GOVERNMENT COLLEGE OF TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University)
Coimbatore – 641 013

Curriculum and Syllabi For
M.E. (POWER SYSTEMS ENGINEERING)
(Full Time)

2018

Regulations

OFFICE OF THE CONTROLLER OF EXAMINATIONS
GOVERNMENT COLLEGE OF TECHNOLOGY
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GOVERNMENT COLLEGE OF TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University, Chennai)

Coimbatore – 641 013.

VISION AND MISSION OF THE INSTITUTION

VISION

To emerge as a centre of excellence and eminence by imparting futuristic technical education in keeping with global standards, making our students technologically competent and ethically strong so that they can readily contribute to the rapid advancement of society and mankind.

MISSION

- To achieve academic excellence through innovative teaching and learning practices
- To enhance employability and entrepreneurship
- To improve the research competence to address societal needs
- To inculcate a culture that supports and reinforces ethical and professional behaviours for a harmonious and prosperous society

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

GOVERNMENT COLLEGE OF TECHNOLOGY

VISION AND MISSION OF THE DEPARTMENT

VISION:

To be a premier department providing value based and enlightening education committed to excellence in Electrical Engineering and Technology professions

MISSION:

- To facilitate quality learning blended with practical engineering skills.
- To prepare students to develop all round competitiveness.
- To motivate Faculty and students to do impactful research on societal needs.

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

GOVERNMENT COLLEGE OF TECHNOLOGY

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

The Programme Educational Objectives (PEOs) of the post graduate program in tune with the Vision and Mission of the department are:

PEO1:

To enable the graduates to apply the principles of power system operation, control and automation to solve electrical power utility problems

PEO2:

To undertake innovative research in the emerging areas of electric power systems

PEO3:

To inculcate leadership skills and effective communication and ability to work in collaborative, multidisciplinary tasks in their profession

PEO4:

To become socially, ethically responsible and demonstrate life-long independent reflective learning skills in their career

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

GOVERNMENT COLLEGE OF TECHNOLOGY

PROGRAMME OUTCOMES (POs)

Students in the Power Systems Engineering Programmeat the time of their graduation should be in possession of the following:

PO1: An ability to independently carry out research /investigation and development work to solve practical problems

PO2: An ability to write and present a substantial technical report/document

PO3: Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program

PO4: Ability to attain professional ethics and intellectual integrity to contribute to the community for sustainable development of society

CURRICULUM FOR CANDIDATES ADMITTED DURING 2018-2019 AND ONWARDS

TWO YEAR M.E PROGRAMME

POWER SYSTEMS ENGINEERING

CHOICE BASED CREDIT SYSTEM-CURRICULUM

FIRST SEMESTER

S. No	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Contact Periods	L	T	P	C
THEORY											
1	18PSFCZ1	Research Methodology And IPR	FC	50	50	100	3	3	0	0	3
2	18PSFC02	Optimization Techniques	FC	50	50	100	5	3	1	0	4
3	18PSPC01	System Theory	PC	50	50	100	3	3	0	0	3
4	18PSPC02	Digital Power System Protection	PC	50	50	100	3	3	0	0	3
5	18PSPC03	Computer Aided Power System Analysis	PC	50	50	100	3	3	0	0	3
6	18PSPC04	Power System Operation And Control	PC	50	50	100	3	3	0	0	3
7	18PSACXX	Audit Course I	AC	50	50	100	2	2*	0	0	0
PRACTICALS											
8	18PSPC05	Power System Simulation Laboratory	PC	50	50	100	3	0	0	3	1.5
TOTAL				400	400	800	25	20	1	3	20.5

SECOND SEMESTER

S. No	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Contact Periods	L	T	P	C
THEORY											
1	18PSPC06	Smart Grid Technology And Applications	PC	50	50	100	3	3	0	0	3
2	18PSPC07	Power System Dynamics And Control	PC	50	50	100	3	3	0	0	3
3	18PSPC08	Restructured Power System And Deregulation	PC	50	50	100	3	3	0	0	3
4	18PSPEXX	Professional Elective I	PE	50	50	100	3	3	0	0	3
5	18PSPEXX	Professional Elective II	PE	50	50	100	3	3	0	0	3
6	18PSACXX	Audit Course II	AC	50	50	100	2	2*	0	0	0
PRACTICALS											
7	18PSPC09	Advanced Power System Simulation Laboratory	PC	50	50	100	3	0	0	3	1.5
8	18PSEE01	Mini Project with Seminar	EEC	100	-	100	4	0	0	4	2
TOTAL				450	350	800	24	17	0	7	18.5

THIRD SEMESTER

S. No	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Contact Periods	L	T	P	C
THEORY											
1	18PSPEXX	Professional Elective III	PE	50	50	100	3	3	0	0	3
2	18PSPEXX	Professional Elective IV	PE	50	50	100	3	3	0	0	3
3	18$OEXX	Open Elective	OE	50	50	100	3	3	0	0	3
PRACTICALS											
4	18PSEE02	Project Phase I	EEC	100	100	200	20	0	0	20	10
TOTAL				250	250	500	29	9	0	20	19

FOURTH SEMESTER

S. No	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Contact Periods	L	T	P	C
1	18PSEE03	Project Phase II	EEC	200	200	400	32	0	0	32	16
TOTAL				200	200	400	32	0	0	32	16

TOTAL CREDITS: 74

NOTE : * - NO CREDIT COURSES

LIST OF PROFESSIONAL ELECTIVE SUBJECTS

S. No	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Contact Periods	L	T	P	C
PROFESSIONAL ELECTIVE I											
1	18PSPE01	Power System Transients and Surge Protection	PE	50	50	100	3	3	0	0	3
2	18PSPE02	Power System Economics	PE	50	50	100	3	3	0	0	3
3	18PSPE03	Power System Planning and Reliability	PE	50	50	100	3	3	0	0	3
4	18PSPE04	Power System Security	PE	50	50	100	3	3	0	0	3
PROFESSIONAL ELECTIVE II											
5	18PSPE05	High Voltage DC Transmission Systems	PE	50	50	100	3	3	0	0	3
6	18PSPE06	Flexible AC Transmission Systems	PE	50	50	100	3	3	0	0	3
7	18PSPE07	Fem Modeling of High Voltage Apparatus and Systems	PE	50	50	100	3	3	0	0	3
8	18PSPE08	EHVAC Transmission Systems	PE	50	50	100	3	3	0	0	3
9	18PSPE09	High Voltage and Insulation Systems	PE	50	50	100	3	3	0	0	3
PROFESSIONAL ELECTIVE III											
10	18PSPE10	Power Electronic Applications to Power System	PE	50	50	100	3	3	0	0	3
11	18PSPE11	Advanced Electric Drives and Controls	PE	50	50	100	3	3	0	0	3
12	18PSPE12	Power Electronics for Renewable Energy	PE	50	50	100	3	3	0	0	3
13	18PSPE13	Distributed Generations and Microgrid	PE	50	50	100	3	3	0	0	3
14	18PSPE14	Insulation Materials and Testing for Industrial Applications	PE	50	50	100	3	3	0	0	3
PROFESSIONAL ELECTIVE IV											
15	18PSPE15	Electromagnetic Interference and Compatibility in System Design	PE	50	50	100	3	3	0	0	3
16	18PSPE16	Fuzzy and Neural Systems	PE	50	50	100	3	3	0	0	3
17	18PSPE17	Intelligent Systems Application to Power Systems	PE	50	50	100	3	3	0	0	3
18	18PSPE18	Computer Relaying and Wide Area Measurement System	PE	50	50	100	3	3	0	0	3
19	18PSPE19	Modern Power Electronics for Traction Applications	PE	50	50	100	3	3	0	0	3
TOTAL CREDITS: 12											

LIST OF OPEN ELECTIVES

SL.No	Course code	Course name	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Contacts Periods	CREDITS			
								L	T	P	C
1	18SEOE01	Vastu Science for Building Construction	OE	50	50	100	3	3	0	0	3
2	18SEOE02	Planning of Smart Cities	OE	50	50	100	3	3	0	0	3
3	18SEOE03	Green Building	OE	50	50	100	3	3	0	0	3
4	18EEOE04	Environment, Health and Safety in Industries	OE	50	50	100	3	3	0	0	3
5	18EEOE05	Climate Change and Adaptation	OE	50	50	100	3	3	0	0	3
6	18EEOE06	Waste to Energy	OE	50	50	100	3	3	0	0	3
7	18GEOE07	Energy in built Environment	OE	50	50	100	3	3	0	0	3
8	18GEOE08	Earth and its Environment	OE	50	50	100	3	3	0	0	3
9	18GEOE09	Natural Hazards and Mitigation	OE	50	50	100	3	3	0	0	3
10	18EDOE10	Business Analytics	OE	50	50	100	3	3	0	0	3
11	18EDOE11	Cost Management of Engineering Projects	OE	50	50	100	3	3	0	0	3
12	18EDOE12	Introduction to Industrial Engineering	OE	50	50	100	3	3	0	0	3
13	18MFOE13	Industrial Safety	OE	50	50	100	3	3	0	0	3
14	18MFOE14	Operations Research	OE	50	50	100	3	3	0	0	3
15	18MFOE15	Composite Materials	OE	50	50	100	3	3	0	0	3
16	18TEOE16	Global Warming Science	OE	50	50	100	3	3	0	0	3
17	18TEOE17	Introduction to Nano Electronics	OE	50	50	100	3	3	0	0	3

SL.No	Course code	Course name	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Contacts Periods	CREDITS			
								L	T	P	C
18	18TEOE18	Green Supply Chain Management	OE	50	50	100	3	3	0	0	3
19	18PSOE19	Distribution Automation System	OE	50	50	100	3	3	0	0	3
20	18PSOE20	Power Quality Assessment And Mitigation	OE	50	50	100	3	3	0	0	3
21	18PSOE21	Modern Automotive Systems	OE	50	50	100	3	3	0	0	3
22	18PEOE22	Virtual Instrumentation	OE	50	50	100	3	3	0	0	3
23	18PEOE23	Energy Auditing	OE	50	50	100	3	3	0	0	3
24	18PEOE24	Advanced Energy Storage Technology	OE	50	50	100	3	3	0	0	3
25	18AEOE25	Design of Digital Systems	OE	50	50	100	3	3	0	0	3
26	18AEOE26	Advanced Processors	OE	50	50	100	3	3	0	0	3
27	18AEOE27	Pattern Recognition	OE	50	50	100	3	3	0	0	3
28	18VLOE28	VLSI Design	OE	50	50	100	3	3	0	0	3
29	18VLOE29	Analog & Mixed Mode VLSI Circuits	OE	50	50	100	3	3	0	0	3
30	18VLOE30	Hardware Description Languages	OE	50	50	100	3	3	0	0	3
31	18CSOE31	Artificial Intelligence and Machine Learning	OE	50	50	100	3	3	0	0	3
32	18CSOE32	Computer Network Engineering	OE	50	50	100	3	3	0	0	3
33	18CSOE33	Big Data Analytics	OE	50	50	100	3	3	0	0	3

LIST OF AUDIT COURSES

S. No	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Contact Periods	L	T	P	C
1	18PSACZ1	English for Research Paper Writing	AC	50	50	100	2	2	0	0	0
2	18PSACZ2	Disaster Management	AC	50	50	100	2	2	0	0	0
3	18PSACZ3	Value Education	AC	50	50	100	2	2	0	0	0
4	18PSACZ4	Constitution of India	AC	50	50	100	2	2	0	0	0
5	18PSACZ5	Pedagogy Studies	AC	50	50	100	2	2	0	0	0
6	18PSACZ6	Stress Management by Yoga	AC	50	50	100	2	2	0	0	0
7	18PSACZ7	Personality Development Through Life Enlightenment Skills	AC	50	50	100	2	2	0	0	0
8	18PSACZ8	Sanskrit For Technical Knowledge	AC	50	50	100	2	2	0	0	0

CURRICULUM DESIGN

S.No	Course Work Subject Area	No of Credits					Percentage
		I	II	III	IV	Total	
1.	Foundation Course	7	0	0	0	07	9.46 %
2.	Professional Cores	13.5	10.5	0	0	24	32.43 %
3.	Professional Electives	0	6	6	0	12	16.22 %
4.	Employability Enhancement Courses	0	2	10	16	28	37.84 %
5.	Open Elective Courses	0	0	3	0	03	4.05 %
Total Credits		**20.5**	**18.5**	**19**	**16**	**74**	**100%**

18PSFCZ1RESEARCH METHODOLOGY AND IPR
(Common to All Branches)
Category : FC

L	T	P	C
3	0	0	3

PREREQUISITES: Nil

COURSE OBJECTIVES:
Upon completion of this course, the students will be familiar with:

- Definition and objectives of Research
- Quantitative methods for problem solving
- Data description and report writing

UNIT IINTRODUCTION L(9)

Definition and objectives of Research – Types of research, Various Steps in Research process, Mathematical tools for analysis, Developing a research question-Choice of a problem Literature review, Surveying, synthesizing, critical analysis, reading materials, reviewing, rethinking, critical evaluation, interpretation, Research Purposes, Ethics in research – APA Ethics code

UNIT II QUANTITATIVE METHODS FOR PROBLEM SOLVING L(9)

Statistical Modeling and Analysis, Time Series Analysis Probability Distributions, Fundamentals of Statistical Analysis and Inference, Multivariate methods, Concepts of Correlation and Regression, Fundamentals of Time Series Analysis and Spectral Analysis, Error Analysis, Applications of Spectral Analysis.

UNIT III DATA DESCRIPTION AND REPORT WRITING L(9)

Tabular and graphical description of data: Tables and graphs of frequency data of one variable, Tables and graphs that show the relationship between two variables , Relation between frequency distributions and other graphs, preparing data for analysis
Structure and Components of Research Report, Types of Report, Layout of Research Report, Mechanism of writing a research report, referencing in academic writing.

UNIT IV INTELLECTUAL PROPERTY L(9)

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

UNIT V PATENT RIGHTS L(9)

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

CONTACT PERIODS:
Lecture: 45 PeriodsTutorial: 0 Periods Practical: 0 PeriodsTotal: 45 Periods

REFERENCE BOOKS:

1. Stuart Melville and Wayne Goddard, "**Research methodology: an introduction for science & engineering students**", Juta Academic, 1996.
2. Donald H.McBurney and Theresa White, "**Research Methods**", 9th Edition, CengageLearning, 2013.
3. RanjitKumar, "**Research Methodology: A Step by Step Guide for Beginners**", 4th Edition, 2014.
4. Dr. C. R. Kotharia and GauravGarg, "**Research Methodology: Methods and Trends**", New age international publishers, Third Edition, 2014.

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

CO1: Develop research question**[Usage]**
CO2: Perform exhaustive literature survey**[Usage]**
CO3: Apply right problem solving methods**[Usage]**
CO4: Prepare data for analysis**[Usage]**
CO5: Write research report**[Usage]**

COURSE ARTICULATION MATRIX

CO/PO	PO1	PO2	PO3	PO4
CO1	-	H	-	L
CO2	-	H	-	-
CO3	-	H	-	L
CO4	-	H	-	-
CO5	-	H	-	H
18PSFCZ1	-	H	-	L

1-Low(L); 2-Medium(M); 3-High(H)

18PSFC02 **OPTIMIZATION TECHNIQUES** **Category: FC**

L	T	P	C
3	1	0	4

PREREQUISITES: NIL

COURSE OBJECTIVES:

To learn the concepts and techniques of optimization and hence to improve management skills.

UNIT-I LINEAR PROGRAMMING (09+03)

Introduction – formulation of linear programming model-Graphical solution–solving LPP using simplex algorithm – Revised Simplex Method.

UNIT-II ADVANCES IN LPP (09+03)

Dualit theory- Dual simplex method – Sensitivity analysis–-Transportation problems–Assignment problems-Traveling sales man problem -Data Envelopment Analysis.

UNIT-III NON LINEAR PROGRAMMING (09+03)

Classification of Non Linear programming – Lagrange multiplier method – Karush – Kuhn Tucker conditions–Reduced gradient algorithms–Quadratic programming method – Penalty and Barrier method.

UNIT-IV INTERIOR POINT METHODS (09+03)

Karmarkar's algorithm–Projection Scaling method–Dual affine algorithm–Primal affine algorithm Barrier algorithm.

UNIT-V DYNAMIC PROGRAMMING (09+03)

Formulation of Multi stage decision problem–Characteristics–Concept of sub-optimization and the principle of optimality–Formulation of Dynamic programming–Backward and Forward recursion– Computational procedure–Conversion offinal value problem in to Initial value problem.

CONTACT PERIODS:
Lecture: 45 PeriodsTutorial: 15Periods Practical: 0 Periods Total: 60 Periods

REFERENCES BOOKS:

1. *Hillier and Lieberman "**Introduction to Operations Research**", TMH, 2000.*
2. *R.Panneerselvam, "**Operations Research**", PHI, 2006*
3. *Hamdy ATaha, "**Operations Research –An Introduction**", Prentice Hall India, 2003.*
4. *Philips, Ravindran and Solberg, "**Operations Research**", John Wiley, 2002.*
5. *Ronald L.Rardin, "**Optimization in Operation Research**" Pearson Education Pvt. Ltd. New Delhi, 2005.*

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

CO1: Apply the basic concepts of optimization techniques.
CO2: Illustrate the basics and advancements inLinear programming techniques
CO3 Understand the significance of non-linear programming techniques
CO4: Know the interior point methods of solving problems
CO5: Study the formation of dynamic programming problems and solution methods

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4
CO1	H	-	H	-
CO2	H	-	H	-
CO3	H	-	H	-
CO4	H	-	H	-
CO5	H	-	H	-
18PSFC02	H	-	H	-

1-Low(L); 2-Medium(M); 3-High(H)

18PSPC01 **SYSTEM THEORY** **Category: PC**

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

To study the various advanced computational techniques in the design of linear and non-linear Control systems

UNIT-I STATE VARIABLE REPRESENTATION (09)

Concepts of state, state variables and state model - State model for linear time invariant systems – State space representation using physical, phase and canonical variables – Transfer function from state model – Direct, cascade and parallel decomposition – Solution of state equation – State transition matrix.

UNIT-II SYSTEM MODELS (09)

Characteristic equation – Eigen values and eigen vectors – Invariance of eigen values – Diagonalization – Jordan canonical form – Concept of controllability and observability – Kalman's and Gilbert's tests – Controllable and Observable Phase Variable forms for SISO and MIMO systems – Effect of pole-zero cancellation on controllability and observability – Pole placement by state feedback – Full order and reduced order observers.

UNIT-III NONLINEAR SYSTEMS (09)

Types of nonlinearity – Phase plane analysis – Singular points – Limit cycles – Construction of phase trajectories – Describing function method – Derivation of describing functions.

UNIT-IV STABILITY ANALYSIS (09)

Introduction-Equilibrium Points - Stability in the sense of Lyapunov - BIBO Stability - Stability of LTI Systems - Equilibrium Stability of Nonlinear Continuous Time Autonomous Systems - Direct Method of Lyapunov - Linear Continuous Time Autonomous Systems - Finding Lyapunov Functions for Nonlinear Continuous Time Autonomous Systems - Krasovskii and Variable - Gradient Method.

UNIT-V ADVANCED CONTROL SYSTEMS (09)

Adaptive Control: Model – Reference Adaptive Control - Fundamental concepts – Self tuning Control – Robust Control - Parameter perturbations – Design of robust control system – PID controllers – Fuzzy Logic Control – Neutral Network Controller – Genetic Algorithm

CONTACT PERIODS:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

REFERENCES BOOKS:

1. *Katushiko Ogata, "**Modern Control Engineering**", Pearson Hall of India Private Ltd, New Delhi, 5th Edition, 2014*
2. *Gopal.M, "**Modern Control System Theory**", New Age International, 2nd Edition 2006.*
3. *Roy Choudhury.D, "**Modern Control Systems**", New Age International, 2005.*
4. *John J. D'Azzo, Houpis.C.H and Sheldon.S.N, "**Linear Control System Analysis and Design with MATLAB**", Taylor Francis, 2003.*
5. *Bubnicki.Z, "**Modern Control Theory**", Springer, 2010.*

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

CO1: Apply the concept of state and characteristic equations for SISO and MIMO systems.

CO2: Analyse advanced control techniques for various linear and nonlinear systems.

CO3: Synthesis open/closed control system of linear and nonlinear system

CO4: Evaluate the stability of linear and nonlinear systems.

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4
CO1	H	-	H	-
CO2	H	-	H	-
CO3	H	-	H	-
CO4	H	-	H	-
18PSPC01	H	-	H	-

1-Low(L); 2-Medium(M); 3-High(H)

18PSPC02 DIGITAL POWER SYSTEM PROTECTION Category: PC

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

To facilitate the students in understanding the basic concepts and recent trends in power system protection and enable the students to design and work with the concepts of digital and numerical relaying

UNIT-I NUMERICAL PROTECTION (09)

Introduction - Block diagram of numerical relay - Sampling theorem - Correlation with a reference wave - Least Error Squared (LES) technique - Digital filtering and numerical over- Current protection.

UNIT-II DIGITAL PROTECTION OF TRANSMISSION LINE (09)

Introduction - Protection scheme of transmission line – Distance relays - Traveling wave relays - Digital protection scheme based upon fundamental signal - Hardware design - Software design - Digital protection of EHV/UHV transmission line based upon traveling wave phenomenon - New relaying scheme using amplitude comparison.

UNIT-III DIGITAL PROTECTION OF SYNCHRONOUS GENERATOR & TRANSFORMER (09)

Introduction - Faults in synchronous generator - Protection schemes for Synchronous Generator - Digital protection of Synchronous Generator - Faults in a Transformer - Schemes used for Transformer Protection - Digital Protection of Transformer.

UNIT-IV DISTANCE AND OVERCURRENT RELAY AND CO-ORDINATION (09)

Directional instantaneous IDMT over current relay - Directional multi-Zone distance relay - Distance relay setting - Co-ordination of distance relays - Co-ordination of over current relays - Computer graphics display - Man-machine interface subsystem - Integrated operation of national power system - Application of computer graphics.

UNIT-V PC APPLICATIONS FOR DESIGNING PROTECTIVE RELAYING SCHEME (09)

Types of faults – Assumptions - Development of algorithm for SC studies - PC based integrated software for SC studies - Transformation to component quantities - SC studies of multiphase systems - Ultra high speed protective relays for high voltage long transmission line.

CONTACT PERIODS:

Lecture: 45 PeriodsTutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES BOOKS:

1. L. P. Singh, ***"Digital Protection - Protective Relaying from Electromechanical to Microprocessor"****, New Age International Ltd., New Delhi, 2004.*

2. Paithankar and Bhide, ***"Fundamentals of Power System Protection"****, Prentice Hall of India Pvt. Ltd., New Delhi, second edition, 2010.*

3. Paithankar , ***"Transmission Network Protection"****, Marcel & Dekker, New York, 1998.*

4. Stanley Horowitz, ***"Protective Relaying for Power System II"****, John Wiley & Sons, 2008.*

5. Rao T.S.M., ***"Digital Relay / Numerical relays"****, Tata McGraw Hill, New Delhi, 2005.*

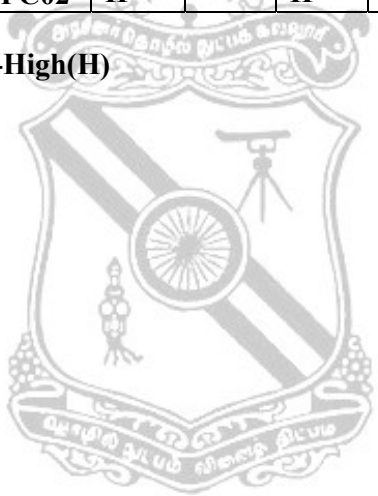
COURSE OUTCOMES:

Upon completion of this course, the students will be able to:
CO1: Understand the underlying principle of digital techniques for power system protection
CO2: Design the relaying scheme for protection of power apparatus using digital techniques
CO3: Evaluate and interpret relay coordination
CO4: Develop PC based algorithm for short circuit studies

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4
CO1	H	-	H	-
CO2	H	-	H	-
CO3	H	-	H	-
CO4	H	-	H	-
18PSPC02	H	-	H	-

1-Low(L); 2-Medium(M); 3-High(H)



18PSPC03 COMPUTER AIDED POWER SYSTEM ANALYSISCategory:PC

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

To perform steady state and transient analyses of power system networks and also to explore the nuancesof estimation of different states of power system

UNIT-I GENERAL INTRODUCTION (09)

Modern Power Systems Operation and Control - Different types of power system analysis – Sparsity - directed Optimal Ordering Schemes - Solution Algorithms - LU Factorization - Bifactoriation and Iterative Methods.

UNIT-II AC AND DC POWER FLOW ANALYSIS (09)

Introduction - Modeling of Power System Components - Power Flow Equations - Formation of Y-Bus Matrix - Power Flow Solution Algorithms - Newton Raphson Load Flow Method - Fast Decoupled Load Flow Method and DC Load Flow Method - AC-DC System Power Flow Analysis - Incorporating Load Models and FACTS devices in Power Flow Algorithm - Incorporating HVDC converter control in power flow - Sequential and Simultaneous Solution Algorithms.

UNIT-III ANALYSIS OF POWER SYSTEM UNDER FAULTED (09)

Introduction to fault analysis and types of faults in power systems - Symmetrical Components - Sequence Networks - Analysis of symmetrical and asymmetrical faults using sequence networks - Bus Impedance Matrix formulation - Short Circuit Analysis of Large Power Systems using Z-bus - Analysis of Open Circuit faults.

UNIT-IV SECURITY ANALYSIS (09)

Basic Concepts - Static Security Analysis at Control Centers - Contingency Analysis - Contingency Selection.

UNIT-V STABILITYANALYSIS (09)

Classification of Power System Stability - Classical Model of Synchronous Machines and Excitation System - Transient Stability Analysis of Multi-Machine Systems - Eigen Analysis of Dynamical Systems - Small Signal Stability Analysis using Classical Model - Basic Concepts of Voltage Stability Analysis.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES BOOKS:

*1. Elgerd O.I., "**Electric Energy Systems Theory - An Introduction**", Second Edition, Tata McGraw-Hill, 2007.*

*2. Bergen A.R. and Vijay Vittal,"**Power Systems Analysis**", Pearson Education Asia, III edition, 2009.*

*3. Grainger J.J. and Stevenson W.D., "**Power System Analysis**", McGraw-Hill, New York, 1994.*

*4. Nagrath I.J. and Kothari D.P., "**Power System Engineering**", Tata McGraw-Hill Publishing Co., Second Edition, 2008.*

*5.Glover J.D., Sarma M. and Overbye T.J., "**Power System Analysis and Design**", Fifth Edition CL Engineering Press, 2012.*

*6. Kundur P., "**Power System Stability and Control**", McGraw Hill, 5th reprint, 2008.*

COURSEOUTCOMES:

Upon completion of this course, the students will be able to:

CO1: Apply various numerical techniques, the role of sparsity and optimal ordering for performing various power system analyses.

CO2: Analyse faulted power system for various types of faults and perform security andstability analysis.

CO3: Synthesis modern power system with recent technologies

CO4: Evaluate the given power system about its operation using various analyses studied.

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4
CO1	H	-	H	-
CO2	H	-	H	-
CO3	H	-	H	-
CO4	H	-	H	-
18PSPC03	H	-	H	-

1-Low(L); 2-Medium(M); 3-High(H)

18PSPC04 POWER SYSTEM OPERATION AND CONTROL

Category:PC

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

To familiarize students with various operation and control techniques as applied to power system for the normal operating condition

UNIT-I REACTIVE POWER AND VOLTAGE CONTROL (09)

Production and absorption of reactive power- Methods of Voltage Control – Shunt reactors – Shunt Capacitors – Series Capacitors – Synchronous condensers – Static VAR systems – Principles of Transmission system compensation – Modeling of reactive compensating devices – Application of tap changing transformers to transmission systems – Distribution system voltage regulation - Modeling of transformer ULTC control systems.

UNIT-IV UNIT COMMITMENT (09)

Constraints in unit commitment – Spinning reserve – Thermal unit constraints – Other constraints – Solution using Priority List method, Dynamic programming method - Forward DP approach, Lagrangian relaxation method.

UNIT-III GENERATION SCHEDULING (09)

The Economic dispatch problem – Thermal system dispatching with network losses considered – The Lambda – iteration method – Gradient method of economic dispatch – Economic dispatch with Piecewise Linear cost functions – Transmission system effects – A two generator system – coordination equations – Incremental losses and penalty factors - Hydro Thermal Scheduling using DP.

UNIT-IV CONTROL OF POWER SYSTEMS (09)

Review of AGC and reactive power control -System operating states by security control functions – Monitoring, evaluation of system state by contingency analysis – Corrective controls (Preventive, emergency and restorative) - Energy control center – SCADA system – Functions – monitoring , Data acquisition and controls – EMS system.

UNIT-V STATE ESTIMATION (09)

Maximum likelihood Weighted Least Squares Estimation: Concepts - Matrix formulation - Example for Weighted Least Squares state estimation ; State estimation of an AC network: Typical results of state estimation on an AC network – State Estimation by Orthogonal Decomposition algorithm – Introduction to Advanced topics : Detection and Identification of Bad Measurements , Estimation of Quantities not being measured, Network Observability and Pseudo measurements – Application of Power Systems State Estimation .

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES BOOKS:

*1. Elgerd O.I, "**Electric Energy System Theory - An Introduction**", - Tata McGraw Hill, New Delhi 2002.*

*2. KundurP ; "**Power System Stability and Control**", Tata McGraw Hill, 5th reprint, 2008.*

*3. Allen J.Wood and Bruce.F.Wollenberg, "**Power Generation Operation and Control**", John Wiley & Sons New York, 2013.*

*4. Mahalanabis A.K, Kothari D.P. and Ahson S.I., "**Computer Aided Power System Analysis and Control**", Tata McGraw Hill publishing Ltd , 1988.*

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

CO1: Revise the knowledge about principles of various operation & control techniques.

CO2: Analyse the performance of the power system for different operation & control techniques.

CO3: Synthesis the power system under different operation & control issues

CO4: Evaluate the power system for different operation & control techniques.

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4
CO1	H	-	H	-
CO2	H	-	H	-
CO3	H	-	H	-
CO4	H	-	H	-
18PSPC04	H	-	H	-

1-Low(L); 2-Medium(M); 3-High(H)

18PSPC05 POWER SYSTEM SIMULATION LABORATORY Category: PC

L T P C

PREREQUISITES: NIL **0 0 31.5**

COURSE OBJECTIVES:

To analyze the performance of power system under normal and abnormal conditions using simulation software

LIST OF EXPERIMENTS:

1. Formulation of Y_{BUS} and Z_{BUS} of power network
2. Power flow analysis by Gauss Seidel/Newton-Raphson/ Fast decoupled method
3. Transient stability analysis of single machine-infinite bus system using classical machine model
4. Optimal load dispatch using lambda-iteration method
5. Unit commitment: Priority-list schemes and dynamic programming
6. Contingency analysis: Generator shift factors and line outage distribution factors
7. Load flow analysis of two-bus system with STATCOM
8. Available Transfer Capability calculation using an existing load flow program
9. Computation of harmonic indices generated by a rectifier feeding R-L load
10. Study of protective relaying schemes of Power Apparatus
11. Demand Side Management in Smart Power Grid
12. Determination of Sequence Impedances of Power Network

CONTACT PERIODS:

Lecture: 0Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

CO1: Acquire expertise in usage of simulation software as applied to power system

CO2: Apply tools to simulate the mathematical model of power network for power system analysis

CO3: Analyze the power system through various numerical methods under normal and abnormal conditions

CO4: Suggest methods for economic operation of power system for improved resource utilization

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4
CO1	H	M	H	-
CO2	H	-	H	-
CO3	H	-	H	-
CO4	H	-	H	H
18PSPC05	H	L	H	L

1-Low(L); 2-Medium(M); 3-High(H)

18PSPC06 SMART GRID TECHNOLOGY AND APPLICATIONS

Category:PC

L T P C

3 0 0 3

PREREQUISITES: NIL

COURSE OBJECTIVES:

To comprehend conventional and modern techniques for the operation and real & reactive power control of power system.

UNIT-I INTRODUCTION (09)

Basic elements of Electrical Power Systems, Overview of Load Flow Analysis, Economic Load Dispatch and Unit Commitment problems, Desirable Traits of a Modern Grid, Principal Characteristics of the Smart Grid, Key Technology Areas, Impact of Smart grid on reliability and carbon emissions.

UNIT-II SENSING AND MEASUREMENT TECHNOLOGIES (09)

Synchro-phasor Technology – Phasor Measurement Unit, Smart metering and demand side integration - Communication infrastructure and protocol for smart metering – Data Concentrator, Meter Data Management System. Demand side Integration – Services, Implementation and Hardware Support of DSI, Distribution Feeder Reconfiguration analysis.

UNIT-III CONTROL AND AUTOMATION TECHNIQUES (09)

Distribution automation equipment – Substation automation equipments: current transformer, potential transformer, Intelligent Electronic Devices, Bay controller, Remote Terminal Unit. Distribution management systems – SCADA: modeling and analysis tools, applications. Renewable sources (Wind, Solar) – Integration to Grid, Controlling Techniques, Challenges and Opportunities, Micro grids.

UNIT-IV POWER ELECTRONICS AND ENERGY STORAGE SYSTEMS (09)

Power Electronics in smart grid – Shunt compensation, Series Compensation, Power Electronics for bulk power flow – FACTS, HVDC, Energy Storage Technologies - Batteries, Flow Battery, Fuel Cell and Hydrogen Electrolyser, Flywheel, Super-Conducting magnetic energy storage system, Super Capacitor.

UNIT-V ICT - STANDARDS AND POLICIES (09)

Data Communication, Dedicated and shared communication channels, Layered architecture and protocols, Communication technology and Information security for the smart grid. Smart Grid – Infrastructure Development planning, Reliability Evaluation, Economics, Power/Energy Trading, Energy Policies, Security and Privacy – Cyber security challenges, Load/Demand Profile uncertainties, Privacy Challenges in DSI and Smart homes.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES BOOKS:

1. *Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, "**Smart Grid Technologies and Applications**", John Wiley Publishers Ltd., 2012.*
2. *Lars T. Berger, Krzysztof Iniewski, "**Smart Applications, Communications and Security**", John Wiley Publishers Ltd., 2012.*
3. *Yang Xiao, "**Communication and Networking in Smart Grids**", CRC Press, Taylor and Francis Group, 2012.*
4. *Caitlin G. Elsworth,"**The Smart Grid and Electric Power Transmission**", Nova Science Publishers, 2010.*
5. *N. S. Rau, "**Optimization Principles: Practical Applications to the Operation and Markets of the Electric Power Industry**",Wiley, IEEE Press, 2003.*

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

CO1: Explore various advanced technologies for improving the performance of the power system operation.

CO2: Know the control and automation techniques.

CO3: Recognize modern techniques for the power grid operation.

CO4: Realize advanced techniques with respect to standards in power system.

CO5: Understand the storage technologies

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4
CO1	H	-	H	-
CO2	H	-	H	-
CO3	H	-	H	H
CO4	H	-	H	H
CO5	H	-	H	-
18PSPC06	H	-	H	L

1-Low(L); 2-Medium(M); 3-High(H)

18PSPC07 POWER SYSTEM DYNAMICS AND CONTROL

Category:PC

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

To understand the stability analysis through theoretical modeling concepts of various power system components

UNIT-I ANALYSIS OF DYNAMICAL SYSTEMS (09)

Concept of Equilibria, Small and Large Disturbance Stability, Example: Single Machine Infinite Bus System, Modal Analysis of Linear Systems, Analysis using Numerical Integration Techniques, Issues in Modeling: Slow and Fast Transients, Stiff Systems.

UNIT-II MODELING OF A SYNCHRONOUS MACHINE (09)

Physical Characteristics, Rotor Position Dependent model, D-Q Transformation, Model with Standard Parameters, Steady State Analysis of Synchronous Machine, Short Circuit Transient Analysis of a Synchronous Machine, Synchronous Machine Connected to Infinite Bus.

UNIT-III MODELING OF EXCITATION AND PRIME MOVER SYSTEMS (09)

Physical Characteristics and Models, Control system components, Excitation System Controllers, Prime Mover Control Systems.

UNIT-IV MODELING OF TRANSMISSION LINES AND LOADS (09)

Transmission Line Physical Characteristics, Transmission Line Modeling, Load Models - Induction machine model, Other Subsystems - HVDC, protection systems

UNIT-V STABILITY ISSUES IN INTERCONNECTED POWER SYSTEMS (09)

Single Machine Infinite Bus System, Multi-machine Systems, Stability of Relative Motion, Frequency Stability: Centre of Inertia Motion, Concept of Load Sharing: Governors, Single Machine Load Bus System: Voltage Stability, Torsional Oscillations.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES BOOKS:

1. *Padiyar K.R., "**Power System Dynamics, Stability & Control**", 2nd Edition,B.S. Publications, Hyderabad, 2008.*
2. *Kundur P., "**Power System Stability and Control**", McGraw Hill Inc., New York,1995.*
3. *Sauer P. and Pai M.A., "**Power System Dynamics and Stability**", Prentice Hall,2006.*
4. *Ramanujam,R.**"Power System Dynamics: Analysis and Simulation",** PHI Learning Pvt. Ltd., 2010*

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

CO1: Model the various power system components.

CO2: Analyze the dynamics and stability issues in power system.

CO3: Comprehend the response of power system under normal/abnormal operating conditions

CO4: Realize stabilized interconnected power systems.

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4
CO1	H	-	H	-
CO2	H	-	H	-
CO3	H	M	H	H
CO4	H	-	H	H
18PSPC07	H	L	H	M

1-Low(L); 2-Medium(M); 3-High(H)

18PSPC08 RESTRUCTURED POWER SYSTEM AND DEREGULATION
Category: PC

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

To explore objectives of national and regional planning of electricity, understand criteria of generation planning, impart learning about optimal power system expansion and its planning, also to learn about un-integrated and bundled power systems

UNIT-I FUNDAMENTALS AND ARCHITECTURE OF POWER MARKETS (09)

Deregulation of Electric utilities: Introduction – Unbundling – Wheeling - Reform motivations-Fundamentals of Deregulated Markets – Types (Future, Day-ahead and Spot) – Participating in Markets (Consumer and Producer Perspective) – Bilateral markets – Pool markets.Independent System Operator (ISO) – Components -Types of ISO - Role of ISO - Lessons and Operating Experiences of Deregulated Electricity Markets in various Countries (UK, Australia, Europe, US, Asia).

UNIT-II TECHNICAL CHALLENGES (09)

Total Transfer Capability – Limitations - Margins – Available transfer capability (ATC) – Procedure - Methods to compute ATC – Static and Dynamic ATC – Effect of contingency analysis – Case Study. Concept of Congestion Management – Bid, Zonal and Node Congestion Principles - Inter and Intra zonal congestion – Generation Rescheduling - Transmission congestion contracts – Case Study.

UNIT-III TRANSMISSION NETWORKS AND SYSTEM SECURITY SERVICES (09)

Transmission expansion in the New Environment – Introduction – Role of transmission planning – Physical Transmission Rights – Limitations – Flow gate - Financial Transmission Rights – Losses – Managing Transmission Risks – Hedging – Investment. Ancillary Services – Introduction – Describing Needs – Compulsory and Demand - Side provision – Buying and Selling Ancillary Services – Standards.

UNIT-IV MARKET PRICING (09)

Transmission pricing in open access system – Introduction – Spot Pricing – Uniform Pricing – Zonal Pricing – Locational Marginal Pricing – Congestion Pricing – Ramping and Opportunity Costs, Embedded cost based transmission pricing methods (Postage stamp, Contract path and MW-mile) – Incremental cost based transmission pricing methods (Short run marginal cost, Long run marginal cost) - Pricing of Losses on Lines and Nodes.

UNIT-V INDIAN POWER MARKET (09)

Current Scenario - Regions – Restructuring Choices – Statewise Operating Strategies - Salient features of Indian Electricity Act 2003 – Transmission System Operator – Regulatory and Policy development in Indian power Sector – Opportunities for IPP and Capacity Power Producer. Availability based tariff – Necessity – Working Mechanism – Beneficiaries – Day Scheduling Process – Deviation from Schedule – Unscheduled Interchange Rate – System Marginal Rate – Trading Surplus Generation – Applications.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES BOOKS:

*1. Kankar Bhattacharya, Math H.J. Bollen and Jaap E. Daalder, "**Operation of Restructured Power Systems**",Kluwer Academic Publishers, 2012.*

*2. Loi Lei Lai, "**Power system Restructuring and Deregulation**", John Wiley & sons, 2001.*

*3. Shahidehpour M and Alomoush M, "**Restructuring Electrical Power Systems**", Marcel Decker Inc., 2001.*

*4. Steven Stoft, " **Power System Economics**", Wiley – IEEE Press, 2002.*

*5. Daniel S. Kirschen and GoranStrbac, "**Fundamentals of Power System Economics**", John Wiley &SonsLtd., 2004.*

6. Web Sites: www.pjm.com, www.caiso.com, www.midwestiso.com.

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

CO1: Review the restructuring of power industry.

CO2: Analyze the way of secured and reliable operation of power systems.

CO3: Design the efficient economic planning of electricity.

CO4: Understand the Indian Electricity Act

CO5: Know the technical issues in Indian Power Market

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4
CO1	H	-	H	-
CO2	H	-	H	-
CO3	H	-	L	M
CO4	H	-	M	H
CO5	H	-	H	H
18PSPC08	H	-	M	M

1-Low(L); 2-Medium(M); 3-High(H)

18PSPC09 ADVANCED POWER SYSTEM SIMULATION LABORATORY
Category:PC

L T P C

0 0 31.5

PREREQUISITES: NIL

COURSE OBJECTIVES:

To get exposure to modern techniques for solving Power System Problems

LIST OF EXPERIMENTS:

1. Application of neural networks to load forecasting and contingency analysis
2. Solution of Unit commitment Problem through Evolutionary algorithm
3. Solution of Economic Dispatch using Evolutionary algorithm
4. Fuzzy logic based Power System Stabilizer
5. Study of Relay Coordination
6. Power System Planning-Circuit Breaker Rating
7. Intelligent control techniques for Automatic Generation Control
8. Soft Computing Techniques for Power System Problems
9. State Estimation of Power System
10. Analysis of Integrating Renewable Energy Sources to Power grid

CONTACT PERIODS:
Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

CO1: Acquire expertise in usage of modern techniques as applied to Power System Issues
CO2: Apply soft computing techniques to Power System problems and evaluate the solution
CO3: Analyze the solution obtained through soft computing techniques
CO4: Suggest suitable technique as applicable to power system problem

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4
CO1	H	-	H	-
CO2	H	-	H	-
CO3	H	-	H	H
CO4	H	-	H	H
18PSPC09	H	-	H	M

1-Low(L); 2-Medium(M); 3-High(H)

18PSEE01 **MINIPROJECT WITH SEMINAR** **Category:EEC**

L	T	P	C
0	0	4	2

PREREQUISITES: NIL

COURSE OBJECTIVES:

To develop student's abilities to transmit technical information clearly and test the same by delivery of Seminar based on the Mini Project.

- Students can take up small problems in the field of Power System Engineering as mini project. It can be related to solution to an engineering problem, verification and analysis of experimental, simulation data available, conducting experiments on various engineering subjects, material characterization, studying a software tool for the solution of an engineering problem etc.
- A project work note should be maintained by the students containing the details of work done, problems faced, solutions evolved etc. and should be duly signed by the Internal Guide on regular intervals.
- The students are expected to utilize the laboratory resources before or after their contact hours as per the prescribed module.

CONTACT PERIODS:

Lecture: 0 Periods Tutorial: 0 Periods Practical: 60 Periods Total: 60 Periods

COURSE OUTCOMES:

CO1: Plan and implement the hardware/ software project

CO2: Develop skills to write technical reports, present and defend their work.

CO3: Demonstrate the project with effective presentation.

COURSE ARTICULATION MATRIX

CO/PO	PO1	PO2	PO3	PO4
CO1	H	-	-	H
CO2	-	H	-	M
CO3	-	H	H	L
18PSEE01	L	M	L	M

1-Low(L); 2-Medium(M); 3-High(H)

18PSEE02 **PROJECT PHASE ICategory:EEC**

L	T	P	C
0	0	20	10

PREREQUISITES: NIL

COURSE OBJECTIVES:

To undertake detailed technical work in the chosen area of theoretical Power Systems Engineering studies through simulations for the benefit of Society.

CONTACT PERIODS:
LECTURE: 0 PERIODS TUTORIAL: 0 PERIODS PRACTICAL: 300 PERIODS TOTAL: 300 PERIODS

COURSE OUTCOMES:

CO1:*Identify the engineering problem based on Societal/Industrial demand through detailed Literature Survey.*

CO2:*Design and evaluate the system using software tools.*

CO3:*Gain expertise in the interpretation of simulation / experimental, technical presentation and documentation.*

COURSE ARTICULATION MATRIX

CO/PO	PO1	PO2	PO3	PO4
CO1	H	-	H	H
CO2	H	M	H	M
CO3	H	H	H	L
18PSEE02	H	M	H	M

1-Low(L); 2-Medium(M); 3-High(H)

18PSEE03 **PROJECT PHASE II** **Category:EEC**

L	T	P	C
0	0	32	16

PREREQUISITES: NIL

COURSE OBJECTIVES:

To undertake detailed technical work in the chosen area of theoretical Power Systems Engineering studies through simulations and hardware development for the benefit of Society.

CONTACT PERIODS:

LECTURE: 0 PERIODS TUTORIAL: 0 PERIODS PRACTICAL: 480 PERIODS TOTAL: 480 PERIODS

COURSE OUTCOMES:

CO1:*Solve the Identified problem with cutting edge technologies.*

CO2:*Design and evaluate the system using software/ hardware tools to develop innovative outputs/ Products in terms of Journal publications/patents.*

CO3:*Gain expertise in the interpretation of simulation / experimental, technical presentation and documentation.*

COURSE ARTICULATION MATRIX

CO/PO	PO1	PO2	PO3	PO4
CO1	H	-	H	H
CO2	H	M	H	M
CO3	H	H	H	L
18PSEE02	H	M	H	M

1-Low(L); 2-Medium(M); 3-High(H)

18PSPE01 POWER SYSTEM TRANSIENTS AND SURGE PROTECTION

Category: PE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

To familiarize students about the power system transients due to internal and external factors and surge protection methods

UNIT-I INTRODUCTION (09)

Review of various types of power system transients - Lightning surges, Switching surges : Inductive energy transient and Capacitive energy transient – Effect of transients on power systems - Relevance of the study and computation of power system transients – Surge voltage and surge current specifications (As per BIS).

UNIT-II LIGHTNING SURGES (09)

Lightning – Overview- Lightning surges - Electrification of thunderclouds – Simpson's theory of thunderclouds – Direct and Indirect strokes – Stroke to conductor, midspan and tower – Conventional lightning protection technique: Collection Volume method

UNIT-III TRANSIENT CALCULATION (09)

Travelling wave concepts – Telegraphic Equation, Wave Propagation, Reflections – Bewley's Lattice diagrams for various cases – Analysis in time and frequency domain – Eigen value approach – Z-transform.

UNIT-IV SWITCHING SURGES (09)

Closing and reclosing of lines – Load rejection – Fault initiation – Fault clearing – Short line faults – Ferro Resonance – Isolator switching surges – Temporary over voltages – Surges on an integrated system – Switching – Harmonics – Protection scheme.

UNIT-V INSULATION CO-ORDINATION (09)

Principles of insulation co-ordination – Recent advancements in insulation co-ordination - BIL, Design of EHV system – Insulation co-ordination as applied to transformer, substations – Examples.

CONTACT PERIODS:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES BOOKS:

1. *Allan Greenwood,* ***"Electrical Transients in power Systems",*** *Willey Interscience, Newyork,Second Edition, 2010.*
2. *Klaus Ragaller.* ***"Surges in High Voltage Networks"****, Plenum Press, NewYork, 1980.*
3. *Indulkar C.S., and Kothari D.P.,* ***"Power System Transients"****- A Statistical approach, Prentice Hall 2004.*
4. *SubirRay,* ***"Electrical Power Systems – Concepts, Theory and Practice",*** *Prentice Hall of India, NewDelhi, 2007.*
5. *Rakosh das Begamurde,* ***"Extra High Voltage AC Transmission Engineering"****, Wiley Eastern Ltd, New Delhi, 2009.*
6. *Chakrabarthy A, Soni M.L, Gupta P.V. and Bhatnagar U.S.* ***"A Text Book on Power System Engineering"****, DhanpatRai& Sons.,NewDelhi, 2008.*
7. *Bewely L.V.,* ***"Travelling waves and Transmission Systems"****, Dover Publications, New York, 1963.*

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

CO1: Understand the concept of transients and surges occur in power system
CO2: Evaluate surge and transient specification through different techniques
CO3: Analyze the impact of transient and surges on power system
CO4: Perform insulation co-ordination as applied to power system components

COURSE ARTICULATION MATRIX

CO/PO	PO1	PO2	PO3	PO4
CO1	H	-	H	-
CO2	H	-	H	-
CO3	H	-	H	-
CO4	H	-	H	-
18PSPE01	H	-	H	-

1-Low(L); 2-Medium(M); 3-High(H)

18PSPE02 POWER SYSTEM ECONOMICS Category: PE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

To give an understanding of the economic principles underlying the operation and planning of the electricity systems including concepts of electricity markets and competition in electricity generation and supply, and the opening of the transmission and distribution systems to third party access

UNIT-I POWER MARKET (09) Market Structure and operation:- Objective of market operation, Electricity market models, Power market types, Market power, Key components in market operation. Demand and supply, Demand analysis – Theory,elasticity of demand, Demand forecasting –Types, techniques. Costs: Short run – Long run - Relationship between short run and long run costs, perfect competition – Monopoly- Monopolistic and Oligopolistic, Determination of market price, Price discrimination.

UNIT-II ELECTRICITY PRICE (09)

Price volatility, ancillary services in electricity power market, automatic generation control and its pricing, Generation assets valuation and risk analysis. -Introduction, VAR for Generation Asset Valuation, Generation Capacity Valuation.

UNIT-III TRANSMISSION CONGESTION MANAGEMENT AND PRICING (09)

Transmission cost allocation methods, LMP, FTR and Congestion Management. Role of FACTS devices in competitive power market, Available Transfer Capability, Distributed Generation in restructured markets.

UNIT-IV REACTIVE POWER MARKET MANAGEMENT (09)

Reactive power requirements under steady state voltage stability and dynamic voltage stability, reactive power requirements to cover transient voltage stability, System losses and loss reduction methods, Power tariffs and Market Forces shaping of reactive power, reactive power requirement of the utilities.

UNIT-V GENERATION SYSTEM CHARACTERISTICS, COST & RELIABILITY ANALYSIS(09)

Characteristic operation of power plants - Choice of power plants - Hydro, Thermal and Nuclear - Size of plant – Input / Output curves. Economic Planning - Generation system - Cost analysis - Capacity cost -Production cost - Plant cost - Timing of unit additions - System cost analysis.Load forecasting and system reliability : Load forecasting - Generation system reliability - Co-ordination methods - Economic operation of power systems - Simple problems.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES BOOKS:

*1.Turner,Wayne.C., "**Energy Management**" Hand Book.,2nd Edition.*
*2. RR Barathwal- Professor IIT Kanpur ."**Industrial Economics-an Introductory text book**"*
*3.Aninydya , "**Micro Economics-Theory and Application**"*
*4. S.K.Jain,"**Applied economics for Engineers and Managers**", Vikas Publishing House.*
*5.D.M.Tagare, **" Series on Electrical Power capacitors Reactive power Management",** Madhav Electricals, Pune, Tata McGraw Hill Publishing Company Ltd.*
*6.KirchmayerL.K., **"Economic Operation of Power System**",John Wiley, New York,1958.*

COURSEOUTCOMES:

Upon completion of this course, the students will be able to:

CO1: Elaborate the principles of power system planning

CO2: Know market/managerial economic aspects

CO3: Understand the social efficiency concepts.

CO4: Analyze power systems with application of economics considerations.

CO5: Assess electric power system for socio-economic standpoint.

COURSE ARTICULATION MATRIX

CO/PO	PO1	PO2	PO3	PO4
CO1	H	-	H	-
CO2	H	-	H	-
CO3	H	-	H	-
CO4	H	-	H	-
CO5	H	-	H	-
18PSPE02	H	-	H	-

1-Low(L); 2-Medium(M); 3-High(H)

18PSPE03 POWER SYSTEM PLANNING AND RELIABILITY
Category: PE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

To teach the concepts of load forecasting, short term and long term planning and methodology of reactive power planning

UNIT-I LOAD FORECASTING (09)

Objectives of forecasting - Load growth patterns and their importance in planning – Load forecasting Based on discounted multiple regression technique-Weather sensitive load forecasting-Determination of annual forecasting-Use of AI in load forecasting.

UNIT-II GENERATION SYSTEM RELIABILITY ANALYSIS (09)

Probabilistic generation and load models- Determination of LOLP and expected value of demand not served –Determination of reliability of isolated and interconnected generation systems.

UNIT-III TRANSMISSION SYSTEM RELIABILITY ANALYSIS (09)

Deterministic contingency analysis- Probabilistic load flow-Fuzzy load flow probabilistic transmission system reliability analysis-Determination of reliability indices like LOLP and expected value of demand not served.

UNIT-IV EXPANSION PLANNING (09)

Basic concepts on expansion planning- Procedure followed for integrate transmission system planning, current practice in India - Capacitor placement problem in transmission system and radial distributions system.

UNIT-V DISTRIBUTION SYSTEM PLANNING OVERVIEW (09)

Introduction, sub transmission lines and distribution substations-Design of primary and secondary systems- Distribution system protection and coordination of protective devices.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

*1. Proceeding of work shop on "**Energy systems planning & manufacturing**",CI.*

*2. Sullivan R.L., " **Power System Planning**",McGrawHill.Inc., US 1997.*

*3. Roy Billinton and Allan Ronald, "**Power System Reliability**" Gardon& Breach, Newyork, 1970.*

*4. TuranGonen, "**Electric Power Distribution System Engineering**", Second Edition, CRC press, 2007.*

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

CO1: Estimate the trend of power consumption by end users.

CO2: Perform efficient short term planning of power systems

CO3: Carry out long term planning of power systems.

CO4: Apply suitable control techniques to meet the constraints of reactive power consumption.

CO5: Know expansion and distribution system planning.

COURSE ARTICULATION MATRIX

CO/PO	PO1	PO2	PO3	PO4
CO1	H	-	H	-
CO2	H	-	H	-
CO3	H	-	H	-
CO4	H	-	H	-
CO5	H	-	H	-
18PSPE03	H	-	H	-

1-Low(L); 2-Medium(M); 3-High(H)

18PSPE04 POWER SYSTEM SECURITY Category: PE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

To enhance the security of power system through the study of various assessment techniques.

UNIT-I BASICS OF POWER SYSTEM SECURITY (09)

Basic concepts: Power system stability – Security-Observability and reliability, deregulation, factors affecting power system security, decomposition and multilevel approach, state estimation, system monitoring, security assessment, static and dynamic – Online and offline, security enhancement.

UNIT-II POWER SYSTEM STATE ESTIMATION (09)

Power system state estimation: DC and AC network, orthogonal decomposition algorithm, detection identification of bad measurements, network observability and pseudo measurements, application of power system state estimation, introduction to supervisory control and data acquisition.

UNIT-III SECURITY ASSESSMENT (09)

Power system security assessment: contingency analysis, network sensitivity factors, contingency selection, performance indices, security constrained optimisation, SCOPF, basis of evolutionary optimization techniques, preventive, emergency and restorative controls though non-linear programming (NLP) and linear programming(LP)methods.

UNIT-IV SECURITY IN DEREGULATED ENVIRONMENT (09)

Need and conditions for deregulation, electricity sector structure model, power wheeling transactions, congestion management methods, available transfer capability (ATC), system security in deregulation.

UNIT-V SECURITY ENHANCEMENT AND RECENT TECHNIQUES (09)

Correcting the generator dispatch by sensitivity methods, compensated factors, security constrained optimization, preventive, emergency and restorative control through LP Method. Voltage Security Assessment – Transient Security Assessment – Methods – Comparison.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. *Wood, A.J. and Wollenberg, B.F., "**Power generation, Operation and Control**", John Wiley and Sons,2012.*
2. *Wood, A.J. and Woolenberg, "**Power generation operation for security**", John Wiley and sons, 1989.*
3. *Abdullah Khan, M (Editor), "**Real time control of power system for security**", vol.2, Proceedings ofsummer school, College of Engineering, Madras, 1976.*
4. *Handsching.E, (Editor) "**Real time control of Electric Power Systems**", Elsevier publishing Co.,Amsterdam, 1972.*

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

CO1: Explore the basics of power system security
CO2: Determine the mathematical models for power system state estimation.
CO3: Analyze through appropriate algorithm for the security assessment and enhancement of power system.
CO4: Evaluate power system for the secured operation through enhancing techniques.
CO5: Understand recent techniques in power system security.

COURSE ARTICULATION MATRIX

CO/PO	PO1	PO2	PO3	PO4
CO1	H	-	H	-
CO2	H	-	H	-
CO3	H	-	H	-
CO4	H	-	H	-
CO5	H	-	H	-
18PSPE04	H	-	H	-

1-Low(L); 2-Medium(M); 3-High(H)

18PSPE05 **HIGH VOLTAGE DC TRANSMISSION SYSTEMS** **Category : PE**

(Common to PED)

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

To understand the HVDC transmission system and its control

UNIT-I DC POWER TRANSMISSION TECHNOLOGY (9)

Introduction - Comparison of AC and DC transmission – Application of DC transmission – Description of DC transmission system – MTDC systems – Types, Control and protection of MTDC systems-Planning for HVDC transmission – Modern HVDC – State of the art.

UNIT-II : ANALYSIS OF HVDC CONVERTERS (10)

Pulse number – Choice of converter configuration – Simplified analysis of Graetz circuits – Converter bridge characteristics – Characteristics of twelve-pulse converter – Detailed analysis of converter

UNIT-III : HVDC SYSTEM CONTROL (8)

General principles of DC Link control – Converter control characteristics – System control hierarchy- Firing angle control – Current and extinction angle control – Starting and stopping of DC link- Power control – Higher level controllers – Telecommunication requirements.

UNIT-IV : HARMONICS AND TYPICAL DISTURBANCES (9)

Introduction – Generation of harmonics – Design of AC filters – DC filters – Carrier frequency and RI noise - CIGRE benchmark model for HVDC control studies – Control system used - Results.

UNIT-V : SIMULATION OF HVDC SYSTEMS (9)

Introduction – System simulation: Philosophy and tools – HVDC system simulation – Modelling of HVDC systems for Digital Dynamic Simulation - Off-line and real time digital simulators.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. *Padiyar .K .R. , '**HVDC Power Transmission Systems** ', New age international(P) Ltd, New Delhi, third edition,2015.*
2. *Edward Wilson Kimbark , '**Direct Current Transmission'**, Vol 1 , Wiley Interscience, Newyork, London, Sydney, 1971.*
3. *Vijay K. Sood, '**HVDC and FACTS Controllers – Applications of Static Converters in Power Systems',** Kluwer Academic Publishers, ,2006.*
4. *Rakosh Das Begamudre , '**Extra High Voltage AC Transmission Engineering'** ,Wiley Eastern Ltd, New Delhi, 2007.*
5. *Arrillaga .J, '**High Voltage Direct Current Transmission'**, Peter Pregrinus London, Second Edition, 1998.*
6. *Adamson .C and Hingorani N.G., '**High Voltage Direct Current Power Transmission**", Garraway Ltd., London, 1967.*

COURSE OUTCOMES:

CO1: Understand the concept and Identify the merits with necessity of HVDC transmission

CO2: Analyse and Design power converters for HVDC transmission system

CO3: Develop HVDC controllers in Real time power system environments

CO4: Explore Harmonics and Disturbances in HVDC environment

CO5: Model the HVDC system in simulation environment and study the performances

COURSE ARTICULATION MATRIX

CO/PO	PO1	PO2	PO3	PO4
CO1	H	-	H	M
CO2	H	-	H	-
CO3	H	-	H	H
CO4	H	-	H	-
CO5	H	-	H	-
18PSPE05	H	-	H	L

1-Low(L); 2-Medium(M); 3-High(H)

18PSPE06 FLEXIBLE AC TRANSMISSION SYSTEMS Category : PE

(Common to PED)

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

To identify the need for static compensators in power system and learn the characteristics and applications of various FACTS controllers.

UNIT-I CONCEPT OF FACTS (09)

Introduction- control of power flow in AC transmission line- Analysis of uncompensated AC Transmission line – Passive compensation: Effect of series and shunt compensation- Need for FACTS controllers- types of FACTS controllers.

UNIT-II : SERIES COMPENSATION SCHEMES (09)

Concept of series compensation -types– variable impedance: GCSC, TCSC and TSSC- Switched converter type compensation using Static Synchronous Series Compensator (SSSC) – configuration, characteristics, control and applications.

UNIT-III : SHUNT COMPENSATION SCHEMES (09)

Concept of shunt compensation - types - Variable Impedance type: TCR and TSC - switched converter type using Static Synchronous Compensator (STATCOM) - configuration, characteristics, control and applications

UNIT-IV : UNIFIED POWER FLOW CONTROL (09)

Unified Power Flow concept -Implementation of Unified Power Flow controller- Characteristics-independent active and reactive power flow control- Modeling of UPFC for load flow and transient stability studies-applications

UNIT-V : COORDINATION OF FACTS CONTROLLERS (09)

Controller Interactions – SVC-SVC, SVC-TCSC and TCSC-TCSC interactions-Coordination of multiple controllers using linear techniques - non linear control techniques (quantitative level).

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. Narain G.Hingorani, Laszio. Gyugyl, “Understanding FACTS Concepts and Technology of Flexible AC Transmission System”, IEEE press and John Wiley & Sons , 2001.
2. Mohan Mathur, R., Rajiv. K. Varma, “Thyristor Based FACTS Controllers for Electrical Transmission Systems”, IEEE press and John Wiley & Sons, Inc, 2002.
3. Padiyar,K.R.,” FACTS Controllers in Power Transmission and Distribution”, New Age International(P) Ltd., Publishers, Reprint 2008.

COURSE OUTCOMES:

CO1: Understand the concept of FACTS

CO2: Illustrate the concepts of static series and shunt compensation
CO3: Design and Analysis of the FACTS controllers and their implementation in power system

COURSE ARTICULATION MATRIX

CO/PO	PO1	PO2	PO3	PO4
CO1	H	-	H	L
CO2	H	-	H	-
CO3	H	-	H	M
18PSPE06	H	-	H	L

1-Low(L); 2-Medium(M); 3-High(H)

18PSPE07 FEM MODELING OF HIGH VOLTAGE APPARATUS AND SYSTEMS
Category: PE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

To acquire knowledge and skills about modelling of high voltage apparatus and systems using FEM

UNIT-I GENERAL CONCEPT (08)

Introduction to Finite Element method – Discretisation - Advantages and disadvantages - History of development and applications - Recent trends.

UNIT-II VARIATIONAL AND WEIGHTED RESIDUAL FORMULATION(10)

Boundary value problem - Approximate method of solution - Review of variational calculus - The Euler - Lagrange equation - Boundary conditions - Method of weighted residuals - Rayleigh Ritz and Galerkin methods of finite element formulations.

UNIT-III GENERAL APPROACH TO FIELD ANALYSIS (09)

Problem definition - Field properties - Maxwell's equations in the Dynamic, Quasi-static and static cases - Static fields in unbounded regions- Continuity conditions of fields at a medium discontinuity.

UNIT-IV ELEMENT SHAPE FUNCTIONS (08)

Parametric functions - Shape functions for 1-D, 2-D and 3-D simplex and complex elements - Asymmetric elements – Isoparametric element formulations.

UNIT-V FIELD MODELING OF HIGH VOLTAGE APPARATUS (10)

Finite element formulation for interior and exterior problems - Static electric field and magnetic field problems - Eddy current problems - Field computation in high voltage apparatus - Electro thermal analysis - Transient field analysis.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. *Charles W.Steels, "**Numerical Computation of Electric and Magnetic fields**", Van Nostrand Reinhold Company, New York, 2013.*
2. *Larry J. Segerlind, "**Applied Finite Element Analysis**", John Wiley, New York, 1984.*
3. *Zienkiewicz.O.C., "**The Finite Element Method**", Tata McGraw Hill Publishing Co., New Delhi, 2000.*
4. *Reddy.J.N., "**An Introduction to the Finite Element Method**", McGraw Hill Book Co., New York, 2006.*
5. *Chari.M.V.K. and Sylvester.P.P., "**Finite Elements in Electrical and Magnetic Field Problems**", John Wiley & Sons, New York, 1980.*
6. *Csendes.Z.J. and Hamann.J.R., "**Surge Arrester Voltage Distribution Analysis by FEM**", IEEE Trans. on Power Apparatus and Systems, Vol.100, No.4, PP.1806-1811.*

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

CO1: Learn about the concept of Finite Element Method and formation methods.
CO2: Familiarize the use of field analysis and element shape functions for HV systems.
CO3: Understand the concepts of field modeling of High Voltage Apparatus.
CO4: Analyze the HV systems using Finite Element Method

COURSE ARTICULATION MATRIX

CO/PO	PO1	PO2	PO3	PO4
CO1	H	-	H	-
CO2	H	-	H	-
CO3	H	-	H	-
CO4	H	-	H	-
18PSPE07	H	-	H	-

1-Low(L); 2-Medium(M); 3-High(H)

18PSPE08 EHVAC TRANSMISSION SYSTEMS
Category: PE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:
To understand the concepts, design and effects of EHVAC transmission system

UNIT-I INTRODUCTION (09)
Standard transmission voltages – Different configurations of EHV and UHV lines – Average values of line parameters – Power handling capacity and line loss – Costs of transmission lines and equipment – Mechanical considerations in line performance.

UNIT-II CALCULATION OF LINE PARAMETERS (09)
Calculation of resistance, inductance and capacitance for multi-conductor lines – Calculation of sequence inductances and capacitances – Line parameters for different modes of propagation – Resistance and inductance of ground return, numerical example involving a typical 400/220kV line using line constant program.

UNIT-III VOLTAGE GRADIENTS OF CONDUCTORS (09)
Charge- Potential relations for multi-conductor lines – Surface voltage gradient on conductors – Gradient factors and their use – Distribution of voltage gradient on sub-conductors of bundle - Voltage gradients on conductors in the presence of ground wires on towers.

UNIT-IV CORONA EFFECTS (09)
Power losses and audible losses: I^2R loss and corona loss - Audible noise generation and characteristics - Limits for audible noise - Day-Night equivalent noise level - Radio interference**:** Corona pulse generation and properties - Limits for radio interference fields.

UNIT-V ELECTROSTATIC FIELD OF EHV LINES (09)
Effect of EHV line on heavy vehicles - Calculation of electrostatic field of AC lines - Effect of high field on human beings, animals, and plants - Measurement of electrostatic fields - Electrostatic Induction in un-energized circuit of a DC line - Induced voltages in insulated ground wires - Electromagnetic interference.

CONTACT PERIODS:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

*1.Rakosh Das Begamudre, "**Extra High Voltage AC Transmission Engineering**",Second Edition, New Age International Pvt. Ltd., 2007.*

*2."**Power Engineer's Handbook**", Revised and Enlarged 6th Edition, TNEB Engineers'Association, October 2002.*

*3."**Microtran Power System Analysis Corporation**",Microtran Reference Manual, Vancouver Canada. (Website: www.microtran.com), 2002.*

4. Roberto Benato, Antonio Paolucci, "EHV AC Undergrounding Electrical Power: Performance and Planning",Springer Science & Business Media, 27-May-2010*

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

CO1: Study the performance of the EHV transmission line.
CO2: Acquire knowledge on design of line conductor for EHV transmission system.
CO3: Understand the voltage gradients of conductors.
CO4: Analyse the corona effects on the EHV lines.
CO5: Know electrostatic field effects on the EHV lines.

COURSE ARTICULATION MATRIX

CO/PO	PO1	PO2	PO3	PO4
CO1	H	-	H	L
CO2	H	-	H	-
CO3	H	-	H	-
CO4	H	-	H	-
CO5	H	-	H	H
18PSPE08	H	-	H	L

1-Low(L); 2-Medium(M); 3-High(H)

18PSPE09 HIGH VOLTAGE AND INSULATION SYSTEMS
Category: PE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:
To familiarize students about high voltage materials and testing techniques

UNIT-I INSULATING MATERIALS IN POWER SYSTEM (09)
Review of insulating materials Gases, Vacuum, liquids and solids - Characterization of insulation condition – Permittivity, capacitance, resistivity and insulation resistance, dielectric dissipation factors - Partial discharges sources, forms and effects - Ageing effects - Electrical breakdown and operating stresses - Standards relating to insulating materials.

UNIT-II BREAKDOWN MECHANISMS OF DIELECTRICS (09)
Introduction to insulation systems used in high voltage power apparatus - Breakdown mechanisms of gases- Breakdown in Electronegative Gases – Breakdown mechanism in Solid Dielectrics- Breakdown mechanisms of liquid: Suspended Solid Particle Mechanism and Cavity Breakdown- Breakdown in Vacuum

UNIT-III GENERATION OF TEST SIGNALS AND MEASUREMENT (09)
Generation of high voltage AC: cascaded transformers and series resonant circuit - Generation of high DC voltages: rectifier circuit, voltage multiplier circuit and Electrostatic Generator - Generation of impulse voltages and Currents: multistage impulse generator circuit and Impulse Current Generation - Measurement of high AC, DC and impulse voltages: voltage divider circuits, Electrostatic Voltmeter and Generating Voltmeter - Digital Storage Oscilloscope for impulse voltage and current measurements (Spectrum Analysis).

UNIT-IV INSULATION TESTING OF ELECTRICAL EQUIPMENTS (09)
Necessity for high voltage testing - Testing of transformers - Bushings – Overhead line and substation insulators - Surge arresters – High voltage cables – Power Capacitors-Circuit breakers and isolators – IEC and Indian standards.

UNIT-V NON-DESTRUCTIVE TESTING (09)
Insulation resistance measurement - Measurement of tan delta and capacitance of dielectrics –-Schering Bridge Method for Grounded Test Specimen– Measurement of Partial discharges - Bridge Circuit –- Oscilloscope as PD Measuring Device -Measurement of Dissolved gas in oil.

CONTACT PERIODS:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. Kuffel,E. and Zaengl, W.S, ***"High Voltage Engineering Fundamentals"****, Pergamon PressOxford, New York, 2013.*

2. Naidu,M.S. and Kamaraju,V, ***"High Voltage Engineering"****, Tata McGraw Hill,New Delhi,2009.*

3. C.L.Wadwa, ***"High Voltage Engineering Fundamentals"*** *,New Age International Publishers,Second Edition, 2017*

*4. Gallagher,T.J., and Permain,A., "****High Voltage Measurement, Testing and Design"****, JohnWiley Sons, New York, 1983.*

5. IEC & IS Standards on HV testing: website: https://archive.org/details/gov.in

6. Adrianus, J.Dekker, ***"Electrical Engineering Materials",*** *Prentice Hall of India, New Delhi,2007.*

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

CO1: *Understand the properties of insulating materials and suggest suitable materials to power Apparatus*

CO2*:Comprehend the mechanism of breakdown in dielectric.*

CO3: *Analyze the methods of generation and measurement of high voltages*

CO4: *Evaluate the condition of High voltage apparatus through appropriate testing methods*

COURSE ARTICULATION MATRIX

CO/PO	PO1	PO2	PO3	PO4
CO1	H	-	H	L
CO2	H	-	H	-
CO3	H	-	H	-
CO4	H	-	H	M
18PSPE09	H	-	H	L

1-Low(L); 2-Medium(M); 3-High(H)

18PSPE10 **POWER ELECTRONIC APPLICATIONS TO POWER SYSTEM** **Category : PE**

(Common to PED)

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

To familiarize the students with the challenges for power electronics circuits when applied to real time power system projects.

UNIT-I : POWER DEVICES AND CIRCUIT CONFIGURATION (09)

Comparison of various devices for converter circuits – Three phase Converters (line commutated and PWM) –Introduction to HVDC-Effect of source and load inductance – Harmonics in power system due to power converters-standards – Advanced converter topologies(Matrix and Multilevel)

UNIT-II : WIND AND SOLAR PV ENERGY CONVERSION SYSTEMS (09)

Basic components of wind energy conversion system- Generators –Types- Solar PV energy conversion system - DC and AC power conditioners for solar PV

UNIT-III : CONVERTER CONTROL (09)

Control characteristics of inverter and rectifier in HVDC–Over view of control techniques for grid connected converters-Control of active and reactive power.

UNIT-IV : POWER QUALITY AND FAULT ANALYSIS (09)

Impact of power electronics in power system-Harmonics- Flicker – Remedies-Fault behavior of wind and solar systems - International standards for grid integration of Renewable Energy Sources.

UNIT-V : MODELING AND POWER FLOW ANALYSIS (09)

Modeling-Converters – Filters-Load flow analysis-Power system with power converter based Renewable Energy-FACTS Controllers- Protection of power converters.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. *Rakesh Das Bagamudure, " **Extra high voltage AC Transmission Engineering**",New age International Ltd., Third Edition, 2007.*
2. *R.SastryVedam, S.Sarma, **" Power Quality VAR compensation in Power systems",** CRC Press,2009.*
3. *Padiyar.K.R.**,"HVDC Power Transmission System"**, Wiley Eastern Limited, New Delhi, 2011.*
4. *Remus Teodorescu, Marco Liserre, Pedro Rodriguez "**Grid Converters for Photovoltaic and Wind Power Systems**"John Wiley and Sons Ltd.,2011*
5. *Mukund R Patel, "**Wind and Solar power systems: design, analysis and operation**", Second Edition, Taylor & Francis, 2006*

COURSE OUTCOMES:

CO1: Identify the suitability of existing and new power electronic converter topologies for improving th*e* performance of renewable energy system.

CO2: Analyze the power system with power electronics based controllers

CO3: Apply relevant power electronic circuits for wind and solar energy conversion systems.

COURSE ARTICULATION MATRIX

CO/PO	PO1	PO2	PO3	PO4
CO1	H	-	H	H
CO2	H	-	H	-
CO3	H	-	H	M
18PSPE10	H	-	H	M

1-Low(L); 2-Medium(M); 3-High(H)

18PSPE11 ADVANCED ELECTRIC DRIVES AND CONTROL Category : PE

(Common to PED)

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

To study and analyze the performance of electric drives with modern controllers and techniques.

UNIT-I : INTRODUCTION (09)

Need for advanced controls - Principle factor affecting the choice of drive – Parameter identification techniques for electric motors – Electromagnetic compatibility of electric drives – Different options for an adjustable speed electric drive – Simulation of electrical drives – Advanced control strategies for electrical drives – DSP based control of electric drives.

UNIT-II : DSP CONTROLLERS AND INSTRUCTION SET (09)

TMS 320 family overview – 320 C24X Series of DSP controllers – Architecture – C24X CPU internal bus structure – Central processing unit – Memory and I/O spaces–Program control – Address modes – System configuration and interrupts – Clocks and low power modes –Digital input/output. Instruction set: Assembly language instructions – Instruction set and description – Accumulator, arithmetic and logic instructions –Auxiliary register and data page pointer instructions – TREG, PREG, Multiply instructions – Branch instructions – Control instructions – I/O and memory instructions.

UNIT-III : PWM INVETER CONTROL (09)

Inverter – Operation principle – Inverter switching – Unipolar – Bipolar – Inverter dead time– Inverter modulation – Different types – Sine Triangle – Analysis of Sine Triangle Modulation – Trapezoidal Modulation – Third harmonic Modulation – Analysis of Third Harmonic Modulation – Output filter requirement for different PWM techniques.

UNIT-IV : SPACE VECTOR MODULATION (09)

Concept of a Space Vector – dq0 Components for Three-phase sine wave source–dq0 Components for Voltage Source Inverter operated in Square Wave Mode –Synchronously rotating reference frame – Space Vector Modulation– Principle –SVM compared to regular sampled PWM Phase Lag reference for SVM – Naturally sampled SVM – Analytical solution – Harmonic losses – Placement of Zero Space Vector – Discontinuous Modulation – Phase Lag reference for discontinuous PWM.

UNIT-V : ADVANCED CONTROLLERS (09)

Current and speed control of Induction Motor – Current control algorithm – Sensorless motion control strategy – Induction Motor Controller using VHDL design. Fuzzy Logic Control of a Synchronous Generator – System representation – VHDL Modelling –FPGA implementation.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. *Bimal K. Bose, "**Power Electronics and Variable Frequency Drives – Technology and Applications**", IEEE Press, 1997.*
2. *Grafame Holmes. D and Thomas A. Lipo, "**Pulse Width Modulation for PowerConverters – Principles and Practice**", IEEE Press, 2003.*
3. *Peter Vas, "**Vector Control of AC Machines**", Oxford University Press, 1990.*
4. *Hamid A. Toliyat and Steven G.Campbell, "**DSP based Electromechanical MotionControl**", CRC Press 2004.*
5. *Ned Mohan, "**Advanced Electric Drives: Analysis, Control and Modelling usingSIMULINK**", John Wiley & Sons Ltd., 2001 .*

COURSE OUTCOMES:

CO1: Gain knowledge about DSP controllers for drive applications.
CO2: Analyze the performance of inverter for drives with various PWM techniques and neuro - fuzzy controllers.
CO3: Identify the suitability of techniques for different drive applications.
CO4: Expertise to enhance the performance of drives with modern controller

COURSE ARTICULATION MATRIX

CO/PO	PO1	PO2	PO3	PO4
CO1	H	-	H	H
CO2	H	-	H	-
CO3	H	-	H	M
CO4	H	-	H	-
18PSPE11	H	-	H	L

1-Low(L); 2-Medium(M); 3-High(H)

18PSPE12 POWER ELECTRONICS FOR RENEWABLE ENERGY

Category: PE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

To realize the applications of power electronics in Renewable energy systems.

RENEWABLE ENERGY SOURCES AND THEIR ENVIRONMENTAL IMPACTS(09)

Environmental aspects of electric energy conversion: impacts of conventional energy generation on environment (cost-GHG Emission) - Qualitative study of different renewable energy resources: Solar, Wind, Ocean, Biomass, Fuel cell, Hydrogen energy systems, Need for hybrid renewable energy systems.

ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION (09)

Review of reference theory fundamentals - Principle of operation, Analysis of Induction generators (SCIG, DFIG) and Synchronous generators (PMSG).

POWER CONVERTERS FOR SOLAR PV SYSTEMS (09)

DC-DC Converters, line commutated converters - Design of solar PV System: selection of inverters, Sizing of PV array and battery Wind: Soft Starters, AC-DC-AC Converters, Matrix Converters.

FIXED AND VARIABLE SPEED WECS (09)

Fixed and variable speed wind energy conversion systems and solar system (stand alone and grid connected mode), Issues of Grid Integration.

HYBRID RENEWABLE ENERGY SYSTEMS (09)

Need for Hybrid Systems (wind-solar-diesel-fuel cell) - Case studies - Maximum Power Point Tracking (MPPT) techniques for wind and solar; Energy storage for stand alone systems.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES:

*1. Rashid .M. H, "**Power electronics Hand book**", Academic press, 2001.*

*2. Rai. G.D, "**Non-conventional energy sources**", Khanna publishers, 2004.*

*3. Rai. G.D, "**Solar energy utilization**", Khanna publishers, 2005.*

*4. Gray, L. Johnson, "**Wind energy system**", Prentice Hall linc, 1995.*

*5.B.H.Khan, "**Non-conventional Energy sources**", Tata McGraw-hill Publishing Company, New Delhi, 2006.*

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

CO1: Revise of environmental impacts of renewable energy systems.
CO2: Acquire knowledge on Role of electrical machines and power converters.
CO3: Plan the novel concepts of WECS and hybrid RES.

COURSE ARTICULATION MATRIX

CO/PO	PO1	PO2	PO3	PO4
CO1	H	-	H	H
CO2	H	-	H	-
CO3	H	-	H	M
18PSPE12	H	-	H	M

1-Low(L); 2-Medium(M); 3-High(H)

18PSPE13 DISTRIBUTED GENERATIONS AND MICROGRID Category : PE

(Common to PED)

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

To introduce the concept of distributed generations, grid integration and recent developments on Microgrid

UNIT-I : Introduction (09)

Conventional power generations – Energy crises – Non Conventional Energy resources : Review of Solar PV and Wind Energy Systems – Fuel cells – Micro turbines – Biomass – Tidal sources

UNIT-II : Distributed Generations (09)

Concept of distributed generations, topologies, selection of sources – Regulatory standards/Frame work – Standards for interconnecting Distributed resources to electric power systems: IEEE standard 1547 – DG installation classes – Security issues in DG implementations – Energy storage elements: Batteries, ultra-capacitors – Flywheels – Captive power plants.

UNIT-III : Impact of Grid Integration (09)

Requirements for grid integration – Limits on operational parameters : voltage, frequency, THD-Response to grid abnormal operating systems – Islanding issues – Impact of grid integration with NCE sources on existing power system – Reliability, Stability and Power quality issues

UNIT-IV : Fundamentals of a Microgrid (09)

Definition and Concept of microgrid – microgrid drivers and benefits – review of sources of microgrids – typical structure and configuration of a microgrid – AC and DC grids – Power electronic interfaces in DC and AC microgrids.

UNIT-V : Control and Operation of Microgrid (09)

Modes of operation and control of microgrid : grid connected and islanded mode – Active and reactive power control, protection issues – anti-islanding schemes: passive, active and communication based techniques – microgrid communication inftrastructure – power quality issues in microgrid – regulatory standards – microgrid economics – introduction to smart grid.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. *Gevork B. Gharehpetian,* ***'Distributed Generation Systems: Design, Operation and Grid Integration",*** *Elsevier, 2017*
2. Fainan Hassan and Math H. J. Bollen, **"Integration of Distributed Generation in the Power System"***, John Wiley and Sons. 2011.*
3. *Chetal Singh Solanki,* ***"SolarPhotovoltaics-Fundamentals, Technologies and applications"****, PH India, 2009.*
4. Nikos Hatziargyriou, **"Microgrid :Architecture and control",** John Wiley, 2014
5. Fereidoon P. Sioshansi**, "Smart grid: Integrating renewable, Distributed and Efficient Energy",** Elsevier, 2012

COURSE OUTCOMES:

CO1: Able to illustrate the concept of distributed generations
CO2: Analyze the impact of grid integration
CO3: Recognize and design of Microgrid and its configuration
CO4: Explore the Economic aspects of Mircrogrid and Smart grid
CO5: Identify the implementation of distributed and microgrid based on the societal needs

COURSE ARTICULATION MATRIX

CO/PO	PO1	PO2	PO3	PO4
CO1	H	-	H	H
CO2	H	-	H	-
CO3	H	-	H	M
CO4	H	-	H	M
CO5	H	-	H	M
18PSPE13	H	-	H	M

1-Low(L); 2-Medium(M); 3-High(H)

18PSPE14 **INSULATION MATERIALS AND TESTING FOR INDUSTRIAL APPLICATIONS** **Category: PE**

(Common to PED)

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

To be familiar with insulation materials, testing and measurement for industrial applications

UNIT-I : INSULATION MATERIALS AND MEASUREMENTS (09)

Dielectrics and insulators, resistance of insulation materials, tests and models. Electrical stress - Mechanical stress - Chemical Attack - Thermal stress - Environmental contamination - Predictive Maintenance - Benefit of new technology – Measurement of Insulation Resistance – Operation of insulation Resistance tester - The Guard Terminal - Evaluation and Interpretation of Results.

UNIT-II : INSULATION TESTS (09)

Diagnostic High Voltage Insulation Tests - Spot reading test - Time Vs. Resistance test - Polarization index test - Step voltage test - Ramp voltage test - Dielectric discharge test - Different Problems/different tests - Potential sources of error/ensuring Quality test – Results - Test leads - Making Measurements above 100 GΩ - Accuracy statements - Delivery of stated voltage - Interference Rejection - Rules on testing and comparing - CAT Rating - CAT Rating Guidelines – Importance of CAT rating - CAT Rating basic statistics.

UNIT-III : TESTING INSULATION RESISTANCE OF ROTATING MACHINERY (09)

Effects of temperature - Effects of Humidity - Ingress Protection - High Potential testing - Current (nA) Readings Vs. Resistance (MΩ) – Burn capability - Drying out electrical equipment - Test item discharge - Charging time for large equipment - Motor driven insulation testers - Test Lead Design - Significant safety enhancements - Things to consider for safe operation - Safety Warnings - Electrical insulation for rotating machines -Insulating liners, separators, sleeving and stator winding insulation.

UNIT-IV : EARTH RESISTIVITY AND MEASUREMENT (09)

Factors affecting Minimum Earth Resistance - Basic Definitions - Requirements for a Good Grounding System - National Electrical Code - Maximum Values - Nature of Earth Electrode - Principles Involved in Earth Resistance Testing - Basic Test Methods for Earth Resistance - Effects of Different Reference Probe Locations - Lazy Spikes - Supplementary Tests.

UNIT-V : ACCURATE MEASUREMENT OF EARTH RESISTANCE FOR LARGE (09)

Testing Challenges in Large Ground Systems – Addressing the Testing Challenges in Large Ground Systems – Nomograph Guide to Getting Acceptable Earth Resistance – Clamp-On Method – Attached Rod Techniques – Measurement of the Resistance of Large Earth Electrode Systems: Intersecting – Curves Method1 – Test as a Large Substation – General Comments – Slope Method – Four Potential Method – Star Delta Method – Determining Tough and Step Potential – Ground Testing Methods Chart.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1.André O. Desjarlais and Robert R. Zarr ***"Insulation Materials: Testing and Applications"****, 4th Volume, ASTMInternational, Jan-2002*

2.Andrew R. Hileman, ***"Insulation Coordination for Power Systems"****, CRC Press, Jan 2002.*

3.Joseph F. Kimpflen, ***"Insulation Materials, Testing, and Applications"****, ASTM International, Jan 1990.*

4.George L Shew, ***"Earth Resistivity Measurement and its Application to Layer Problems"****, University of Southern California Press, 1936.*

COURSE OUTCOMES:

CO1: Illustrate various measurements and tests of insulators in power system.

CO2: Comprehend the approaches of calculations of insulation specifications.

CO3: Practice the requirements of insulation as applied to large power system.

COURSE ARTICULATION MATRIX

CO/PO	PO1	PO2	PO3	PO4
CO1	H	-	H	-
CO2	H	-	H	-
CO3	H	-	H	-
18PSPE14	H	-	H	-

1-Low(L); 2-Medium(M); 3-High(H)

18PSPE15 **ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY IN SYSTEM DESIGN** **Category : PE**

(Common to PED)

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

To Outline the EMI/EMC problems and provide information for solutions to mitigate EMI through system level design as per prescribed standards.

UNIT-I : EMI ENVIRONMENT **(09)**

EMI/EMC concepts and definitions - Sources of EMI- conducted and radiated EMI- Practical Experiences and Constraints – An Overview of EMI and EMC – Analytical examples – Celestial Electromagnetic Noise – Lightning discharge – ESD - EMP.

UNIT-II : OPEN AREA TEST SITES, MEASURMENT OF RI AND CI **(09)**

Open area Test site and measurements – Measurement precautions, errors and site imperfections – Terrain roughness imperfections, normalized site attenuation – Antenna factor measurement – RI measurements – Anechoic chamber – TEM cell – Reverberating chamber – GTEM – Comparison. CI measurement - characterization of conduction currents and voltages – conducted EM noise on power supply lines – Conducted EMI from equipment, immunity, detectors and measurement.

UNIT-III : EMI MITIGATION **(09)**

Grounding – Shielding – Electrical Bonding – EMI Filters – characteristics – Power line filter design, installation and evaluation – EMI suppression cables - Connectors – gaskets – isolation transformers – opto isolators – transient and surge suppression devices – EMC accessories.

UNIT-IV : SIGNAL INTEGRITY AND EMC STANDARDS **(09)**

SI problems – analysis – issues in design – modeling and simulation. Standards for EMI / EMC – BS, FCC, CISPR, IEC, EN – IEEE/ANSI standards - Military standards - MIL STD 461E/462 – VDE standards – EMI/EMC standards in Japan. Comparison.

UNIT-V : EMC DESIGN OF PCBs **(09)**

PCB Traces impedance - Routing, Control, Power Distribution Decoupling - Zoning, Motherboard Designs and Propagation Delay Performance Models.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. *Kodali V.P., **"Engineering EMC Principles, Measurements and Technologies", IEEE Press, 2001.***
2. *Mark I Montrose., **"EMC and the Printed Circuit Board Design, Theory and Layout Made Simple", IEEE Press, 1999***
3. *Henry W.Ott, "**Noise Reduction Techniques in Electronic Systems", John Wiley and Sons,NewYork, Second Edition, 1988.***
4. *Paul C.R., "**Introduction to Electromagnetic Compatibility" , John Wiley and Sons Inc., Second Edition, 2006.***
5. *Kodali V.P., **"Engineering EMC Principles, Measurements and Technologies", IEEE Press, 1996.***
6. *Bernhard Keiser, "**Principles of Electromagnetic Compatibility", Artech house, Third Edition, 1987***

COURSE OUTCOMES:

Upon completion of this course, the student will be able to
CO1: Review the basics of EMI/ EMC
CO2: Familiarize with EMI measurements Diagnose and solve basic electromagnetic compatibility problems
CO3: Understand the EMI mitigation technologies and able to design filters
CO4: Gain knowledge on suppression cables, surge suppression devices and EMC accessories
CO5: Possess knowledge on EMC standards
CO6: Design the Cable routing & connection and understand the Interconnection Techniques for EMI free system.

COURSE ARTICULATION MATRIX

CO/PO	PO1	PO2	PO3	PO4
CO1	H	-	H	-
CO2	H	-	H	-
CO3	H	-	H	-
CO4	H	-	H	-
CO5	H	-	H	-
CO6	H	-	H	-
18PSPE15	H	-	H	-

1-Low(L); 2-Medium(M); 3-High(H)

18PSPE16 **FUZZY AND NEURAL SYSTEMS** **Category : PE**

(Common to PED)

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

To provide knowledge on Neural Networks and Fuzzy Logic Control and understand the use these for controlling real time systems.

UNIT-I : INTRODUCTION TO NEURAL NETWORKS (09)

Introduction – Biological and Artificial neural networks - Learning rules – Training - ADALINE - MADALINE – BAM – Discrete Hopfield networks.

UNIT-II : ARTIFICIAL NEURAL NETWORKS (09)

Theory, Architecture and Applications of Back propagation network – Counter propagation network – Kohenen's Self Organising Maps.

UNIT-III : INTRODUCTION TO FUZZY (09)

Fuzzy sets and membership – Chance Vs ambiguity – Classical sets – Fuzzy sets – Fuzzy relations – Tolerance and Equivalence relations – Value assignments.

UNIT-IV : FUZZIFICATION AND DEFUZZIFICATION (09)

Fuzzification – Membership value assignments – Fuzzy to Crisp conversions -Lambda – Cuts for Fuzzy sets and relations – Defuzzification methods. Simple Neuro – Fuzzy Controller.

UNIT-V : FUZZY ARITHMETIC, NUMBERS, VECTORS AND EXTENSION PRINCIPLE (09)

Extension principle – Fuzzy numbers – Interval analysis in arithmetic – Approximate methods of extension: Vertex method, DSW algorithm, Restricted DSW algorithm – Fuzzy vectors – Classical predicate logic – Approximate reasoning – Fuzzy tautologies, contradictions, Equivalence and Logical proofs.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. *LaureneFausett, "**Fundamentals of Neural Networks**", Prentice Hall, New Jersey, 2004*
2. *Timothy J.Ross, "**Fuzzy logic with Engineering Applications**", Wiley India Pvt. Ltd., 3rd Ed., 2010*
3. *Kosko.B "**Neural Network and fuzzy systems**"- Prentice Hall of India Pvt. Ltd., New Delhi, 2007*
4. *S N Sivanandam., S N Deepa, "**Principles of Soft Computing**", Wiley India Pvt. Ltd., 2nd Ed., 2011*
5. *Robert .J.Schalkoff, "**Artificial Neural Networks**", McGraw Hill, Singapore, 2011*

COURSE OUTCOMES:

Upon completion of this course, the student will be able to

CO1: Familiarize with the basic concepts of neural networks.

CO2: Learn about BAM and discrete Hopfield networks.

CO3: Master the functioning of back propagation network and Kohenen's self organizing map

CO4: Familiarize with the concept of Fuzzy sets and able to differentiate crisp set and fuzzy sets

CO5: Analyzefuzzification and Defuzzification.

CO6: Comprehend Neuro-Fuzzy modelling

COURSE ARTICULATION MATRIX

CO/PO	PO1	PO2	PO3	PO4
CO1	M	-	-	-
CO2	M	-	-	-
CO3	M	-	M	-
CO4	M	-	L	-
CO5	M	-	M	-
CO6	M	-	M	-
18PSPE16	M	--	L	-

L – Low, M – Moderate (Medium), H- High

18PSPE17 INTELLIGENT SYSTEMS APPLICATION TO POWER SYSTEMS

Category: PE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

To provide fundamentals of intelligent systems and their applications in Power systems including electrical power system operation, control and utilization

UNIT-I KNOWLEDGE-BASED INTELLIGENT SYSTEMS (09)

Concepts and theory - Knowledge representation techniques - Structure of a rule-based expert system - Forward and backward chaining inference techniques.

UNIT-II FUZZY SYSTEMS (09)

Concepts of Fuzzy reasoning - Membership Functions and Fuzzy sets - Fuzzy rules - Defuzzification methods - Fuzzy inference - Building a fuzzy expert system.

UNIT-III ARTIFICIAL NEURAL NETWORKS (09)

Concepts of ANN - Neuron and Perceptron - Multilayer neural networks - Forward and Backward Propagation - Neural Network Training - Hopfield network.

UNIT-IV EVOLUTIONARY COMPUTATION (09)

Concepts of Evolutionary computing - Genetic algorithms - Chromosomes, fitness function, cross-over and mutation - Evolutionary Programming - Hybrid Algorithms**:** Simulated Annealing - Combined Genetic Algorithm and Simulated Annealing - Fuzzy Neural Systems - Fuzzy Genetic Algorithm.

UNIT-V APPLICATION OF INTELLIGENT TECHNIQUES IN POWER SYSTEM (09)

Applications in Control and Utilization – Intelligent process control - Intelligent robot control and Utilization - Case study**:** To study the performance of genetic algorithm on solving - DeJong problems and Colville problems - To investigate the effects of parameter setting and solution acceleration technique on the performance of genetic algorithm – Application of genetic algorithm to Electrical Engineering problems.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

*1. K.Y. Lee and M.A. El-Sharkawi, "**Modern Heuristic Optimization Techniques: Theory and Applications to Power Systems**", Wiley-IEEE Press, 2008.*

*2. M. Negnevitsky,"**Artificial Intelligence-A Guide to Intelligent Systems**", Addison-Wesley, 2005.*

*3. K. Warwick, A. Ekwue and R. Aggarwal, "**Artificial Intelligence Techniques in Power Systems**", IEE Power Engineering Series 22, UK, IEE Press, 1997.*

*4. L.L. Lai,"**Intelligent System Applications in Power Engineering**", Wiley, 1998.*

*5. T.S. Dillon and M.A. Laughton, "**Expert System Applications in Power Systems**", Prentice Hall, 1990*

6. Selected reference papers in IEEE Transactions and IEE Proceedings.

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

CO1: Understand the fundamental concepts and characteristics and methodologies ofintelligent systems.

CO2: Analyzethe intelligent system approaches in real-time electrical power systems

CO3: Design the artificial intelligence systems, evolutionary computation algorithms,uncertainty representation and reasoning mechanisms for a particular application.

CO4: Integrate the intelligent system approaches in real-time electrical power engineering and control problems.

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4
CO1	M	-		-
CO2	M	-	M	-
CO3	H	-	H	-
CO4	H	-	H	L
18PSPE17	H	-	M	L

L – Low, M – Moderate (Medium), H- High

18PSPE18COMPUTER RELAYING AND WIDE AREA MEASUREMENT SYSTEM

Category: PE

L T P C

3 0 03

PREREQUISITES: NIL

COURSE OBJECTIVES:

The goal of this course is to understand the operating principles of a computer relays and wide area measurement systems through the computer hierarchy in the substation, system relaying and control

UNIT-IINTRODUCTION (09)

Historical background - Expected benefits - Computer relay architecture - Analog to digital converters - Anti-aliasing filters - Substation computer hierarchy - Fourier series Exponential fourier series - Sine and cosine fourier series – Phasor.

UNIT-II FILTERS IN COMPUTER RELAYING (09)

Walsh functions - Fourier transforms - Discrete fourier transform - Random processes - Filtering of random processes - Kalman filtering - Digital filters - Windows and windowing - Linear phase Approximation - Filter synthesis – Wavelets - Elements of artificial intelligence.

UNIT-III REPRESENTATION OF PHASORS (09)

Introduction - Phasor representation of sinusoids - Fourier series and Fourier transform and DFT Phasor representation - Phasor Estimation of Nominal Frequency Signals - Formulas for updating phasors - Nonrecursive updates - Recursive updates - Frequency Estimation.

UNIT-IV PHASOR MEASUREMENT UNITS (09)

A generic PMU - The global positioning system - Hierarchy for phasor measurement systems - Functional requirements of PMUs and PDCs - Transient Response of: Phasor Measurement Units, of instrument transformers, filters. Transient response during electromagnetic transients and power swings.

UNIT-V PHASOR MEASUREMENT APPLICATIONS (09)

State Estimation - History, Operator's load flow - Weighted least square: least square, Linear weighted least squares, Nonlinear weighted least squares - Static state estimation - State estimation with Phasors measurements - Linear state estimation – Protection system with phasor inputs: Differential and distance protection of transmission lines - Adaptive protection - Adaptive out-of-step protection.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

*1. A.G. Phadke, J.S. Thorp, "**Computer Relaying for Power Systems**", John Wiley and Sons Ltd., Research Studies Press Limited, 2nd Edition, 2009.*

*2.A.G. Phadke, J.S. Thorp, "**Synchronized Phasor Measurements and Their Applications**", Springer.*

*3. Antonello Monti, Carlo Muscas, Ferdinanda Ponci,**"Phasor Measurement Units and Wide Area Monitoring Systems"** Academic Press, 09-Jun-2016*

*4.Stanley H. Horowitz, Arun G. Phadke, **"Power System Relaying"**, John Wiley & Sons, 25-Oct-2013*

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

CO1: Demonstrate knowledge of fundamental theories, principles and practice of computer relaying, Wide area measurement system.

CO2: Analyze the power system with computer relaying and Wide area measurement system.

CO3: Validate the recent relaying technologies which work towards smart grid

CO4: Design wide area measurement systems for Smart grid.

COURSE ARTICULATION MATRIX

CO/PO	PO1	PO2	PO3	PO4
CO1	M	-	M	-
CO2	H	-	M	-
CO3	H	-	M	M
CO4	H	-	H	M
18PSPE18	H	-	M	L

L – Low, M – Moderate (Medium), H- High

18PSPE19 MODERN POWER ELECTRONICS FOR TRACTION APPLICATIONS **Category : PE**

(Common to PED)

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

To annotate the theoretical concepts of dynamics of electric tractions using modern power electronics

UNIT-I : FUNDAMENTAL OF ELECTRIC DRIVES (09)

Basic concepts, Characteristics and operating modes of drive motors, Starting, braking and speed control of motors, Four quadrant drives, Nature and classification of load torque and associated controls used in Process industries, Selection of motors and rating.

UNIT-II : DC MOTOR DRIVES (09)

Starting, braking and speed control, Analysis of separately excited dc motor with continuous armature current and discontinuous armature current, Analysis of dc series motor drives, Comparative evaluation of phase angle control, Semi-converter operation of full converter, Single phase half controlled and fully controlled rectifier fed dc motors, Sequence control, Three phase half controlled and fully controlled rectifier fed dc motors, Dual converter with circulating and non-circulating current controlled drives, Closed loop control system of dc motor drives, Reversible drives, Analysis and performance characteristics of chopper fed dc motors, Motoring and braking operations, Multiphase chopper, Phase locked loop control of dc drive.

UNIT-III : INDUCTION MOTOR DRIVES (09)

Operation with unbalanced source voltages and unbalanced rotor impedances, Effect of time harmonics on the motor performance, Braking, Stator voltage control of induction motor, Variable voltage variable frequency (VVVF) operation, Voltage source inverter (VSI) fed induction motor drive, Static rotor resistance control, Slip power recovery systems, closed loop control of ac drives, Introduction to field oriented control of ac motors, Comparison of ac and dc drive, Their selection for particular application.

UNIT-IV : ELECTRIC TRACTION (09)

General features of electrical traction, Mechanics of train movement, Nature of traction load, Speed-time curves, Calculations of Traction drive rating and Energy consumption, Train resistance, Adhesive weight and Coefficient of Adhesion, Tractive effort for acceleration and propulsion, Power and Energy output from driving axles, Methods of speed control and braking of motors for traction load, Electric drive systems for electric traction.

UNIT-V : TRACTION MOTORS AND CONTROL (09)

Desirable characteristics of Traction motors-Motors used for Traction purpose-Methods of starting and speed control of D.C Traction motors-Rheostatic Control- Energy saving with plain Rheostatic control- Series-parallel control- Energy saving with series parallel starting - Shunt Transititon - Bridge-Transition- Drum control-contactor type bridge Transition controller –Metadyne control-Multiple unit control -Regenerative braking.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. G.K. Dubey, ***"Fundamental of Electrical Drives"****, Narosa Publication, Reprint 2015*
2. B.K. Bose, ***"Power Electronics & Variable Frequency drive"****, IEEE press,1997*
3. K. Pillai, ***"First Course on Electrical Drives"****, New Age International 3rd edition 2017.*
4. VedamSubramanyam, ***"Electric Drives– concepts and applications"****, Tata McGraw Hill, 2011*
5. C. Garg, ***"Utilization of Electrical Power and Electrical Traction"****, Khanna Publication*. 1990

COURSE OUTCOMES:

CO1: Analyze the power converters for traction applications.

CO2: Analyze the performance of dc motor drives and induction motor drives for various operating conditions.

CO3: Estimate energy consumption rating of motor for traction application.
CO4: Understand about the various control methods for electrical traction.

COURSE ARTICULATION MATRIX

CO/PO	PO1	PO2	PO3	PO4
CO1	H	-	M	-
CO2	H	-	M	-
CO3	H	-	M	-
CO4	M	-	-	-
18PSPE19	H	-	M	-

L – Low, M – Moderate (Medium), H- High

18SEOE01 VASTU SCIENCE FOR BUILDING CONSTRUCTION

(Common to All Branches)

Category: OE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

To impart basic knowledge of vastu science and its impact on human well being.

UNIT I - INTRODUCTION (9)

Traditional definition - Meaning of Vastu and Vaastu -its classification -Relationship to earth - concept of existence and manifestation – planatory influence on earth.

UNIT II - SPACE THEORY IN VASTU (9)

Features of good building site -good building shapes -macro, micro, enclosed and material spaces - relationship between built space, living organism and universe -impact of built space on human psyche. Flow of energy within built space and outside -zoning of functional areas - fitting of components in the building -significance of water bodies and energy -The cube as the basic structure.

UNIT III - COSMOGRAM & SETTLEMENT CONCEPTS (9)

: Orientation of building, site, layout and settlement -positive and negative energies - importance of cardinal and ordinal directions -The celestial grid or-mandala and its type.The Vaastu Purusha Mandala and its significance in creation of patterns, and lay-outs, extension of this to aural and visual fields -Types of Lay-Outs

UNIT IV - INTERFACE OF TIME, VIBRATION AND RHYTHM (9)

Theory of vibration and energy transfer – equation of time and space – manifestation in living organism – human beings – measurement of the energy– Kirlian energy of various forms-documentation of objects – filaments and streamers.

UNIT V - MEASUREMENTS & MATERIALS (9)

Units of measurement -Mana shastra -Ayadi techniques -Tala system and Hasta system of measures -Musical measurements compared to space measurements -resultant ambience in built space.Use of wood, stone, metal, brick and time- making technology, corbelling technology,jointing technology -foundations for heavy and light structures -Landscaping in and around buildings -Aesthetic in Indian Architecture.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. Dr.Prasanna Kumar Acharya-Manasara -Ox ford1 University Press1927 -(English version)
2. K.S.Subramanya Sastri -Maya Matam -Thanjavur Maharaja Sarjoji saraswathil Mahal Library -Thanjavur-1966.
3. Stella Kramresh -The Hindu Temple Vol.1 & II Motital Banarsidass Publishers Pvt. Ltd., Delhi -1994.
4. Bruno Dagens -Mayamatam, Vol.1 & IIIGNCA and Motilal Bamarsidars, .Publishers Pvt. Ltd-s Delhi -1994.
5. George Birdsall -Feng Shui: The Key Concepts -January 2011

COURSE OUTCOMES:

The students are able to

CO1: Obtain exposure on various concepts of vastu

CO2: Understand the theories in Vastu.

CO3: familiarize with the Cosmogram and settlement concepts of vastu

CO4: Understand the role of vasthu in energy flow manifestation in living beings.

CO5: Plan a structure considering various vastu techniques.

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4
CO1	-	-	-	M
CO2	-	-	M	H
CO3	-	-	-	H
CO4	-	-	L	H
CO5	-	-	M	M
18SEOE01	-	-	L	H

L – Low, M – Moderate (Medium), H- High

18SEOE02 - PLANNING OF SMART CITIES
(Common to All Branches)

Category: OE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

To have an exposure on development of smart cities considering various fields related and their challenges.

UNIT I –SMART CITIES DEVELOPMENT POTENTIALS AND CHALLENGES (9)
Perspectives of Smart Cities: Introduction and Overview - Implementation Challenges - Methodological issues - Spatial distribution of start up cities – Re imagining post industrial cities - Implementation Challenges for Establishing Smart Urban Information and Knowledge Management System

UNIT II – ROLE OF ICT, REMOTE SENSING, AND GEOGRAPHICAL INFORMATION SYSTEM (9)
Optimising Green Spaces for Sustainable Urban Planning - 3D City Models for Extracting Urban Environmental Quality Indicators - Assessing the Rainwater Harvesting Potential - The Strategic Role of Green Spaces - Monitoring Urban Expansion

UNIT III –ENVIRONMENT, ENERGY, DISASTER MANAGEMENT AND SUSTAINABLE DEVELOPMENT (9)
Alternatives for Energy Stressed Cities - Social Acceptability of Energy-Efficient Lighting - Energy Management - Urban Dynamics and Resource Consumption - Issues and Challenges of Sustainable Tourism - Green Buildings: Eco-friendly Technique for Modern Cities

UNIT IV– MULTIFARIOUS MANAGEMENT FOR SMART CITIES (9)
An Assessment of Domestic Water Use Practices - An Issue of Governance in Urban Water Supply - Assessment of Water Consumption at Urban Household Level - Water Sustainability - Socio-economic Determinants and Reproductive Healthcare System - Problems and Development of Slums.

UNIT V – INTELLIGENT TRANSPORT SYSTEM (9) Introduction to Intelligent Transportation Systems (ITS)- The Range of ITS Applications -Network Optimization-Sensing Traffic using Virtual Detectors- In-Vehicle Routing, and Personal route information-The Smart Car-Commercial Routing and Delivery-Electronic Toll Collection-The Smart Card-Dynamic Assignment- Traffic Enforcement. Urban Mobility and Economic Development

CONTACT PERIODS:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. *Poonam Sharma, Swati Rajput, "Sustainable Smart Cities in India_ Challenges and Future Perspectives Springer 2017 Co.(P) Ltd. 2013*
2. *Ivan Nunes Da Silva, Rogerio Andrade Flauzino-Smart Cities Technologies-ExLi4EvA (2016)*
3. *Stan McClellan, Jesus A. Jimenez, George Koutitas (eds.)-Smart Cities_ Applications, Technologies, Standards, and Driving Factors-Springer International Publishing (2018)*
4. *Stan Geertman, Joseph Ferreira, Jr., Robert Goodspeed, John Stillwell, "Planning Support Systems and Smart Cities" , Springer, 2015*

COURSE OUTCOME:

CO1: Identify the potential and challenges in smart city development.
CO2: Apply the different tools for sustainable urban planning.
CO3: Understand the concepts of environment, energy and disaster management.
CO4: Identify the proper methods for water and waste water management.
CO5: Familiarize with the intelligent transport systems.

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4
CO1	H	-	-	H
CO2	H	-	M	L
CO3	M	-	-	H
CO4	M	-	M	M
CO5	L	-	L	-
18SEOE02	M	-	L	L

L – Low, M – Moderate (Medium), H- High

18SEOE03 - GREEN BUILDING
(Common to All Branches)

Category: OE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

- To introduce the different concepts of sustainable design and green building techniques and how they may be synthesized to best fit a specific construction project.

UNIT I - INTRODUCTION (9)

Life Cycle impacts of materials and products – sustainable design concepts – strategies of Design for the Environment -The sun-earth relationship and the energy balance on the earth's surface, climate, wind – Solar radiation and solar temperature – Sun shading and solar radiation on surfaces – Energy impact on the shape and orientation of buildings – Thermal properties of building materials.

UNIT II - ENERGY EFFICIENT BUILDINGS (9)

Passive cooling and day lighting – Active solar and photovoltaic- Building energy analysis methods- Building energy simulation- Building energy efficiency standards- Lighting system design- Lighting economics and aesthetics- Impacts of lighting efficiency – Energy audit and energy targeting- Technological options for energy management.

UNIT III - INDOOR ENVIRONMENTAL QUALITY MANAGEMENT (9)

Psychrometry- Comfort conditions- Thermal comfort- Ventilation and air quality-Air conditioning requirement- Visual perception- Illumination requirement- Auditory requirement- Energy management options- -Air conditioning systems- Energy conservation in pumps- Fans and blowers- Refrigerating machines- Heat rejection equipment- Energy efficient motors- Insulation.

UNIT IV - GREEN BUILDING CONCEPTS (9)

Green building concept- Green building rating tools- Leeds and IGBC codes. – Material selection Embodied energy- Operating energy- Façade systems- Ventilation systems- Transportation- Water treatment systems- Water efficiency- Building economics

UNIT V - GREEN BUILDING DESIGN CASE STUDY (9)

Students to work through a controlled process of analysis and design to produce drawings and models of their own personal green building project. Topics include building form, orientation and site considerations; conservation measures; energy modeling; heating system and fuel choices; renewable energy systems; material choices; and construction budget-Case Study on green construction and design.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. *Kibert, C.* ***"Sustainable Construction: Green Building Design and Delivery"****, John Wiley & Sons, 2005*
2. *Edward G Pita,* ***"An Energy Approach- Air-conditioning Principles and Systems",*** *Pearson Education, 2003.*
3. *Colin Porteous,* ***"The New Eco-Architecture"****, Spon Press, 2002.*
4. *Energy Conservation Building Codes: www.bee-india.nic.in*
5. *Lever More G J,* ***"Building Energy Management Systems",*** *E and FN Spon, London, 2000.*
6. *Ganesan T P,* ***"Energy Conservation in Buildings",*** *ISTE Professional Center, Chennai, 1999.*
7. *John Littler and Randall Thomas,* ***"Design with Energy: The Conservation and Use of Energy in Buildings",*** *Cambridge University Press, 1984.*

COURSE OUTCOMES:

The students are able to

CO1: Describe the concepts of sustainable design
CO2: Familiarize with green building techniques including energy efficiency management.
CO3: Understand the indoor environmental quality management in green building.
CO4: Perform the green building rating using various tools.
CO5: Create drawings and models of their own personal green building project.

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4
CO1	M	-	-	H
CO2	H	-	M	H
CO3	H	-	-	H
CO4	M	-	M	M
CO5	M	-	-	M
18SEOE03	M	-	L	H

L – Low, M – Moderate (Medium), H- High

18EEOE04 - ENVIRONMENT, HEALTH AND SAFETY IN INDUSTRIES
(Common to All Branches)

Category : OE

L	T	P	C
3	0	0	3

PREREQUISITES : NIL

COURSE OBJECTIVES:
On completion of this course the students are able to:
1. Get knowledge about occupational health hazard and safety measures at work place
2. Learn about accident prevention and safety management
3. Learn about general safety measures in industries

UNIT I OCCUPATIONAL HEALTH AND HAZARDS (8)
Occupation, Health and Hazards - Safety Health and Management: Occupational Health Hazards - Ergonomics - Importance of Industrial SafetyRadiation and Industrial Hazards : Types and effects - Vibration - Industrial Hygiene - Different air pollutants in industries and their effectsElectrical, fire and Other Hazards - General causes, Machine Guards and its types, Automation.

UNIT II SAFETY A WORKPLACE (10)
Safety at Workplace - Safe use of Machines and Tools: Safety in use of different types of unit operations - Ergonomics of Machine guarding - working in different workplaces - Operation, Inspection and maintenance Plant Design and Housekeeping, Industrial lighting, Vibration and Noise.

UNIT III ACCIDENT PREVENTION (9)
Accident Prevention Techniques - Principles of accident prevention - Definitions, Theories, Principles - Hazard identification and analysis, Event tree analysis, Hazop studies, Job safety analysis - Theories and Principles of Accident causation - First Aid : Body structure and functions - Fracture and Dislocation, Injuries to various body parts.

UNIT IV SAFETY MANAGEMENT (9)
Safety Management System and Law - Legislative measures in Industrial Safety: Various acts involved in Detail- Occupational safety, Health and Environment Management : Bureau of Indian Standards on Health and Safety, 14489, 15001 - OSHA, Process safety management (PSM) and its principles - EPA standards- Safety Management : Organisational& Safety Committee - its structure and functions.

UNIT V GENERAL SAFETY MEASURES (9)
Plant Layout for Safety -design and location,distance between hazardous units, lighting, colour coding, pilot plant studies,Housekeeping - Accidents Related with Maintenance of Machines - Work Permit System : Significance of Documentation Directing Safety : Definition, Process, Principles and Techniques Leadership : Role, function and attribution of a leader Case studies - involving implementation of health and safety measures in Industries.

CONTACT PERIODS:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 PeriodsTotal 45 Periods

REFERENCE BOOKS :

1. *R.K. Jain and Sunil S. Rao, Industrial safety, Health and Environment Management, Khanna publishers, New Delhi (2006).*
2. *Frank P. Lees - Loss of Prevention in Process Industries, Vol 1 and 2, Butterworth - Heinamann Ltd., London (1991)*
3. *Industrial Safety - National Council of India*
4. *Factories Act with Amendments 1987, Govt. of India Publications DGFASLI, Mumbai*

COURSE OUTCOMES:

At the end of the course student will be able to:

CO1 : Gain the knowledge about occupational health hazard and safety measures at work place
CO2 : be Able to learn about accident prevention and safety management
CO3 : Understand occupational health hazards and general safety measures in industries
CO4 : Got to know various laws, standards and legislations.
CO5 : Able to learn about safety and proper management of industries

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4
CO1	-	-	L	M
CO2	L	-	-	L
CO3	L	-	L	L
CO4	L	L	-	M
CO5	-	-	L	L
18EEOE04	L	-	L	L

L-Low, M-Moderate(Medium), H-High

18EEOE05 - CLIMATE CHANGE AND ADAPTATION
(Common to All Branches)

Category : OE

L	T	P	C
3	0	0	3

PREREQUISITES : NIL

COURSE OBJECTIVES:

On completion of this course the students are able to:

1. Able get knowledge about Climate system and its changes and causes
2. Able to learn about impacts, adaptation and mitigation of climate change
3. Able to learn about clean technology and clean energy

UNIT I EARTH'S CLIMATE SYSTEM (09)

Introduction-Climate in the spotlight - The Earth's Climate Machine – Climate Classification - Global Wind Systems – Trade Winds and the Hadley Cell – The Westerlies - Cloud Formation and Monsoon Rains – Storms and Hurricanes - The Hydrological Cycle – Global Ocean Circulation – El Nino and its Effect - Solar Radiation – The Earth's Natural Green House Effect – Green House Gases and Global Warming – Carbon Cycle.

UNITII OBSERVED CHANGES AND ITS CAUSES (09)

Observation of Climate Change – Changes in patterns of temperature, precipitation and sea level rise – Observed effects of Climate Changes – Patterns of Large Scale Variability – Drivers of Climate Change – Climate Sensitivity and Feedbacks – The Montreal Protocol – UNFCCC – IPCC – Evidences of Changes in Climate and Environment – on a Global Scale and in India – climate change modeling.

UNIT III IMPACTS OF CLIMATE CHANGE (09)

Impacts of Climate Change on various sectors – Agriculture, Forestry and Ecosystem – Water Resources – Human Health – Industry, Settlement and Society – Methods and Scenarios – Projected Impacts for Different Regions – Uncertainties in the Projected Impacts of Climate Change – Risk of Irreversible Changes.

UNIT IV CLIMATE CHANGE ADAPTATION AND MITIGATION MEASURES(09)

Adaptation Strategy/Options in various sectors – Water – Agriculture –- Infrastructure and Settlement including coastal zones – Human Health – Tourism – Transport – Energy – Key Mitigation Technologies and Practices – Energy Supply – Transport – Buildings – Industry – Agriculture – Forestry - Carbon sequestration – Carbon capture and storage (CCS) - Waste (MSW & Bio waste, Biomedical, Industrial waste – International and Regional cooperation.

UNITV CLEAN TECHNOLOGY AND ENERGY (09)

Clean Development Mechanism – Carbon Trading - examples of future Clean Technology – Biodiesel – Natural Compost – Eco- Friendly Plastic – Alternate Energy – Hydrogen – Bio-fuels – Solar Energy – Wind – Hydroelectric Power – Mitigation Efforts in India and Adaptation funding.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 PeriodsTotal: 45 Periods

REFERENCE BOOKS:

1. *Jan C. van Dam, Impacts of Climate Change and Climate Variability on Hydrological Regimes, Cambridge University Press, 2003.*
2. *IPCC fourth assessment report - The AR4 synthesis report, 2007*
3. *IPCC fourth assessment report –Working Group I Report,* ***" The physical Science Basis",*** *2007*
4. *IPCC fourth assessment report - Working Group II Report,* ***" Impacts, Adaptation and Vulnerability",*** *2007*
5. *IPCC fourth assessment report – Working Group III Report" Mitigation of Climate change", 2007*
6. *Bates, B.C., Z.W. Kundzewicz, S. Wu and J.P. Palutikof, Eds.,* ***'Climate Change and Water'.*** *Technical Paper of the Intergovernmental Panel on Climate Change, IPCC Secretariat, Geneva, 2008.*
7. *Dash Sushil Kumar,* ***"Climate Change – An Indian Perspective"****, Cambridge University Press India Pvt. Ltd, 2007.*

COURSE OUTCOMES:

At the end of the course the student will be able:

CO1: To understand the climatic system and the factors influencing the climatic changes
CO2: To articulate the protocol and effect of climatic changes
CO3 : To assess the uncertainty and impact of climatic changes
CO4 : To develop strategies for adaptation and mitigation of climatic changes
CO5: To identify clean technologies for sustainable growth

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4
CO1	L	-	-	H
CO2	M	-	-	H
CO3	L	-	L	M
CO4	M	-	L	M
CO5	M	-	L	H
18EEOE05	M	-	L	H

L-Low, M-Moderate(Medium), H-High

18EEOE06 - WASTE TO ENERGY
(Common to All Branches)

Category: OE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:
On completion of this course the students are able to:
Able to get knowledge about the utilization of waste and its purpose.

UNITI INTRODUCTION (09)
Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forestresidue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNITII BIOMASS PYROLYSIS (09)
Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods -Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT III BIOMASS GASIFICATION (09)
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.

UNITIVBIOMASS COMBUSTION (09)
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.

UNITV BIOGAS (09)
Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technologyand 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 in India

CONTACT PERIODS:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 PeriodsTotal 45 Periods

REFERENCE BOOKS:

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

COURSE OUTCOMES:

At the end of the course the student will be able :

CO1: Understand solid waste management techniques

CO2: Know what is biomass

CO3 : Study Methods and factors considered for biomass gasification

CO4 : Know equipmentmeant for biomass combustion

CO5 : Understand about biogas and its development in India

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4
CO1	-	-	-	H
CO2	-	-	-	L
CO3	-	-	-	L
CO4	L	-	-	L
CO5	L	-	L	M
18EEOE06	-	-	-	M

L-Low, M-Moderate(Medium), H-High

18GEOE07 - ENERGY IN BUILT ENVIRONMENT
(Common to All Branches)

Category : OE

L	T	P	C
3	0	0	3

PREREQUISITES : NIL

COURSE OBJECTIVES:

On completion of this course students are able to:

1. About energy use and its management
2. Understand constructional requirements of buildings
3. Know relationship of energy and environment

UNIT I INTRODUCTION (09)

Indoor activities and environmental control - Internal and external factors on energy use - Characteristics of energy use and its management -Macro aspect of energy use in dwellings and its implications - Thermal comfort - Ventilation and air quality - Air-conditioning requirement - Visual perception - Illumination requirement - Auditory requirement

UNITII LIGHTINGREQUIREMENTS IN BUILDING (09)

The sun-earth relationship - Climate, wind, solar radiation and temperature - Sun shading and solar radiation on surfaces - Energy impact on the shape and orientation of buildings – Lighting and daylighting: Characteristics and estimation, methods of day-lighting – Architecturalconsiderations for day-lighting

UNIT III ENERGY REQUIREMENTS IN BUILDING (09)

Steady and unsteady heat transfer through wall and glazed window - Standards for thermal performance of building envelope - Evaluation of the overall thermal transfer - Thermal gain andnet heat gain - End-use energy requirements - Status of energy use in buildings - Estimation of energy use in a building

UNITIV ENERGY AUDIT (09)

Energy audit and energy targeting - Technological options for energy management - Natural andforced ventilation – Indoor environment and air quality - Airflow and air pressure on buildings -Flow due to stack effect

UNIT V COOLING IN BUILT ENVIRONMENT (09)

Passive building architecture – Radiative cooling - Solar cooling techniques - Solar desiccant dehumidification for ventilation - Natural and active cooling with adaptive comfort – Evaporativecooling – Zero energy building concept.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 PeriodsTotal 45 Periods

REFERENCE BOOKS:

1. *J. Krieder and A. Rabl (2000), Heating and Cooling of Buildings: Design for Efficiency,McGraw-Hill.*
2. *S. M. Guinnes and Reynolds (1989), Mechanical and Electrical Equipment for Buildings,Wiley.*
3. *A. Shaw (1991), Energy Design for Architects, AEE Energy Books.*
4. *ASHRAE (2001), Handbook of Fundamentals, ASHRAE, Atlanta, GA.*
5. *Reference Manuals of DOE-2 (1990), Orlando Lawrence-Berkeley Laboratory,University of California, and Blast, University of Illinois, USA.*

COURSE OUTCOMES:

At the end of the course the student will be able :

CO1: Understand energy and its usage
CO2: To know lighting to be given to a building
CO3 : To study energy requirements in a building
CO4 : Understand energy audit
CO5 : To study architectural specifications of a building.

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4
CO1	H	M	M	H
CO2	M	L	L	H
CO3	H	M	L	H
CO4	H	H	H	H
CO5	M	H	M	M
18GEOE07	H	M	M	H

L-Low, M-Moderate(Medium), H-High

18GEOE08 - EARTH AND ITS ENVIRONMENT
(Common to All Branches)

Category: OE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:
To know about the planet earth, the geosystems and the resources like ground water and air and to learn about the Environmental Assessment and sustainability.

UNIT I-EVOLUTION OF EARTH (09)
Evolution of earth as habitable planet - Evolution of continents - oceans and landforms - evolution of life through geological times - Exploring the earth's interior - thermal and chemical structure - origin of gravitational and magnetic fields.

UNIT II-GEOSYSTEMS (09)
Plate tectonics - working and shaping the earth - Internal Geosystems – earthquakes – volcanoes - climatic excursions through time - Basic Geological processes - igneous, sedimentation - metamorphic processes.

UNITIII-GROUND WATER GEOLOGY (09)
Geology of groundwater occurrence - recharge process - Groundwater movement - Groundwater discharge and catchment hydrology - Groundwater as a resource - Natural groundwater quality and contamination - Modeling and managing groundwater systems.

UNITIV- ENVIRONMENTAL ASSESMENT AND SUSTAINABILITY (09)
Engineering and sustainable development - population and urbanization - toxic chemicals and finite resources - water scarcity and conflict - Environmental risk - risk assessment and characterization - hazard assessment - exposure assessment.

UNITV-AIR AND SOLIDWASTE (09)
Air resources engineering - introduction to atmospheric composition – behaviour - atmospheric photochemistry - Solid waste management – characterization - management concepts.

CONTACT PERIODS:
Lecture: 45 periods Tutorial:0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:
1. John Grotzinger and Thomas H. Jordan, Understanding Earth, Sixth Edition, W. H. Freeman, 2010.
2. Younger, P. L., Groundwater in the Environment: An introduction, Blackwell Publishing, 2007.
3. Mihelcic, J. R., Zimmerman, J. B., Environmental Engineering: Fundamentals, Sustainability and Design, Wiley, NJ, 2010.

COURSE OUTCOMES:

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

CO1: Know about evolution of earth and the structure of the earth.

CO2: Understand the internal Geosystems like earthquakes and volcanoes and the various geological processes.

CO3: Understand the geological process of occurrence and movement of groundwater and the modeling systems.

CO4: Assess the Environmental risks and the sustainability developments.

CO5: Learn about the photochemistry of atmosphere and the solid waste management concepts.

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4
CO1	L	M	M	L
CO2	H	M	M	L
CO3	M	L	L	H
CO4	H	H	M	M
CO5	L	M	M	M
18GEOE08	M	M	M	M

L-Low, M-Moderate(Medium), H-High

18GEOE09 - NATURAL HAZARDS AND MITIGATION

(Common to All Branches)Category: OE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

To get idea about the various natural hazards like Earthquakes, slope stability, floods, droughts and Tsunami and the mitigation measures.

UNIT I-EARTHQUAKES (09)

Definitions and basic concepts - different kinds of hazards – causes - Geologic Hazards – Earthquakes - causes of earthquakes – effects - plate tectonics - seismic waves - measures of size of earthquakes - earthquake resistant design concepts.

UNIT II- SLOPE STABILITY (09)

Slope stability and landslides - causes of landslides - principles of stability analysis - remedial and corrective measures for slope stabilization.

UNITIII- FLOODS (09)

Climatic Hazards – Floods - causes of flooding - regional flood frequency analysis - flood control measures - flood routing - flood forecasting - warning systems.

UNIT IV-DROUGHTS (09)

Droughts – causes - types of droughts - effects of drought - hazard assessment - decision making - Use of GIS in natural hazard assessment – mitigation - management.

UNITV-TSUNAMI (09)

Tsunami – causes – effects – undersea earthquakes – landslides – volcanic eruptions – impact of sea meteorite – remedial measures – precautions – case studies.

CONTACT PERIODS:

Lecture: 45 periods Tutorial:0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. Donald Hyndman and David Hyndman, Natural Hazards and Disasters, Brooks/Cole Cengage Learning, 2008.
2. Edward Bryant, Natural Hazards, Cambridge University Press, 2005.
3. J Michael Duncan and Stephan G Wright, Soil Strength and Slope Stability, John Wiley & Sons, Inc, 2005.
4. Amr S Elnashai and Luigi Di Sarno, Fundamentals of Earthquake Engineering, John Wiley & Sons, Inc, 2008

COURSE OUTCOMES

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

CO1: Understand the basic concepts of earthquakes and the design concepts of earthquake resistant buildings.

CO2: Acquire knowledge about the causes and remedial measures of slope stabilization.

CO3: Gain knowledge about the causes and control measures of flood.

CO4: Understand the types, causes and mitigation of droughts.

CO5: Know the causes, effects and precautionary measures of Tsunami.

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4
CO1	H	M	M	H
CO2	M	M	M	L
CO3	H	H	L	M
CO4	H	L	M	L
CO5	H	H	M	H
18GEOE09	H	M	M	M

L-Low, M-Moderate(Medium), H-High

18EDOE10 - BUSINESS ANALYTICS
(Common to All Branches)

Category: OE

L	T	P	C
3	0	0	3

PREREQUISTES :NIL

COURSE OBJECTIVES:

- Understand the role of business analytics within an organization.
- Analyze and solve problems from different industries such as manufacturing, service, retail,software, banking and finance, sports, pharmaceutical, aerospace etc.

BUSINESS ANALYTICS AND PROCESS (9)

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

REGRESSION ANALYSIS (9)

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

STRUCTURE OF BUSINESS ANALYTICS (9)

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

FORECASTING TECHNIQUES (9)

Forecasting Techniques: Qualitative and Judgmental Forecasting, StatisticalForecasting Models, Forecasting Models for Stationary Time Series, ForecastingModels for Time Series with a Linear Trend, Forecasting Time Series withSeasonality, Regression Forecasting with Casual Variables, Selecting AppropriateForecasting Models.Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation UsingAnalytic Solver Platform, New-Product Development Model, Newsvendor Model,Overbooking Model, Cash Budget Model.

DECISION ANALYSIS AND RECENT TRENDS IN BUSINESS ANALYTICS (9)

Decision Analysis: Formulating Decision Problems, Decision Strategies with thewithout Outcome Probabilities, Decision Trees, The Value of Information, Utilityand Decision Making.

Recent Trends: Embedded and collaborative business intelligence, Visual datarecovery, Data Storytelling and Data journalism

CONTACT PERIODS:

Lecture : 45 Periods Tutorial : 0 Periods Practical : 0 Periods Total : 45 Periods

REFERENCE BOOKS:

1. *Marc J. Schniederjans, Dara G.Schniederjans, Christopher M. Starkey***"Business analytics Principles, Concepts, and Applications"**, Pearson FT Press.

*2. PurbaHalady Rao,2013"****Business Analytics: An application focus****",* PHI Learning Pvt. Ltd..

3.*R.N.Prasad, Seema Acharya,2011"****Fundamentals of Business Analytics****", Persons Education.*

4.*James Evans***"Business Analytics"**, Persons Education.

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Students will demonstrate knowledge of data analytics.
CO2: Students will demonstrate the ability of think critically in making decisions based on dataand deep analytics.
CO3: Students will demonstrate the ability to use technical skills in predicative and prescriptivemodeling to support business decision-making.

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4
CO1	M	L	-	-
CO2	M	L	-	-
CO3	M	L	M	M
18EDOE10	M	L	L	L

L-Low, M-Moderate (Medium), H-High

18EDOE11 -COST MANAGEMENT OF ENGINEERING PROJECTS
(Common to All Branches)

Category: OE

L	T	P	C
3	0	0	3

PREREQUISTES :NIL

COURSE OBJECTIVES :

- To be familiar with cost management and project planning.
- To acquire knowledge of decision making, price strategies and total quality management tools.

INTRODUCTION TO COST MANAGEMENT (9)

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 PLANNING ACTIVITIES (9)

Project: meaning, Different types, why to manage, cost overruns centers, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical 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 ANALYSIS (9)

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 AND BUDGETORY CONTROL (9)

Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing, Costing of service sector, Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

TQM AND OPERATIONS REASEARCH TOOLS (9)

Total Quality Management and Theory of constraints, Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

CONTACT PERIODS:

Lecture : 45 Periods Tutorial : 0 Periods Practical : 0 Periods Total : 45 Periods

REFERENCES BOOKS:

1. **Cost Accounting a Managerial Emphasis**, *Prentice Hall of India, New Delhi.*
2. Charles T. Horngren and George Foster, Advanced **Management Accounting.**
3. Robert S Kaplan Anthony A. Alkinson, **Management & Cost Accounting.**
4. Ashish K. Bhattacharya, **Principles & Practices of Cost Accounting** *A. H. Wheeler publisher.*
5. N.D. Vohra, **Quantitative Techniques in Management***, Tata McGraw Hill Book Co. Ltd.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Understanding methods concepts of cost management.

CO2: Developing the skills for project planning.

CO3: Evaluating the cost behavior and profit.

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4
CO1	M	-	-	-
CO2	M	L	-	-
CO3	M	M	L	M
18EDOE11	M	L	-	L

L-Low, M-Moderate (Medium), H-High

18EDOE12 -INTRODUCTION TO INDUSTRIAL ENGINEERING
(Common to All Branches)

Category: OE

L	T	P	C
3	0	0	3

PREREQUISTES :NIL

COURSE OBJECTIVES :

- The objective of this course is to provide foundation in Industrial Engineering in order to enable thestudents to make significant contributions for improvements in different organisations.

INTRODUCTION (9)

Concepts of Industrial Engineering – History and development of Industrial Engineering – Roles ofIndustrial Engineer – Applications of Industrial Engineering – Production Management VsIndustrial Engineering – Operations Management – Production System – Input Output Model –Productivity – Factors affecting Productivity – Increasing Productivity of resources – Kinds ofProductivity measures.

PLANT LOCATION AND LAYOUT (9)

Factors affecting Plant location – Objectives of Plant Layout – Principles of Plant Layout – Typesof Plant Layout – Methods of Plant and Facility Layout – Storage Space requirements – PlantLayout procedure – Line Balancing methods.

WORK SYSTEM DESIGN (9)

Need – Objectives – Method Study procedure – Principles of Motion Economy – WorkMeasurement procedures – Work Measurement techniques.

STATISTICAL QUALITY CONTROL (9)

Definition and Concepts – Fundamentals – Control Charts for variables – Control Charts forattributes – Sampling Inspection – Sampling Plans.

PRODUCTION PLANNING AND CONTROL (9)

Forecasting – Qualitative and Quantitative forecasting techniques – Types of production – Processplanning – Economic Batch Quantity – Tool control – Loading – Scheduling and control ofproduction – Dispatching–Progress control.

CONTACT PERIODS:
Lecture : 45 Periods Tutorial : 0 Periods Practical : 0 Periods Total : 45 Periods

REFERENCES BOOKS:

*1.O.P.Khanna, 2010**, Industrial Engineering and Management,** Dhanpat Rai Publications.*
*2.Ravi Shankar, 2009**, Industrial Engineering and Management,** Galgotia Publications & PrivateLimited.*
*3. Martand Telsang,2006**, Industrial Engineering and Production Management,** S. Chand and Company.*
*4. M.I. Khan,2004**, Industrial Engineering and Production Management,** New Age International..*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Understanding thefunctioning of various kinds of Industries.

CO2: Developing the knowledge in plant location layout and work system design.

CO3: Evaluating the cost optimization in industries.

COURSE ARTICULATION MATRIX

CO/PO	PO1	PO2	PO3	PO4
CO1	M	-	-	-
CO2	M	L	-	-
CO3	M	M	L	M
18EDOE12	M	L	-	L

L-Low, M-Moderate (Medium), H-High

18MFOE13- INDUSTRIAL SAFETY

(Common to All Branches)Category: OE

L	*T*	*P*	*C*
3	*0*	*0*	*3*

PREREQUISTES :NIL

COURSE OBJECTIVES:

- To be familiar with industrial safety equipments and techniques.
- To acquire practical knowledge of maintenance techniques available in industry.

UNIT –I INDUSTRIAL SAFETY **(9)**

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

UNIT –II FUNDAMENTALS OF MAINTENANCE ENGINEERING **(9)**

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

UNIT –III WEAR AND CORROSION **(9)**

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.

UNIT –IV FAULT TRACING **(9)**

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 combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT –V PERIODIC AND PREVENTIVE MAINTENANCE **(9)**

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 and importance.

CONTACT PERIODS:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

REFERENCES BOOKS:

1. Higgins & Morrow ***"Maintenance Engineering Handbook",*** *Da Information Services, 2008*

2. H.P.Garg ***"Maintenance Engineering"****, S. Chand and Company, 2010.*

3. Audels ***"Pump-hydraulic Compressors",*** *Mcgrew Hill Publication, 1943.*

4. Winterkorn, Hans ***"Foundation Engineering Handbook"****, Chapman & Hall London, 1975.*

COURSE OUTCOMES :

On completion of this course, students will be able to

O1: Understand types of industrial safety equipments and techniques available.
O2: Acquire practical knowledge of maintenance techniques available in industry.
CO3: Acquire knowledge on fault tracing techniques in industrial safety.

COURSE ARTICULATION MATRIX

CO/ PO	PO1	PO2	PO3	PO4
CO1	M	-	L	L
CO2	L	-	L	L
CO3	L	H	L	L
18MFOE13	L	L	L	L

L – Low, M – Moderate (Medium), H – High

18MFOE14- OPERATIONS RESEARCH

(Common to All Branches)

Category: OE

L	*T*	*P*	*C*
3	*0*	*0*	*3*

PREREQUISTES :NIL

COURSE OBJECTIVES :

- To familiarize students with the basic concepts, models and statements of the operations research theory.

UNIT- I INTRODUCTION (9)

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

UNIT- II LINEAR PROGRAMMING PROBLEM (9)

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

UNIT-III NON LINEAR PROGRAMMING PROBLEM (9)

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

UNIT -IV SEQUENCING AND INVENTORY MODEL (9)

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

UNIT -V GAME THEORY (9)

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

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCES BOOKS:

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 :

On completion of this course, students will be able to

CO1: Apply basic theoretical principles in optimization and formulate the optimization models.
CO2: Develop mathematical skills to analyse and solve integer programming, network models arising from a wide range of industrial applications.
CO3: Implement optimization techniques in engineering problems.

COURSE ARTICULATION MATRIX

CO/ PO	PO1	PO2	PO3	PO4
CO1	H	-	-	M
CO2	M	L	-	M
CO3	L	L	H	M
18MFOE14	M	L	L	M

L – Low, M – Moderate (Medium), H – High

18MFOE15 - COMPOSITE MATERIALS
(Common to All Branches)

Category: OE

L	*T*	*P*	*C*
3	*0*	*0*	*3*

PREREQUISITES: NIL

COURSE OBJECTIVES :

- To be familiar with composite materials and their advantages, applications.
- To acquire knowledge of reinforcement, manufacturing and strength analysis of composites.

UNIT- I INTRODUCTION **(9)**

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.

UNIT- II REINFORCEMENT **(9)**

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.

UNIT- III MANUFACTURING OF METAL MATRIX COMPOSITES **(9)**

Casting – Solid State diffusion technique, Cladding – Hot isostatic 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.

UNIT-IV MANUFACTURING OF POLYMER MATRIX COMPOSITE **(9)**

Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT-V STRENGTH ANALYSIS OF COMPOSITES **(9)**

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

CONTACT PERIODS:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

REFERENCES BOOKS:

1. Lubin, George, ***"Hand Book of Composite Materials",****Springer, 1982.*
*2. K.K.Chawla, "****Composite Materials"****,Springer, 2011*
3. Deborah D.L. Chung ***, "Composite Materials Science and Applications"*** *,Springer, 2010.*
*4. Danial Gay, Suong V. Hoa, and Stephen W.Tasi, "****Composite Materials Design and Applications"****, CRC Press,2002.*
*5.R.W.Cahn, "****Material Science and Technology – Vol 13– Composites",*** *VCH, West Germany, 1996.*
*6.WD Callister, Jr., Adapted by R. Balasubramaniam, "****Materials Science and Engineering, An introduction"****, John Wiley & Sons, NY, Indian edition, 2007.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Understand the nature of composite materials and composite reinforcements.

CO2: Develop the skills for manufacturing of composites.

CO3: Evaluate the strength of composite materials.

COURSE ARTICULATION MATRIX:

CO/ PO	PO1	PO2	PO3	PO4
CO1	M	L	-	L
CO2	M	-	L	-
CO3	M	-	-	-
18MFOE15	M	-	-	-

L – Low, M – Moderate(Medium), H – High

18TEOE16 – GLOBAL WARMING SCIENCE
(Common to All Branches)

Category : OE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

- To make the students to learn about the material consequences of climate change, sea level change due to increase in the emission of greenhouse gases and to examine the science behind mitigation and adaptation proposals.

INTRODUCTION **(9)**

Terminology relating to atmospheric particles – Aerosols-types, characteristics, measurements – Particle mass spectrometry. Anthropogenic-sources, effects on humans.

CLIMATE MODELS **(9)**

General climate modeling- Atmospheric general circulation model, Oceanic general circulation model, Sea ice model, Land modelconcept, Paleo-climate, Weather prediction by Numerical process. Impacts of climate change, Climate Sensitivity, Forcings and feedbacks.

EARTH CARBON CYCLE AND FORECAST **(9)**

Carbon cycle-process, importance, advantages. Carbon on Earth, Global carbon reservoirs, Interactions between human activities and Carbon cycle. Geologic time scales, Fossil fuels and energy, Perturbed Carbon cycle.

GREEN HOUSE GASES **(9)**

Blackbody Radiation, Layer model, Earth’ s atmospheric composition and Green house gases effects on weather and climate. Radiative equilibrium. Earth’ s energy balance.

GEO ENGINEERING **(9)**

Solar mitigation, Strategies – Carbon dioxide removal, solar radiation management, Recent observed trends in global warming for sea level rise, drought, glacier extent.

CONTACT PERIODS:

Lecture: 45 PeriodsTutorial: 0 Periods Practical: 0 PeriodsTotal: 45 Periods

REFERENCE BOOKS:

1 *Archer, David.* ***GlobalWarming: Understanding the Forecast****, Wiley, 2011*

2 *Budyko,* ***Climate Changes, American Geophysical Society****, Washington, D.C.,244 pp.*

3 *Bodansky,* ***May we engineer the climate?****Clim. Change 33, 309-321.*

4 *Dickinson,* ***Climate Engineering-A review of aerosol approaches to changing the global energy*** *balance, Clim. Change 33, 279-290.*

5 *Climate Change 2007-****The Physical Science Basis: Working Group I Contribution to the Fourth Assessment Report of the IPCC****. Cambridge University Press,2007.*

COURSE OUTCOMES:

On completion of this course, the students will be able to:

CO1: Understand the current warming in relation to climate changes throughout the Earth.

CO2: Assess the best predictions of current climate models.

CO3: Able to know about current issues, including impact from society, environment, economy as well as ecology related to greenhouse gases.

COURSE ARTICULATION MATRIX:

CO/ PO	PO1	PO2	PO3	PO4
CO1	M	L	L	L
CO2	L	L	M	M
CO3	H	M	L	H
18TEOE16	M	L	L	M

L – Low, M – Moderate (Medium), H – High

18TEOE17 – INTRODUCTION TO NANO ELECTRONICS
(Common to All Branches)

Category : OE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

- To make the students to provide strong, essential, important methods and foundations of quantum mechanics and apply quantum mechanics on engineering fields.

INTRODUCTION **(9)**

Particles and Waves, Operators in quantum mechanics, The Postulates of Quantum Mechanics, The Schrodinger Equation Values and Wave Packet Solutions, Ehrenfest's Theorem.

ELECTRONIC STRUCTURE AND MOTION **(9)**

Atoms- The Hydrogen Atom, Many-Electron Atoms, Many-Electron Atoms.Pseudopotentials, Nuclear Structure, Molecules, Crystals. Translational motion – Penetration through barriers – Particle in a box. Two Terminal Quantum Dot Devices, Two Terminal Quantum Wire Devices.

SCATTERING THEORY **(9)**

The formulation of scattering events- scattering cross section, stationary scattering state. Partial wave stationary scattering events, Multi-channel scattering, Solution for Schrodinger Equation- radial and wave equation, Greens' function.

CLASSICAL STATISTICS **(9)**

Probabilities and microscopic behaviors, Kinetic theory and transport processes in gases, Magnetic properties of materials, The partition function.

QUANTUM STATISTICS **(9)**

Statistical mechanics- Basic Concepts, Statistical models applied to metals and semiconductors. The thermal properties of solids- The electrical properties of materials. Black body radiation, Low temperatures and degenerate systems.

CONTACT PERIODS:

Lecture: 45 PeriodsTutorial: 0 Periods Practical: 0 PeriodsTotal: 45 Periods

REFERENCE BOOKS:

1 *Peter L. Hagelstein, Stephen D. Senturia, and Terry P. Orlando,* ***Introductory Applied Quantum Statistical Mechanics****, Wiley (2004).*

2 *A. F. J. Levi,* ***Applied Quantum Mechanics*** *(2nd Edition), Cambridge (2006).*

3 *Walter A Harrison,* ***Applied Quantum Mechanics****, Stanfor University (2008).*

4 *Richard Liboff,* ***Introductory Quantum Mechanics****, 4th edition, Addison Wesley (2003).*

5 *P.W. Atkins and R.S. Friedman,* ***Molecular Quantum Mechanics*** *Oxford University Press, 3rd edition 1997.*

COURSE OUTCOMES:

On completion of this course, students will be able to:

CO1: The student should be familiar with certain nanoelectronic systems and building blocks such as: low-dimensional semiconductors, hetero structures.

CO2: The student should be able to set up and solve the Scfrödinger equation for different types of potentials in one dimension as well as in 2 or 3 dimensions for specific cases.

CO3: Potentially be able to join a research group in nanoscience / nanotechnology as a student researcher.

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4
CO1	M	L	H	M
CO2	L	L	M	L
CO3	H	H	M	L
18TEOE17	M	M	M	L

L – Low, M – Moderate (Medium), H – High

18TEOE18 – GREEN SUPPLY CHAIN MANAGEMENT
(Common to All Branches)

Category : OE

L	T	P	C
3	0	0	3

PREREQUISITES:NIL

COURSE OBJECTIVES:

- To make the students to learn and focus on the fundamental strategies, tools and techniques required to analyze and design environmentally sustainable supply chain systems.

INTRODUCTION (9)

Logistics – aim, activities, importance, progress, current trends. Integrating logistics with an organization.

ESSENTIALS OF SUPPLY CHAIN MANAGEMENT (9)

Basic concepts of supply chain management, Supply chain operations – Planning and sourcing, Making and delivering. Supply chain coordination and use of Technology. Developing supply chain systems.

PLANNING THE SUPPLY CHAIN (9)

Types of decisions – strategic, tactical, operational. Logistics strategies, implementing the strategy. Planning resources – types, capacity, schedule, controlling material flow, measuring and improving performance.

ACTIVITIES IN THE SUPPLY CHAIN(9)

Procurement – cycle, types of purchase. Inventory management – EOQ, uncertain demand and safety stock, stock control. Material handling – purpose of warehouse and ownership, layout, packaging. Transport – mode, ownership, routing vehicles.

SUPPLY CHAIN MANAGEMENT STRATEGIES (9)

Five key configuration components, Four criteria of a good supply chain strategies, Next generation strategies- New roles for end to end supply chain management. Evolution of supply chain organization.

CONTACT PERIODS:

Lecture: 45 PeriodsTutorial: 0 Periods Practical: 0 PeriodsTotal: 45 Periods

REFERENCE BOOKS:

1 *Rogers,Dale., and Ronald Tibben-Lembke."**An Examination of Reverse Logistics Practices."** Journal of Business Logistics 22, no. 2 (2001) : 129-48.*

2 *Guide, V., Kumar Neeraj, et al. "**cellular Telephone Reuse: The ReCellular Inc. Case."** Managing Closed-Loop Supply Chains. Case: Part 6, (2005): 151-156.*

3 *Mark, K. "**Whirlpool Corrporation: Reverse Logistics."** Richard Ivey School of Business. Case: 9B11D001, August 8, 2011.*

4 *Porter, Michael E., and Mark R. Kramer. "**Strategy and Society: The Link between Competitive Advantage and Corporate Social Responsibility."** Harvard Business Revies 84, no. 12 (2006): 78-92.*

5 *Shoshnah Cohen, Josep Roussel, "**Strategic Supply Chain Management",** the five disciplines for top performance, McGraw-Hill, (2005.)*

COURSE OUTCOMES:

On completion of this course, students will be able to:

CO1: Evaluate complex qualitative and quantitative data to support strategic and operational decisions.

CO2: Develop self-leadership strategies to enhance personal and professional effectiveness.

CO3: The importance of the design and redesign of a supply chain as key components of an organization's strategic plan.

COURSE ARTICULATION MATRIX

CO/ PO	PO1	PO2	PO3	PO4
CO1	M	H	H	M
CO2	L	H	M	H
CO3	H	H	H	M
18TEOE18	M	H	H	M

L – Low, M – Moderate (Medium), H – High

18PSOE19 **DISTRIBUTION AUTOMATION SYSTEM**
(Common to all Branches)

Category: OE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

To study about the distributed automation and economic evaluation schemes of power network

UNIT-I INTRODUCTION (09)

Introduction to Distribution Automation (DA) - Control system interfaces- Control and data requirements- Centralized (vs) decentralized control- DA system-DA hardware-DAS software.

UNIT-II DISTRIBUTION AUTOMATION FUNCTIONS (09)

DA capabilities - Automation system computer facilities- Management processes- Information management- System reliability management- System efficiency management- Voltage management- Load management.

UNIT-III COMMUNICATION SYSTEMS (09)

Communication requirements - reliability- Cost effectiveness- Data requirements- Two way capability- Communication during outages and faults - Ease of operation and maintenance- Conforming to the architecture of flow.Distribution line carrier- Ripple control-Zero crossing technique- Telephone, cableTV,radio, AM broadcast, FM SCA,VHF radio, microwave satellite, fiber optics-Hybrid communication systems used in field tests.

UNIT-IV ECONOMIC EVALUATION METHODS (09)

Development and evaluation of alternate plans- select study area – Select study period- Project load growth-Develop alternatives- Calculate operating and maintenance costs-Evaluate alternatives.

UNIT-V ECONOMIC COMPARISON (09)

Economic comparison of alternate plans-Classification of expenses - capital expenditures-Comparison of revenue requirements of alternative plans-Book life and continuing plant analysis- Year by year revenue requirement analysis, Short term analysis- End of study adjustment-Break even analysis, sensitivity analysis - Computational aids.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. *IEEE Tutorial course* ***"Distribution Automation",*** IEEE Working Group on Distribution Automation, IEEE Power Engineering Society. Power Engineering Education Committee, IEEE Power Engineering Society. Transmission and Distribution Committee, Institute of Electrical and Electronics Engineers, 1988
2. Maurizio Di Paolo Emilio, **"Data Acquisition Systems: From Fundamentals to Applied Design"**, Springer Science & Business Media, 21-Mar-2013
3. Taub, **"Principles Of Communication Systems",** Tata McGraw-Hill Education, 07-Sep-2008
4. M.K. Khedkar, G.M. Dhole, **"A Textbook of Electric Power Distribution Automation",** Laxmi Publications, Ltd., 2010.

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

CO1: Analyse the requirements of distributed automation
CO2: Know the functions of distributed automation
CO3: Perform detailed analysis of communication systems for distributed automation.
CO4: Study the economic evaluation method
CO5: Understand the comparison of alternate plans

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4
CO1	H	-	M	-
CO2	M	-	-	-
CO3	H	-	M	-
CO4	M	-	L	-
CO5	H	-	L	-
18PSOE19	M	-	L	-

L – Low, M – Moderate (Medium), H- High

18PSOE20 **POWER QUALITY ASSESSMENT AND MITIGATION** **Category : OE**

(Common to all Branches)

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

To identify, analyze and create solutions for the power quality problems in power system networks.

UNIT-I : INTRODUCTION (09)

Importance of power quality - Terms and definitions as per IEEE std.1159 for transients, short and long duration voltage variations, interruptions, short and long voltage fluctuations, imbalance, flickers - Symptoms of poor power quality- Definitions and terminology of grounding- Purpose of groundings- Good grounding practices - problems due to poor grounding.

UNIT-II : FLICKERS AND TRANSIENT VOLTAGES (09)

RMS voltage variations in power system, complex power, voltage regulation and per unit system - Basic power flow and voltage drop - Devices for voltage regulation and impact of reactive power management - Causes and effects of voltage flicker - Short term and long term flickers -Methods to reduce flickers- Transient over voltages, impulsive transients, switching transients - Effect of surge impedance and line termination - control of transient voltages.

UNIT-III : VOLTAGE INTERRUPTIONS (09)

Definitions -Voltage sags versus interruptions - Economic impact, Major causes and consequences -characteristics, assessment, Influence of fault location and fault level on voltage sag - Areas of vulnerability, Assessment of equipment sensitivity, Voltage sag limits for computer equipment-CBEMA, ITIC, SEMI F 42curves, Report of voltage sag analysis, Voltage sag indices, Mitigation measures for voltage sag- DSTATCOM, UPQC,UPS, DVR, SMEs, CVT, utility solutions and end user solutions.

UNIT-IV : WAVEFORM DISTORTION (09)

Definition of harmonics, inter-harmonics, sub-harmonics- Causes and effects - Voltage versus current distortion, Fourier analysis, Harmonic indices, A.C. quantities under non-sinusoidal conditions, Triplet harmonics, characteristic and non characteristic harmonics- Series and Parallel resonances- Consequence - Principles for controlling and Reducing harmonic currents in loads, K-rated transformer -Computer tools for harmonic analysis- Locating sources of harmonics, Harmonic filtering- Passive and active filters - Modifying the system frequency response- IEEE Harmonic standard 519-1992.

UNIT-V : ANALYSIS AND CONVENTIONAL MITIGATION METHODS (09)

Analysis of power outages, Analysis of unbalance condition: Symmetrical components inphasor quantities, Instantaneous symmetrical components, Instantaneous real and reactive powers - Analysis of distortion: On–line extraction of fundamental sequence components from measured samples – Harmonic indices – Analysis of voltage sag: Detorit Edison sag score, Voltage sag energy, Voltage Sag Lost Energy Index (VSLEI)- Analysis of voltage flicker, Reduced duration and customer impact of outages, Classical load balancing problem: Open loop balancing, Closed loop balancing, current balancing, Harmonic reduction, Voltage sag reduction.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. M. H. J. Bollen, ***"Understanding Power Quality Problems, Voltage Sag and Interruptions",*** *IEEE Press, series on Power Engineering, 2000.*

2. Roger C. Dugan, Mark F. McGranaghan, Surya Santoso and Wayne Beaty H., ***"Electrical Power SystemQuality"****, Second Edition, McGraw Hill Publication Co., 2008.*

3. G.T.Heydt, ***"Electric Power Quality",*** *Stars in a Circle Publications, 1994(2nd edition).*

*4. Enrique Acha, Manuel Madrigal****, "Power System Harmonics: Computer Modeling and Analysis****", John Wiley and Sons, 2001.*

*5. Arrillaga J. and Watson N****."Power System Harmonics"****2nd edition on; John Willey&sons, 2003*

6. IEEE Std. 519-1992/ IEEE Std. 1159 IEEE recommended practices and requirements for harmonics control in electrical power system.

COURSE OUTCOMES:

CO1: *Acquire knowledge about the power quality issues and standards like IEEE,IEC on voltage, Frequency and harmonics.*

CO2: *Recognize the practical issues in the power system*

CO3:*Analyze the impact of power electronic devices and techniques in power system*

CO4:*Develop trouble shooting skills and innovative remedies for various power quality problems in power system*

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4
CO1	M	-	-	-
CO2	M	-	M	-
CO3	H	-	M	-
CO4	H	-	M	L
18PSOE20	H	-	M	L

L – Low, M – Moderate (Medium), H- High

18PSOE21 **MODERN AUTOMOTIVE SYSTEMS**

(Common to all Branches) **Category : OE**

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

To expose the students with theory and applications of Automotive Electrical and Electronic Systems.

UNIT-I : INTRODUCTION TO MODERN AUTOMOTIVE ELECTRONICS **(08)**

Introduction to modern automotive systems and need for electronics in automobiles- Role of electronics and microcontrollers- Sensors and actuators- Possibilities and challenges in automotive industry- Enabling technologies and industry trends.

UNIT-II : SENSORS AND ACTUATORS **(09)**

Introduction- basic sensor arrangement- Types of sensors- Oxygen sensor, engine crankshaft angular position sensor – Engine cooling water temperature sensor- Engine oil pressure sensor- Fuel metering- vehicle speed sensor and detonation sensor- Pressure Sensor- Linear and angle sensors- Flow sensor- Temperature and humidity sensors- Gas sensor- Speed and Acceleration sensors- Knock sensor- Torque sensor- Yaw rate sensor- Tyre Pressure sensor- Actuators - Stepper motors – Relays.

UNIT-III : POWER TRAIN CONTROL SYSTEMS IN AUTOMOBILE **(09)**

Electronic Transmission Control - Digital engine control system: Open loop and close loop control systems- Engine cooling and warm up control- Acceleration- Detonation and idle speed control - Exhaust emission control engineering- Onboard diagnostics- Future automotive power train systems.

UNIT-IV : SAFETY, COMFORT AND CONVENIENCE SYSTEMS **(10)**

Cruise Control- Anti-lock Braking Control- Traction and Stability control- Airbag control system- Suspension control- Steering control- HVAC Control.

UNIT-V : ELECTRONIC CONTROL UNITS (ECU) **(09)**

Need for ECUs- Advances in ECUs for automotives - Design complexities of ECUs- V-Model for Automotive ECU‘s- Architecture of an advanced microcontroller (XC166 Family, 32-bit Tricore) used in the design of automobile ECUs- On chip peripherals, protocol interfaces, analog and digital interfaces.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1 *Ronald K.Jurgen, "**Äutomotive Electronics Handbook**", McGraw Hill, 2000.*

2 *LjuboVlacic, Michel Parent and FurnioHarshima, "**Intelligent Vehicle Technologies: Theory and Applications**", Butterworth Heinemann publications, 2001.*

3. *Denton, "**Automotive Electrical and Electronic Systems**", Burlington, MA 01803, Elsevier Butterworth-Heinemann, 2004.*

4. *Jack Erjavec, "**Äutomotive Technology – A System Approach**", Thomson Delmar Learning, 3rd edition, 2004.*

5. *XC166 Family and 32-bit **Tricore Family of microcontrollers**.*

COURSE OUTCOMES:

CO1: Familiar with various automotive electronics systems.
CO2: Explore the control strategies of automotive systems.
CO3: Apply modern techniques to automobiles.
CO4: Design and implementation of advanced controller for automobiles.

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4
CO1	H	-	L	-
CO2	M	-	M	-
CO3	H	-	M	-
CO4	H	-	M	M
18PSOE21	H	-	M	L

L – Low, M – Moderate (Medium), H- High

18PEOE22 **VIRTUAL INSTRUMENTATION** **Category:OE**

(Common to All Branches)

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

To comprehend the Virtual instrument action programming concepts towards measurements and control.

UNIT-I : INTRODUCTION **(07)**

Introduction - advantages - Block diagram and architecture of a virtual instrument - Conventional Instruments versus Traditional Instruments - Data-flow techniques, graphical programming in data flow, comparison with conventional programming.

UNIT-II : GRAPHICAL PROGRAMMING AND LabVIEW **(09)**

Concepts of graphical programming - LabVIEW software - Concept of VIs and sub VI - Display types - Digital - Analog - Chart and Graphs. Loops - structures - Arrays – Clusters- Local and global variables – String - Timers and dialog controls.

UNIT-III : MANAGING FILES & DESIGN PATTERNS **(11)**

High-level and low-level file I/O functions available in LabVIEW – Implementing File I/O functions to read and write data to files – Binary Files – TDMS – sequential programming – State machine programming – Communication between parallel loops –Race conditions – Notifiers & Queues – Producer Consumer design patterns

UNIT-IV : PC BASED DATA ACQUISITION **(09)**

Introduction to data acquisition on PC, Sampling fundamentals, ADCs, DACs, Calibration, Resolution, - analog inputs and outputs - Single-ended and differential inputs - Digital I/O, counters and timers, DMA, Data acquisition interface requirements - Issues involved in selection of Data acquisition cards - Use of timer-counter and analog outputs on the universal DAQ card.

UNIT-V : DATA ACQUISITION AND SIGNAL CONDITIONING **(09)**

Components of a DAQ system, Bus, Signal and accuracy consideration when choosing DAQ hardware – Measurement of analog signal with Finite and continuous buffered acquisition- analog output generation – Signal conditioning systems – Synchronizing measurements in single & multiple devices – Power quality analysis using Electrical Power Measurement tool kit.

CONTACT PERIODS:

LECTURE: 45 PERIODS TUTORIAL: 0 PERIODS PRACTICAL: 0 PERIODS TOTAL: 45 PERIODS

REFERENCE BOOKS:

*1. Jeffrey Travis, Jim Kring, **'LabVIEW for Everyone: Graphical Programming Made Easy and Fun (3rd Edition),** Prentice Hall, 2006**.***

*2. Sanjeev Gupta, **'Virtual Instrumentation using LabVIEW'** TMH, 2004*

*3. Gary W. Johnson, Richard Jennings, **'Lab-view Graphical Programming'**,McGraw Hill Professional Publishing, 2001*

*4. Robert H. Bishop, **'Learning with Lab-view'**, Prentice Hall, 2003.*

*5. Kevin James, '**PC Interfacing and Data Acquisition: Techniques for Measurement**, Instrumentation and Control', Newness, 2000*

COURSE OUTCOMES:

CO1: *Gain Knowledge of graphical programming techniques using LabVIEW software.*

CO2: *Explore the basics of programming and interfacing using related hardware.*

CO3:*Outline the aspects and utilization of PC based data acquisition and Instrument interfaces.*

CO4: *Create programs and Select proper instrument interface for a specific application.*

COURSE ARTICULATION MATRIX

CO/PO	PO1	PO2	PO3	PO4
CO1	M	L	L	L
CO2	M	L	L	L
CO3	M	L	L	L
CO4	M	L	M	L
18PEOE22	M	L	L	L

L – Low, M – Moderate (Medium), H- High

18PEOE23 **ENERGY AUDITING** **Category: OE**

(Common to All Branches)

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

To Comprehend energy management schemes and perform economic analysis and load management in electrical systems.

UNIT-I : BASICS OF ENERGY MANAGEMENT **(09)**

Energy Scenario – Energy Sector Reforms – Impact on environment – Strategy for future and conservation – Basics of Energy and it forms (Thermal and Electrical). Energy Audit: Need – Types and Methodology - Audit Report – Energy Cost, Benchmarking and Energy performance – System Efficiency. Facility as an energy system – Methods for preparing process flow, Material and energy balance diagrams.

UNIT-II : ACTION PLANNING AND MONITORING **(09)**

Energy Management System – Performance assessment – Goal setting by Manager – Action plan implementation – Financial Management: Investment - Financial analysis techniques, ROI, Risk and sensitivity analysis, role of Energy Service Companies. Project management: Steps in detail. – Energy monitoring and interpretance of variances for remedial actions. Environmental concerns: UNFCC – Kyoto protocol – COP – CDM – PCF – Sustainable development.

UNIT-III : STUDY OF THERMAL UTILITIES **(09)**

Combustion of Oil, Coal and Gas – Performance Evaluation of Boilers – Boiler blow down – Boiler water treatment – Energy Conservation Opportunity – Cogeneration: Principal – Options - Classification – Influencing Factors and technical parameters. Waste heat recovery: Classification – application – benefits - Different heat recovery devices.

UNIT-IV : STUDY OF ELECTRICAL UTILITIES **(09)**

Electricity Billing – Electricity load management – Motor efficiency and tests – Energy efficient motors – Factors affecting motor efficiency and loss minimization – Motor load survey. Lighting System: Types and features – recommended luminance levels – Lighting system energy efficiency study – Energy Efficient Technologies: Maximum demand controllers – Intelligent PF controllers – Soft starters and VFDs – Variable torque load uses – Energy efficient transformers, Light controllers and Electronic ballasts.

UNIT-V : ENERGY ASSESSMENT IN UTILITY SYSTEMS **(09)**

Performing Financial analysis: Fixed and variable costs – Payback period – methods – factors affecting analysis – Waste Minimization Techniques: Classification – Methodology. Performance assessment of HVAC Systems: Measurements, Procedure – Evaluation. Assessment of Pumps: Measurements, Procedure – Evaluation.

CONTACT PERIODS:

LECTURE: 45 PERIODS TUTORIAL: 0 PERIODS PRACTICAL: 0 PERIODS TOTAL: 45 PERIODS

REFERENCE BOOKS:

*1. Murphy W.R. and G.Mckay Butter worth , "**Energy Management**", Heinemann Publications.*
*2. Paul o' Callaghan, **"Energy Management",** Mc-Graw Hill Book Company – 1st edition; 1998.*
*3. John.C.Andreas, **"Energy Efficient Electric Motors",** Marcel Dekker Inc Ltd – 2nd edition; 1995.*
*4. W.C.Turner, **"Energy Management Handbook",** John Wiley and Sons, Fifth edition, 2009.*
*5. **"Energy Management and Good Lighting Practice: fuel efficiency**" – booklet 12 – EEO.*
6. www.em-ea.org/gbook1.asp

COURSE OUTCOMES:

CO1: *Possess knowledge on energy management.*

CO2: *Analyze the feature of energy audit methodology and documentation of report.*

CO3: *Able to plan energy management action and develop the understanding of implementation.*

CO4: *Familiarize with thermal utilities.*

CO5: *Familiarize with electrical utilities.*

CO6: *Perform assessment of different systems.*

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4
CO1	M	L	M	M
CO2	M	H	M	M
CO3	M	M	L	L
CO4	L	L	L	L
CO5	H	M	M	L
CO6	M	L	M	L
18PEOE23	M	M	M	L

L – Low, M – Moderate (Medium), H- High

18PEOE24 ADVANCED ENERGY STORAGE TECHNOLOGY Category : OE

(Common to All Branches)

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

To explore the fundamentals, technologies and applications of energy storage.

UNIT-I : ENERGY STORAGE: HISTORICAL PERSPECTIVE, INTRODUCTION AND CHANGES (09)

Storage Needs- Variations in Energy Demand- Variations in Energy Supply- Interruptions in Energy Supply- Transmission Congestion - Demand for Portable Energy-Demand and scale requirements - Environmental and sustainability issues.

UNIT-II : TECHNICAL METHODS OF STORAGE (09)

Introduction: Energy and Energy Transformations, Potential energy (pumped hydro, compressed air, springs)- Kinetic energy (mechanical flywheels)- Thermal energy without phase change passive (adobe) and active (water)-Thermal energy with phase change (ice, molten salts, steam)- Chemical energy (hydrogen, methane, gasoline, coal, oil)- Electrochemical energy (batteries, fuel cells)- Electrostatic energy (capacitors), Electromagnetic energy (superconducting magnets)- Different Types of Energy Storage Systems.

UNIT-III PERFORMANCE FACTORS OF ENERGY STORAGE SYSTEMS (09)

Energy capture rate and efficiency- Discharge rate and efficiency- Dispatch ability and load flowing characteristics, scale flexibility, durability – Cycle lifetime, mass and safety – Risks of fire, explosion, toxicity- Ease of materials, recycling and recovery- Environmental consideration and recycling , Merits and demerits of different types of Storage.

UNIT-IV : APPLICATION CONSIDERATION (09)

Comparing Storage Technologies- Technology options- Performance factors and metrics- Efficiency of Energy Systems- Energy Recovery - Battery Storage System: Introduction with focus on Lead Acid and Lithium- Chemistry of Battery Operation, Power storage calculations, Reversible reactions, Charging patterns, Battery Management systems, System Performance, Areas of Application of Energy Storage: Waste heat recovery, Solar energy storage, Green house heating, Power plant applications, Drying and heating for process industries, energy storage in automotive applications in hybrid and electric vehicles.

UNIT-V : HYDROGEN FUEL CELLS AND FLOW BATTERIES (09)

Hydrogen Economy and Generation Techniques, Storage of Hydrogen, Energy generation - Super capacitors: properties, power calculations – Operation and Design methods - Hybrid Energy Storage: Managing peak and Continuous power needs, options - Level 1: (Hybrid Power generation) Bacitor "Battery + Capacitor" Combinations: need, operation and Merits; Level 2: (Hybrid Power Generation) Bacitor + Fuel Cell or Flow Battery operation-Applications: Storage for Hybrid Electric Vehicles, Regenerative Power, capturing methods.

CONTACT PERIODS:

LECTURE: 45 PERIODS TUTORIAL: 0 PERIODS PRACTICAL: 0 PERIODS TOTAL: 45 PERIODS

REFERENCE BOOKS:

*1. DetlefStolten,**"Hydrogen and Fuel Cells: Fundamentals, Technologies and Applications"**, Wiley, 2010.*

*2. Jiujun Zhang, Lei Zhang,Hansan Liu, Andy Sun, Ru-Shi Liu**, "Electrochemical Technologies for Energy Storage and Conversion",** John Wiley and Sons, 2012.*

*3. Francois Beguin and ElzbietaFrackowiak ,**"Super capacitors"**, Wiley, 2013.*

*4. Doughty Liaw, Narayan and Srinivasan, **"Batteries for Renewable Energy Storage"**, The Electrochemical Society, New Jersy,2010.*

COURSE OUTCOMES:

CO1: *Recollect the historical perspective and technical methods of energy storage.*

CO2: *Learn the basics of different storage methods.*

CO3: *Determine the performance factors of energy storage systems.*

CO4: *Identify applications for renewable energy systems.*

***CO5:** Understand the basics of Hydrogen cell and flow batteries.*

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4
CO1	H	L	M	L
CO2	M	L	M	L
CO3	H	L	M	L
CO4	H	L	M	M
CO5	H	L	L	L
18PEOE24	L	L	M	L

L – Low, M – Moderate (Medium), H- High

Category : OE

18AEOE25 -DESIGN OF DIGITAL SYSTEMS **L T P C**
(Common to all Branches) **3 0 0 3**

PREREQUISITES: Nil

***COURSE OBJECTIVES*:**

- Design synchronous and asynchronous sequential circuits
- Develop VHDL code for digital circuits
- Implementation in PLDs
- Fault diagnosis

SYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN **(9)**

Analysis of Clocked Synchronous Sequential Circuits - Modeling, state table reduction, state assignment, Design of Synchronous Sequential Networks, Design of iterative circuits - ASM chart - ASM realization.

ASYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN **(9)**

Analysis of Asynchronous Sequential Circuits - Races in ASC – Primitive Flow Table - Flow Table Reduction Techniques, State Assignment Problem and the Transition Table – Design of ASC – Static and Dynamic Hazards – Essential Hazards – Data Synchronizers.

SYSTEM DESIGN USING PLDS **(9)**

Basic concepts – Programming Technologies - Programmable Logic Element (PLE) - Programmable Array Logic (PLA) - Programmable Array Logic (PAL) –Design of combinational and sequential circuits using PLDs – Complex PLDs (CPLDs)

INTRODUCTION TO VHDL **(9)**

Design flow - Software tools – VHDL: Data Objects - Data types - Operators – Entities and Architectures – Components and Configurations – Signal Assignment –Concurrent and Sequential statements — Behavioral, Data flow and Structural modeling – Transport and Inertial delays – Delta delays - Attributes – Generics – Packages and Libraries

LOGIC CIRCUIT TESTING AND TESTABLE DESIGN **(9)**

Digital logic circuit testing - Fault models - Combinational logic circuit testing - Sequential logic circuit testing-Design for Testability - Built-in Self-test, Board and System Level Boundary Scan. Case Study: Traffic Light Controller

CONTACT PERIODS:

LECTURE : 45 PERIODS TUTORIAL : 0 PERIODS PRACTICAL : 0 PERIODS TOTAL : 45 PERIODS

REFERENCE BOOKS:

1. Donald G. Givone, **"Digital principles and Design"**, Tata McGraw Hill, 2002.
2. Nelson, V.P., Nagale, H.T., Carroll, B.D., and Irwin, J.D., **"Digital Logic Circuit Analysis and Design"**, Prentice Hall International, Inc., New Jersey, 1995
3. Volnei A. Pedroni, **"Circuit Design with VHDL"**, PHI Learning, 2011.
4. Parag K Lala, **"Digital Circuit Testing and Testability",** Academic Press, 1997
5. Charles H Roth, **"Digital Systems Design Using VHDL,"** Cencage 2nd Edition 2012.
6. Nripendra N Biswas **"Logic Design Theory"** Prentice Hall of India,2001

***COURSE OUTCOMES*:**

Upon completion of the course the students will be able to:

CO1: Design synchronous and asynchronous sequential circuits based on specifications

CO2: Develop algorithm and VHDL code for design of digital circuits

CO3: Illustrate digital design implementation on PLDs .

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4
CO1	H	M	M	M
CO2	H	M	M	H
CO3	H	M	M	M
18AEOE25	H	M	M	M

L – Low, M – Moderate (Medium), H- High

Category : OE

18AEOE26 - ADVANCED PROCESSORS (Common to all Branches)	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

PREREQUISITES: Nil

***COURSE OBJECTIVES*:**

- To introduce the basics of CISC and RISC
- Describe the architectural features of Pentium processors
- Describe ARM and Special processors

MICROPROCESSOR ARCHITECTURE **(9)**

Instruction set – Data formats – Instruction formats – Addressing modes – Memory hierarchy – register file – Cache – Virtual memory and paging – Segmentation – Pipelining – The instruction pipeline – pipeline hazards – Instruction level parallelism – reduced instruction set – Computer principles – RISC versus CISC – RISC properties – RISC evaluation.

HIGH PERFORMANCE CISC ARCHITECTURE –PENTIUM **(9)**

The software model – functional description – CPU pin descriptions – Addressing modes – Processor flags – Instruction set – Bus operations – Super scalar architecture – Pipe lining – Branch prediction – The instruction and caches – Floating point unit– Programming the Pentium processor.

HIGH PERFORMANCE CISC ARCHITECTURE – PENTIUM INTERFACE **(9)**

Protected mode operation – Segmentation – paging – Protection – multitasking – Exception and interrupts - Input /Output – Virtual 8086 model – Interrupt processing.

HIGH PERFORMANCE RISC ARCHITECTURE: ARM **(9)**

ARM architecture – ARM assembly language program – ARM organization and implementation – ARM instruction set - Thumb instruction set.

SPECIAL PURPOSE PROCESSORS **(9)**

Altera Cyclone Processor – Audio codec – Video codec design – Platforms – General purpose processor – Digital signal processor – Embedded processor – Media Processor – Video signal Processor – Custom Hardware – Co-Processor.

CONTACT PERIODS:

LECTURE : 45 PERIODS TUTORIAL : 0 PERIODS PRACTICAL : 0 PERIODS TOTAL : 45 PERIODS

REFERENCE BOOKS:

1. Daniel Tabak, **"Advanced Microprocessors"**, McGraw Hill. Inc., 2011.
2. James L. Antonakos, **"The Pentium Microprocessor",** Pearson Education, 1997.
3. Steve Furber, **"ARM System –On –Chip architecture",**Addison Wesley, 2009.
4. Gene .H. Miller, **"Micro Computer Engineering",** Pearson Education, 2003.
5. Barry. B. Brey, **"The Intel Microprocessors Architecture, Programming and Interfacing",** PHI, 2008.
6. Valvano, **"Embedded Microcomputer Systems"** Cencage Learing India Pvt Ltd, 2011.
7. Iain E.G.Richardson**, "Video codec design",** John Wiley & sons Ltd, U.K, 2002.

***COURSE OUTCOMES*:**

Upon completion of the course the students will be able to:

CO1: Distinguish between RISC and CISC generic architectures.

CO2: Describe the architectural features of Pentium processors

CO3: Develop simple applications using ARM processors

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4
CO1	L	L	M	L
CO2	H	M	M	L
CO3	H	M	M	L
18AEOE26	M	M	M	L

L – Low, M – Moderate (Medium), H- High

Category : OE

18AEOE27- PATTERN RECOGNITION **L T P C**

(Common to all Branches) **3 0 0 3**

PREREQUISITES: Nil

***COURSE OBJECTIVES*:**

- To get knowledge in pattern recognition in computer vision techniques
- To get knowledge in structural pattern methods
- To get knowledge on neural networks and fuzzy systems.

PATTERN CLASSIFIER (9)

Overview of pattern recognition -Discriminant functions-Supervised learning –Parametric estimation-Maximum likelihood estimation –Bayesian parameter estimation- Perceptron algorithm-LMSE algorithm – Problems with Bayes approach –Pattern classification by distance functions-Minimum distance pattern classifier.

UNSUPERVISED CLASSIFICATION (9)

Clustering for unsupervised learning and classification - Clustering concept-C-means algorithm-Hierarchical clustering procedures- Graph theoretic approach to pattern clustering - Validity of clustering solutions.

STRUCTURAL PATTERN RECOGNITION (9)

Elements of formal grammars-String generation as pattern description - recognition of syntactic description- Parsing-Stochastic grammars and applications - Graph based structural representation.

FEATURE EXTRACTION AND SELECTION (9)

Entropy minimization – Karhunen - Loeve transformation-feature selection through functions approximation- Binary feature selection.

NEURAL NETWORKS (9)

Neural network structures for Pattern Recognition –Neural network based Pattern associators-Unsupervised learning in neural Pattern Recognition-Self organizing networks-Fuzzy logic-Fuzzy classifiers-Pattern classification using Genetic Algorithms.

CONTACT PERIODS:

LECTURE : 45 PERIODS TUTORIAL : 0 PERIODS PRACTICAL : 0 PERIODS TOTAL : 45 PERIODS

REFERENCE BOOKS:

1. R. O Duda, P.E Hart and Stork, **"Pattern Classification",** Wiley, 2012.
2. Robert J. Sehalkoff, **"Pattern Recognition: Statistical, Structural and Neural Approaches",** JohnWiley & Sons Inc., 2007.
3. Tou & Gonzales, **"Pattern Recognition Principles",** Wesley Publication Company, 2000.
4. Morton Nadier and P. Eric Smith, **"Pattern Recognition Engineering",** John Wiley & Sons, 2000.

***COURSE OUTCOMES*:**

Upon completion of the course, the students will have:

CO1: Apply parametric estimation and supervised learning techniques for pattern classification

CO2: Describe the structural pattern recognition methods

CO3: Apply neural networks, fuzzy systems and Genetic algorithms to pattern recognition and classification.

***COURSE ARTICULATION MATRIX*:**

CO/PO	PO1	PO2	PO3	PO4
CO1	H	M	M	L
CO2	H	M	M	L
CO3	H	M	M	M
18AEOE27	H	M	M	L

L – Low, M – Moderate (Medium), H- High

18VLOE28 - VLSI DESIGN
(Common to all Branches)

L	T	P	C
3	0	0	3

Category:OE

PREREQUISITES:Nil

COURSE OBJECTIVES:

- To gain knowledge on MOS and CMOS Circuits with its characterization
- To design CMOS logic and sub-system
- To understand low power CMOS VLSI Design

INTRODUCTION TO MOS CIRCUITS (9)

MOS Transistor Theory -Introduction MOS Device Design Equations -MOS Transistor as a Switches - Pass Transistor - CMOS Transmission Gate -Complementary CMOS Inverter - Static Load MOS Inverters - Inverters with NMOS loads - Differential Inverter - Tri State Inverter - BiCMOS Inverter.

CIRCUIT CHARACTERIZATION AND PERFORMANCE ESTIMATION (9)

Delay Estimation, Logical Effort and Transistor Sizing, Power Dissipation, Sizing Routing Conductors, Charge Sharing, Design Margin and Reliability.

CMOS CIRCUIT AND LOGIC DESIGN (9)

CMOS Logic Gate Design, Physical Design of CMOS Gate, Designing with Transmission Gates, CMOS Logic Structures, Clocking Strategies, I/O Structures.

CMOS SUB SYSTEM DESIGN (9)

Data Path Operations - Addition/Subtraction, Parity Generators, Comparators, Zero/One Detectors, Binary Counters, ALUs, Multipliers, Shifters, Memory Elements, Control-FSM, Control Logic Implementation.

LOW POWER CMOS VLSI DESIGN (9)

Introduction to Low Power Design, Power Dissipation in FET Devices, Power Dissipation in CMOS, Low-Power Design through Voltage Scaling – VTCMOS Circuits, MTCMOS Circuits, Architectural Level Approach – Pipelining and Parallel Processing Approaches, Low Power Basics CMOS Gate and Adder Design.

CONTACT PERIODS:

LECTURE : 45 PERIODS TUTORIAL : 0 PERIODS PRACTICAL : 0 PERIODS TOTAL : 45 PERIODS

REFERENCE BOOKS:

1. Sung Ms Kang, Yusuf Lablebici, **"CMOS Digital Integrated Circuits: Analysis & Design",** Tata Mc-Graw Hill, 2011.
2. N. Weste and K. Eshranghian, **"Principles of CMOS VLSI Design",** Addison Wesley, 1998.
3. Neil H.E. Weste, David Harris, Ayan Banerjee**,"CMOS VLSI Design:A Circuits and Systems Perspective "**, 2013, Pearson Education
4. Kiat-Seng Yeo, Kaushik Roy, **"Low-Voltage, Low-Power VLSI Subsystems"** – McGraw-Hill Professional, 2004.
5. Gary K. Yeap**, "Practical Low Power Digital VLSI Design",** Kluwer Academic Press, 2002.
6. Jan M. Rabaey, **"Digital Integrated Circuits: A Design Perspective"**,Pearson Education, 2003.

***COURSE OUTCOMES*:**

After completing this course, the students will have:

CO1: knowledge on MOS and CMOS Circuits with its characterization
CO2: an ability to design CMOS logic and sub-system
CO3: an understanding of low power CMOS VLSI Design

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4
CO1	L	-	-	H
CO2	L	-	-	H
CO3	L	-	-	H
18VLQE28	L	-	-	H

L – Low, M – Moderate (Medium), H- High

Category : OE

18VLOE29 - ANALOG & MIXED MODE VLSI CIRCUITS
(Common to all Branches)

L	T	P	C
3	0	0	3

PREREQUISITES:Nil

***COURSE OBJECTIVES*:**

- To acquire knowledge on MOS circuit configuration and CMOS amplifier
- To analyze and design Operational amplifier
- To understand mixed signal circuits

MOS CIRCUIT CONFIGURATION (9)

Basic CMOSCircuits-Basic Gain Stage-Gain Boosting Techniques-Super MOS Transistor-Primitive Analog Cells, Current Source, Sinks and References MOS Diode/Active resistor, Simple current sinks and mirror, Basic current mirrors, Advance current mirror, Current and Voltage references, Bandgap references.

CMOS AMPLIFIER (9)

CMOS Amplifier Performances matrices of amplifier circuits, Common source amplifier, Common gate amplifier, Cascode amplifier, Frequency response of amplifiers and stability of amplifier.

CMOS DIFFERENTIAL AMPLIFIER (9)

CMOS Differential Amplifier Differential signalling, source coupled pair, Current source load, Common mode rejection ratio, CMOS Differential amplifier with current mirror load, Differential to single ended conversion. Linear Voltage-Current Converters-CMOS, Bipolar and Low – VoltageBiCMOS Op-Amp Design-Instrumentation Amplifier Design.

BICMOS CIRCUIT TECHNIQUES AND CURRENT-MODE SIGNAL PROCESSING (9)

Basic BiCMOS Circuit Techniques, Current -Mode Signal Processing: Continuous-Time Signal Processing – Sampled-Data Signal Processing – Switched-Current Data Converters.

ANALOG FILTERS AND A/D CONVERTERS (9)

Sampled-Data Analog Filters, Over Sampled A/D Converters and Analog Integrated Sensors: First-order and Second SC Circuits-Bilinear Transformation –Cascade Design – Switched-Capacitor Ladder Filter

CONTACT PERIODS:

LECTURE : 45 PERIODS TUTORIAL : 0 PERIODS PRACTICAL : 0 PERIODS TOTAL : 45 PERIODS

REFERENCE BOOKS:

1. *Behzad Razavi,* ***Design of Analog CMOS Integrated circuits****, Tata McGraw Hill Education, 2002.*
2. Mohammed Ismail, Terri Fiez, AnalogVLSI signal and Information Processing, McGraw-Hill International Editons, 1994.
3.R. Jacob Baker, Harry W. Li, and David E. Boyce, CMOS: Circuit Design , Layout and Simulation, Prentice Hall of India, 1997.
4. David A. Johns and Ken Martin, Analog Integrated circuit Design, John Wiley & Son, 2013
5. Greogorian and Tames, Analog Integrated Circuit for Switched Capacitor Circuits,

***COURSE OUTCOMES*:**

Upon completion of this course, the students will have:

CO1: Knowledge on MOS circuit configuration and CMOS amplifier
CO2: To analyze and design Operational amplifier
CO3: An understanding on mixed signal circuits

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4
CO1	L	-	M	H
CO2	L	-	M	H
CO3	L	-	M	H
18VLOE29	L	-	M	H

L – Low, M – Moderate (Medium), H- High

Category : OE

18VLOE30 - HARDWARE DESCRIPTION LANGUAGES
(Common to all Branches)

L	T	P	C
3	0	0	3

PREREQUISITES:Nil

COURSE OBJECTIVES:

- To gain knowledge on HDLs and Modeling styles
- To understand the VHDL and Verilog HDL.
- To design sub-systems USING VHDL/VERILOG

BASIC CONCEPTS OF HARDWARE DESCRIPTION LANGUAGES (9)

VLSI Design flow, Features of VHDL, Capabilities, Hierarchy, Syntax and Semantics of VHDL; Basic Language Elements - Data objects - Variable signal, and constant, Data types, Operators and signal assignments, Design Suits - Entities, architecture declaration, configurations, Packages.

MODELING STYLES (VHDL) (9)

Behavioral Modeling - Process statement, Sequential assignment statements, Loops, wait statement, assertion statement, Delay Model – Inertial delay Model, Transport delay model; Gate Level Modeling – Component instantiation statements; Data flow Modeling - Concurrent assignment statement, Conditional assignment statements, Procedures, functions, Generics, attributes, Model simulation - Writing a test bench, Logic Synthesis.

INTRODUCTION TO VERILOG HARDWARE DESCRIPTION LANGUAGE (9)

Key features, Capabilities, Language Constructs and Conventions in Verilog, Syntax and Semantics of Verilog; Basic Language Elements: Operators, nets, registers, vectors, arrays, parameters, system tasks, complier directives, Module, port connection rules.

MODELING STYLES (VERILOG) (9)

Gate Level Modeling - Gate types, Gate delays; Dataflow Modeling – continuous assignment, Behavioral Modeling - Initial & Always Construct, Assignments with Delays, wait construct, Multiple always blocks, If and if - else, assign, Loop Construct, Sequential and Parallel blocks, Switch level modeling - MOS switches, CMOS switches.

DESIGN SUB-SYSTEMS USING VHDL/VERILOG (9)

Combinational logics – Adder, Subtractor, Decoders, Encoders, Multiplexer, code Converter; Flip flop, state machines – Mealy type FSM, Moore type FSM, Counters and Shift register. Synthesis of digital logic circuits.

CONTACT PERIODS:

LECTURE : 45 PERIODS TUTORIAL : 0 PERIODS PRACTICAL : 0 PERIODS TOTAL : 45 PERIODS

REFERENCE BOOKS:

1. J. Bhaskar, **"A VHDL Primer**, 3rd Edition, Pearson Education, 2015.
2. Douglas Perry, **"VHDL"**, McGraw Hill International, New York, 1998.
3. S. Brown & Z. Vransesic, **"Fundamental of digital Logic with Verilog design",** Tata McGraw Hill, 2002.
4. S. Palnitkar, **"Verilog HDL: A Guide to Digital Design and Synthesis"**, Prentice Hall (NJ, USA), 2003.
5. Frank Vahid, **"Digital Design",** Wiley, 2006.
6. Peter J Ashenden, **"The Designer's Guide to VHDL",** Morgan KaufmannPublishers, 2008.
7. Navabi**, "VHDL Analysis & Modeling of digital systems",** McGraw Hill, 1998.

***COURSE OUTCOMES*:**

After completing this course, the students will have:

CO1: knowledge on HDLs and Modeling styles

CO2: to write the VHDL and Verilog HDL codes

CO3: to design sub-systems USING VHDL/VERILOG

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4
CO1	L	-	-	H
CO2	L	-	-	H
CO3	L	-	-	H
18VLOE30	L	-	-	H

L – Low, M – Moderate (Medium), H- High

18CSOE31 -ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
(Common to All Branches)

Category : OE

L	T	P	C
3	0	0	3

PREREQUISITES: Nil

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Artificial Intelligence and intelligent agents, history of Artificial Intelligence*
- *Building intelligent agents (search, games, constraint satisfaction problems)*
- *Machine Learning algorithms*
- *Applications of AI (Natural Language Processing, Robotics/Vision)*
- *Solving real AI problems through programming with Python, Tensor Flow and Keras library.*

UNIT IFOUNDATIONS OF AI L(9)

Introduction - History of Artificial Intelligence - Intelligent Agents - Uninformed Search Strategies - Informed (Heuristic) Search Strategies - Adversarial Search - Constraint Satisfaction Problems.

UNIT IISUPERVISED AND UNSUPERVISED LEARNING L(9)

Maximum likelihood estimation -Regression -Linear, Multiple, Logistic - bias-variance, Bayes rule, maximum a posteriori inference- Classification techniques - k-NN, naïve Bayes - Decision Trees - Clustering - k-means, hierarchical, high-dimensional- Expectation Maximization.

UNIT IIIENSEMBLE TECHNIQUES AND REINFORCEMENT LEARNING L(9)

Graphical Models - Directed and Undirected Models - Inference - Learning- maximum margin, support vector machines - Boosting and Bagging - Random Forests - PCA and variations - Markov models, hidden Markov models -Reinforcement Learning- introduction - Markov Decision Processes - Value-based methods - Q-learning- Policy-based methods

UNIT IV DEEP LEARNING L(9)

Neural Network Basics - Deep Neural Networks - Recurrent Neural Networks (RNN) - Deep Learning applied to Images using CNN - Tensor Flow for Neural Networks & Deep Learning

UNIT V AI APPLICATIONS L(9)

Applications in Computer Vision : Object Detection- Face Recognition - Action and Activity Recognition -Human Pose Estimation.

Natural Language Processing - Statistical NLP and text similarity - Syntax and Parsing techniques - Text Summarization Techniques - Semantics and Generation - Application in NLP - Text Classification -speech Recognition - Machine Translation - Document Summarization - Question Answering

Applications in Robotics : Imitation Learning - Self-Supervised Learning -Assistive and Medical Technologies - Multi-Agent Learning

CONTACT PERIODS:

Lecture: 45 Periods Tutorial : 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS

1. Peter Norvig and Stuart J. Russell,"**Artificial Intelligence: A Modern Approach**", Third edition
2. Tom Mitchell, **"Machine Learning"**, McGraw-Hill, 1997
3. Ian Goodfellow, Yoshua Bengio, and Aaron Courvillem, "**Deep Learning**", MIT press, 2016.
4. Michael Nielson , **"Neural Networks and Deep Learning"**
5. Christopher Bishop, **"Pattern Recognition and Machine Learning",** Springer, 2006
6. Richard Sutton and Andrew Barto, **Reinforcement Learning: An introduction",** MIT Press,1998
7. Kevin P. Murphy, **"Machine Learning: A Probabilistic Perspective"**, MIT Press, 2012.
8. Trevor Hastie, Robert Tibshirani, Jerome Friedman, **"The Elements of Statistical Learning"**, Second Edition ,Springer, 2011

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

CO1: Develop expertise in popular AI & ML technologies and problem-solving methodologies. ***[Familiarity]***

CO2: Use fundamental machine learning techniques, such as regression, clustering, knearest neighbor methods, etc.***[Usage]***

CO3: Distinguish between supervised and unsupervised machine learning methods.***[Usage]***

CO4: Gain knowledge of the different modalities of Deep learning currently used. ***[Familiarity]***

CO5: Use popular AI & ML technologies like Python, Tensorflow and Keras todevelop Applications.***[Usage]***

***COURSE ARTICULATION MATRIX*:**

CO/PO	PO1	PO2	PO3	PO4
CO1	H	H	H	M
CO2	H	M	M	L
CO3	H	M	H	L
CO4	M	M	H	M
CO5	H	M	H	M
18CSOE31	H	M	H	L

L – Low, M – Moderate (Medium), H- High

18CSOE32 - COMPUTER NETWORK ENGINEERING
(Common to All Branches)

Category : OE

L	T	P	C
3	0	0	3

PREREQUISITES: Nil

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *The hardware and software architecture of Computer Networks*
- *The concepts of internetworking*
- *Issues in resource allocation*
- *End-to-end protocols and data transmission*
- *Network management models*

UNIT I FOUNDATION **L(9)**

Applications – Requirements – Network Architecture – Implementing Network software – Performance – Perspectives on connecting – Encoding – Framing – Error detection – Reliable transmission – Ethernet and Multiple Access Networks – Wireless.

UNIT II INTERNETWORKING **L(9)**

Switching and bridging – IP – Routing – Implementation and Performance – Advanced Internetworking – The Global Internet – Multicast – Multiprotocol and Label Switching – Routing among Mobile devices.

UNIT III CONGESTION CONTROL AND RESOURCE ALLOCATION **L(9)**

Issues in Resource allocation – Queuing disciplines – Congestion Control – Congestion avoidance mechanism – Quality of Service.

UNIT IV END-TO-END PROTCOLS AND DATA **L(9)**

Simple Demultiplexer – Reliable Byte Stream –Remote Procedure Call – RTP – Presentation formatting - Multimedia data.

UNIT V NETWORK MANAGEMENT **L(9)**

SNMPv1 and v2 Organization and information model - Communication model – Functional model - SNMP proxy server- Remote monitoring- RMON1 andRMON2.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial : 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS

1. Larry L. Peterson, Bruce S. Davie, **"Computer Networks a Systems approach"**, Fifth edition, Elsevier, 2011.
2. Priscilla Oppenheimer, **"Top-down Network Design: A Systems Analysis Approach to Enterprise Network Design"**, 3rd Edition, Cisco Press, 2010.
3. James D. McCabe, Morgan Kaufmann, **"Network Analysis, Architecture, and Design"**, Third Edition, Elsevier, 2007.
4. William Stallings, **"SNMP, SNMPv2, SNMPv3, and RMON 1 and 2,"** Third Edition, Pearson Education, 2012
5. Mani Subramanian, **"Network Management Principles and practice"**, Pearson Education, 2010.

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

CO1: Explain the architecture and applications of Computer Networks. ***[Familiarity]***

CO2: Analyze the performance of MAC protocols. ***[Assessment]***

CO3: Configure switches and Routers. ***[Assessment]***

CO4: Design algorithms to ensure congestion control and QOS. ***[Usage]***

CO5: Appreciate the performance of End-to-End protocols and data transmission techniques. ***[Assessment]***

CO6: Use SNMP and RMON.***[Usage]***

***COURSE ARTICULATION MATRIX*:**

CO/PO	PO1	PO2	PO3	PO4
CO1	H	M	H	H
CO2	H	H	M	H
CO3	H	H	M	H
CO4	H	H	M	H
CO5	H	H	M	M
CO6	H	H	M	H
18CSOE32	H	M	M	M

L – Low, M – Moderate (Medium), H- High

18CSOE33 - BIG DATA ANALYTICS
(Common to All Branches)

Category : OE

L	T	P	C
3	0	0	3

PREREQUISITES: Nil

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Statistical methods*
- *Bayesian, Support Vector and Kernel Methods*
- *Time Series Analysis and Rule Induction*
- *Neural networks and Fuzzy Logic*
- *Visualization Techniques*

UNIT I STATISTICAL CONCEPTS AND METHODS L(9)

Statistical Concepts: Probability, Sampling and Sampling Distributions, Statistical Inference, Prediction and Prediction Errors–Resampling- Statistical Method: Linear Models, Regression Modeling, Multivariate Analysis.

UNIT II BAYESIAN METHODS AND SUPPORT VECTOR AND KERNEL METHODS L(9)

Bayesian Methods: Bayesian Paradigm, modeling, inference and networks – Support Vector and Kernel Methods: Kernel Perceptron, Overfitting and Generalization Bounds, Support Vector Machines, Kernel PCA and CCA.

UNIT III TIME SERIES ANALYSIS AND RULE INDUCTION L(9)

Analysis of time series: linear systems analysis, nonlinear dynamics, Delay Coordinate Embedding - Rule induction: Propositional Rule Learning, Rule Learning as search, Evaluating quality of rules, Propositional rule induction, First order rules-ILP systems.

UNIT IV NEURAL NETWORKS AND FUZZY LOGIC L(9)

Neural networks: learning and generalization, competitive learning, principal component analysis and neural networks; Fuzzy logic: extracting fuzzy models from data, fuzzy decision trees.

UNIT V STOCHASTIC SEARCH METHODS AND VISUALIZATION L(9)

Stochastic Search Methods: Stochastic Search by Simulated Annealing, Adaptive Search by Evolution- Evolution Strategies- Genetic Algorithms & Programming- Visualization : Classification of Visual Data Analysis Techniques, Data Type to be Visualized, Visualization Techniques, Interaction Techniques and Specific Visual Data Analysis Techniques.

CONTACT PERIODS:

Lecture: 45 Periods Tutorial : 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1 Michael Berthold, David J. Hand, **"Intelligent Data Analysis-An Introduction"**, Second Edition, Springer,2007.

2 Bill Franks, **"Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with advanced analystics"**, John Wiley & sons, 2012.

3 Jimmy Lin and Chris Dyer, **"Data Intensive Text Processing using Map Reduce"**, Morgan and Claypool Publishers, 2010.

4 Tom White, **"Hadoop: The Definitive Guide"**, O`Reilly Publishers, 2012

5 David Loshin, "**Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph**", Morgan Kaufmann, 2013.

6 Paul Zikopoulos, Chris Eaton, "**Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data**", McGraw-Hill Education, 2011.

***COURSE OUTCOMES**:*

Upon completion of this course, the students will be able to:

CO1: Explain the statistical concepts and methods.***[Familiarity]***
CO2: Use Bayesian, support vector and kernel Methods.***[Usage]***
CO3: Perform Time series analysis. ***[Usage]***
CO4: Use Rule induction.***[Usage]***
CO5: Apply Neural network and Fuzzy logic. ***[Usage]***
CO6: Use Stochastic search methods. ***[Usage]***
CO7: Explain Visualization Techniques.***[Familiarity]***

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4
CO1	H	M	M	M
CO2	H	H	M	M
CO3	H	H	M	M
CO4	H	H	M	M
CO5	H	H	M	M
CO6	H	H	M	M
CO7	H	H	M	M
18CSOE33	H	H	H	M

L – Low, M – Moderate (Medium), H- High

18PSACZ1 - ENGLISH FOR RESEARCH PAPER WRITING
(Common to all Branches)

Category : AC

L	T	P	C
2	0	0	0

PREREQUISITES: Nil

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Writing quality research papers in English*

UNIT I **L(6)**

Planning and Preparation, Word Order, Breaking up long sentences,Structuring Paragraphs and Sentences, Being Concise and RemovingRedundancy, Avoiding Ambiguity and Vagueness

UNIT II **L(6)**

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism

UNIT III **L(6)**

Sections of a Paper, Abstracts, Introduction, Review of the Literature, Methods, Results, Discussion, Conclusions, TheFinal Check

UNIT IV **L(6)**

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

UNIT V **L(6)**

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions, useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

CONTACT PERIODS:

LECTURE: 30 PERIODS TUTORIAL:0 PERIODS PRACTICAL:0 PERIODS TOTAL:30 PERIODS

REFERENCE BOOKS:

1 **Goldbort R (2006) Writing for Science, Yale University Press** (available on GoogleBooks).

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 Wallwork , English for Writing Research Papers**, Springer New York Dordrecht Heidelberg London, 2011.

COURSE OUTCOMES:

Upon completion of this course the students will be able to,

CO1: Utilize writing skills to write best quality research paper and provide better readability.
CO2: Describe each section of a paper with clarity.
CO3: Review the papers efficiently.
CO4: Utilize the key skills to write title, abstract, introduction and literature review of the paper.
CO5: Write the methods, results, Discussion and Conclusion using the required skills and useful phrases.

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4
CO1	-	M	-	M
CO2	-	H	-	M
CO3	-	H	-	M
CO4	-	H	-	M
CO5	-	H	-	M
18PSACZ1	-	H	-	M

L – Low, M – Moderate (Medium), H- High

18PSACZ2 - DISASTER MANAGEMENT
(Common to all Branches)

Category : AC

L	T	P	C
2	0	0	0

PREREQUISITES: Nil

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Key concepts in disaster risk reduction.*
- *Types of disasters and hazards.*
- *Disaster prone areas in India.*
- *Strengths and weaknesses of disaster management approaches.*
- *Risk assessment methods.*

UNIT I INTRODUCTION L(6)

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

UNIT IIREPERCUSSIONS OF DISASTERS AND HAZARDS L(6)

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.

UNIT III DISASTER PRONE AREAS IN INDIA L(6)

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

UNIT IVDISASTER PREPAREDNESS AND MANAGEMENT L(6)

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.

UNIT V RISK ASSESSMENT L(6)

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.

CONTACT PERIODS:

LECTURE: 30 PERIODS TUTORIAL:0 PERIODS PRACTICAL:0 PERIODS TOTAL:30 PERIODS

REFERENCE BOOKS:

1 R. Nishith, Singh AK, "**Disaster Management in India: Perspectives, issues and strategies**" New Royal book Company.

2 Sahni, Pardeep Et.Al. (Eds.)," **Disaster Mitigation Experiences And Reflections**", Prentice Hall Of India, New Delhi.

3 Goel S. L. , "**Disaster Administration And Management Text And Case Studies**" ,Deep &Deep Publication Pvt. Ltd., New Delhi.

4 Jagbir Singh,**"Disaster Management: Future Challenges and Opportunities",** I.K. International Publishing House Pvt. Ltd. , New Delhi, 2007.

COURSE OUTCOMES:

Upon completion of this course the students will be able to,

CO1: Differentiate hazard and disaster and types of disasters.

CO2: Identify the causes and types of manmade and natural disaster.

CO3: Describe the disaster prone areas in India.

CO4: To predict and, where possible, prevent disasters, mitigate their impact on vulnerable populations, and respond to and effectively cope with their consequences

CO5: Provide survival strategies based on risk assessment.

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4
CO1	L	-	-	M
CO2	L	-	-	M
CO3	L	-	-	H
CO4	M	-	-	H
CO5	M	-	-	H
18PSACZ2	L	-	-	H

L – Low, M – Moderate (Medium), H- High

18PSACZ3 - VALUE EDUCATION
(Common to all Branches)

Category : AC

L	T	P	C
2	0	0	0

PREREQUISITES: Nil

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- Value of education and self- development
- Requirements of good values in students
- Importance of character

UNIT I - ETHICS AND SELF-DEVELOPMENT **L(6)**

Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non-moral valuation. Standards and principles. Value judgements.

UNIT II - PERSONALITY AND BEHAVIOR DEVELOPMENT **L(6)**

Soul and Scientific attitude .Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness.Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance.

UNIT III - VALUES IN HUMAN LIFE **L(6)**

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

UNIT IV - VALUES IN SOCIETY **L(6)**

True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

UNIT V - POSITIVE VALUES **L(6)**

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

CONTACT PERIODS:

LECTURE: 30 PERIODS TUTORIAL:0 PERIODS PRACTICAL:0 PERIODS TOTAL:30 PERIODS

REFERENCE BOOKS:

1. Chakroborty, S.K. **"Values and Ethics for organizations Theory and practice",** Oxford University Press, New Delhi
2. Dr. Yogesh Kumar Singh, **"Value Education",** A.P.H Publishing Corporation,New Delhi
3. R.P Shukla, **"Value Education and Human Rights",** Sarup and Sons, NewDelhi.
4. https://nptel.ac.in/courses/109104068/36

COURSE OUTCOMES

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

CO1: Understand the values and work ethics

CO2: Enhance personality and behaviour development

CO3: Apply the values in human life.

CO4: Gain Knowledge of values in society.

CO5: Learn the importance of positive values in human life.

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4
CO1	-	-	-	M
CO2	-	-	-	H
CO3	-	-	-	H
CO4	-	-	-	H
CO5	-	-	-	H
18PSACZ3	-	-	-	H

L – Low, M – Moderate (Medium), H- High

18PSACZ4 - CONSTITUTION OF INDIA
(Common to all Branches)

Category : AC

L	T	P	C
2	0	0	0

PREREQUISITES: Nil

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Indian constitution*
- *Constitutional rights & duties*
- *Organs of governance*
- *Local administration*
- *Roles and functions of Election commission*

UNIT I - INDIAN CONSTITUTION **L(6)**

History of Making of the Indian Constitution: History Drafting Committee, (Composition & Working) - Philosophy of the Indian Constitution: Preamble Salient Features

UNIT II - CONSTITUTIONAL RIGHTS & DUTIES **L(6)**

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.

UNIT III -ORGANS OF GOVERNANCE **L(6)**

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.

UNIT IV - LOCAL ADMINISTRATION **L(6)**

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.

UNIT V - ELECTION COMMISSION **L(6)**

Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

CONTACT PERIODS:

LECTURE: 30 PERIODS TUTORIAL:0 PERIODS PRACTICAL:0 PERIODS TOTAL:30 PERIODS

REFERENCE BOOKS:

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

COURSE OUTCOMES

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

CO1: Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.

CO2: Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.

CO3: Understand the various organs of Indian governance.

CO4: Familiarize with the various levels of local administration.

CO5: Gain knowledge on election commission of India.

***COURSE ARTICULATION MATRIX*:**

CO/PO	PO1	PO2	PO3	PO4
CO1	-	-	-	M
CO2	-	-	-	M
CO3	-	-	-	M
CO4	-	-	-	M
CO5	-	-	-	M
18PSACZ4	-	-	-	M

L – Low, M – Moderate (Medium), H- High

18PSACZ5 - PEDAGOGY STUDIES
(Common to all Branches)

Category : AC

L	T	P	C
2	0	0	0

PREREQUISITES: Nil

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- Understanding of various theories of learning, prevailing pedagogical practices and design of curriculum in engineering studies.
- Application of knowledge in modification of curriculum, its assessment and introduction of innovation in teaching methodology.

UNIT I - INTRODUCTION **L(6)**

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.

UNIT II - PEDAGOGICAL PRACTICES **L(6)**

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 practicesMethodology for the in depth stage: quality assessment of included studies.

UNIT III - PEDAGOGICAL APPROACHES **L(6)**

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.Teacher's attitudes and beliefs and Pedagogic strategies.

UNIT IV - PROFESSIONAL DEVELOPMENT **L(6)**

Professional development: alignment with classroom practices and follow-up support.Peer support from the head teacher and the community. Curriculum and assessment Barriers to learning: limited resources and large class sizes.

UNIT V - CURRICULUM AND ASSESSMENT **L(6)**

Research gaps and future directionsResearch design ContextsPedagogy Teacher education Curriculum and assessment Dissemination and research impact.

CONTACT PERIOD:

LECTURE: 30 PERIODS TUTORIAL:0 PERIODS PRACTICAL:0 PERIODS TOTAL:30 PERIODS

REFERENCE BOOKS:

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:

Upon completion of this course the students will be able to,

CO1: Explain the concept of curriculum, formal and informal education systems and teacher education.
CO2: Explain the present pedagogical practices and the changes occurring in pedagogical approaches.
CO3: Understand the relation between teacher and community, support from various levels of teachers to students and limitation in resources and size of the class.
CO4: Perform research in design a problem in pedagogy and curriculum development.

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4
CO1	M	-	-	H
CO2	M	-	-	H
CO3	M	-	-	H
CO4	M	-	-	H
18PSACZ5	M	-	-	H

L – Low, M – Moderate (Medium), H- High

18PSACZ6- STRESS MANAGEMENT BY YOGA
(Common to all Branches)

Category : AC

L	T	P	C
2	0	0	0

PREREQUISITES: Nil

COURSE OBJECTIVES:
Upon completion of this course, the students will be familiar with:

- *Eight parts of yoga*
- *Techniques to achieve overall health of body and mind*
- *Breathing techniques and its effects*

UNIT I **L(6)**
Definitions of Eight parts of yog. (Ashtanga).

UNIT II **L(6)**
Yam and Niyam.-Do`s and Don't's in life.

UNIT III **L(6)**
Ahinsa, satya, astheya, bramhacharya and aparigraha ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan.

UNIT IVL(6)
Asan and Pranayam : Various yog poses and their benefits for mind & body.

UNIT VL(6)
Regularization of breathing techniques and its effects-Types of pranayam.

CONTACT PERIOD:
LECTURE: 30 PERIODS TUTORIAL:0 PERIODS PRACTICAL:0 PERIODS TOTAL:30 PERIODS

REFERENCE BOOKS:

1 **'Yogic Asanas for Group Tarining-Part-I"** :Janardan Swami Yogabhyasi Mandal, Nagpur
2 "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama(Publication Department), Kolkata
3 **Pandit Shambu Nath, "Speaking of Stress Management Through Yoga and Meditation",**New Dawn Press,New Delhi.
4 K.N Udupa**, "Stress and its management by Yoga",** Motilal Banarsidass Publ,New Delhi.

COURSE OUTCOMES*:*
Upon completion of this course, the students will be able to:
CO1:understand the basics of Yoga.
CO2: Identify Do's and Dont's in life.
CO3: Follow ethical and moral guidelines given by Yamas and Niyamas in life.
CO4: Develop healthy mind in a healthy body thus improving social health by Asan and Pranayam
CO5: Use breathing techniques to live a stress free life

***COURSE ARTICULATION MATRIX*:**

CO/PO	PO1	PO2	PO3	PO4
CO1	-	-	-	H
CO2	-	-	-	H
CO3	-	-	-	H
CO4	M	-	-	H
CO5	M	-	-	M
18PSACZ6	L	-	-	H

L – Low, M – Moderate (Medium), H- High

18PSACZ7- PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

(Common to all Branches)

Category : AC

L	T	P	C
2	0	0	0

PREREQUISITES: Nil

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- Techniques toachievethehighestgoalhappily
- How tobecomeapersonwithstablemind,pleasingpersonalityanddetermination
- Awakeningwisdominstudents

UNIT I **L(6)**

Neetisatakam-Holisticdevelopmentofpersonality-Verses-19,20,21,22(wisdom)-Verses-29,31,32(pride&heroism)-Verses-26,28,63,65(virtue)

UNIT II **L(6)**

Verses- 52,53,59(dont's)-Verses-71,73,75,78(do's). - Approachtodaytodayworkandduties.- ShrimadBhagwad Geeta - Chapter2-Verses 41,47,48,

UNIT III **L(6)**

ShrimadBhagwad Geeta -Chapter3-Verses13,21, 27, 35,Chapter6-Verses5,13,17,23,35,-Chapter18-Verses45,46, 48.

UNIT IV **L(6)**

Statementsofbasicknowledge.-ShrimadBhagwad Geeta: -Chapter2-Verses56,62,68 -Chapter12-Verses13,14,15,16,17, 18-PersonalityofRolemodel.

UNIT V **L(6)**

ShrimadBhagwad Geeta:Chapter2-Verses17, Chapter3-Verses36,37,42, Chapter4-Verses18,38,39-Chapter18–Verses37,38,63

CONTACT PERIOD:

LECTURE: 30 PERIODS TUTORIAL: 0 PERIODS PRACTICAL: 0 PERIODS TOTAL: 30 PERIODS

REFERENCE BOOKS:

1. **"Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram (Publication Department), Kolkata**
2. **Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.**
3. **"Bhagavad Gita: The Song of God", Swami Mukundananda, Jagadguru Kripaluji Yog, USA**
4. **"Bhagavad-Gita As It Is", A.C. Bhaktivedanta Swami Prabhupada,, Bhaktivedanta Book Trust Publications**

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: Understand the Holisticdevelopment
CO2: Understand the day todaytodayworkandduties
CO3: Understand mankind topeaceandprosperity
CO4: Become versatilepersonality.

***COURSE ARTICULATION MATRIX*:**

CO/PO	PO1	PO2	PO3	PO4
CO1	-	-	-	M
CO2	-	-	-	M
CO3	-	-	-	M
CO4	-	-	-	H
18PSACZ7	-	-	-	M

L – Low, M – Moderate (Medium), H- High

18PSACZ8- SANSKRIT FOR TECHNICAL KNOWLEDGE
(Common to all Branches)

Category : AC

L	T	P	C
2	0	0	0

PREREQUISITES: Nil

COURSE OBJECTIVES:
Upon completion of this course, the students will be familiar with:

- Alphabets and tense of the language.
- Sentence formation
- The Technical information in Sanskrit Literature

UNIT I **L(6)**
Alphabets in Sanskrit, Past/Present/Future Tense

UNIT II **L(6)**
Simple Sentences - Order, Introduction of roots

UNIT III **L(6)**
Technical information about Sanskrit Literature

UNIT IV **L(6)**
Technical concepts of Engineering-Electrical, Mechanical

UNIT V **L(6)**
Technical concepts of Engineering-Architecture, Mathematics

CONTACT PERIOD:
LECTURE: 30 PERIODS TUTORIAL:0 PERIODS PRACTICAL:0 PERIODS TOTAL:30 PERIODS

REFERENCE BOOKS:

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

COURSE OUTCOMES:
Upon completion of this course the students will be able to,
CO1: Read and write sentences
CO2: Explore the huge knowledge from ancient literature
CO3: Use technical concepts to develop logic in mathematics and engineering.

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4
CO1	-	M	-	-
CO2	M	-	-	-
CO3	M	M	M	-
18PSACZ8	L	L	L	-

L – Low, M – Moderate (Medium), H- High