ITEM NO.	APPENDIX

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL ENGINEERING

M.E., POWER SYSTEMS PROGRAMME

REVISED REGULATIONS & SYLLABI

(Students Admitted From the Academic Year 2018-2019)

VISION - MISSION STATEMENT

Vision

Empowering the community of students of Department of Electrical Engineering with very high morals, values, ethics, skills and technical knowledge through a rich curriculum blending the equal proportions of theoretical and hands-on experience by a process of transformation via hard-work and perseverance, with a view to serving the society in the role of socially responsible engineers so as to look after the needs of the nation and to elevate the standard of living of the people by incorporating innovation and sustained research.

Mission

- To attract the students to pursue not only the under graduation, but also up to the research level, with the exquisite infrastructure, learned faculties, state-of-the-art laboratories etc., from the Indian and International diasporas.
- To foster the global standards in learning, teaching and research that owes to an overall development of the department, faculties and students within the university and from across the globe as well.
- To enhance the caliber of students to be the most sought for, by the industrial and research entities.
- To enable for a diversified and challenging career that is ensued by the highest degree of professionalism, entrepreneurship, managerial and administrative expertise.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

The core objectives of the M.E. programme in Power Systems are intended

PEO-1

To develop professional knowledge in power systems domain so as to have successful career in industries, research and academia.

PEO-2

To enhance analytical skills to solve challenging complex problems in power and energy sectors using modern tools and technologies.

PEO-3

To inculcate research attitude and lifelong learning among the students.

PEO-4

To demonstrate professional and ethical behavior and be engaged in executing projects in multidisciplinary environment for the benefit of society.

Programme Outcomes (PO)

PO-1

Ability to apply the enhanced knowledge in advanced technologies for modeling, analyzing and solving contemporary issues in power sector with a global perspective.

PO-2

Ability to critically analyze and carry out detailed investigation on multifaceted complex problems in area of Power Systems and envisage advanced research in thrust areas.

PO-3

Ability to identify, analyze and solve real-life engineering problems in the area of Power Systems and provide strategic solutions satisfying the safety, cultural, societal and environmental aspects/ needs.

PO-4

Ability for continued pursuance of research and to design, develop and propose theoretical and practical methodologies towards research and development support for the Power System infrastructure.

PO-5

Ability to develop and utilize modern tools for modeling, analyzing and solving various Engineering problems related to Power Systems.

PO-6

Willingnessand ability to work in a team of engineers/ researchers with mutual understandings to take unsophisticated challenges, in the field of Power Systems, lead and motivate the group to inculcate multidisciplinary and collaborative approach.

PO-7

Willingnessand ability to take up administrative challenges including the management of various projects of interdisciplinary nature and carry out the same in an efficient manner giving due consideration to societal, environmental, economical and financial factors.

PO-8

Abilityto express ideas clearly and communicate orally as well as in writing with others in an effective manner, adhering to various national and international standards and practices for the documentation and presentation of the contents.

PO-9

Ability to engage in self-education and life-long learning to enable globalcompetency.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
PEO 1	✓	✓	✓	✓	✓	✓			✓
PEO 2	✓	✓	✓		✓				✓
PEO 3			✓	✓	✓		✓	✓	✓
PEO 4		✓		✓		✓	✓	✓	

CURRICULUM - 2019

SEMESTER I									
Course Code	Category	Course	L	T	P	CA	FE	Total	Credits
EEPSPC11	PC	Power System Analysis	3	-	-	25	75	100	3
EEPSPC12	PC	Power System Dynamics	3	-	-	25	75	100	3
EEPSPE13	PE	Program Elective-I	3	-	-	25	75	100	3
EEPSPE14	PE	Program Elective-II	3	-	-	25	75	100	3
EEPSMC15	MC	Research Methodology and IPR	2	-	-	25	75	100	2
EEPSCP16	CP	Power System Analysis Lab	-	-	3	40	60	100	2
EEPSCP17	CP	Power System Simulation Lab	-	-	3	40	60	100	2
EEPSAC18	AC	Audit Course-I	2	-	-	-	-	-	0
			Total			205	495	700	18

SEMESTER II									
Course Code	Category	Course	L	T	P	CA	FE	Total	Credits
EEPSPC21	PC	Power System Protection	3	-	-	25	75	100	3
EEPSPC22	PC	Power System Stability	3	-	-	25	75	100	3
EEPSPE23	PE	Program Elective-III	3	-	-	25	75	100	3
EEPSPE24	PE	Program Elective-IV	3	-	-	25	75	100	3
EEPSOE25	OE	Open Elective	3	-	-	40	60	100	3
EEPSCP26	CP	Artificial Intelligence Applications to Power Systems Lab	-	-	3	40	60	100	2
EEPSTS27	TS	Industrial Training and Seminar / Mini project *		Tr 2	S 2	40	60	100	2
EEPSAC28	AC	Audit Course-II	2	-	-	-	-	-	0
			Total			205	495	700	19

SEMESTER III									
Course Code	Category	Course	L	T	P	CA	FE	Total	Credits
EEPSPE31	PE	Program Elective-V	3	-	-	25	75	100	3
EEPSOE32	OE	Open Elective -II	3	-	-	25	75	100	3
EEPSTH33	TH-I	ThesisPhase-I & Viva-voce	-	Pr 16	S 4	40	60	100	10
			Total			90	210	300	16

SEMESTER IV									
Course Code	Category	Course	L	T	P	CA	FE	Total	Credits
EEPSTH41	TH-II	Thesis work & Viva-voce Phase-II	-	Pr 24	S 6	40	60	100	15
			Total			40	60	100	15

Note: * - Four weeks during the summer vacation at the end of II Semester.

L: Lecture, P: Practical, T: Thesis, CA: Continuous Assessment; FE: Final Examination

COURSES OF STUDY AND SCHEME OF EXAMINATION(REGULATION – 2019)

M.E (POWER SYSTEMS)- PART-TIME

S E M E S T E R – I										
Course Code	Category	Course	L	T	P	CA	FE	Total	Credits	Equivalent Course Code in M.E. Full Time
PEEPSPC11	PC	Power System Analysis	3	-	-	25	75	100	3	EEPSPC11
PEEPSPC12	PC	Power System Dynamics	3	-	-	25	75	100	3	EEPSPC12
PEEPSMC13	MC	Research Methodology and IPR	2	-	-	25	75	100	2	EEPSMC15
PEEPSCP14	CP-I	Power System Analysis Lab	-	-	3	40	60	100	2	EEPSCP16
Total						115	285	400	10	

S E M E S T E R – II										
Course Code	Category	Course	L	T	P	CA	FE	Total	Credits	Equivalent Course Code in M.E. Full Time
PEEPSPC21	PC	Power System Protection	3	-	-	25	75	100	3	EEPSPC21
PEEPSPC22	PC	Power System Stability	3	-	-	25	75	100	3	EEPSPC22
PEEPSOE23	OE	Open Elective - I	3	-	-	25	75	100	3	EEPSOE25
PEEPSCP24	CP-III	Artificial Intelligence Applications to Power Systems Lab	-	-	3	40	60	100	2	EEPSCP26
Total						115	285	400	11	

S E M E S T E R – III										
Course Code	Category	Course	L	T	P	CA	FE	Total	Credits	Equivalent Course Code in M.E. Full Time
PEEPSPE31	PE	Program Elective-I	3	-	-	25	75	100	3	EEPSPE13
PEEPSPE32	PE	Program Elective-II	3	-	-	25	75	100	3	EEPSPE14
PEEPSCP33	CP-II	Power System Simulation Lab	-	-	3	40	60	100	2	EEPSCP17
Total						90	210	300	8	

S E M E S T E R – IV										
Course Code	Category	Course	L	T	P	CA	FE	Total	Credits	Equivalent Course Code in M.E. Full Time
PEEPSPE41	PE	Program Elective-III	3	-	-	25	75	100	3	EEPSPE23
PEEPSPE42	PE	Program Elective-IV	3	-	-	25	75	100	3	EEPSPE24
PEEPSTS43	TS	Industrial Training and Seminar / Mini project		Tr 2	S 2	40	60	100	2	EEPSTS27
Total						90	210	300	8	

S E M E S T E R –V										
Course Code	Category	Course	L	T	P	CA	FE	Total	Credits	Equivalent Course Code in M.E. Full Time
PEEPSPE51	PE	Program Elective-V	3	-	-	25	75	100	3	EEPSPE31
PEEPSOE52	OE	Open Elective - II	3	-	-	25	75	100	3	EEPSOE32
PEEPSTH53	TH-I	ThesisPhase-I & Viva-voce	-	Pr 16	S 4	40	60	100	10	EEPSTH33
Total						90	210	300	16	

S E M E S T E R –VI										
Course Code	Category	Course	L	T	P	CA	FE	Total	Credits	Equivalent Course Code in M.E. Full Time
PEEPSTH61	TH-II	ThesisPhase-II& Viva-voce	-	Pr 24	S 6	40	60	100	15	EEPSTH41
Total						40	60	100	15	

PE – PROGRAM ELECTIVES

1. State Estimation and Security Assessment of Power Systems
2. Smart Grid
3. Extra High Voltage AC and DC Transmission
4. Wind and Solar Systems
5. Electrical Power Distribution System
6. Power System Operation and Control
7. Energy Management and Energy Audit
8. Electric and Hybrid Vehicles
9. Restructured Power Systems
10. SCADA System and Applications
11. Power Quality
12. Artificial Intelligence Techniques
13. Power System Transients
14. FACTS and Custom Power Devices
15. Industrial Load Modeling and Control
16. Systems Theory

OE-OPEN ELECTIVES

1. Business Analytics
2. Industrial Safety
3. Operations Research
4. Cost Management of Engineering Projects
5. Composite Materials
6. Waste to Energy

AC-AUDIT COURSES

1. English for Research Paper Writing
2. Disaster Management
3. Sanskrit for Technical Knowledge
4. Value Education
5. Constitution of India
6. Pedagogy Studies
7. Stress Management by Yoga
8. Personality Development through Life Enlightenment Skills.

EEPSPC11	POWER SYSTEM ANALYSIS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce applications of computer in power system analysis.
- To understand the mathematical modelling of transmission line, transformer and synchronous machine.
- To study the importance of sparse matrix techniques for large scale power system.
- To impart in depth knowledge of various power flow studies in power system.
- To develop the computational algorithm to simulate balanced and unbalanced faults in power system.
- To understand the multi machine stability problem in power system.

Modelling of Power System

Elements of transmission network – overhead transmission line representation, transformer representation, synchronous machine representation - Distinction between steady state, quasi steady state and transient modelling of power system - Importance of power flow, short circuit and stability studies in the planning and operation of power system.

Sparsity Techniques

Sparse systems - Theorems of sparse matrix - Strategies for reducing bandwidth of matrices – Direct solution of sparse network equations by optimally ordered triangular factorization – Sparsity and optimal ordering.

Power Flow Studies

Power flow model using bus admittance matrix – Review of power flow algorithms – Gauss-Seidal method, Newton-Raphson method and Fast decoupled power flow method- AC-DC power flow analysis – Multi area power flow analysis with tie-line control – Harmonic power flow – Three phase power flow – Distribution power flow – Contingency analysis – Sensitivity analysis.

Short Circuit Studies

Short circuit analysis of a multi-node power system using bus impedance matrix ZBUS - Building algorithm for ZBUS - Algorithm for symmetrical fault analysis using ZBUS - Development of voltage and current equations under unsymmetrical faults using symmetrical components and algorithm for unsymmetrical fault analysis using ZBUS.

Stability Studies

Mathematical model for stability analysis of multi machines - Computational algorithm for power system stability solution of swing equation - Modified Euler method and 4th order Runge-Kutta method.

REFERENCES:

1. Arrillaga.J and Watson.N.R, "Computer Modelling of Electrical Power Systems", Wiley publishers, 2001.
2. Pai M.A, "Computer Techniques in Power System Analysis", Tata McGraw Hill, 2006.
3. George Kusic, "Computer Aided Power System Analysis", CRC Press, 2009.
4. Kothari D.P and Nagrath I.J, "Modern Power system analysis", Tata McGraw Hill, 2011.
5. Stagg G.Wand El- Abiad .A.H, "Computer Methods in Power System Analysis", McGrawHill Book Co,1983.
6. Singh L.P, "Advanced power system analysis and dynamics", New age international publishers, 2012.

COURSE OUTCOMES:

Students will be able to

1. Acquire knowledge about the modelling of power system components.
2. Ability to introduce the sparsity techniques in power system analysis.
3. Ability to develop computer program for various power flow studies.
4. Attain knowledge about the abnormal operation of power system under balanced and unbalanced conditions.
5. Understand the computational procedure for obtaining the swing curve.

Mapping with Programme Outcomes									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓						✓
CO2	✓		✓						
CO3	✓	✓	✓	✓	✓				
CO4	✓	✓	✓	✓	✓	✓			✓
CO5	✓	✓	✓	✓	✓				

EEPSPC12	POWER SYSTEM DYNAMICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To review the mathematical background of various power system components that enables the operator to construct efficient system model during various operating states is expected.
- To introduce the basics of dynamics and stability problems based on the modelling of synchronous machines

- To bring out the importance of various modelling of excitation and speed governing systems in detail.
- To facilitate extension of the existing techniques in understanding the fundamental concepts of active power flow control to ensure stability of dynamic systems.
- To make the students realize the significance of various methodologies and to study various remedial measures in ensuring a better reactive power flow control.
- To study various power system stabilizers in enhancing better dynamic control of the power system.

Introduction

Concept and importance of power system stability in the operation and design – distinction between transient and dynamic stability – complexity of stability problem in large system – necessity for reduced models – stability of interconnected systems

Machine Modelling and Machine Controllers

Electromagnetic Model of Synchronous Generator - Park Equations - modelling of the Induction Motor - basic equations in the d–q Reference Frame - steady-state operation of Synchronous generator and Induction Motor - exciter and voltage regulator - function of excitation systems - typical excitation system configuration - saturation function - stabilising circuit - function of speed governing systems - block diagram and state space representation of IEEE type excitation systems and IEEE mechanical hydraulic governor for hydro turbines and electrical hydraulic governors for steam turbines.

Modelling of Classical Power Plant Components

Introduction - gas turbines - combined-cycle power plants - types of turbines and governing systems for steam turbines - model block diagrams - new thermal governor model - modelling of hydro turbines and governor control systems - turbine conduit dynamics and controls - overview of wind turbines concepts - fixed and variable-speed wind turbines - modelling the wind turbine generators, constant-speed wind turbine, doubly fed induction generator wind turbine system - DFIG Model.

Active Power Flow Control

Small and large disturbances and deviations - UCTE load frequency control – primary, secondary and tertiary control - system modelling, inertia, droop, regulation, and dynamic frequency response - block diagram of the system dynamics and load damping - effect of governor droop on regulation - increasing load by adjusting prime mover power - spinning reserves - Under Frequency Load Shedding and operation in islanding.

Reactive Power Flow Control

Sensitivity coefficients - voltage and reactive power control - reactive power compensation - grid voltage and reactive power control methods – automatic high-side voltage control in power plants - grid hierarchical voltage regulation - Basic

SVR and TVR Concepts - primary and secondary voltage regulation: architecture and modelling - tertiary voltage regulation - block diagram with the excitation system, analysis of effect of AVR on synchronizing and damping components.

REFERENCES:

1. MirceaEremia, Mohammad Shahidehpour, "Handbook of Electrical Power System Dynamics - Modeling, Stability, and Control", IEEE Press – John Wiley & Sons, Inc., Hoboken, New Jersey, 2013.
2. Harry G. Kwatny, Karen Miu-Miller, "Power System Dynamics and Control: A Nonlinear Hybrid Systems Perspective", Springer New York, 2016.
3. Mohamed EL-Shimy, "Dynamic Security of Interconnected Electric Power Systems- Vol-2 - Dynamics and stability of conventional and renewable energy systems", Verlag Publishers, Deutschland, Germany, 2015.
4. AbhijitChakrabarti, "Power System Dynamics and Simulation", PHI Learning Private Ltd, Delhi, 2015
5. R.Ramunujam, "Power System Dynamics Analysis and Simulation", PHI Learning Private Limited, New Delhi, 2010
6. K.Umarao, "Computer Techniques and Models in Power System", I.K. International, Second Edition, New Delhi 2014.
7. L.P.Singh, "Advanced Power System Analysis and Dynamics", New Age International (P) Ltd, Publishers, Fifth Edition, NewDelhi, 2014.

COURSE OUTCOMES:

Students will be able to

1. Understand about various approaches in modelling of power system components and analyze for the dynamic operation of the power system
2. Handle modern speed governing and turbine systems for various classical power plants
3. Obtain improved skills with the detailed study of various IEEE type excitation systems for improved power system operation, stability, control and protection.
4. Ensure enhanced capability in adopting efficient engineering aspects for real power - frequency and reactive power – voltage controls of electrical energy generation and utilization.
5. Have clear understanding of managerial functions like planning, organizing, controlling various power system utilities.

Mapping with Programme Outcomes									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓		✓	✓					
CO2	✓			✓	✓	✓			
CO3	✓		✓	✓	✓				
CO4	✓	✓		✓	✓	✓			✓
CO5	✓					✓	✓		✓

EEPSMC15	RESEARCH METHODOLOGY AND IPR	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES:

- To gain a sound knowledge of scientific research for undertaking a valid study
- To explore the techniques of defining a research problem and investigate the various research designs, highlighting their main characteristics
- To understand the ethical issues of writing technical papers
- To provide an insight on intellectual property
- To address new and international developments in IPR.

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

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

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.

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology.Patent information and data bases.Geographical Indications. 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”, Juta Academic, 1996
2. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”, Juta Academic, 2004
3. Ranjit Kumar, “Research Methodology: A Step by Step Guide for beginners”,Sage Publications Ltd, 2014
4. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd,2007.
5. Mayall , “Industrial Design”, McGraw Hill, 1992.
6. Niebel , “Product Design”, McGraw Hill, 1974.
7. Asimov , “Introduction to Design”, Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “ Intellectual Property in New Technological Age”, 2016.
9. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

COURSE OUTCOMES:

Students will be able to:

1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics
4. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
6. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Mapping with Programme Outcomes									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓		✓	✓					
CO2	✓	✓	✓	✓	✓				
CO3					✓	✓		✓	✓
CO4	✓		✓	✓	✓				✓
CO5				✓		✓		✓	
CO6				✓		✓		✓	✓

EEPSCP16	POWER SYSTEM ANALYSIS LAB	L	T	P	C
		0	0	3	2

COURSE OBJECTIVES:

- To introduce the students to the field of programming and usage of software packages related to power systems such as MI POWER, ETAP, PSCAD, C++, etc.
- To enhance the analyzing and problem solving skills of students.
- To deal with the practical aspects of the Core and Elective subjects offered in the Programme.
- To impart the practical insight of these subjects to the students through the actual implementation and analysis

List of Experiments:

1. 1. Formation of bus admittance and impedance matrices
2. 2. Load flow study based on Gauss - Seidal method
3. 3. Load flow study based on Newton-Raphson method
4. 4. Load flow study based on Fast Decoupled Load flow method
5. 5. DC load flow analysis
6. 6. Contingency analysis
7. 7. State estimation based on WLSE method
8. 8. Economic load dispatch

COURSE OUTCOMES:

Students will be able to:

1. Know concepts in problem solving
2. Develop programming in C++ language
3. Analyze simulation results and effective documentation
4. Exhibit professional behavior and competence
5. Acquire expertise in usage of modern software tools

Mapping with Programme Outcomes									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				
CO2	✓	✓	✓		✓				✓
CO3	✓	✓	✓	✓	✓				
CO4						✓	✓	✓	
CO5	✓	✓	✓		✓			✓	✓

EEPSCP17	POWER SYSTEM SIMULATION LAB	L	T	P	C
		0	0	3	2

COURSE OBJECTIVES:

- To introduce the students to the field of programming and usage of software packages related to power systems such as MI POWER, ETAP, PSCAD, C++, etc.
- To enhance the analyzing and problem solving skills of students.
- To deal with the practical aspects of the Core and Elective subjects offered in the Programme.
- To impart the practical insight of these subjects to the students through the actual implementation, analysis and/or simulation.

List of Experiments:

1. Load frequency control of single area system
2. Load frequency control of two area system
3. Symmetrical short circuit study
4. Unsymmetrical short circuit study
5. Transient stability analysis
6. Optimal power flow analysis
7. Voltage stability study
8. Performance characteristic of buck-boost converter
9. Economic load dispatch based on Bmn co-efficients

COURSE OUTCOMES:

Students will be able to:

1. Know concepts in problem solving
2. Develop programming in C++ language
3. Analyze simulation results and effective documentation
4. Exhibit professional behavior and competence
5. Acquire expertise in usage of modern software tools

Mapping with Programme Outcomes									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				
CO2	✓	✓	✓		✓				✓
CO3	✓	✓	✓	✓	✓				
CO4						✓	✓	✓	
CO5	✓	✓	✓		✓			✓	✓

EEPSPC21	POWER SYSTEM PROTECTION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the concept of power system protection.
- To detail the schemes for overcurrent protection.
- To describe the transformer protection schemes.
- To emphasize the protection of transmission lines.
- To acquire wide knowledge onGenerator and Induction Motor Protection
- To introduce the automation of substation

Overcurrent Protection

Introduction-need for protective systems-nature and causes of faults-types of faults- effects of faults-protection requirements- protection zones- primary and back-up protection- directional protection- classification of protective relays-classification of protective schemes-operating principles and relay construction-Evolution of digital relays from electromechanical relays - Performance and operational characteristics of digital protection- Basic elements of digital protection

Overcurrent protection-types of overcurrent relay-over current protective schemes-protection of feeders and ring mains- directional over-current relay-drawbacks of over-current relays- earth fault and phase fault protection - combined earth fault and phase fault protection scheme - phase fault protective scheme-directional earth fault relay- static over current relays

Transformer Protection

Types of faults in transformers- over-current protection- percentage differential protection of transformers- percentage differential relay with harmonic restraint- restricted earth fault protection - protection against incipient faults- protection against over-fluxing- differential protection of bus bars- protection against external and internal faults- - high impedance bus bar differential scheme- supervisory relay -protection of three – phase bus bars- Digital Differential Protection of Transformers

Protection of Transmission Lines

Distance protection- simple impedance relay- reactance relay- mho relay- comparison between distance relays- distance protection of a three-phase line- need for carrier-aided protection- unit type carrier aided directional protection- carrier-aided distance schemes for acceleration of zone II- carrier-based phase comparison scheme- Digital Line Differential Protection

Generator and Induction Motor Protection

Percentage differential protection scheme against stator phase and ground faults- transverse differential protection- protection against rotor faults- protection against abnormal operating conditions- unbalanced loading –over speeding- loss of excitation – loss of prime mover- induction motor protection- protection against phase faults and ground faults- protection against abnormal operating conditions from supply side and mechanical side

Substation Automation

Topology and functionality- system elements- system requirements- hardware implementation- communication methods- communication protocols and formats- network protocols- substation automation functionality- system configuration and testing- upgrading an existing substation- communication networks for power systems automation- introduction to IEC 61850 – advantages of IEC 61850- Recent Advances in Digital Protection of Power Systems.

REFERENCES:

1. Y.G. Paithankar and S.R Bhide, “Fundamentals of Power System Protection”, Prentice-Hall of India, 2013.
2. Badri Ram and D.N Vishwakarma, “Power System Protection and Switchgear”, Tata McGraw Hill Education Private Limited, 2011.
3. Alstom, “Network Protection & Automation Guide”, 2011
4. Juan M. Gers and Edward J. Holmes, “Protection of Electricity Distribution Networks”, The Institution of Engineering and Technology, 2011
5. C. Christopoulos and A.Wright, “Electrical power system protection”, Springer, 2013
6. S.R.Bhide “Digital Power System Protection” PHI LearningPvt.Ltd.2014

COURSE OUTCOMES:

1. Obtain fundamental knowledge about various protection schemes.
2. Become proficient in overcurrent and transformer protection schemes.
3. Gain familiarity about the protection of transmission lines.
4. Acquire knowledge on Generator and Induction Motor Protection
5. Familiarize with the substation automation.

Mapping with Programme Outcomes									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓		✓	✓	✓				✓
CO2	✓		✓	✓		✓			
CO3	✓		✓	✓	✓	✓			
CO4	✓		✓	✓	✓	✓			
CO5	✓		✓	✓	✓	✓	✓		

EEPSPC22	POWER SYSTEM STABILITY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To distinguish between the different types of power system stability studies
- To understand the concept of small signal stability
- To study the various solution methodologies for transient stability analysis
- To analyse the voltage stability assessment methods

Introduction to Power System Stability

Basic concepts and definitions- classification of stability -Rotor angle stability, voltage stability and voltage collapse -Distinction between mid-term and long-term stability-Nature of system response during severe upsets-blackouts around the world – ill effects of instability.

Small Signal Stability

State space representation – Eigen values - Modal matrices – synchronous machine classical model representation -Small signal stability of single machine connected to infinite bus system – Effect of field circuit dynamics - Effect of excitation system - Small signal stability of multi machine system - Small signal stability enhancement methods

Transient Stability Analysis

Distinction between transient and dynamic stability - an elementary view of the transient stability problem – assumptions made in stability studies – Equal area criterion to test the transient stability of simple power systems – calculation of critical clearing angle and clearing time – limitations of equal area criterion. Factors influencing transient stability - Review of numerical integration methods -Modified Euler's method and 4^{th} order Runge - Kuttamethod .

Voltage Stability Analysis

Difficulties with reactive power transmission – Steady state stability analysis of two bus system using PV and QV curves – Voltage stability assessment using indices – Determination of weakest bus or weakest bus ordering vector – Large disturbance analysis – Phase balancing and power factor correction of unsymmetrical loads.

Methods of improving stability

Transient stability enhancement – steam turbine fast valving – high speed excitation systems – high speed fault clearing – single pole switching – independent pole operation of circuit breakers – generator tripping. Small signal stability enhancement – PSS – selection of PSS location.

REFERENCES:

1. Kundur P, "Power System Stability and Control", McGraw Hill Education, 2006.
2. Taylor C W, "Power System Voltage Stability", McGraw Hill, Inc., 1994.
3. Miller T.J.E, "Reactive power control in electric systems", Wiley India, 2010.
4. Anderson P.N, Fouad, A.A, "Power system control and stability", Wiley India, 2008.
5. Sauer P W and Pai M A, "Power System Dynamics and Stability", Pearson, 2003.

COURSE OUTCOMES:

Students will be able to

1. Familiarize with the different types of stability in power systems.
2. Understand the significance about small signal stability analysis and its enhancement.
3. Gain knowledge on Transient stability analysis
4. Know the significance of voltage stability analysis.
5. Investigate the various methods to enhance transient stability

Mapping with Programme Outcomes									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓		✓				
CO2	✓		✓	✓		✓			
CO3	✓			✓	✓				
CO4	✓			✓	✓				
CO5		✓	✓	✓					✓

EEPSCP26	ARTIFICIAL INTELLIGENCE APPLICATIONS TO POWER SYSTEMS LAB	L	T	P	C
		0	0	3	2

COURSE OBJECTIVES:

- To introduce the students to the field of programming and usage of AI techniques applied to power systems
- To enhance the programming and problem solving skills of students.
- To deal with the practical aspects of the Core and Elective subjects offered in the Programme.

List of Experiments:

1. ANN for load forecasting
2. Fuzzy Logic Controller for load frequency control
3. Genetic Algorithm based economic load dispatch
4. Particle Swarm Optimization based optimal placement of FACTS devices
5. ANN for fault analysis
6. Particle Swarm Optimization based environmental economic dispatch
7. ANN for economic load dispatch
8. ANN for price forecasting

COURSE OUTCOMES:

Students will be able to:

1. Know concepts in problem solving using AI techniques
2. Develop programming in MATLAB
3. Analyze simulation results and effective documentation
4. Exhibit professional behavior and competence
5. Acquire expertise in usage of modern software tools

Mapping with Programme Outcomes									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓	✓	✓				✓
CO2	✓	✓	✓	✓	✓				✓
CO3	✓	✓		✓	✓				
CO4					✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓			✓	✓

		L	T	P	C
EEPSTS27	INDUSTRIAL TRAINING AND SEMINAR /MINI PROJECT	0	0	2	2

COURSE OBJECTIVES:

- To train the students in the field work related the Power Systems and to have a practical knowledge in carrying out Power Systems field related works.
- To train and develop skills in solving problems during execution of certain works related to Power Systems.
- To work on a technical topic related to Power Systems and acquire the ability of written and oral presentation
- To acquire the ability of writing technical papers for Conferences and Journals

Each student should individually undergo a training program in reputed industries in the field of Power Systems during the summer vacation (at the end of second semester for full – time / fourth semester for part – time) for a minimum stipulated period of four weeks. At the end of the training, the student has to submit a detailed report on the training he/she had, within ten days from the commencement of the third semester for Full-time / fifth semester for part-time.

The student will be evaluated, by a team of staff members nominated by Head of the department, through a viva-voce examination.

Further, each student will work for two periods per week guided by student counsellor. He/she will be asked to present a seminar of not less than fifteen minutes and not more than thirty minutes on any technical topic of student's choice related to Power Systems and to engage in discussion with audience and will defend the presentation. A brief copy of the presentation also should be submitted. Evaluation will be done by the student counselor based on the technical presentation and the report and also on the interaction shown during the seminar.

COURSE OUTCOMES:

Students will be able to:

1. Face the challenges in the field with confidence.
2. Benefit by the training with managing the situation that arises during the execution of works related to Power Systems.
3. Get the training to face the audience and to interact with the audience with confidence.
4. Tackle any problem during group discussion in the corporate interviews.
5. Gain practical knowledge in carrying out Power Systems field related works.

Mapping with Programme Outcomes									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1						✓	✓	✓	✓
CO2						✓	✓	✓	
CO3						✓	✓	✓	
CO4						✓	✓	✓	✓
CO5						✓	✓	✓	✓

EEPSTH33	THESIS PHASE-I& VIVA-VOCE	L	T	P	C
		0	0	10	10

COURSE OBJECTIVES:

- To carry out thesis work Phase – I which is an integral part of the thesis consisting of problem statement, literature review, thesis overview and scheme of implementation.
- To attempt the solution to the problem by analytical/simulation/experimental methods and validate with proper justification.

METHOD OF EVALUATION:

The student undergoes literature survey and identifies the topic of thesis and finalizes in consultation with Guide/Supervisor and prepares a comprehensive thesis report after completing the work to the satisfaction of the supervisor.

The progress of the thesis is evaluated based on a minimum of three reviews. The review committee will be constituted by the Head of the Department.

A thesis report is required at the end of the semester.

The thesis work is evaluated based on oral presentation and the thesis report jointly by external and internal examiners constituted by the Head of the Department.

COURSE OUTCOMES:

Students will be able to:

1. Review quality of Literature survey and Novelty in the problem
2. Assess clarity of Problem definition and Feasibility of problem solution
3. Validate the relevance to the specialization
4. Acquire Knowledge on the clarity of objective and scope
5. Improve the quality of Written and Oral Presentation

Mapping with Programme Outcomes									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1				✓	✓				
CO2	✓	✓	✓	✓	✓				
CO3	✓	✓	✓	✓	✓				
CO4	✓	✓	✓	✓	✓				
CO5								✓	✓

EEPSTH41	THESISPHASE-II& VIVA-VOCE	L	T	P	C
		0	0	15	15

COURSE OBJECTIVES:

- To carry out Thesis work Phase – II which the remaining part of the thesis.
- To attempt the solution to the problem by analytical/simulation/experimental methods and validate with proper justification.

METHOD OF EVALUATION:

The progress of the thesis is evaluated based on a minimum of three reviews. The review committee will be constituted by the Head of the Department.

A thesis report is required at the end of the semester.

The thesis work is evaluated based on oral presentation and the thesis report jointly by external and internal examiners constituted by the Head of the Department.

COURSE OUTCOMES:

Students will be able to:

1. Identify the real world power system problems
2. Analyze, design and implement solution methodologies
3. Apply modern engineering tools for solution
4. Write technical reports following professional ethics
5. Develop effective communication skills to present and defend their research work to a panel of experts.

Mapping with Programme Outcomes									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1			✓	✓	✓				
CO2	✓	✓	✓	✓	✓				
CO3	✓	✓	✓	✓	✓				✓
CO4			✓	✓	✓			✓	
CO5								✓	

PROGRAM ELECTIVES

EEPSPEXX	STATE ESTIMATION AND SECURITY ASSESSMENT OF POWER SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To acquire fundamental knowledge in power system state estimation
- To gain knowledge in distribution system state estimation
- To perform observability analysis in the power system networks
- To obtain knowledge to assess the security of the electric power system
- To explore the strategies for power system operations enhancement
- To get conceptual aspects in power system state estimation and strategies to enhance the secure power system operations

Introduction

State estimation- Energy management system- SCADA system- Energy control centers- Security monitoring and control- Concepts of reliability, security and stability - State transitions and control strategies- Data acquisition systems - Modulation techniques, MODEMS, Power line carrier communication.

Power System State Estimation

Static state estimation: Active and reactive power bus measurements - Line flow measurements - Line current measurements – Bus voltage measurements - Measurement model and assumptions - Weighted least square state estimation algorithm- Maximum likelihood estimation - Decoupled formulation of WLS state

estimation- Fast decoupled state estimation - State estimation using DC model of power system- Weighted least absolute value state estimation - Comparison of state estimation algorithms.

Network Observability Analysis

Tracking state estimation: Algorithm - Computational aspects - Measurement redundancy - Accuracy and variance of measurements - Variance of measurement residuals- Detection, identification and suppression of bad measurements – Kalman filtering approach- Computational aspects - Approximations to reduce computations - Pseudo measurements- Virtual measurements- External system equivalencing- Network observability - Observability analysis using phasor measurement units.

Distribution System State Estimation

Distribution system state estimation- State of the art methods – Comparison of different DSSE algorithms- Developments in measurement system and DSSE design- Pseudo measurements- System architecture.

Security Assessment and Security Enhancement

Contingency analysis: Linearized AC and DC models of power systems for security assessment - Line outage distribution factors and generation shift factors for DC and linearized AC models - Single contingency analysis using these factors - Double line outage analysis techniques using bus impedance matrix and factors of bus admittance matrix- Fast contingency algorithms for nonlinear A.C. models- Contingency ranking and security indices-Correcting the generator dispatch for security enhancement using linearized DC models – Methods using sensitivity factors - Compensated factors - Optimization methods. Emergency and restorative control procedures.

REFERENCES:

1. Ali Abur, “Power System State Estimation Theory and Implementation”, Marcel Dekker, 2004.
2. A.J. Wood, B.F. Wollenberg and G.B. Sheble, “Power Generation, Operation and Control”, John Wiley and Sons, 3rd Edition, 2013.
3. Mahalanabis, Kothari and Ahson, “Computer Aided Power System Analysis and Control”, Tata McGraw Hill Publishers, 1991.
4. AbhijitChakrabarti and SunitaHalder, “Power System Analysis Operation and Control”, PHI Learning, 2010.
5. G.L. Kusic, “Computer Aided Power System Analysis”, Prentice Hall of India, 1989.
6. Davide Della Giustina, Marco Pau, Paolo AttilioPegoraro, FerdinandaPonci and Sara Sulis, “Electrical Distribution System State Estimation: Measurement Issues and Challenges”, IEEE Instrumentation & Measurement Magazine, 2014.

COURSE OUTCOMES:

Students will be able to

1. Understand the conceptual aspects in power system state estimation.
2. Demonstrate various state estimation methods.
3. Be proficient to perform observability analysis.
4. Able to conduct distribution state estimation.
5. Realize the security assessment and enhancement strategies.

Mapping with Programme Outcomes									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓	✓					
CO2	✓	✓	✓	✓	✓	✓			
CO3				✓	✓	✓			
CO4			✓	✓	✓				
CO5			✓	✓	✓	✓			

EEPSPEXX	SMART GRID	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To familiarize with the fundamentals of smart grids
- To get exposed to Smart Grid technologies, functionalities and capabilities
- To study about the performance analysis tools for smart grid
- To know about the various stability assessment tools for smart grid
- To focus on smart metering and demand-side integration
- To familiarize with the application of FACTS and Energy storage devices in smart grid

Introduction

Motivation for smart grid- smart grid Definition -benefits- Comparison of Traditional Grid and Smart Grid-Characteristics of a Smart Grid -Stakeholders in smart grid development- Smart grid technology framework , functionalities and capabilities- Cost Components for the Smart Grid: Transmission Systems and Sub-Stations End- Distribution End- Consumer End- Cost-Benefit Analysis

Load Flow and Contingency Analysis for Smart Grid

Introduction to Load Flow Studies - Challenges to Load Flow in Smart Grid - Weaknesses of the Present Load Flow Methods - Load Flow methodology for Smart Grid Design - DSOPF Application To The Smart Grid- Static Security Assessment (SSA) and Contingencies - Contingencies and Their Classification - Contingency Studies for the Smart Grid.

Stability Assessment for Smart Grid

Introduction to Stability - Strengths and Weaknesses of Existing Voltage Stability Analysis Tools - Voltage Stability Assessment - Voltage Stability Assessment Techniques - Voltage Stability Indexing - Analysis Techniques for Steady-State Voltage Stability Studies - Angle Stability Assessment

Smart Metering

Introduction – Smart metering – Comparison of Conventional and smart metering – Benefits of smart meters- Functional block diagram of a smart meter-stages in Smart meter architecture- – Communication infrastructure and protocols for smart metering – Demand side integration.

FACTS and Energy Storage in the Smart Grid

Introduction – Renewable energy generation – Fault current limiting – Shunt compensation – Series compensation – FACTS devices – HVDC-Energy storage-applications and technologies.

REFERENCES:

1. JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, JianZhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", John Wiley & Sons, 2012.
2. James Momoh, "Smart Grid: Fundamentals of design and analysis", John Wiley & sons Inc, 2012.
3. Krzysztof Iniewski, "Smart Grid Infrastructure & Networking", Tata McGraw Hill, 1st edition, 2012.
4. Stuart Borlase,"Smart Grids: Infrastructure, Technology, and Solutions", CRC press, 2013.
5. SawanSen,SamarjitSengupta, AbhijitChakrabarti, "Electricity pricing-regulated, deregulated and smart grid systems", CRC press, 2015.
6. Mini S. Thomas, John Douglas McDonald, "Power system SCADA and smart grids", CRC press, 2015.

COURSE OUTCOMES:

1. Acquire knowledge on the concept of smart grids.
2. Implement Load flow and contingency methods for smart grid.
3. Identify stability assessment tools for smart grid.
4. Gain knowledge on smart metering infrastructure.
5. Realize the application of FACTS and energy storage devices in smart grid.

Mapping with Programme Outcomes									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓		✓			✓			
CO2	✓	✓	✓	✓					
CO3	✓		✓	✓	✓				
CO4	✓		✓		✓				
CO5	✓		✓	✓			✓	✓	✓

EPSPEXX	EXTRA HIGH VOLTAGE AC AND DC TRANSMISSION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the extra high voltage AC and DC transmission.
- To learn about the properties of bundle conductors and voltage control using compensators.
- To introduce the HVDC transmission system with types, control and protection.

- To discuss about the design factors of lines and cables.
- To learn about the overvoltage problem in extra high voltage system.

Introduction

Introduction to EHV AC and DC transmission -Role of EHV AC Transmission - Standard Transmission Voltages - Power-Handling Capacity and Line Loss - comparison between HVAC and HVDC overhead and underground transmission schemes - Factors concerning choice of HVAC and HVDC transmission - Block diagram of HVAC and HVDC transmission schemes.

EHV AC Transmission

Properties of bundled conductors - Surface voltage gradient on single and multi-conductor bundles - Corona effects - Power loss - Charge voltage diagram with Corona - Noise generation and their characteristics - Corona pulses, their generation and properties (qualitative study only)- Problems of EHV AC transmission at power frequency - Voltage control using compensators - Cascade connection of components.

HVDC Transmission

Analysis of DC transmission systems - Harmonics on AC and DC sides and filters for their suppression - Multi terminal D.C. Transmission systems; application, types, control and protection - Parallel operation of A.C. and D.C. transmission - Voltage stability in AC/DC systems - Modern developments in HVDC transmission - HVDC systems simulation.

EHV lines and Cable Transmission

Electrical Characteristics of EHV Cables - Properties of Cable-Insulation Materials - Breakdown and Withstand Electrical Stresses in Solid Insulation— Statistical Procedure - Design Basis of Cable Insulation - Tests on Cable Characteristics- Surge Performance of Cable Systems -Gas Insulated EHV Lines- Design factors under steady state - Design basis of cable insulation.

Testing, Overvoltage and Design of EHV Systems

EHV Testing - Standard specifications and standard wave shapes for testing - Generation of switching surges for transformer testing - Impulse voltage generators - Generation of impulse currents - General layout of EHV laboratory. Over voltages in EHV systems - Origin and types - Switching surges - Lightning surges- Design of EHV Lines - Design factors under steady state- steady state limits - Line insulation coordination based upon transient over voltages - Design examples.

REFERENCES:

1. Rakosh Das Begamudre, “Extra High Voltage AC Transmission Engineering”, New Age International Pvt Ltd Publishers, 4th edition, 2014.
2. S. Rao, “EHV-AC, HVDC Transmission and Distribution Engineering”, Khanna Publishers, 3rd edition, 2001.
3. Padiyar K.R., “HVDC Power Transmission Systems”, New Age International Pvt Ltd; 3rd edition, 2015.
4. Kuffel and Zaengl, “High Voltage Engineering Fundamentals”, Elsevier; 2nd edition, 2008.

COURSE OUTCOMES:

Students will be able to

1. Understand the basic comparison of HVAC and HVDC for overhead and underground transmission system.
2. Derive the surface voltage gradient of single, double, and more than three conductor bundles and expression for a charge voltage diagram for evaluation of the power loss.
3. Analyze the DC transmission system in case of harmonics and discuss about the multi terminal DC transmission system.
4. Gain Knowledge about the design factors about lines and cables.
5. Learn about protection of HVAC and HVDC systems.

Mapping with Programme Outcomes									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1		✓		✓					
CO2	✓	✓		✓	✓				
CO3	✓	✓	✓						
CO4	✓	✓	✓	✓	✓				
CO5	✓		✓	✓					

EEPSPEXX	WIND AND SOLAR SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To educate the students significantly the concept of wind energy system.
- To prepare students to excel in research in wind energy system.
- To impart knowledge in solar energy system through global, rigorous post graduate education.
- To make the students to understand the new developments in solar energy system.
- To provide students with a solid foundation in mathematical, scientific and engineering fundamentals required to solve wind and solar energy problems.
- To train students with good scientific and engineering knowledge so as to comprehend, analyze, design, and create novel products and solutions for the real time problems.

Introduction

Wind resources – Nature and occurrence of wind – Power in the wind – Wind characteristics – Principles of wind energy conversions – Components of wind energy conversion system (WECS) – Classification of WECS – Advantages and disadvantages of WECS.

Wind Electric Generators

Characteristics of Induction generators – Permanent magnet generators – Single phase operation of induction generators – Doubly fed generators – Grid connected and stand alone systems – Controllers for wind driven self excited systems and capacitor excited isolated systems – Synchronized operation with grid supply – Real and reactive power control.

Wind Power Management

Wind energy storage – Storage systems – Wind farms and grid connections – Grid related problems on absorption of wind – Grid interfacing arrangement – Simulation of wind energy conversion system – Operation, Control and technical issues of wind generated electrical energy – Inter connected operation – Hybrid systems.

Introduction to Solar Energy and Its Prospects

Sun as source of energy – Availability of solar energy – Nature of solar energy – solar energy & environment – Various methods of using solar energy – solar thermal, photovoltaic, photosynthesis - present & future scope of solar energy.

Storage of solar energy – Types of energy storage – Thermal storage – Electrical storage – Chemical storage – Hydro storage – Solar ponds – Principle of operation of solar ponds – Application of solar ponds.

Photo Voltaic System

Solar cells & panels – Structure of PV cells – semiconductor materials for PV cells - I-V characteristics of PV systems – PV models and equivalent circuits- effects of irradiance and temperature on PV characteristics .

A basic photo voltaic system for power generation – Advantages and disadvantages of photo voltaic solar energy conversion –Application of solar photo voltaic system – components of PV systems- Design of PV systems- Power conditioning and storage arrangement – Maximum power point tracking - Introduction to string inverters.

REFERENCES:

1. G.D. Rai, “Non-conventional Energy Resources”, Khanna Publishers, 2011.
2. G.N. Tiwari, “Solar Energy: Fundamentals, Design, Modeling & Application”, Narosa Publishing House, 2013.
3. SirajAhamed, “Wind Energy: Theory & Practice” PHI Learning Private Limited, 2010.
4. G.D. Rai, “Solar Energy Utilisation”, Khanna Publishers, Fifth Edition, 2011.
5. B.H. Khan, “Non conventional Energy Resources”, Tata McGraw Hill, Second Edition, 2010.

COURSE OUTCOMES:

Students will be able to

1. Understand the basic concept of wind energy conversion system.
2. Impart knowledge on wind electric generators in power systems.
3. Develop skill to control the wind generated electrical energy.
4. Train to know about the various types of solar collectors and its storage.
5. Understand the basic knowledge of photo voltaic system.

Mapping with Programme Outcomes									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓			✓					
CO2	✓			✓					✓
CO3	✓		✓	✓					
CO4		✓				✓			
CO5	✓					✓	✓		✓

EEPSPEXX	ELECTRIC POWER DISTRIBUTION SYSTEM	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Learning about power distribution system
- Learning of SCADA System
- Understanding Distribution Automation

Distribution of Power, Management, Power Loads - Load Forecasting Short-term and Long-term - Power System Loading, Technological Forecasting - Advantages ofDistribution Management System (D.M.S.) Distribution Automation Definition - Restoration / Reconfiguration of Distribution Network - Different Methods and Constraints - Power Factor Correction

Interconnection of Distribution - Control & Communication Systems - Remote Metering - Automatic Meter Reading and itsimplementation

SCADA: Introduction, Block Diagram-SCADA Applied To Distribution Automation-Common Functions of SCADA-Advantages of Distribution Automation through SCADA

Calculation of Optimum Number of Switches, Capacitors, Optimum-Switching Device Placement in Radial Distribution Systems-Sectionalizing Switches – Types, Benefits-Bellman's Optimality Principle-Remote Terminal Units-Energy efficiency in electrical distribution &Monitoring

Maintenance of Automated Distribution Systems-Difficulties in Implementing Distribution-Automation in Actual Practice, Urban/Rural Distribution- Energy Management- AI techniques applied to Distribution Automation

REFERENCES:

1. A.S. Pabla, "Electric Power Distribution", Tata McGraw Hill Publishing Co. Ltd., 2011.
2. M.K. Khedkar, G.M. Dhole, "A Text Book of Electrical power Distribution Automation", University Science Press, New Delhi, 2010
3. Anthony J Panseni, "Electrical Distribution Engineering", CRC Press, 2005
4. James Momoh, "Electric Power Distribution, automation, protection & control", CRC Press, 2007

COURSE OUTCOMES:

Students will be able to

1. Gain Knowledge of power distribution system
2. Study of Distribution automation and its application in practice
3. Learn SCADA system
4. Know the optimal placement of switching devices
5. learn about AI techniques applied to power systems

Mapping with Programme Outcomes									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓	✓	✓				
CO2	✓	✓		✓	✓				
CO3	✓	✓		✓	✓				
CO4	✓		✓	✓	✓				
CO5	✓			✓					✓

EPSPEXX	POWER SYSTEM OPERATION AND CONTROL	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To bring out the need for operating the power system in a viable and affordable manner
- To get an overview of power system operation and control
- To emphasize on the development of algorithms suitable for efficient operation
- To point out the significance of unit commitment and hydro-thermal schedule
- To address the problems associated with interconnected networks, the need for maintaining co-coordinated actions and the use of controllers for smooth and satisfactory operation of power systems

Economic Operation of Power Systems

Characteristics of Steam Plants - Characteristics of Hydro Plants - Analytical Form for Input-Output Characteristics of Thermal Units - Constraints in Operation - Economic Load Dispatch neglecting Transmission Losses - Lambda iteration method - Derivation of Transmission Loss Formula - Economic Load Dispatch with Transmission Losses - Gradient Methods of Economic Dispatch - Newton's Method.

Optimal Power Flow

Optimal Power Flow - Problem statement and formulation - Solution of OPF- Gradient method - Newton's method -Linear Sensitivity Analysis - Linear Programming method - Security constrained optimal power flow - Interior Point Algorithm.

Hydrothermal Scheduling

Hydrothermal Coordination - hydroelectric plant models - Scheduling Problems - Short Term Hydro Thermal Scheduling - lambda-gamma method with losses - gradient approach – hydro units in series – pumped storage hydro scheduling - dynamic programming and linear programming base solution methods.

Unit Commitment

Unit commitment problem – spinning reserve – thermal unit constraints – Hydro constraints- Fuel Constraints – solution methods – priority List method – dynamic programming method – Lagrangian Relaxation method.

Automatic Generation Control

Basic generator control loops - speed governing system - isochronous governor - governors with speed-droop characteristics - speed regulation - load sharing by parallel generating units - control of power output of generating units - turbine model - generator load model - block diagram of an isolated power system - state space representation - fundamentals of automatic generation control - steady state analysis - concept of control area - AGC of two area interconnected power system - tie-line frequency bias control - bias for selection of bias factor - generation rate constraint - discrete integral controller for AGC.

REFERENCES:

1. Wood and Wollenberg, "Power Generation, Operation and Control", John Wiley and Sons, 2013.
2. Das. D, "Electrical Power Systems", New Age International Publishers, New Delhi, 2009.
3. Murthy P.S.R, "Operation and Control in power systems", Tata McGraw Hill, 2009.
4. Kothari D.P and Dhillon J.S, "Power System Optimization", Prentice Hall of India, New Delhi, 2010.
5. JiZhong Zhu, "Optimization of Power System Operation", Wiley IEEE Press, New Jersey, 2009.
6. Kirchmayer, " Economic Operation of Power Systems",2009
7. Elgerd.O.I, "Electric Energy Systems: Theory – An Introduction", Tata McGraw Hill, New Delhi, 2001.

COURSE OUTCOMES:

Students will be able to

1. Gain knowledge on economic load dispatch.
2. Solve optimal power flow problems using various solution methods.
3. Get exposed to hydro thermal scheduling.
4. Understand the significance of Unit Commitment
5. Focus on control aspects in power systems.

Mapping with Programme Outcomes									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓		✓					
CO2	✓	✓		✓	✓				
CO3	✓				✓				
CO4	✓			✓	✓				
CO5	✓		✓	✓	✓				✓

EEPSPEXX	ENERGY MANAGEMENT AND ENERGY AUDIT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To familiarize about forms of Energy
- To learn the present energy scenario and the need for energy management
- To understand energy management concepts and various methods
- To understand the basic components of energy audit
- To learn the various techniques of energy audit and usage of instruments
- To analyse and report the outcome of energy audit

Introduction

Basics of Energy and its various forms - Conventional and Non- conventional sources - Energy policy - Energy conservation act 2001 - Energy managers and energy auditors - Roles and responsibility of energy managers - Energy labelling and energy standards.

Energy Management

Supply side and demand side management - Energy management methods, Energy management systems - Energy monitoring - Energy review and energy bench marking - Energy performance - maximizing system efficiencies - Optimizing the input energy requirements - Energy action planning.

Energy Audit

Definition, Energy audit- need, Types of energy audit - Preliminary audit, detailed audit, methodology and approach - Instruments for energy audit - Energy saving calculations.

Energy Assessment and Reporting

Evaluation of saving opportunities – Determining the savings in INR - Noneconomic factors - Conservation opportunities, estimating cost of implementation - Energy audit reporting - Plant energy study report, importance - Effective organization - Report writing and presentation.

Energy Economics

Energy economics - Depreciation - Financial analysis techniques - Discount rate, Payback period, Internal rate of return, Net present value, Life cycle costing –

Energy Service Company (ESCO) concept – Cumulative Sum (CUSUM) technique - ESCO contracts.

REFERENCES:

1. Wayne C. Turner, Steve Doty, "Energy Management Handbook", CRC press, Taylor & Frances group, Eighth Edition, 2012.
2. Barney L. Capehart, Wayne C. Turner, William J. Kennedy, "Guide to Energy Management", CRC press, Taylor & Frances group, Eighth Edition, 2016.
3. Thumann, P.E, William J. Younger, "Hand Book of Energy Audits", CRC press, Taylor & Frances group, Seventh Edition, 2007.
4. L.C. Witte, P.S. Schmidt, D.R. Brown, "Industrial Energy Management and Utilization", Hemisphere Publication, Washington, 1988.
5. Astop T.D & Croft D.R, "Energy Efficiency for Engineers and Technologists", Scientific& Technical, Longman, 1990.

COURSE OUTCOMES:

Students will be able to

1. Understand and to acquire fundamental knowledge in the field of energy and on both the conventional and non-conventional energy technologies.
2. Acquire the capability and skills needed for the energy monitoring, auditing and management of Energy.
3. Get the idea of the Energy Management Systems and their essential elements.
4. Understand the need for energy audit, types and Instruments for energy audit.
5. Capable for Report writing and presentation of energy audit.

Mapping with Programme Outcomes									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓			✓		✓			
CO2	✓			✓		✓	✓	✓	✓
CO3	✓			✓	✓	✓	✓		
CO4	✓		✓			✓	✓	✓	
CO5	✓					✓	✓	✓	✓

EEPSPEXX	ELECTRIC AND HYBRID VEHICLES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand upcoming technology of hybrid system
- To understand different aspects of drives application
- Learning the electric Traction

History of hybrid and electric vehicles - Social and environmental importance of hybrid and electric vehicles - Impact of modern drive-trains on energy supplies –

Basics of vehicle performance, vehiclepowersource characterization Transmission characteristics -Mathematical models to describe vehicle performance

Basic concept of hybrid traction-Introduction to various hybrid drive-train topologies-Power flow control in hybrid drive-train topologies-Fuel efficiency analysis.

Introduction to electric components used in hybrid and electric vehicles-Configuration and control of DC Motor drives-Configuration and control of Introduction Motor drives configuration and control of Permanent Magnet Motor drives Configuration and control of Switch Reluctance-Motor drives, drive system efficiency

Matching the electric machine and the internal combustion engine (ICE)Sizing the propulsion motor, sizing the power electronics Selecting the energy storage technology-Communications, supporting subsystems

Introduction to energy management and their strategies used in hybrid and electric vehicle-Classification of different energy management strategies Comparison of different energy management strategies Implementation issues of energy strategies

REFERENCES:

1. HeberttSira -Ramirez, R. Silva Ortigoza, "Control Design Techniques in Power Electronics Devices", Springer, 2006.
2. Siew-Chong Tan, Yuk-Ming Lai, Chi Kong Tse, "Sliding mode control of switching Power Converters", CRC Press, 2011.
3. C. Mi, M. A. Masrur and D. W. Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons,2011.
4. S. Onori, L. Serrao and G. Rizzoni, "Hybrid Electric Vehicles: Energy Management Strategies", Springer,2015.
5. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press,2004.
6. T. Denton, "Electric and Hybrid Vehicles", Routledge,2016.

COURSE OUTCOMES:

Students will be able to:

1. Acquire knowledge about fundamental concepts, principles, analysis and design of hybrid and electric vehicles.
2. Learn about electric drives in vehicles /traction.
3. Familiarize with the different electrical components used in hybrid and electric vehicles.
4. Understand the models to describe hybrid vehicles and their performance.
5. Understand the different strategies related to energy storagesystems.

Mapping with Programme Outcomes									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓		✓	✓					
CO2	✓		✓						
CO3	✓			✓					✓
CO4	✓			✓					
CO5	✓			✓					✓

EEPSPEXX	RESTRUCTURED POWER SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the concept of restructuring the power industry and market models
- To impart knowledge on fundamental concepts of congestion management
- To know about transmission pricing
- To understand the concepts of different ancillary services
- To illustrate various power sector in India

Introduction to Restructuring of Power Industry

Reasons for restructuring of power industry-Vertically Integrated Utilities and Power Pools-Different Entities involved-Market models-Benefits from a Competitive Electricity Market-Role of the Independent System Operator (ISO)- Operational Planning Activities of ISO- The ISO in Pool Markets- The ISO in Bilateral Markets-Worldwide Movement of Power Industry Restructuring

Transmission Congestion Management

Introduction-Definition of congestion- reasons for transfer capability limitation-importance of congestion management- features of congestion management – classification of congestion management methods- Bid, Zonal and Node congestion principles – Inter zonal and intra zonal congestion – Generation rescheduling – Transmission congestion contracts.

Transmission Open Access and Pricing

Power Wheeling- Transmission Open Access- Types of Transmission Services in Open Access-Power Trading- Cost Components in Transmission- Pricing of Power Transactions-Locational marginal pricing - Embedded Cost Based Transmission Pricing - Incremental Cost Based Transmission Pricing.

Ancillary Services Management

General Description of some Ancillary Services-Frequency control-Reserves services-Reactive power and voltage control service-Black start capability service-

Scheduling and Dispatch Services- Synchronous Generators as Ancillary Service Providers – co-optimization of energy and reserve services.

Reforms in Indian Power Sector

Introduction – Framework of Indian power sector – Reform initiatives – Salient features of Indian Electricity Act 2003 –IEGC- Transmission system operator – Power Exchange – Regulatory and policy development in Indian power sector- opportunities for IPP and capacity power producer – Availability based tariff.

REFERENCES:

1. K Bhattacharya, M Bollen, JE Daalder, "Operation of Restructured Power Systems", Kluwer academic publishers, 2001.
2. S. C. Srivastava and S. N. Singh, "Operation and Management of Power system in Electricity Market", Alpha Science, 2015.
3. S.A.Khaparde and A.R.Abhyankar, "Restructured Power Systems", Narosa Publishing House, New Delhi, India, 2008.
4. Mohammad Shahidehpour and MuwaffaqAlomoush, "Restructured Electric Power System operation trading and volatility", Marcel Dekker Inc,2001.
5. Loi Lei Lai, "Power System Restructuring and Deregulation", John Wiley & Sons Ltd, England, 2001.
6. Xiao-Ping Zhang, "Restructured Electric Power Systems: Analysis of Electricity Markets with Equilibrium Models", John Wiley & Sons, 2010.

COURSE OUTCOMES:

Students will be able to

1. Understand the difference between traditional and restructured power systems
2. Acquire knowledge about various congestion management methods.
3. Familiarize with electricity pricing and transmission open access.
4. Get knowledge about significant ancillary services.
5. Learn about the reform initiatives undertaken in Indian power sector.

Mapping with Programme Outcomes									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓			✓					
CO2	✓			✓	✓	✓			
CO3	✓		✓	✓		✓			
CO4	✓			✓	✓				
CO5	✓					✓	✓	✓	

EEPSPEXX	SCADA SYSTEM AND APPLICATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand what is meant by SCADA and its functions
- To know SCADA communication
- To get an insight into its application

Introduction to SCADA-Data acquisition systems-Evolution of SCADA-Communication technologies- Monitoring and supervisory functions-SCADA applications in Utility –Automation

Industries SCADA- Industries SCADA System Components-Schemes- Remote Terminal Unit (RTU)-Intelligent Electronic Devices (IED) - Programmable Logic Controller (PLC)-Communication Network, SCADA Server, SCADA/HMI Systems

SCADA Architecture-Various SCADA architectures, advantages and disadvantages of each system-single unified standard architecture -IEC 61850

SCADA Communication-various industrial communication technologies - wired and wireless methods and fiber optics-Open standard communication protocols

SCADA Applications: Utility applications-Transmission and Distribution sector operations, monitoring, analysis and improvement-Industries - oil, gas and water-Case studies, Implementation, Simulation Exercises

REFERENCES:

1. Stuart A. Boyer: “SCADA-Supervisory Control and Data Acquisition”, Instrument Society of America Publications, USA, 2004
2. Gordon Clarke, Deon Reynders, “Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems”, Newnes Publications, Oxford, UK,2004
3. William T. Shaw, “Cyber security for SCADA systems”, Penn Well Books,2006
4. David Bailey, Edwin Wright, “Practical SCADA for industry”, Newnes,2003
5. Michael Wiebe, “A guide to utility automation: AMR, SCADA, and IT systems for electric power”, PennWell, 1999

COURSE OUTCOMES:

Students will be able to:

1. Describe the basic tasks of Supervisory Control Systems (SCADA) as well as their typical applications.
2. Acquire knowledge about SCADA architecture, various advantages and disadvantages of each system.
3. Knowledge about single unified standard architecture IEC 61850.
4. To learn about SCADA system components: remote terminal units, PLCs, intelligent electronic devices, HMI systems, SCADA server.
5. Learn and understand about SCADA applications in transmission and distribution sector, industries etc.,

Mapping with Programme Outcomes									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓	✓					
CO2	✓	✓	✓	✓					
CO3	✓	✓	✓	✓	✓				
CO4	✓	✓	✓	✓	✓	✓			✓
CO5	✓	✓	✓	✓	✓				✓

EEPSPEXX	POWER QUALITY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand the different power quality issues to be addressed
- Understand the recommended practices by various standard bodies like IEEE,IEC, etc. on voltage & frequency, harmonics
- Understanding STATIC VAR Compensators

Introduction-power quality-voltage quality-overview of power quality phenomena classification of power quality issues-power quality measures and standards-THD-TIF-DIN-C- message weights-flicker factor transient phenomena-occurrence of power quality problems - power acceptability curves-IEEE guides, standards and recommended practices.

Harmonics-individual and total harmonic distortion RMS value of a harmonic waveform- Triplex harmonics-important harmonic introducing devices - SMPS-Three phase power converters - arcing devices saturable devices-harmonic distortion of fluorescent lamps-effect of power system harmonics on power system equipment and loads.

Modeling of networks and components under non-sinusoidal conditions transmission and distribution systems Shunt capacitors-transformers-electric machines-ground systems loads that cause power quality problems power quality problems created by drives and its impact on drive

Power factor improvement- Passive Compensation Passive Filtering, Harmonic Resonance - Impedance Scan Analysis- Active Power Factor Corrected Single Phase Front End, Control Methods for Single Phase APFC Three Phase APFC and Control Techniques, PFC Based on Bilateral Single Phase and Three Phase Converter

Static VAR compensators-SVC and STATCOM Active Harmonic Filtering-Shunt Injection - Filter for single phase, three-phase three-wire and three-phase four- wire systems d-q domain control of three phase shunt active filters uninterruptible power supplies constant voltage- Transformers series active power filtering techniques for harmonic cancellation and isolation- Dynamic Voltage Restorers for sag , swell and flicker problems. Grounding and wiring introduction NEC grounding

requirements-reasons for grounding typical grounding and wiring problems solutions to grounding and wiring problems

REFERENCES:

1. G.T. Heydt, "Electric power quality", McGraw-Hill Professional, 2007
2. Math H. Bollen, "Understanding Power Quality Problems", IEEE Press, 2000
3. J. Arrillaga, "Power System Quality Assessment", John Wiley, 2000
4. J. Arrillaga, B.C. Smith, N.R. Watson &A. R.Wood , "Power system Harmonic Analysis", Wiley, 1997

COURSE OUTCOMES:

Students will be able to:

1. Acquire knowledge about the harmonics, harmonic introducing devices and effect of harmonics on system equipment and loads
2. Develop analytical modeling skills needed for modeling and analysis of harmonics in networks and components
3. Introduce the active power factor correction based on static VAR compensators and its control techniques
4. Introduce the series and shunt active power filtering techniques for harmonics.
5. Find solutions to grounding and wiring problems

Mapping with Programme Outcomes									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓	✓					
CO2		✓	✓	✓					
CO3		✓	✓	✓					✓
CO4		✓	✓	✓					✓
CO5		✓		✓					✓

EEPSPEXX	APPLICATION OFAI TECHNIQUES TO POWER SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To give an insight to the students about the significance of soft computing techniques and artificial neural networks.
- To teach the importance, architecture, algorithm and application of artificial neural networks.
- To impart knowledge on fuzzy logic systems.
- To give exposure to genetic algorithm and swarm optimization methods.

Introduction and Artificial Neural Networks

Introduction of soft computing – Comparison of soft computing and hard computing – types and applications of soft computing techniques - Biological neural networks – Evolution of Neural Networks – Basic Models of Artificial Neural

Networks –Terminologies of ANNs – Learning and Training the neural network – McCulloch-Pitts neuron model- Perceptron Model – Back propagation network

Associative Memory and Unsupervised Neural Networks

Auto associative and hetero associative memory in neural network - Discrete Hopfield network. Fixed weight competitive network – Self organizing network – Adaptive Resonance Theory- Identification and control of linear and nonlinear dynamic systems using Matlab-Neural Network toolbox-- Application of ANN to Electric Load Forecasting and Economic Load Dispatch

Fuzzy Logic System

Introduction to Classical Sets and Fuzzy sets – Fuzzy set operation - approximate reasoning – extension principle - Fuzzy statements - Decomposition of compound rules. Fuzzification - Membership value assignments using intuition - Membership functions- Defuzzification - Fuzzy rule and knowledge bases - fuzzy logic controller - Implementation of fuzzy logic controller using Matlab fuzzy logic toolbox-Application to Speed control of electric motors and Load–Frequency Control.

Genetic Algorithm

Optimization – Traditional optimization methods – Concept of Evolutionary Algorithm – Genetic Algorithm – encoding and decoding of variables – GA operators – fitness function –fitness scaling - procedures of GA - flow chart of GA. Implementation of GA to power system optimization problems.

Swarm Optimization

Basic concept of Swarm intelligence - Ant colony optimization (ACO) - Particle swarm optimization (PSO) and Artificial Bee colony algorithm (ABC).Application of above algorithms in power system optimization problems.

REFERENCES:

1. LawreneFaussett, "Fundamental of neural networks", Prentice Hall, 2004.
2. Rajasekaran and VijayalakshmiPai G.A, “Neural Networks, Fuzzy Logic and Genetic Algorithms – Synthesis and Applications”, Prentice Hall, 2015.
3. Marco Dorigo,Stützle Thomas, “Ant Colony Optimization”, Prentice Hall India Learning Private Limited, 2004.
4. Russell C. Eberhart , Yuhui Shi and James Kennedy, “Swarm Intelligence”, Morgan Kaufmann, 1st edition, 2001.
5. Jesse Russell, Ronald Cohn, “Artificial Bee Colony Algorithm”, Book on Demand Ltd., 2012.

COURSE OUTCOMES:

1. Understand the concept, architecture and algorithm of each AI tchnique
2. Familiarize with the application of various artificial neural networks.
3. Acquire knowledge about fuzzy logic systems.
4. Implement genetic algorithm for various power system optimization problems.
5. Get introduced to various swarm optimization methods.

Mapping with Programme Outcomes									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓	✓					
CO2	✓	✓	✓	✓	✓				✓
CO3	✓	✓	✓	✓	✓				
CO4	✓	✓	✓	✓	✓				
CO5	✓	✓	✓	✓	✓				✓

EEPSPEXX	POWER SYSTEM TRANSIENTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Learn the reasons for occurrence of transients in a power system
- Understand the change in parameters like voltage & frequency during transients
- To know about the lightning phenomenon and its effect on power system

Fundamental circuit analysis of electrical transients-Laplace Transform method of solving simple Switching transients - Damping circuits – Abnormal switching transients, Three-phase circuits and transients - Computation of power system transients

Principle of digital computation – Matrix method of solution-Modal analysis- Z transform- Computation using EMTP-Lightning, switching and temporary over voltages, Lightning-Physical phenomena of lightning.

Interaction between lightning and power system-Influence of tower footing resistance and Earth Resistance-Switching: Short line or kilometric fault-Energizing transients – closing and-re-closing of lines-line dropping, load rejection – over voltages induced by faults

Switching HVDC line travelling waves on transmission line-Circuits with distributed Parameters Wave Equation-Reflection, Refraction, Behavior of Travelling waves at the line terminations-Lattice Diagrams – Attenuation and Distortion-Multi-conductor system-and Velocity wave

Insulation co-ordination: Principle of insulation co-ordination in Air Insulated substation (AIS) and Gas Insulated Substation (GIS) Co- ordination between insulation and protection level-Statistical approach- Protective devices-Protection of system against over voltages-lightning arresters –substation earthing

REFERENCES:

1. Allan Greenwood, “Electrical Transients in Power System”, Wiley & Sons Inc. New York, 1991
2. C.S.Indulkar, DP Kothari, “Power System Transients” – A Statistical approach, Prentice Hall, 1996.

3. Akihiro Ametani, Naoto Nagaoka, Yoshihiro Baba, Teruo Ohno, "Power System Transients: Theory and Applications", CRC Press, 2013.
4. Lou van der Sluis, "Transients in Power Systems", John Wiley & Sons, 2001.
5. Arrillaga.J and Watson.N.,"Power systems Electromagnetic Transients simulation", The Institution of Engineering and Technology, London, 2007.
6. Bewley, L..V., "Travelling Waves on Transmission System", Power Publications Inc., 1993.

COURSE OUTCOMES:

Students will be able to:

1. Know about various transients that could occur in power system and their mathematical formulation
2. Design various protective devices in power system for protecting equipment and personnel
3. Coordinate the insulation of various equipment in power system
4. Model the power system for transient analysis
5. Understand the travelling wave phenomena

Mapping with Programme Outcomes									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓		✓	✓					
CO2	✓	✓		✓					
CO3	✓	✓	✓	✓					
CO4	✓	✓		✓					
CO5	✓		✓	✓					

EPSPEXX	FACTS AND CUSTOM POWER DEVICES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn the active and reactive power flow control in power system
- To understand the need for static compensators
- To develop the different control strategies used for compensation

Reactive power flow control in Power Systems-Control of dynamic power unbalances in Power System - Power flow control-Constraints of maximum transmission line loading - Benefits of FACTS Transmission line compensation - Uncompensated line –Shunt compensation, Series compensation Phase angle control – Reactive power compensation Shunt and Series compensation principles-Reactive compensation at transmission and distribution level

Static versus passive VAR compensator-Static shunt compensators: SVC and-STATCOM - Operation and control of TSC, TCR and STATCOM -Compensator control-Comparison between SVC and STATCOM

Static series compensation: TSSC, SSSC - Static voltage and phase angle regulators-TCVR and TCPAR Operation and Control-Applications, Static series compensation-GCSC, TSSC, TCSC and Static synchronous series compensators and their Control- SSR and its damping Unified Power Flow Controller-Circuit Arrangement, Operation-and control of UPFC-Basic Principle of P and Q control-Independent real and reactive power flow control-Applications.

Introduction to interline power flow controller - Modeling and analysis of FACTS - Controllers- Simulation of FACTS controllers- Power quality problems in distribution systems - harmonics, loads that create harmonics-modeling, harmonic -propagation, series and parallel resonances mitigation of harmonics-passive filters, active filtering – shunt , series and hybrid and their control

Voltage swells, sags, flicker, unbalance and mitigation of these problems by power line conditioners-IEEE standards on power quality.

REFERENCES:

1. K R Padiyar, “FACTS Controllers in Power Transmission and Distribution”, New Age International Publishers, 2007
2. X P Zhang, C Rehtanz, B Pal, “Flexible AC Transmission Systems- Modelling and Control”, Springer Verlag, Berlin, 2006
3. N.G. Hingorani, L. Gyugyi, “Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems”, IEEE Press Book, Standard Publishers and Distributors, Delhi, 2001.
4. K.S.Sureshkumar ,S. Ashok , “FACTS Controllers & Applications”, E-book edition, Nalanda Digital Library, NIT, Calicut, 2003
5. G T Heydt, “Power Quality”, McGraw-Hill Professional, 2007
6. T J E Miller, “Static Reactive Power Compensation”, John Wiley and Sons, New York, 1982.

COURSE OUTCOMES:

Students will be able to:

1. Acquire knowledge about the fundamental principles of Passive and Active Reactive Power Compensation Schemes at Transmission and Distribution level in Power Systems.
2. Learn various Static VAR Compensation Schemes like Thyristor/GTO Controlled Reactive Power Systems, PWM Inverter based Reactive Power Systems.
3. Develop analytical modeling skills needed for modeling and analysis of such Static VAR Systems.
4. Equip with basic procedure of FACTS controller Design.
5. Gain knowledge on IEEE standards on power quality.

Mapping with Programme Outcomes									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓		✓						
CO2	✓	✓	✓	✓	✓				
CO3	✓		✓	✓	✓				✓
CO4	✓			✓					
CO5	✓		✓		✓				✓

EEPSPEXX	INDUSTRIAL LOAD MODELING AND CONTROL	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the energy demand scenario
- To understand the modeling of load and its ease to study load demand industrially
- To know Electricity pricing models
- Study Reactive power management in Industries

Electric Energy Scenario-Demand Side Management-Industrial Load Management- Load Curves-Load Shaping Objectives-Methodologies-Barriers-Classification of Industrial Loads-Continuous and Batch processes – Load Modeling

Electricity pricing – Dynamic and spot pricing-Models-Direct load control-Interruptible load control-Bottom up approach- scheduling- Formulation of load-Models Optimization and control algorithms – Case studies

Reactive power management in industries-controls-power quality impacts-application of filters - Energy saving in industries- Cooling and heating loads

Load profiling-Modeling - Cool storage-Types - Control strategies - Optimal operation - Problem formulation - Case studies

Captive power units-Operating and control strategies-Power Pooling- Operation models- Energy banking-Industrial Cogeneration - Selection of Schemes - Optimal Operating Strategies- Peak load saving - Constraints Problem formulation- Case study-Integrated Load management for Industries

REFERENCES:

1. C.O. Bjork " Industrial Load Management - Theory, Practice and Simulations", Elsevier, Netherlands,1989
2. C.W. Gellings and S.N. Talukdar,. Load management concepts. IEEE Press, New York, 1986, pp.3-28
3. Y. Manichaikul and F.C. Schweppe ,"Physically based Industrial load", IEEE Trans. on PAS, April,1981, pp.1439-1445

4. H. G. Stoll, "Least cost Electricity Utility Planning", Wiley Inter science Publication, USA, 1989.
5. I.J.Nagarath and D.P.Kothari, Power System Engineering., Tata McGraw Hill publishers, NewDelhi, 2007
6. IEEE Bronze Book- "Recommended Practice for Energy Conservation and cost effective planning in Industrial facilities", IEEE Inc, USA, 1984

COURSE OUTCOMES:

Students will be able to:

1. Know about load control techniques in industries and its application
2. Learn different types of industrial processes and optimize the process using tools like LINDO and LINGO
3. Apply load management to reduce demand of electricity during peak time
4. Apply different energy saving opportunities in industries
5. Understand the concepts through case studies

Mapping with Programme Outcomes									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓		✓			✓			
CO2	✓		✓		✓	✓			
CO3	✓		✓		✓	✓			
CO4	✓		✓		✓	✓			
CO5	✓		✓						✓

EEPSPEXX	SYSTEMS THEORY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To impart knowledge on basic design concept.
- To solve linear and non-linear state equations.
- To understand about the role of controllability and Observability.
- To educate on stability analysis.
- To learn about modal concepts.
- To get familiarised with design of state and output feedback controllers.

Basics of Design Concepts

Design specifications-sensitivity and stability- Limitations- Controller structure- one and two degrees of freedom- PID controllers and Lag-lead compensators- Root locus design, Design using bode plots and Routh- Hurwitz criterion - Design examples.

State Variable Representation

Concept of State-State equation for Dynamic Systems -Time invariance and linearity- Non uniqueness of state model-State Diagrams, Existence and uniqueness of solutions to Continuous-time state equations-Solution of Nonlinear and Linear Time Varying State equations-Role of Eigenvalues and Eigenvectors.

Controllability and Observability

Effect of sampling on controllability, Observability, State and output feedback observers, Estimated state feedback-Stabilizability and Detectability-Test for Continuous time Systems- Time varying and Time invariant case- Reducibility-System Realizations.

Stability Analysis

Introduction-Equilibrium Points-Stability in the sense of Lyapunov-BIBO Stability-Stability of LTI Systems-Equilibrium Stability of Nonlinear Continuous Time Autonomous Systems-The Direct Method of Lyapunov and the Linear/ Non-linear Continuous-Time Autonomous Systems.

Modal Control

Introduction-Controllable and Observable Companion Forms-SISO and MIMO Systems-The Effect of State Feedback on Controllability and Observability-Pole Placement by State Feedback for both SISO and MIMO Systems-Full Order and Reduced Order Observers.

REFERENCES:

1. Arthur G. O. Mutambara, "Design and Analysis of Control Systems", CRC Press, Indian reprint 2009.
2. M. Gopal, "Modern Control System Theory", New Age International, 2005.
3. Z. Bubnicki, "Modern Control Theory", Springer, 2005.
4. Graham C. Goodwin, Stefan F. Graebe and Mario E. Salgado, "Control system Design", PHI (Pearson), 2003.
5. D. Roy Choudhury, "Modern Control Systems", New Age International, 2005.

COURSE OUTCOMES:

1. Learn the basic design concepts with examples.
2. Gain an enhanced knowledge about state space analysis.
3. Attain knowledge about time varying and time invariant feedback concepts.
4. Acquire conceptual knowledge about stability analysis.
5. Familiarize about modal control concepts.

Mapping with Programme Outcomes									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓							
CO2		✓	✓	✓	✓				
CO3	✓	✓	✓						
CO4			✓	✓					✓
CO5			✓	✓					

OPEN ELECTIVES

EEPSOEXX	BUSINESS ANALYTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand the role of business analytics within anorganization.
- Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of anorganization.
- To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decisionmaking.
- To become familiar with processes needed to develop, report, and analyze business data.
- Use decision-making tools/Operations researchtechniques.
- Manage business process using analytical and managementtools.
- Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospaceetc.

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics.Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression.Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models.

Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making- Recent Trends in Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

REFERENCES:

1. Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey,Business analytics-Principles, Concepts, and Applications, Pearson FTPress, 2014
2. James Evans,Business Analytics, Pearson'sEducation, 2012

COURSE OUTCOMES:

Students will be able to

1. Demonstrate knowledge of dataanalytics.
2. Demonstrate the ability of think critically in making decisions based on data and deep analytics.
3. Demonstrate the ability to use technical skills in predicative and prescriptive modeling to support businessdecision-making.
4. Demonstrate the ability to translate data into clear, actionableinsights.

EEPSOEXX	INDUSTRIALSAFETY	L	T	P	C
		3	0	0	3

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 andmethods.

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.

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

Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, 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 combustionengine, v. Boiler,Electrical motors, Types of faults in machine tools and their generalcauses.

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, 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 andimportance

REFERENCES:

1. Higgins & Morrow, Maintenance Engineering Handbook, Da Information Services, 1987
2. H. P. Garg, Maintenance Engineering, S. Chand andCompany, 2010.
3. Audels,Pump-hydraulic Compressors, Mcgraw HillPublication, 1944.
4. Winterkorn, Fang, Foundation Engineering Handbook, Galgotia, 2010.

		L	T	P	C
EEPSOEXX	OPERATIONSRESEARCH	3	0	0	3

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

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

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

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

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

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 Optimisation: 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

COURSE OUTCOMES:

Student should be able to

1. Students should able to apply the dynamic programming to solve problems of discreet and continuousvariables.
2. Students should able to apply the concept of non-linearprogramming

3. Students should able to carry out sensitivityanalysis
4. Student should able to model the real world problem and simulateit.

EEPSOEXX	COST MANAGEMENT& ENGINEERING PROJECTS	L	T	P	C
		3	0	0	3

Introduction and Overview of the Strategic Cost Management Process- Cost concepts in decision-making; relevant cost, Differential cost, Incremental cost and Opportunity cost.Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non-technical activities.Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts.Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems.Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning

Total Quality Management and Theory of constraints.Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis.Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets.Measurement of Divisional profitability pricing decisions including transfer pricing.

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

REFERENCES:

1. Horngren, Cost Accounting: A Managerial Emphasis, Pearson, 2012
2. Charles T. Horngren and George Foster, Advanced ManagementAccounting, Pearson, 2007
3. Robert S Kaplan, Anthony A. Alkinson, Management & CostAccounting, Pearson, 2004
4. AshishK. Bhattacharya, Principles & Practices of Cost Accounting, PHI, 2004
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co.Ltd, 2009.

EEPSOEXX	COMPOSITE MATERIALS	L	T	P	C

		3	0	0	3

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

Reiforcements: preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isotactic pressing.Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

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

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

REFERENCES:

1. R.W.Cahn,Material Science and Technology – Vol 13 – Composites, VCH, West Germany, 2000.
2. WD Callister, Jr., Adapted by R. Balasubramaniam,Materials Science and Engineering, An introduction, John Wiley & Sons, NY, Indian edition, 2007.
3. Lubin,Hand Book of CompositeMaterials, Springer, 1982
4. K.K.Chawla,Composite Materials, Springer, 1987
5. Deborah D.L.Chung, Composite Materials Science and Applications, Springer, 2010
6. Danial Gay, Suong V. Hoa, and Stephen W. Tasi, Composite Materials Design and Applications CRC Press, 2002.

EEPSOEXX	WASTE TO ENERGY	L	T	P	C

		3	0	0	3

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers,digesters.

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields andapplications.

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme inIndia.

REFERENCES:

1. Desai, Ashok V., Non-Conventional Energy, Wiley Eastern Ltd.,1990.
2. Khandelwal, K. C. and Mahdi, S. S., Biogas Technology - A Practical Hand Book - Vol. I & II, Tata McGraw Hill Publishing Co. Ltd.,1983.
3. Challal, D. S., Food, Feed and Fuel from Biomass, IBH Publishing Co. Pvt. Ltd.,1991.
4. C. Y. Were Ko-Brobby and E. B. Hagan, Biomass Conversion and Technology, John Wiley & Sons,1996

AUDIT COURSES

EEPSACXX	ENGLISH FOR RESEARCH PAPER WRITING	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES:

Students will be able to:

- Understand that how to improve your writing skills and level ofreadability
- Learn about what to write in eachsection
- Understand the skills needed when writing a Title Ensure the good quality of paperat very first-time submissionsyllabus.

Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction.

Review of the Literature, Methods, Results, Discussion, Conclusions, the Final Check.

Key skills that are needed when writing a Title, key skills are needed when writing an Abstract, key skills that are needed when writing an Introduction, skills needed when writing a Review of the Literature,

Skills that are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills that are needed when writing the conclusion.

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

REFERENCES:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on GoogleBooks) Model Curriculum of Engineering & Technology PG Courses [Volume-I] [41]
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's book.
4. Adrian Wall work , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

EEPSACXX	DISASTER MANAGEMENT	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES:

Students will be able to:

- Learn to demonstrate a critical understanding of key concepts in disaster riskreduction and humanitarianresponse.
- Critically evaluate disaster risk reduction and humanitarian response policy and practice from multipleperspectives.
- Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflictsituations.
- Critically understand the strengths and weaknesses of disaster managementapproaches, planning andprogramming.

Introduction Disaster

Definition, Factors and Significance; Difference between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.

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.

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

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.

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.

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.

REFERENCES:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies" New Royal bookCompany.
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., NewDelhi.

		L	T	P	C
EEPSACXX	SANSKRIT FOR TECHNICAL KNOWLEDGE	2	0	0	0

COURSE OBJECTIVES:

- To get a working knowledge in illustrious Sanskrit, the scientific language in theworld
- Learning of Sanskrit to improve brainfunctioning
- Learning of Sanskrit to develop the logic in mathematics, science &othersubjects
- Enhancing the memorypower
- The engineering Scholars equipped with the Sanskrit will be able to explode thehuge knowledge from ancientliterature.

Alphabets in Sanskrit, past/ present/ future tense, simple sentences.Order, Introduction of roots technical information about Sanskritliterature. Technical concepts of Engineering – electrical, mechanical, architecture, mathematics

REFERENCES :

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, NewDelhi
2. "Teach Yourself Sanskrit" PrathamaDeeksha -VempatiKutumbshastri, RashtriyaSanskritSansthanam, New DelhiPublication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., NewDelhi.

COURSEOUTCOMES:

Students will be ableto

1. Understanding basic Sanskritlanguage
2. Ancient Sanskrit literature about science & technology can beunderstood.
3. Being a global language, will help to develop logic instudents.

EEPSACXX	VALUE EDUCATION	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES:

- Understand value of education and self-development
- Imbibe good values instudents
- Let the should know about the importance ofcharacter

Values and self-development –Social values and individual attitude and work ethics, Indian vision of humanism.Moral and non- moral valuation.Standards and principles.Valuejudgements.

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.

Personality and Behavior Development - Soul and Scientific attitude.PositiveThinking.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 savingnature.

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

REFERENCES:

1. Chakroborty, S.K. "Values and Ethics for organizations Theory and practice",Oxford University Press, NewDelhi.

COURSE OUTCOMES

Students will be able to

1. Knowledge ofself-development.
2. Learn the importance of Humanvalues
3. Developing the overallpersonality

EEPSACXX	CONSTITUTION OF INDIA	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES:

- Understand the premises informing the twin themes of liberty and freedom from acivilrightsperspective.
- 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 Indiannationalism.
- Address the role of socialism in India after the commencement of theBolshevik revolution in 1917 and its impact on the initial drafting of the IndianConstitution.

History of Making of the Indian Constitution:

History, Drafting Committee, (Composition & Working)

Philosophy of the Indian Constitution

Preamble, Salient Features

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.

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.

Local Administration

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO 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.

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.

REFERENCES:

1. The Constitution of India, 1950 (Bare Act), GovernmentPublication.
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 inIndia.
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 ofdirect.
4. Elections through adult suffrage in the Indian Constitution.
5. Discuss the passage of the Hindu Code Bill of1956.

EEPSACXX	PEDAGOGY STUDIES	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES:

- Review existing evidence on the review topic to inform programme design andpolicy making undertaken by the DFID, other agencies andresearchers.
- Identify critical evidence gaps to guide thedevelopment.

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.

Thematic overview

Pedagogical practices are being used by teachers, in formal and informal classrooms in developing countries. Curriculum, Teacher education.

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.eachers' attitudes and beliefs and Pedagogic strategies.

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 classsizes.

Research gaps and future directions

Research design, Contexts, Pedagogy Teacher education, Curriculum and assessment, Dissemination and research impact.

REFERENCES:

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 developingcountries.
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population oflearners.
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effectivepedagogy.

EEPSACXX	STRESS MANAGEMENT BY YOGA	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES:

- To achieve overall health of body andmind
- To overcomestress

Definitions of Eight parts of yoga.(Ashtanga) Yam and Niyam

1. Do`s and Don't's in life.
   i) Ahinsa, satya, astheya, bramhacharyaandaparigraha
   ii) Shaucha, santosh, tapa, swadhyay,ishwarpranidhan
2. Asan and Pranayam
   i) Various yoga poses and their benefits for mind & body
   ii) Regularization of breathing techniques and its effects-Types ofpranayam

REFERENCES:

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

COURSE OUTCOMES:

Students will be able to:

1. Develop healthy mind in a healthy body thus improving social healthalso
2. Improveefficiency

EEPSACXX	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES:

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality anddetermination
- To awaken wisdom in students

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)

Approach to day to day work andduties ShrimadBhagwadGeeta :

- 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.

Statements of basic knowledge.ShrimadBhagwadGeeta:

- Chapter2-Verses 56, 62,68
- Chapter 12 -Verses 13, 14, 15, 16,17, 18

Personality of Role model.ShrimadBhagwadGeeta:

- Chapter2-Verses 17, Chapter 3-Verses36,37,42,
- Chapter 4-Verses 18,38,39
- Chapter18 – Verses37,38,63

REFERENCES:

1. "Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram(Publication Department),Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) byP.Gopinath,
3. Rashtriya Sanskrit Sansthanam, NewDelhi.

COURSE OUTCOMES:

Students will be able to:

1. Study of Shrimad - Bhagwad- Geeta will help the student in developing his personalityandachieve the highest goal inlife
2. The person who has studied Geeta will lead the nation and mankind to peace andprosperity
3. Study of Neetishatakam will help in developing versatile personality of students