an electric field – Conductors and Insulators – Electric field inside a dielectric material – polarization – Dielectric – Conductor and Dielectric – Dielectric boundary conditions – Energy stored and energy density in a static electric field – Current density – conduction and Convection current densities – Ohm's law in point form – Equation of continuity.

UNIT – 5

Force in Magnetic fields &Time Varying Fields:

Magnetic force - Moving charges in a Magnetic field – Lorentz force equation — a differential current loop as a magnetic dipole ,Time varying fields – Faraday's laws of electromagnetic induction – Its integral and point forms ,Statically and Dynamically induced EMFs -Modification of Maxwell's equations for time varying fields – Displacement current.

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

- Know about analysis of electrostatic fields and properties of potential gradients.
- Know about the dielectric boundary conditions and electric stress control and optimization and time varying fields.
- Understand different Electric Fields.
- Distinguish between conductors and dielectrics.
- Understand the force in magnetic fields and time varying fields.

Text Books:

1. "Engineering Electromagnetic" by William H. Hayt & John. A. Buck, McGraw-Hill Companies, 7th Editon.2005
2. "Electromagnetics" by J. D Kraus McGraw-Hill Inc. 4th edition 1992

Reference Books:

1. "Field Theory", Gangadhar, Khanna Publishers.
2. "Elements of Electromagnetic field theory", Sadiku, Oxford Publ.
3. "Electromagnetics" by J P Tewari.
4. "Introduction to E-Magnetics" by CR Paul and S.A. Nasar, McGraw-Hill Publications
5. "Introduction to Electro Dynamics" by D J Griffiths, Prentice-Hall of India Pvt.Ltd, 2nd edition
6. "Electromagnetics" by Plonsy and Collin
7. "Engineering Electro magnetics" by Nathan Ida, Springer (India) Pvt. Ltd.2nd Edition.

I-I	RESEARCH METHODOLOGY AND IPR	CATEGORY	L-T-P 2-0-0	CREDITS 2

UNIT-I

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT-II

Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT-III

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT-IV

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

UNIT-V

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

REFERENCES:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd,2007.
5. Mayall, "Industrial Design", McGraw Hill, 1992.

I-Semester	SIMULATION LABORATORY – I	CATEGORY	L-T-P 0-0-4	CREDITS 2

Pre-requisite: Electrical Power systems

Course Educational Objectives:

The student should understand the modelling of various aspects of Power System analysis and develop the MATLAB programming.

List of experiments

1. Formation of Y- Bus by Direct-Inspection Method.
2. Load Flow Solution Using Gauss Siedel Method
3. Load Flow Solution Using Newton Raphson Method
4. Load Flow Solution Using Fast Decoupled Method
5. Formation of Z-Bus by Z-bus building algorithm
6. Symmetrical Fault analysis using Z-bus
7. Unsymmetrical Fault analysis using Z-bus
8. Economic Load Dispatch with & without transmission losses
9. Transient Stability Analysis Using Point By Point Method
10. Load Frequency Control of Single Area Control & Two Area Control system with and without controllers.

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

- Distinguish between different load flow methods.
- Analyze Y-bus & Z-bus algorithm.
- Analyze symmetrical & unsymmetrical faults.
- Understand importance of Load flow control
- Understand importance of Economic load dispatch and transient stability analysis.

I-Semester	HIGH VOLTAGE LABORATORY	CATEGORY	L-T-P 0-0-4	CREDITS 2

Pre-requisite: High Voltage Engineering

Course Educational Objectives:

The Student understand the breakdown strength and characteristics of different configurations of the gaps and breakdown strength of oil and insulators.

Any 10 of the following experiments are to be conducted.

List of Experiments

1. Millivolt drop test and Tong tester calibration
2. Breakdown characteristics of sphere-sphere gap
3. Measurement of Leakage current and breakdown voltage of pin insulator
4. Breakdown test of transformer oil
5. Breakdown characteristics of rod-rod gap
6. Measurement of Leakage current and insulation resistance of polypropylene scale
7. Measurement of Leakage current and insulation resistance of polypropylene rope
8. Breakdown characteristics of plane-rod-gap
9. Measurement of leakage current and breakdown voltage of suspension insulator
10. Breakdown characteristics of point-sphere gap
11. Measurement of tan delta and dielectric constant
12. Power frequency testing of HV transformer
13. Power frequency testing of HV Bushing
14. Power frequency testing of HV Cable.

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

- Design the various testing procedures of various insulators.
- Design the procedure for calibration of tong tester.
- Compute the breakdown strength of dielectric coil.
- Determine he leakage current of various insulators.

I-I	AUDIT COURSE – I	CATEGORY	L-T-P 2-0-0	CREDITS 0

II-Semester	HIGH VOLTAGE TESTING TECHNIQUES	CATEGORY	L-T-P 3 -0-0	CREDITS 3

Pre-requisite:Basics of high voltage engineering.

Course Educational Objectives:

- To understand Nondestructive testing methods.
- To understand testing standards for different HV power applications.
- To understand the power frequency and over voltage testing methods
- To understand the impulse testing of transformers and other HV equipment
- To understand the partial discharges and RIV in HV equipment

UNIT – 1

Non Destructive Testing Techniques : Measurement of DC Resistivity – Dielectric loss and dielectric constant of insulating materials – Schering bridge method – Transformer ratio arm bridge for high voltage and high current applications – null detectors.

UNIT – 2

High Voltage Testing of Power Apparatus: Need for testing standards – Standards for porcelain/Glass insulators-Classification of porcelain/glass insulator tests – Tests for cap and pin porcelain/Glass insulators.

UNIT – 3

High voltage AC testing methods-Power frequency tests-Over voltage tests on insulators, Isolators, Circuit Breakers and power cables. Artificial Contamination Tests : Contamination flashover phenomena-Contamination Severity-Artificial contamination tests-Laboratory Testing versus in-Service Performance-Case study.

UNIT – 4

Impulse Testing: Impulse testing of transformers, insulators, Surge diverters, Bushings, cables, circuit breakers.

UNIT – 5

Partial Discharge Measurement: PD equivalent model-PD currents-PD measuring circuits-Straight and balanced detectors-Location and estimation of PD in power apparatus-PD measurement by non-electrical methods-Calibration of PD detectors. RIV Measurements : Radio Interference – RIV – Measurement of RI and RIV in laboratories and in field. Different test arrangements and their limitations.

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

- Understand non-destructive testing techniques
- Analyze HV testing of apparatus
- Understand HVAC testing methods.
- Analyze impulse testing electrical equipment's.
- Learn partial discharge measurement techniques.

Text Books:

1. High Voltage Engineering – by E.KUFFEL and W.S.ZAENGL, Pergamon press, Oxford 1984.
2. High Voltage Engineering – by M.S.Naidu and V.Kamaraju, Tata McGraw Hill Publishing Company Limited, New Delhi – 2001.

Reference Books:

5. Discharge Detection in H.V. Equipment – by KREUGER, F.H. Haywood London – 1964.
6. Hyltencavallius. N. High voltage laboratory planning Enile Haefely & Co. Ltd. Based Switzerland 1988.
7. Ryan H.M. and Whiskand: design and operation perspective of British UHV Lab IEE pre 133 H.V. Testing Techniques Halfly

II-Semester	SURGE PHENOMENON AND INSULATION COORDINATION	CATEGORY	L-T-P 3-0-0	CREDITS 3

Pre-requisite: Basic concepts oftravelling wave techniques and their applications in electrical power systems, lightening and switching over voltages, insulation co-ordination in power systems.

Course Educational Objectives:

- To understand travelling wave phenomenon in transmission systems.
- To understand the reflection and refraction phenomena in transmission lines
- To understand the lightning phenomena and over voltages power transmission systems.
- To understand the surge voltage distribution in HV transformer windings
- To know Insulation gradation for different electrical power apparatus and coordination in insulation systems.

UNIT – 1

Traveling Waves: Transmission line equation, attenuation and distortion point-Typical cases. Reflection of traveling waves: Behaviors of waves at a transaction point-Typical case. Travelling waves on multi conductor systems

UNIT – 2

Successive Reflections: Reflection lattice, Effect of insulation capacitance. Standing waves and natural frequencies of transmission lines-Transient response of lines and systems with distributed parameters

UNIT – 3

Lightning Phenomena and over voltage in power systems. Mechanism of the lightning stroke – Mathematical model of the lightning stroke. Over voltages produced in power systems due to lightning – Over voltage due to faults in the system and switching surges. General principles of lightning protection – Tower – Footing resistance – Insulation withstand voltages and impulse flashover characteristics of protective gaps.

UNIT – 4

Surge Voltage distribution in transformer windings initial and final distribution characteristics: Protection of windings against over voltages. Protection of transmission lines, transformers and rotating machines against over voltages. Use of rod gaps and lightning arresters protective characteristics. Selection of the lightning arresters.

UNIT – 5

Insulation coordination lightning surge and switching surge characteristics of insulation structures. Geo-metric gap factors test procedures, correlation between insulation for protective levels. Protective devices Zno arresters, valve type-etc., protective tubes

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

- Understand concepts of travelling waves and their behavior in transmission systems.
- Understand lighting phenomena and over voltages in power systems.
- Understand the behavior of the transformer due to surge voltages induced in the windings.
- Understand insulation coordination in a substation.
- Understand operations of over voltage protective devices.

TextBooks:

1. Traveling waves of Transmission systems – by LV Bewley. Dover publications Inc., New York (1963).

Reference Books:

1. Lewis, w.w., protection of transmission lines and systems against lightning, dover publications, Inc., New York (1965).
2. Diesendorf.W, Insulation Co-ordination ELBS in H.V. Electrical Power Systems, Butter worth publications, London, (1974)
3. Rakesh Das Begmudre, E.H.V. Transmission Engineering: Wielly Eastern Ltd., New Delhi, (1986).

II-Semester	PARTIAL DISCHARGE IN HV EQUIPMENT (ELECTIVE-III)	CATEGORY	L-T-P 3-0-0	CREDITS 3

Pre-requisite:Knowledge in High Voltage Equipment.

Course Educational Objectives:

- To know about Partial Discharges, and their occurrence and recurrence
- To know about discharges at DC and AC voltages
- To know the partial discharge detection methods
- To know the partial discharge location methods
- To know different partial discharge detection methods in HV equipment.

UNIT – 1

Types of partial discharges and its occurrence and recurrence and magnitudes: Definition of Partial discharges, inception of internal discharges, Inception of corona discharges.

UNIT – 2

Discharges by electrical treeing. Discharges at AC Voltages, corona discharges, Discharges at D.C. Voltages, discharges at impulse voltages.

Object of discharge detection, Quantities related to the magnitude of discharges, choice of PD as a measure for discharges.

UNIT – 3

Electrical discharge detection & Detection circuits : Basic diagram, amplification of impulses, sensitivity, resolution, observation. Straight detection.

Balanced detection, calibrators, Interferences, choice between straight detection & balance detection, common mode rejection.

UNIT – 4

Location of Partial discharges: Non-electric location, location by separation of electrodes, location with electrical probes. Location by traveling waves, PD location in cables & switchgear by traveling waves. Evaluation of discharges: Recognition, mechanisms of deterioration, evaluation, specification.

UNIT – 5

Detection in actual specimen: Detection in capacitors, cables, bushings. Transformers, machine insulation, Gas-insulated switchgear.

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

- Analyze the types of partial discharge that occurs in the insulation systems and in apparatus.
- Compute the partial discharges in solid dielectrics.
- Analyze the detection of discharges using different detection circuits.
- Location of partial discharge in electrical apparatus and systems.
- Detection of partial discharges in various instruments.

TextBooks:

1. Partial Discharges in HV Equipment by F.Kruguer, Butterworths & Co., Publications Ltd., 1989.

2. Partial Discharges in Electrical Power Apparatus. by Dieter Kind, Y. Narayana Rao- VDE-Verlag publisher

II-Semester	GAS INSULATED SYSTEMS AND SUBSTATIONS (ELECTIVE-III)	CATEGORY	L-T-P 3-0-0	CREDITS 3

Pre-requisite:Conduction and Breakdown in gases, and substation.

Course Educational Objectives:

- To Study and learn about SF6 gas properties and application in electrical apparatus.
- To Study and learn about layout of SF_6 Substation.
- To Study and learn about Design and Construction of GIS Stations
- To Study and learn about Testing of G.I.S
- To study the Diagnostics and Fast Transient Phenomena in GIS

UNIT – 1

Introduction to GIS and Properties of SF6:

Characteristics of GIS, Introduction to SF_6, Physical Properties, Chemical Properties, Electrical Properties, Specifications of SF_6 Gas for GIS Applications, Handling of SF_6 Gas Before Use, Safe Handling of SF_6 Gas in Electrical Equipment, Equipment for Handling the SF_6 Gas, SF_6 and Environment.

UNIT – 2

Layout of GIS Stations:

Advantages of GIS Stations, Comparison With Air Insulated Substations, Economics of GIS,User Requirements for GIS,Main Features of a GIS,General Arrangement of a GIS,Planning and Installation,Components of a GIS station.

UNIT – 3

Design and Construction of GIS Stations:

Introduction,Ratings of GIS Components,DesignFeatures,Estimation of Different types of Electrical Stresses,Design Aspects of GIS Components,Insulation Design for GIS,Thermal Considerations in the Design of GIS,Effect of Very Fast Transient over voltages(VFTO)on the GIS Design,Insulation Coordination in GIS ,GIS Grounding Systems,Gas handling and Monitoring System Design.

UNIT – 4

Testing of GIS

Introduction, Various Tests on GIS,Design Approach for Manufacturing and Type Tests,Quality Assurance in Manufacturing,Shipping and Erection,On-Site Testing of GIS, Dielectric Tests, commonly used On-site Test Methods,Experience during On-Site Testing,Condition Monitoring and Diagnostic Methods.

UNIT – 5

GIS Diagnostics and Fast Transient Phenomena in GIS

Introduction, Characteristics of imperfections in Insulation, Insulation Diagnostic Methods, PD Measurement, UHF Method, Disconnector Switching in Relation to Very Fast Transients,Origin of VFTO, Propagation and Mechanism of VFTO,VFTO Characteristics,Effect of VFTO,Testing of GIS for VFTO.

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

- Know the Properties of SF_6
- Understand design and construction of G.I.S Substations
- Analyze transient Phenomenon and testing of G.I.S
- Analyze diagnostics of GIS
- Understand layout of GIS

Text Book:

1. M.S.Naidu, "Gas Insulated Substations" I.K International publishing house Pvt.Ltd, New Delhi

Reference Books:

1. O.Kindsen&K.V.Menon, "Future developments trend in GIS Technology" 3rd workshop & conference on EHV Technology, Indian Institute of Science, Bangalore, August 2-4, 1995.
2. V.N.Maller and M.S.Naidu "Advances in High Voltage Insulation & Arc Interruption in SF6 and Vaccum", Pergamon Press, Oxford, 1982.

II-Semester	PULSE POWER ENGINEERING (ELECTIVE-III)	CATEGORY	L-T-P 3-0-0	CREDITS 3

Pre-requisite:Basic concepts of Pulse forming networks and energy storage devices.

Course Educational Objectives:

- To know the static and dynamic breakdown strength of dielectric materials and various switches
- To know the energy storage device like Marx generator, inductive energy storage, rotor and homo polar generators, fly wheels.
- To know the behavior of different switches for arc interruptions
- To know the design of pulse forming networks in transmission lines and power and voltage adding.
- To know about pulse power generators

UNIT – 1

Static and Dynamic Breakdown Strength of dielectric Materials

Introduction-Gases-static breakdown-pulsed breakdown-spark formation-liquids-basic electrical Process-steamer breakdown-practical considerations-solids-General observations-charge Transport, injection and Breakdown-statistical Interpretation of breakdown Strength Measurements

UNIT – 2

Energy Storage

Pulse Discharge Capacitors-Marx Generators-classical Marx generators-LC Marx Generator-Basic Pulsed-Power Energy Transfer Stage-inductive energy storage-power and voltage multiplication-rotors and homo polar Generators

UNIT – 3

Switches

Closing switches-gas switches-semiconductor closing switches-magnetic switches-summary-opening switches-fuses-mechanical interrupters-superconducting opening switches-plasma opening switches-plasma flow switches-semiconductor opening switches

UNIT – 4

Pulse forming networks:

Transmission lines-terminations and junctions-transmission lines with losses-the finite transmission line as a circuit element-production of pulses with lossless transmission lines-RLC networks-circuit simulation with LEITER

Power and Voltage Adding: Adding of Power-Voltage Adding-voltage adding by transit-time Isolation- voltage adding by Inductive Isolation-Blumlein Generators-Cumulative Pulse Lines

UNIT – 5

Examples of Pulsed-power Generators:

Single-pulse generators: KALIF-PBFA 2 and the Z-Machine- HERMES III

Repetitive Generators: RHEPP and Generators with opening switches

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

- Compute the static and dynamic breakdown in various dielectrics
- Various energy storage devices, repetitive generators and cumulative pulse lines.
- Analyze about various switching operations.
- Design about various pulse forming networks and their applications.
- Design the various Pulse power generators.

Text Books:

3. Pulsed Power Engineering by Professor Dr.HasjoachimBluhm.

Reference Books:

1. Explosive Pulsed Power -L. L. Altgilbers, J. Baird, B. Freeman, C. S. Lynch, and S. I. Shkuratov -Imperial College Press.
2. Advances in Pulsed Power Technology, Vol. 1 & 2, Plenum Press.
3. Pulsed Power Systems: Principles and Applications-Dr.HasjoachimBluhm-Springer

II-Semester	FLEXIBLE AC TRANSMISSION SYSTEMS (ELECTIVE–IV)	CATEGORY	L-T-P 3 -0-0	CREDITS 3

Pre-requisite: Concepts on Power Electronics and Power Systems

Course Educational Objectives:

- To study the performance improvements of transmission system with FACTS.
- To study the effect of static shunt compensation.
- To study the effect of static series compensation.
- To study the effect of UPFC.

UNIT – 1

FACTS concepts, Transmission interconnections, power flow in an AC System, loading capability limits, Dynamic stability considerations, importance of controllable parameters, basic types of FACTS controllers, benefits from FACTS controllers.

UNIT – 2

Basic concept of voltage and current source converters, comparison of current source converters with voltage source converters.

Static shunt compensation : Objectives of shunt compensation, midpoint voltage regulation, voltage instability prevention, improvement of transient stability, Power oscillation damping, methods of controllable VAr generation, variable impedance type static VAr generation, switching converter type VAr generation, hybrid VAr generation.

UNIT – 3

SVC and STATCOM: The regulation slope, transfer function and dynamic performance, transient stability enhancement and power oscillation damping, operating point control and summary of compensation control.

UNIT – 4

Static series compensators: Concept of series capacitive compensation, improvement of transient stability, power oscillation damping, functional requirements. GTO thyristor controlled series capacitor (GSC), thyristor switched series capacitor (TSSC), and thyristor controlled series capacitor (TCSC), control schemes for GSC, TSSC and TCSC.

UNIT – 5

Unified Power Flow Controller: Basic operating principle, conventional transmission control capabilities, independent real and reactive power flow control, comparison of the UPFC to series compensators and phase angle regulators. Introduction to Inter line Power Flow Controller (IPFC)

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

- Know the performance improvement of transmission system with FACTS.
- Get the knowledge of effect of static shunt and series compensation.
- Know the principle of operation and various controls of UPFC
- Determine an appropriate FACTS device for different types of applications.

Text Books:

1. "Understanding FACTS Devices" N.G.Hingorani and L.Guygi, IEEE Press.
   Indian Edition is available:--Standard Publications

Reference Books:

1. Sang.Y.HandJohn.A.T, "Flexible AC Transmission systems" IEEE Press (2006).
2. HVDC & FACTS Controllers: applications of static converters in power systems-
   Vijay K.Sood- Springer publishers

II-Semester	EHVAC TRANSMISSION (ELECTIVE–IV)	CATEGORY	L-T-P 3 -0-0	CREDITS 3

Pre-requisite: Transmission line parameters and properties, Corona etc.

Course Educational Objectives:

- To calculate the transmission line parameters.
- To calculate the field effects on EHV and UHV AC lines.
- To have knowledge of corona, RI and audible noise in EHV and UHV lines.
- To have knowledge of voltage control and compensation problems in EHV and UHV transmission systems.

UNIT – 1

E.H.V. A.C. Transmission, line trends and preliminary aspects, standard transmission voltages – power handling capacities and line losses – mechanical aspects. Calculation of line resistance and inductance: resistance of conductors, temperature rise of conductor and current carrying capacity. Properties of bundled conductors and geometric mean radius of bundle, inductance of two conductor lines and multi conductor lines, Maxwell's coefficient matrix. Line capacitance calculation. Capacitance of two conductor line, and capacitance of multi conductor lines, potential coefficients for bundled conductor lines, sequence inductances and capacitances and diagonalization.

UNIT – 2

Calculation of electro static field of AC lines - Effect of high electrostatic field on biological organisms and human beings. Surface voltage Gradient on conductors, surface gradient on two conductor bundle and cosine law, maximum surface voltage gradient of bundle with more than 3 sub conductors, Mangolt formula.

UNIT – 3

Corona : Corona in EHV lines – corona loss formulae – attenuation of traveling waves due to corona – Audio noise due to corona, its generation, characteristics and limits, measurement of audio noise.

UNIT – 4

Power Frequency voltage control : Problems at power frequency, generalized constants, No load voltage conditions and charging currents, voltage control using synchronous condenser, cascade connection of components : Shunt and series compensation, sub synchronous resonance in series – capacitor compensated lines

UNIT – 5

Reactive power compensating systems: Introduction, SVC schemes, Harmonics injected into network by TCR, design of filters for suppressing harmonics injected into the system.

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

- Calculate the transmission line parameters.
- Calculate the field effects on EHV and UHV AC lines.
- Determine the corona, RI and audible noise in EHV and UHV lines.
- Analyze voltage control and compensation problems in EHV and UHV transmission systems.
- Understand reactive power compensation using SVC and TCR

Text Books:

1. Extra High Voltage AC Transmission Engineering – Rakesh Das Begamudre, Wiley Eastern ltd., New Delhi – 1987.
2. EHV Transmission line reference book – Edison Electric Institute (GEC) 1986.

II-Semester	SMART GRID TECHNOLOGIES (ELECTIVE–IV)	CATEGORY	L-T-P 3 -0-0	CREDITS 3

Pre-requisite: Basic knowledge on smart concept communication protocols, renewable energy systems and electronic circuits.

Course Educational Objectives:

- To understand concept of smart grid and developments on smart grid.
- To understand smart grid technologies and application of smart grid concept in hybrid electric vehicles etc.
- To have knowledge on smart substations, feeder automation and application for monitoring and protection.

UNIT – 1

Introduction to Smart Grid: Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Functions of Smart Grid, Opportunities & Barriers of Smart Grid, Difference between conventional & smart grid, Concept of Resilient &Self-Healing Grid, Present development & International policies on Smart Grid. Case study of Smart Grid.

UNIT – 2

Smart Grid Technologies: Part 1: Introduction to Smart Meters, Real Time Prizing, Smart Appliances, Automatic Meter Reading(AMR), Outage Management System(OMS), Plug in Hybrid Electric Vehicles(PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation, Phase Shifting Transformers.

UNIT – 3

Smart Grid Technologies: Part 2: Smart Substations, Substation Automation, Feeder Automation. Geographic Information System(GIS), Intelligent Electronic Devices(IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System(WAMS), Phase Measurement Unit(PMU).

UNIT – 4

Micro grids and Distributed Energy Resources: Concept of micro grid, need & applications of micro grid, formation of micro grid, Issues of interconnection, protection & control of micro grid. Plastic & Organic solar cells, Thin film solar cells, Variable speed wind generators, fuel cells, micro turbines, Captive power plants, Integration of renewable energy sources.

UNIT – 5

Power Quality Management in Smart Grid: Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

Information and Communication Technology for Smart Grid: Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighborhood Area Network (NAN), Wide Area Network (WAN).

Course Outcomes:

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

- Understand smart grids and analyze the smart grid policies and developments in smart grids.
- Develop concepts of smart grid technologies in hybrid electrical vehicles etc.
- Understand smart substations, feeder automation, GIS etc.
- Analyze micro grids and distributed generation systems.
- Analyze the effect of power quality in smart grid and to understand latest developments in ICT for smart grid.

Text Books:

1. Ali Keyhani, Mohammad N. Marwali, Min Dai "Integration of Green and Renewable Energy in Electric Power Systems", Wiley
2. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response", CRC Press.

Reference Books:

1. JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama,"Smart Grid: Technology and Applications", Wiley
2. Jean Claude Sabonnadière, NouredineHadjsaïd, "Smart Grids", Wiley Blackwell 19
3. Peter S. Fox Penner, "Smart Power: Climate Changes, the Smart Grid, and the Future of Electric Utilities", Island Press; 1 edition 8 Jun 2010
4. S. Chowdhury, S. P. Chowdhury, P. Crossley, "Micro grids and Active Distribution Networks." Institution of Engineering and Technology, 30 Jun 2009
5. Stuart Borlase, "Smart Grids (Power Engineering)", CRC Press
6. Andres Carvallo, John Cooper, "The Advanced Smart Grid: Edge Power Driving Sustainability: 1", Artech House Publishers July 2011

II-Semester	SIMULATION LABORATORY – II	CATEGORY	L-T-P 0-0-4	CREDITS 2

Course Educational Objectives:

The Student should understand the different types of high voltage generation circuits and the behavior of lines due to switching operations.

List of Experiments

6. Simulation of Marx circuit(5 stages).
7. Simulation of Tesla-coil circuit.
8. Simulation and generation of Lightening, Switching and pulse current/voltage wave form
9. Simulation of Transient circuits with travelling waves.
10. Simulation of capacitance switching.
11. Simulation of current growth in the gap with the help of Townsend theory.
12. Simulation of series resonant circuit.
13. Simulation of Impulse current generation circuit.
14. Simulation of Impulse voltage generation circuit.
15. Simulation of Paschen's law curve.

Course Outcomes:

The student should be able to design and analyze the different high voltage generation circuits and the behavior of lines due to switching operations.

II-Semester	POWER SYSTEMS LABORATORY	CATEGORY	L-T-P 0 -0-4	CREDITS 2

Course Educational Objectives:

- To understand the experimental determination of various parameters used in power system area and to analyze the performance of transmission line with and without compensation.

List of Experiments:

1. Determination of Sequence Impendence of an Alternator by direct method.

2. Determination of Sequence impedance of an Alternator by fault Analysis.

3. Measurement of sequence impedance of a three phase transformer

   (a). by application of sequence voltage. (b). using fault analysis.

4. Power angle characteristics of a salient pole Synchronous Machine.

5. Poly-phase connection on three single phase transformers and measurement of phase

displacement.

6.Determination of equivalent circuit of 3-winding Transformer.

7. Measurement of ABCD parameters on transmission line model.

8. Performance of long transmission line without compensation.

9. Study of Ferranti effect in long transmission line.

10. Performance of long transmission line with shunt compensation.

Course Outcomes:

After the Completion of lab they will understand procedure for determination of various parameters used in power system as well as performance of transmission line.

II-Semester	MINI PROJECT WITH SEMINAR	CATEGORY	L-T-P 0-0-4	CREDITS 2

Note:
It is recommended that a Supervisor/advisor should be allotted to each student at the end of the semester-I or allot at the start of the semester-II

Syllabus content:

A Student has to select one paper published in any of the IEEE Transactions and simulate the same. The student has to present the progress of the work at the middle of the semester. At the end of the semester, the student has to present the results by explaining the idea of the topic, methodology, finding of the simulations. A Student should also submit a report of the entire work carried out under this course. The end semester presentation must be video recorded and preserved.

II-Semester	AUDIT COURSE – II	CATEGORY	L-T-P 2-0-0	CREDITS 0

III-Semester	INDUSTRIAL SAFTEY (Elective-V)	CATEGORY	L-T-P 3-0-0	CREDITS 3

Pre-requisite: Engineering Fundamentals

Course Educational Objectives:

- To learn safety aspects of any industrial area
- To learn fundamentals and types of maintenance engineering
- To learn causes and effects of wear and Corrosion and their prevention
- To learn identification of faults and their repair
- To learn preventive maintenance- periodic an preventive-maintenance of industrial systems

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

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

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

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

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

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

- Understand the general industrial requirements like lighting, cleanliness prevention from hazards and accidents.
- Analyze maintenance requirements of the industry and cost associated.
- Analyze wear and corrosion aspects of the industry and their prevention.
- Identifying the faults prone areas and their repair and periodic maintenance.

Reference Books:

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

III-Semester	POWER QUALITY (Elective-V)	CATEGORY	L-T-P 3-0-0	CREDITS 3

Pre-requisite: Knowledge on electric circuit analysis, power systems and power electronics and concept of reactive power compensation techniques.

Course Educational Objectives:

- To understand significance of power quality and power quality parameters.
- To know types of transient over voltages and protection of transient voltages.
- To understand harmonics, their effects, harmonic indices and harmonic minimization techniques.
- To understand the importance of power devices and their applications.
- To understand different compensation techniques to minimize power quality disturbances.

UNIT– 1

Introduction to power quality: Overview of Power Quality, Concern about the Power Quality, General Classes of Power Quality Problems, Voltage Unbalance, Waveform Distortion, Voltage fluctuation, Power Frequency Variations, Power Quality Terms, Voltage Sags, swells, flicker and Interruptions - Sources of voltage and current interruptions, Nonlinear loads.

UNIT– 2

Transient and Long Duration Voltage Variations: Source of Transient Over Voltages - Principles of Over Voltage Protection, Devices for Over Voltage Protection, Utility Capacitor Switching Transients, Utility Lightning Protection, Load Switching Transient Problems.

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 generation

UNIT– 3

Harmonic Distortion and solutions: Voltage vs. Current Distortion, Harmonics vs. Transients - Power System Quantities under Non-sinusoidal Conditions, Harmonic Indices, Sources of harmonics, Locating Sources of Harmonics, System Response Characteristics, Effects of Harmonic Distortion, Inter harmonics, Harmonic Solutions Harmonic Distortion Evaluation, Devices for Controlling Harmonic Distortion, Harmonic Filter Design, Standards on Harmonics

UNIT– 4

Custom Power Devices: Custom power and custom power devices, voltage source inverters, reactive power and harmonic compensation devices, compensation of voltage interruptions and current interruptions, static series and shunt compensators, compensation in distribution systems, interaction with distribution equipment, installation considerations.

UNIT– 5

Application of custom power devices in power systems: Static and hybrid Source Transfer Switches, Solid state current limiter - Solid state breaker. P-Q theory – Control of P and Q, Dynamic Voltage Restorer (DVR): Operation and control – Interline Power Flow Controller (IPFC): Operation and control of Unified Power Quality Conditioner (UPQC); Generalized power quality conditioner

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

- Identify the issues related to power quality in power systems.
- Address the problems of transient and long duration voltage variations in power systems.
- Analyze the effects of harmonics and study of different mitigation techniques.
- Identify the importance of custom power devices and their applications.
- Acquire knowledge on different compensation techniques to minimize power quality disturbances.

Text Books:

1. Electrical Power Systems Quality, Dugan R C, McGranaghan M F, Santoso S, and Beaty H W, Second Edition, McGraw-Hill, 2002.
2. Understanding Power Quality Problems: Voltage Sags and Interruptions, Bollen M H J, First Edition, IEEE Press; 2000.
3. Guidebook on Custom Power Devices, Technical Report, Published by EPRI, Nov 2000
4. Power Quality Enhancement Using Custom Power Devices – Power Electronics and Power Systems, Gerard Ledwich, ArindamGhosh, Kluwer Academic Publishers, 2002.

Reference Books:

1. Power Quality Primer, Kennedy B W, First Edition, McGraw-Hill, 2000.
2. Power System Harmonics, Arrillaga J and Watson N R, Second Edition, John Wiley & Sons, 2003.
3. Electric Power Quality control Techniques, W. E. Kazibwe and M. H. Sendaula, Van Nostrad Reinhold, New York.
4. Power Quality c.shankaran, CRC Press, 2001
5. Harmonics and Power Systems –Franciso C.DE LA Rosa-CRC Press (Taylor & Francis).
6. Power Quality in Power systems and Electrical Machines-EwaldF.fuchs, Mohammad A.S. Masoum-Elsevier
7. Power Quality, C. Shankaran, CRC Press, 2001
8. Instantaneous Power Theory and Application to Power Conditioning, H. Akagiet.al., IEEE Press, 2007.
9. Custom Power Devices - An Introduction, ArindamGhosh and Gerard Ledwich, Springer, 2002
10. A Review of Compensating Type Custom Power Devices for Power Quality Improvement, Yash Pal et.al., Joint International Conference on Power System Technology and IEEE Power India Conference, 2008. POWERCON 2008.

III-Semester	POWER SYSTEM TRANSIENTS (Elective-V)	CATEGORY	L-T-P 3-0-0	CREDITS 3

Pre-requisite: This course required knowledge of circuit transients, symmetrical components, fault analysis and lightning.

Course Educational Objectives:

- To study the effect of over voltages on power system.
- To study the techniques of travelling wave on transmission lines.
- To study the effect of lightning and switching transients on power systems.

Unit 1 : Basic Concepts and Simple Switching Transients;- Switching an LR,LC,RLC circuits Transients Analysis of Three-Phase power Systems: – Symmetrical components inthree-phase Systems, Sequence Components for Unbalanced Network Impedances, the Sequence Networks, analysis of Unsymmetrical Three-Phase Faults-single line-to-Ground Fault, Three phase-to-ground fault.

Unit 2 : Travelling Waves:- Velocity of Travelling waves and Characteristic Impedance, Energy Contents of Travelling Waves, Attenuation and Distortion of Electromagnetic Waves, telegraph equations-lossless line, distortion less line, Reflection and Refraction of Travelling Waves, Reflection of Travelling Waves against Transformer-and-Generator-windings, the Origin Transient Recovery voltages, bewley-lattice diagram. travelling waves and multi conductor system.

Unit 3 :Switching Transients:- arc interruption in circuit breaker , transient recovery voltage, arc-circuit interaction, interruption of capacitive currents, interruption of inverse currents, interruption of fault current in transmission line and transformers.

Unit 4 : Power System Transient Recovery Voltages:-Characteristics of the Transient Voltage- Short-circuit test duties based on IEC 60056 (1987),ANSI/IEEE Standards, the Harmonization between IEC and ANSI/IEEE Standards with respect to Short-circuit Test duties, transient recovery voltage for Different types of faults.

Unit 5 : Lightning –Induced Transients:-Mechanism of Lightning, wave shape of the lightning current, Direct lighting Stroke to transmission line towers, direct lightening stroke to a line, lightning protection scheme. Numerical simulation of electrical transients, The Electromagnetic Transient Program, principles of numerical techniques used in transient simulation.

Course Outcomes:

After completion of this course the students will be able to:

- Understand the severity of over voltages due to faults on a given power system.
- To limit the effects of lightning over voltages in power systems.
- Understand the various transient over voltages and their effects on power system.

Text Books:

1. Electrical Transients in Power System by Allen Greenwood, McGraw Hill 1990
2. Bewley LV “travelling waves on transmission system” Dover publications Inc.,

Reference Books :

1. Power system grounding & transients by A.P.SakisMeliopolous.
2. "Transients in power systems" by Lou Van Sluis
3. Walter Diesendorf, Insulation co-ordination in high-voltage electric power systems, Butterworths, London, (1974),
4. J. G. Anderson: EHV Transmission Line Reference Book (Edison Electric Institute, New York, 1968) p. 126.

III-Semester	OPERATIONS RESEARCH (Open Elective)	CATEGORY	L-T-P 3-0-0	CREDITS 3

Pre-requisite: Engineering mathematics

Course Educational Objectives:

- To understand the Mathematical modeling of physical systems and its solving techniques with and without constraints.
- To understand the solving of LPP problem using graphical and simplex method.
- To understand the Solving of non-linear programming problem.
- To understand the scheduling and sequencing problem of different models with geometric programming.
- To understand the Solving of LPP using dynamic programming and graph theory.

Unit 1:

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

Unit 2

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplexmethod - sensitivity analysis - parametric programming

Unit 3:

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flowproblem - CPM/PERT

Unit 4

Scheduling and sequencing - single server and multiple server models - deterministic inventorymodels - Probabilistic inventory control models - Geometric Programming.

Unit 5

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

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

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

References:

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

III-Semester	ENERGY AUDIT CONSERVATION & MANAGEMENT (Open Elective)	CATEGORY	L-T-P 3-0-0	CREDITS 3

Pre-requisite: Electrical power systems and measurements.

Course Educational Objectives:

- To learn the basics of energy audit and energy conservation schemes.
- To comprehend the principles of energy management and understand the need of energy efficient motors and lighting design practices.
- To learn about power factor improvement techniques and energy instruments.
- To learn about the economic aspects o\f energy equipment.

UNIT– 1

Basic Principles of Energy Audit

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

UNIT– 2

Energy Management

Principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting. Energy manager, qualities and functions, language, Questionnaire – check list for top management

UNIT– 3

Energy Efficient Motors and Lighting

Energy efficient motors, factors affecting efficiency, loss distribution, constructional details, characteristics – variable speed , variable duty cycle systems, RMS - voltage variation-voltage unbalance-over motoring-motor energy audit. lighting system design and practice, lighting control, lighting energy audit

UNIT– 4

Power Factor Improvement and energy instruments

Power factor – methods of improvement, location of capacitors, Power factor with non-linear loads, effect of harmonics on p.f, p.f motor controllers – Energy Instruments- watt meter, data loggers, thermocouples, pyrometers, lux meters, tongue testers, application of PLC's

UNIT– 5

Economic Aspects and their computation

Economics Analysis depreciation Methods, time value of money, rate of return, present worth method, replacement analysis, lifecycle costing analysis – Energy efficient motors. Calculation of simple payback method, net present value method- Power factor correction, lighting – Applications of life cycle costing analysis, return on investment.

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

1. Understand the principle of energy audit and their economic aspects.
2. Recommend energy efficient motors and design good lighting system.
3. Understand advantages to improve the power factor.
4. Evaluate the depreciation of equipment.

Text Books:

- Energy management by W.R.Murphy & G.Mckay Butter worth, Heinemann publications, 1982
- Energy management hand book by W.C Turner, John Wiley and sons, 1982.

Reference Books:

1. Energy efficient electric motors by John.C. Andreas, Marcel Dekker Inc Ltd-2nd edition,1995
2. Energy management by Paul o' Callaghan, Mc-graw Hill Book company-1st edition, 1998
3. Energy management and good lighting practice : fuel efficiency- booklet12-EEO

III-Semester	COMPOSITE MATERIALS (Open Elective)	CATEGORY	L-T-P 3-0-0	CREDITS 3

Pre-requisite: Engineering Physics

Course Educational Objectives:

4. To learn characteristics of composite materials and know effects of reinforcement
5. To learn application of different fibers, understand rules of mixtures
6. To learn manufacturing of ceramic matrix, carbon matrix and applications
7. To learn preparation of moulding compounds ,properties and applications
8. To learn strength and failure criteria

UNIT–1: INTRODUCTION: Definition – Classification and characteristics of Composite materials.Advantages and application of composites.Functional requirements of reinforcement and matrix.Effectof reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT – 2: REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers,carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particlereinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures.Isostrain and Isostress conditions.

UNIT – 3: Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique,Cladding – Hot isostaticpressing. Properties and applications. Manufacturing of Ceramic MatrixComposites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carboncomposites: Knitting, Braiding, Weaving. Properties and applications.

UNIT–4: Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT – 5: Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum straincriteria, interacting failure criteria, hydrothermal failure. Laminate first play failure-insight strength;Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

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

5. Understand characteristics and advantages of composite materials
6. Acquire knowledge of reinforcement, glass fiber, etc.
7. Identify the usage of metal matrix composites
8. Understand manufacturing of polymer matrix composites
9. Understand manufacturing of polymer matrix composites
10. Identify different types of failures.

Text Books:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

References Books:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

III SEMESTER	DISSERTATION PHASE-I	CATEGORY	L-T-P 0-0-20	CREDIT 10

IV SEMESTER	DISSERTATION PHASE-II	CATEGORY	L-T-P 0-0-32	CREDIT 16

AUDIT 1 and 2: ENGLISH FOR RESEARCH PAPER WRITING

Course objectives:

Students will be able to:

Understand that how to improve your writing skills and level of readability

Learn about what to write in each section

Understand the skills needed when writing a Title Ensure the good quality of paper at very first-time submission

Syllabus

Units	CONTENTS	Hours
1	Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	4
2	Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction	4
3	Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.	4
4	key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,	4
5	skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions	4
6	useful phrases, how to ensure paper is as good as it could possibly be the first- time submission	4

Suggested Studies:

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

AUDIT 1 and 2: DISASTER MANAGEMENT

Course Objectives: -Students will be able to:

learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.

critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.

develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.

critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in

Syllabus

Units	CONTENTS	Hours
1	**Introduction** Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.	4
2	**Repercussions Of Disasters And Hazards**: Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man- made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.	4
3	**Disaster Prone Areas In India** Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics	4
4	**Disaster Preparedness And Management** Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.	4
5	**Risk Assessment** Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.	4
6	**Disaster Mitigation** Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.	4

Suggested Readings:

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

AUDIT 1 and 2: SANSKRIT FOR TECHNICAL KNOWLEDGE

Course Objectives

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

Syllabus

Unit	Content	Hours
1	• Alphabets in Sanskrit, • Past/Present/Future Tense, • Simple Sentences	8
2	• Order • Introduction of roots • Technical information about Sanskrit Literature	8
3	• Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics	8

Suggested reading

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

Course Output

Students will be able to

1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood

Being a logical language will help to develop logic in

AUDIT 1 and 2: SANSKRIT FOR TECHNICAL KNOWLEDGE

Course Objectives

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

Syllabus

Unit	Content	Hours
1	• Alphabets in Sanskrit, • Past/Present/Future Tense, • Simple Sentences	8
2	• Order • Introduction of roots • Technical information about Sanskrit Literature	8
3	• Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics	8

Suggested reading

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

Course Output

Students will be able to

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

AUDIT 1 and 2: VALUE EDUCATION

Course Objectives

Students will be able to

1. Understand value of education and self- development
2. Imbibe good values in students
3. Let the should know about the importance of character

Syllabus

Unit	Content	Hours
1	• Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. • Moral and non- moral valuation. Standards and principles. • Value judgements	4
2	• Importance of cultivation of values. • Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. • Honesty, Humanity. Power of faith, National Unity. • Patriotism.Love for nature ,Discipline	6
3	• Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. • Punctuality, Love and Kindness. • Avoid fault Thinking. • Free from anger, Dignity of labour. • Universal brotherhood and religious tolerance. • True friendship. • Happiness Vs suffering, love for truth. • Aware of self-destructive habits. • Association and Cooperation. • Doing best for saving nature	6
4	• Character and Competence –Holy books vs Blind faith. • Self-management and Good health. • Science of reincarnation. • Equality, Nonviolence ,Humility, Role of Women. • All religions and same message. • Mind your Mind, Self-control. • Honesty, Studying effectively	6

Suggested reading

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

Course outcomes

Students will be able to 1.Knowledge of self-development

2.Learn the importance of Human values 3.Developing the overall personality

AUDIT 1 and 2: CONSTITUTION OF INDIA

Course Objectives:

Students will be able to:

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

Syllabus

Units	Content	Hours
1	• **History of Making of the Indian Constitution:** History Drafting Committee, (Composition & Working)	4
2	• **Philosophy of the Indian Constitution:** Preamble Salient Features	4
3	**Contours of Constitutional Rights & Duties:** Fundamental Rights Right to Equality Right to Freedom Right against Exploitation Right to Freedom of Religion Cultural and Educational Rights Right to Constitutional Remedies Directive Principles of State Policy Fundamental Duties.	4
4	**Organs of Governance:** Parliament Composition Qualifications and Disqualifications Powers and Functions • Executive President Governor Council of Ministers Judiciary, Appointment and Transfer of Judges, Qualifications Powers and Functions	4

5	**Local Administration:** District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CE of Municipal Corporation. Pachayati raj: Introduction, PRI: ZilaPachayat. Elected officials and their roles, CEO ZilaPachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy	O 4
6	**Election Commission:** Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.	4

Suggested reading

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

Course Outcomes:

Students will be able to:

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

AUDIT 1 and 2: PEDAGOGY STUDIES

Course Objectives:

Students will be able to:

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

Syllabus

Units	Content	Hours
1	**Introduction and Methodology:** Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions**.** Overview of methodology and Searching.	4
2	• Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. • Curriculum, Teacher education.	2
3	• Evidence on the effectiveness of pedagogical practices • Methodology for the in depth stage: quality assessment of included studies. • How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? • Theory of change. • Strength and nature of the body of evidence for effective pedagogical practices. • Pedagogic theory and pedagogical approaches. • Teachers' attitudes and beliefs and Pedagogic strategies.	4
4	• Professional development: alignment with classroom practices and follow-up support • Peer support • Support from the head teacher and the community. • Curriculum and assessment • Barriers to learning: limited resources and large class sizes	4
5	**Research gaps and future directions** Research design Contexts Pedagogy Teacher education Curriculum and assessment Dissemination and research impact.	2

Suggested reading

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

Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course Outcomes:

Students will be able to understand:

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

AUDIT 1 and 2: STRESS MANAGEMENT BY YOGA

Course Objectives

1. To achieve overall health of body and mind
2. To overcome stress

Syllabus

Unit	Content	Hours
1	• Definitions of Eight parts of yog. (Ashtanga)	8
2	Yam and Niyam. Do`s and Don't's in life. i) Ahinsa, satya, astheya, bramhacharya and aparigraha ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan	8
3	• Asan and Pranayam 1. Various yog poses and their benefits for mind & body 2. Regularization of breathing techniques and its effects-Types of pranayam	8

Suggested reading

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

Course Outcomes:

Students will be able to:

1. Develop healthy mind in a healthy body thus improving social health also

2. Improve efficiency

AUDIT 1 and 2: PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

Course Objectives

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

Syllabus

Unit	Content	Hours
1	Neetisatakam-Holistic development of personality • Verses- 19,20,21,22 (wisdom) • Verses- 29,31,32 (pride & heroism) • Verses- 26,28,63,65 (virtue) • Verses- 52,53,59 (dont's) • Verses- 71,73,75,78 (do's)	8
2	• Approach to day to day work and duties. • Shrimad Bhagwad Geeta : Chapter 2-Verses 41, 47,48, • Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35, • Chapter 18-Verses 45, 46, 48.	8
3	• Statements of basic knowledge. • Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 • Chapter 12 -Verses 13, 14, 15, 16,17, 18 • Personality of Role model. Shrimad Bhagwad Geeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42, • Chapter 4-Verses 18, 38,39 • Chapter18 – Verses 37,38,63	8

Suggested reading

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

Course Outcomes

Students will be able to

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

Study of Neetishatakam will help in developing versatile personality of students