DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

Scheme and Syllabi of

M.E. (EEE)

Power Systems and Power Electronics

2016 - 2017

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

(Autonomous) (Affiliated to Osmania University)

Gandipet, Hyderabad-500075

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

(AUTONOMOUS)

Gandipet, Hyderabad – 500 075

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

VISION AND MISSION OF THE INSTITUTE

Vision:

- To be a centre of excellence in technical education and research.

Mission:

- To address the emerging needs through quality technical education and advanced research.

VISION AND MISSION OF THE DEPARTMENT

Vision:

- To be in forefront in assimilating cutting edge technologies in the field of Power & Electronics arena.

Mission:

- Imparting need based Engineering Education
- Extending the consultancy through Centre of Excellence with the support of public and private sector organizations
- Exposure to practical problems through Industry Institute interaction
- Solutions to practical problems through incubation center
- Complementing the engineering training through extra and co-curricular activities
- Taking technologies blended with ethics and morals to the society for sustainable growth to cater to the needs of the society.

Programme Educational Objectives (PEO)

Post graduates of the PS&PE programme

PEO1: Will excel in power system and power electronics area.

PEO2: Will become successful in executing software related applications.

PEO3: Will carry out research in new and applied technologies relevant to PS & PE.

PEO4: Will develop with professional ethics, effective communication skills, and knowledge of societal impacts of computing technologies.

Programme Outcomes (PO)

POs describe what students are expected to know or be able to do by the time of Post Graduation from the program.

Post graduate students of PS&PE program will acquire ability to

PO1: Apply knowledge of core subject which is derived ab initio in their four year UG program.

PO2: Stimulate an idea which is thought provoking in formulating engineering requirement.

PO3: Form a problem, analyze, diagnose and arrive for many solutions.

PO4: Design (which is blended with simulation) prototype model which is a primitive.

PO5: Use digital techniques, program skills & modern simulation tools necessary for soft computing methods.

PO6: Fulfill the aphorism "Think locally act Globally" in order to cater to the needs of society such as Cultural and Environmental issues.

PO7: Maintain the knowledge levels on par with contemporary competencies.

PO8: Comprehend the professional, ethical, legal, security and social responsibilities.

PO9: aware that education is possession that cannot be isolated from the individual throughout their life.

PO10: Communicate cogently with people from all walks of life.

PO11: Demonstrate the capability and knowledge to modify the problem formulation and methods of solution based on the results to arrive at acceptable outcome, independently.

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

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Scheme of Instruction & Examination

M.E. (Power Systems & Power Electronics) Four-Semester Course (Full-Time) 2016-17

S. No	Subject	Periods Per Week		Semester Exam Duration(Hrs.)	Max. Marks		Credits
		L	T/P		Internal Assessment	End Exam	
SEMESTER-I							
1	Core 1	3	1	3	30	70	4
2	Core 2	3	1	3	30	70	4
3	Core 3	3	1	3	30	70	4
4	Elective 1	3	-	3	30	70	3
5	Elective 2	3	-	3	30	70	3
6	Elective 3	3	-	3	30	70	3
7	Lab-1	-	3	-	50	-	2
8	Seminar-I	-	3	-	50	-	2
9	Soft Skills	--	2	--	* Non-Credit		
	Total	**18**	**11**		**280**	**420**	**25**
*Internal Assessment only and awarded with "Satisfactory/Not Satisfactory							
SEMESTER-II							
1	Core 4	3	1	3	30	70	4
2	Core 5	3	1	3	30	70	4
3	Core 6	3	1	3	30	70	4
4	Elective 4	3	-	3	30	70	3
5	Elective 5	3	-	3	30	70	3
6	Elective 6	3	-	3	30	70	3
7	Lab-2	-	3	-	50	-	2
8	Seminar-II	-	3	-	50	-	2
9	Mini Project	-	2		50	-	1
	Total	**18**	**11**		**330**	**420**	**26**
SEMESTER-III							
1	Project Seminar (i) Problem formulation & submission of synopsis within 8 weeks from the commencement of 3rd sem. (50 Marks) (ii). Preliminary work on Project implementation (50 Marks)				100	-	**6**
	Total				**100**	-	**6**
SEMESTER-IV							
1	Project Work & Dissertation				100	100	**12**
	Total				**100**	**100**	**12**

M.E (Power Systems and Power Electronics)

List of Theory and Practical Subjects

Sl.No	Code No	Core Subjects
1	16EEC101	Power Semi-Conductor Devices and Circuits
2	16EEC102	Distribution System Planning and Automation
3	16EEC103	Advanced Computer Methods in Power Systems
4	16EEC104	Power System Stability
5	16EEC105	Advanced Electric Drives
6	16EEC106	Flexible AC Transmission Systems
		Practicals
7	16EEC107	Power Systems Lab
8	16EEC108	Power Electronics Lab
9	16 EG 104	Soft Skills Lab
10	16EEC109	Seminar-I
11	16EEC110	Seminar- II
12	16EEC111	Mini Project
13	16EEC112	Project Seminar
14	16EEC113	Project Work & Dissertation
		Elective Subjects
15	16EEE101	Machine Modeling and Analysis
16	16EEE102	Modern Control Theory
17	16EEE103	Advanced Power System Protection
18	16EEE104	Real Time Applications in Power Systems
19	16EEE105	Deregulation of Power Systems
20	16EEE106	Soft Computing Techniques to Power Systems
21	16EEE107	Renewable Energy Sources
22	16EEE108	Reliability Modeling in Power Systems
23	16EEE109	Power Quality Engineering
24	16EEE110	Energy Management
25	16EEE111	Advanced Microprocessor Systems
26	16EEE112	Digital Control Systems
27	16EEE113	HVDC Transmission
28	16EEE114	Research Methodology & Professional Ethics

16EEC101 Power Semiconductor Devices and Circuits (Core)

Instruction	: 3L + 1T Periods / Week
Duration of Semester Examination	: 3 Hours
Semester End Examination	: 70 Marks
Sessional	: 30 Marks
Credits	: 4

Course Objectives: The objectives of the course are to:

1. *Understand switching characteristics of Power Electronic Devices*
2. *Understand principles of operation of dc-dc converters*
3. *Understand principles of operation of dc-dc converters*
4. *Study the operational principles of resonant converters*
5. *Get familiarity with different types of dc-dc converters used in switching power supplies.*

Course Outcomes: After completion of the course students will be able to

1. *Demonstrate the knowledge of switching characteristics of various power semiconductor devices*
2. *Design dc-dc buck ,boost, buck-boost and Cuk converters*
3. *Demonstrate the knowledge of various PWM techniques used in dc-ac single and three phase inverters*
4. *Analyze various types of resonant converters*
5. *Comprehend various dc-dc converters (with electrical isolation) used in SMPS and also able to demonstrate power supply the protection schemes*

UNIT I

Switching Characteristics: Power MOSFETs and IGBTs, Limitations and Safe Operating Areas (SOAs), Latching in IGBTs. Thyristors-Converter & Inverter grade, GTO, RCT, and MCT.

UNIT II

Switch Mode D.C-D.C Converters: Step-down converter (Buck), Step-up converter (Boost), Buck-Boost converter, Control of D.C-D.C converters, Cuk converter

UNIT III

Switch Mode D.C-A.C Inverters: Pulse width modulated switching schemes, Sinusoidal PWM and Square wave PWM of Single phase Inverters and Three phase Voltage source Inverters, Effect of Blanking time on output voltage in PWM Inverters.

UNIT IV

Resonant Converters: Classification, Basic resonant circuit concepts, Load resonant, Resonant switch converters, Resonant D.C Link Inverters with Zero Voltage Switching, High frequency Link Integral half-Cycle converters.

UNIT V

Power Supply Applications: Overview of switching power supplies, DC-AC converters with electrical isolation, Electrical isolation in the feedback loop, Fly-back converters forward converters, Push pull converters, Full bridge converters, Power supply protection, Applications.

Text Books:

1. Mohan, Undeland, Robbins, 'Power Electronics', John Wiley,2003.
2. Rashid M.H, 'Power Electronics', Prentice Hall of India, 1993.

Suggested Reading:

1. Sen P.C, 'Power Electronics', Tata McGraw Hill Pvt. Ltd., New Delhi, 1987.
2. Singh M.D and Khanchandani K.B, 'Power Electronics', Tata McGraw Hill,2008

With effect from the academic year 2016-2017

16EEC102 Distribution System Planning and Automation (Core)

Instruction	: 3L + 1T Periods / Week
Duration of Semester Examination	: 3 Hours
Semester End Examination	: 70 Marks
Sessional	: 30 Marks
Credits	: 4

Course Objectives:

1. *To understand electric distribution system planning aspects*
2. *To understand role and functioning of sub-transmission and distribution sub-stations*
3. *To study the aspects of feeder analysis and improvement of voltage levels with special reference to primary and secondary distribution systems*
4. *To study the application of capacitors in distribution systems.*
5. *To understand distribution automation covering SCADA, CIS, GIS, AMR*

Course Outcomes: After completion of this course, the student

1. *Able to know different planning models in the distribution system planning*
2. *Will have knowledge of role and functioning of sub-transmission and distribution sub-stations*
3. *Capable of doing the primary feeder and secondary feeder voltage drop and power loss calculations*
4. *Competent to calculate the reactive power requirements of distribution system*
5. *Acquire knowledge of different aspects of Distribution automation*
6. *Capable of finding load flow results of distribution system using ladder iterative technique.*

UNIT I

Distribution System Planning: Introduction, Distribution system Planning, Factors effecting planning, Present techniques, Planning models, Planning in the future, Future nature of distribution planning, Role of computer in Distribution planning, Load characteristics and Load models, Wye connected loads, Delta connected loads.

UNIT II

Sub-Transmission Lines & Substations: Types of sub transmission, Distribution substation, Bus schemes, Substation location, Rating of substation, Calculation of voltage drops with primary feeders, Derivation of the K constant, Application curves, Interpretation of the Percentage Voltage drop formula.

UNIT III

Primary Feeders: Types of primary feeders, Primary feeder loading, Tie lines, Design of radial primary feeders, Voltage drop calculations by ABCD constants, Uniformly distributed load, Non uniformly distributed load, Distribution Feeder Analysis, The ladder iterative technique.

UNIT IV

Secondary Feeders: Secondary voltage levels, Present design practice, Secondary Banking, Economic design of secondaries, Total annual cost equation, Voltage drop and Power loss calculations, Distribution system voltage regulation, Quality of services, Voltage control, Application of capacitors in Distribution system.

UNIT V

Distribution Automation: Distribution Automation, Project planning, Definitions, Communication, Sensors, Supervisory Control and Data Acquisition Systems (SCADA), Consumer Information Service(CIS), Geographical Information System (GIS), Automatic Meter Reading (AMR), Automation system.

Text Books:

1. Gonen Turan, 'Electric Power Distribution System Engineering', CRC Press, 2014
2. A.S. Pabla, 'Electric Power Distribution', Tata McGraw Hill, 2011

Suggested Reading:

1. William.Kersting, 'Distribution System Modelling & Analysis', CRC Press, 2012.
2. V. Kamaraju, 'Electrical Power Distribution systems', Tata McGraw Hill, 2009.

16EEC103 Advanced Computer Methods in Power Systems (Core)

Instruction	: 3L + 1T Periods / Week
Duration of Semester Examination	: 3 Hours
Semester End Examination	: 70 Marks
Sessional	: 30 Marks
Credits	: 4

Course Objectives:

1. *To study the importance of incidence matrices of given power system network.*
2. *To form Bus Impedance and Admittance matrices of given power system*
3. *To understand the importance of power flow studies in power systems and study different methods to conduct power flow studies*
4. *To study related mathematical modelling aspects required for power flow studies*
5. *To study SC studies and its importance an power systems*

Course Outcomes: After completion of the course, the student

1. *Will have knowledge to draw network graphs, formulate bus incidence matrices form the graphs*
2. *Able to form and manipulate bus admittance and impedance matrices, based on an understanding of incidence and primitive network, so as to reflect changes in network*
3. *Will take advantage of techniques such as triangularization, LU, LDU factorization for network reduction and solutions.*
4. *Will formulate power flow equations and become adept to solving these equations by applying Gauss-seidel and Newton-Raphson methods.*
5. *Will have knowledge to calculate short circuit calculations for different types of faults*
6. *Will develop algorithms and write programs for power flow solutions by iterative techniques.*

UNIT I

Graph Theory: Network graph, Incidence Matrices, Element node incidence matrix, Bus incidence matrix, Branch path incidence matrix, Basic and Augmented cut set incidence matrices, Basic and Augmented branch incidence matrices, Basic and Augmented loop incidence matrices, Construction of Primitive network element, Network Matrix Formation of Y Bus.

UNIT II

Formulation of Z-Bus: Matrix representation of power systems, Triangularization, Gaussian elimination method, LU, LDU, Crowds and Cholesky factorization, Algorithm for formation of Z-Bus matrix, Modification of bus impedance matrix for changes in the network, Addition of branch and link.

UNIT III

Load Flow Studies-I: Concepts of load flow, Classification of buses, Representation of fixed tap setting and on load tap changing transformers, Load flow solution using Gauss-Seidel & Newton-Raphson methods, Treatment of voltage controlled buses, Acceleration factors.

UNIT IV

Load Flow Studies-II: Decoupled and fast decoupled method, Flow chart and comparison of different methods, Numerical analysis, Distribution Load Flow Methods

UNIT V

Short Circuit Studies: Review of Z_{Bus} calculations, Basic assumption in short circuit studies, Short circuit calculations using Z_{Bus}-System representation, Short circuit calculations for balanced three phase network using ZBUS, Fault impedance and admittance matrices for 3-phase to ground and line to ground faults.

Text Books:

1. Stagg & El-Abiad, 'Computer methods in Power System Analysis', Tata McGraw Hill, 1968.
2. Kusic Gearge L, 'Computer Aided Power System Analysis', - Prentice Hall, 1986.
3. M.A.Pai, 'Computer techniques in Power System Analysis', Tata McGraw Hill, 2006.

Suggested Reading:

1. L.P. Singh, 'Advanced Power System Analysis and Dynamics', New Age International Publishers, 2012.
2. Abhijit Chakrabarti & Sunita Halder, 'Power System Analysis: Operation and Control' Prentice Hall India, 3rd edition 2010.

16EEC104 Power Systems Stability (Core)

Instruction	: 3L + 1T Periods / Week
Duration of Semester Examination	: 3 Hours
Semester End Examination	: 70 Marks
Sessional	: 30 Marks
Credits	: 4

Course Objectives:

1. *To Understand modeling aspects of Synchronous machine and importance of park's transformation to carryout system studies.*
2. *To Understand the stability aspects of power system.*
3. *To Understand the modling aspect of controller such as Excitation system, Turbine and Governor models and FACTS controller.*
4. *To Understand the 'Low Freq Oscillation' occurring in Power System and its importance to mitigate.*
5. *To Understand the phenomena of SSR Oscillation in series compensated transmission network.*

Course Outcomes: After completion of the course, the student will be able to:

1. *Acquire knowledge to model the syn. m/c to carryout system studies.*
2. *Acquire knowledge to evaluate performance of power system form steady state stability, transient stability and voltage stability point of view.*
3. *Acquire to knowledge to model PS controllers such as excitation system, Turbine-Governor FACTS controller for stability studies.*
4. *Acquire knowledge to mitigate low freq Oscillation in power system; improving system damping through supplementary excitation control.*
5. *Acquire knowledge to analyze SSR Oscillation occurring in series compensated network through damping controls and its importance in power transfer and stability of the system.*

UNIT I

Synchronous Machine Modeling: The Synchronous machine, Park's transformation, Flux linkage equations, Voltage equations, Current formulation of state space equations, Per-unit conversion, Normalizing Voltage and torque equations, Torque and power, Equivalent circuits of synchronous machine, Flux linkage state space model, Treatment of saturation Synchronous machine connected to infinite bus, Current , Voltage and flux linkage models.

UNIT II

Steady State Stability: Basic concept of stability, types of stability, Stability criteria for single and multi-machine systems.

Transient Stability: The swing equation for single and multi-machine system, Basic assumptions, Different methods of solution of swing equation, Determination of critical time and critical angle,.

Voltage Stability: Concept of voltage stability, Characteristics of network, Generator and load, for voltage stability, Voltage stability and angular stability in power systems, Factors contributing and affecting voltage stability / collapse, Prevention of voltage collapse, Voltage stability static indices, Reactive power - voltage control, 'P-V' curves and 'Q-V' curves, Power Flow analysis for voltage stability, Voltage critical and angle critical for a two bus system.

UNIT III

IEEE Excitation, Turbine and Governor Models and Facts Controls: IEEE Excitation System Models - 1, 2, 3. Hydraulic Power and Governor Models, Models for steam turbine, Improvement of Transient stability- SVC, SSSC & UPFC.

UNIT IV

Low Frequency Oscillations: Low frequency oscillation and supplementary controls, Transfer function of low frequency oscillation studies, improving system damping with supplementary excitation, Design of supplementary excitation system, State equation for single machine connected to infinite bus through long transmission line system.

UNIT V

Sub-Synchronous Resonance (SSR): Sub-Synchronous Resonance and Sub Synchronous oscillations in series compensated transmission system, Turbine-Generator Torsional Characteristics, Torsional interaction with power system controls, Sub-Synchronous resonance damping schemes.

Text Books:

1. Yao-Nan-Yu, 'Power System Dynamics', Academic Press, 1983.
2. Prabha Kundur, 'Power System Stability & Control', Tata McGraw Hill Edition, 1993.
3. KR Padiyar, 'FACTS Controllers in Power Transmission & Distribution', New Age International Publishers, 2007.

Suggested Reading:

1. Stagg and El-Abiad, 'Computer Methods in Power systems', McGraw Hill, 1968.
2. P.M. Anderson and A A Foud, 'Power System Control and Stability', IEEE Press, 2002.

16EEC105 Advanced Electric Drives (Core)

Instruction	: 3L + 1T Periods / Week
Duration of Semester Examination	: 3 Hours
Semester End Examination	: 70 Marks
Sessional	: 30 Marks
Credits	: 4

Course Objectives:

1. *To Understand the principles of commutation in converters and study the performance, stability and control aspects of DC motors and Induction motors.*
2. *To Understand the microprocessor based control of electric drives*
3. *To Study the working principles and control aspects of special motors: Brushless DC motor, Switched Reluctance Motor drives.*

Course Outcomes: *After completion of this course, the student will be able to:*

1. *Identify and consider the requirement of power converters for a given application.*
2. *Illustrate the digital methods of DC motor speed control techniques.*
3. *Show how the changes effect in different speed control schemes of Induction motor.*
4. *Analyse the performance of Synchronous motor with and without sinusoidal supply.*
5. *Recognize and formulate problems encountered by special motor drives for a particular application.*

UNIT I

Review of Power Converters: Generalized theory and Kron's primitive machine model; reference frame theory and per unit system; Commutation in Thyristor power converters, Principle of natural commutation and forced commutation, Discontinuous conduction in converters, DC choppers, Force commutated inverters, Frequency conversion. Inverter voltage control, Harmonic neutralisation, Voltage controller.

UNIT II

DC Motor Control: General considerations, Evaluation of a dc drive performance Forced commutation schemes to improve the performance of the drives, Steady-State Analysis of the Three-Phase Converter Controlled rectifiers, Steady-state analysis of chopper controlled dc motors , State space model and digital simulation of dc motors, three phase drives. DC motor speed control using microprocessor(Block Diagram and Flowchart Approach only),

UNIT III

A C Motor Control: Induction Motor (IM): Speed control of IM, Analysis of IM on non sinusoidal voltage waveforms, Analysis of CSI fed IM ,Performance of CSI fed IM, Static slip energy recovery schemes employing Converter cascades in the rotor circuit Dynamic behavior and stability of Variable frequency IM, Induction motor speed control using microprocessor (Block Diagram and Flowchart Approach only).

UNIT IV

Synchronous Motor (SM) Control: Analysis of SM fed from non sinusoidal supplies, Performance of SM on non sinusoidal voltages, Performance of CSI fed SM, Marginal angle control of SM, stability of SM on non sinusoidal supplies, Synchronous motor speed control using microprocessor (Block Diagram and Flowchart Approach only).

UNIT V

Special Motor Drives: **Switched reluctance motor** drive construction, Working principle, Normalized torque-speed characteristics, Speed Control Schemes,
Brushless DC Motor construction: Working principle, Torque-speed characteristics, Speed Control Schemes,
Solar Powered Drive: motors suitable for pump drives, solar powered pump drives
Battery Powered Drives: battery powered vehicles, basics, current status and scope for growth

Text Books:

1. Vedam Subramanyam, 'Thyristor Control of Electric Drives', Tata McGraw Hill Publishing Co., New Delhi, 1987.
2. G.K.Dubey, Fundamentals of Electrical Drives; Narosa Publishing House, 1995
3. P.S.Bimbra, Generalised theory of Electrical Machines, Khanna Publication, 2006.

Suggested Reading:

1. R. Krishnan, ' Electric Motor Drive: Modeling, Analysis and Control' Prentice Hall of India, 2001.
2. B.K.Bose, 'Power Electronics and AC Drives', Prentice Hall, 2002.

With effect from the academic year 2016-2017

16EEC106 Flexible AC Transmission Systems (Core)

Instruction	: 3L + 1T Periods / Week
Duration of Semester Examination	: 3 Hours
Semester End Examination	: 70 Marks
Sessional	: 30 Marks
Credits	: 4

Course Objectives: Objectives of the course are to

1. *Understand concepts of various FACTS devices and controllers which can be used for interconnected power transmission systems*
2. *Study the various converter topologies used in FACTS*
3. *Study the principles of operation and control of shunt FACTS controllers suitable for reactive power compensation, power flow and stability problems*
4. *Study the principles of operation and control of Series FACTS controllers*
5. *Study the principles of operation and control of combined FACTS controllers*

Course Outcomes: After completion of the course students will be able to

1. *Select the appropriate FACTS device/controller based on the needs of inter connected power transmission systems.*
2. *Select various converter topologies used in FACTS for harmonic reduction.*
3. *Demonstrate the knowledge of shunt compensators(i.e SVC,STATCOM) for the end of line voltage support and transient stability problems*
4. *Analyze the operation and control of GCSC, TCSC and SSSC.*
5. *Describe the principles, operation and control of UPFC and also demonstrate the knowledge of UPFC for P and Q control*

UNIT I

General System Considerations and FACTS: Transmission Interconnections, Flow of Power in an AC System, Power Flow and Dynamic Stability Considerations of a Transmission Interconnection, principles of series and shunt compensation, Basic Types of FACTS Controllers, Benefits from FACTS, Application of FACTS.

UNIT II

Voltage-Source Converters: Basic concept of Voltage-Sourced Converters, single-Phase Full-wave Bridge converter operation, single phase-leg operation, square-Wave Voltage Harmonics for a single-phase bridge, Three-phase full-wave bride converter, sequence of valve conduction process in each phase-leg, three-level voltage-sourced converter, Pulse-Width Modulation (PWM) converter, Generalized Technique of Harmonic Elimination and voltage control.

UNIT III

Shunt Compensators: Objectives of Shunt Compensation, Midpoint Voltage Regulation for Line Segmentation, End of Line Voltage Support to Prevent Voltage Instability, improvement of Transient Stability, Power Oscillation Damping, Static Var Compensators, SVC and STATCOM, The Regulation Slope, Transfer Function and dynamic Performance, Transient Stability Enhancement and Power Oscillation Damping

UNIT IV

Series Compensators: Objectives of Series Compensation, concept of series capacitive compensation, voltage stability, improvement of transient stability, power oscillation damping, GTO thyristor controlled series capacitor, Thyristor controlled series capacitor, SSSC.

UNIT V

Combined Compensators: Introduction, Unified Power Flow Controller (UPFC), basic operating principles, independent real and reactive power flow control, control structure, basic control system for P and Q control.

Text Books:

1. Narain G. Hingorani, Laszlo Gyugyi, 'Understanding FACTS', IEEE press, 1999.
2. Y.H.Song, A.T.Johns, 'Flexible A.C.Transmission System', IEE, London, 1999

Suggested Reading:

1. KR Padiyar, **'**Facts Controllers In Power Transmission and Distribution', 2nd edition, New Age Publications, 2016.
2. R. Mohan Mathur, Rajiv K. Varma, 'Thyristor-Based FACTS Controllers for Electrical Transmission Systems', Wiley Publications IEEE Press, 2002
3. Timothy J.E. Miller, 'Reactive Power Control in Electric Systems', 1982.

16EEC107 Power Systems Lab

Instruction : 3 Periods / Week
Internal Marks : 50 Marks
Credits : 2

Course Objectives:

1. *To Simulate and compare the various aspects economic load dispatch and load flows..*
2. *To Simulate and observe the stability studies of transient and steady state*
2. *To simulate and observe behavior of a system during the Short circuit*
3. *To Conduct experiments on a given system to know performance when subjected to various faults*
4. *To Conduct experiments on different types of relays*

Course Outcomes: The student will be able to

1. *Validate the adaptability of economic load dispatch and load flow for a given situation by simulation results.*
2. *Design a controller for FACTS application by simulation*
3. *Demonstrate the effects of different sequence reactances of a synchronous machine by experimentation.*
4. *Acquainted with the characteristics of different relays by experimentation*
5. *Acquire the knowledge to calculate the sequence reactances from fault-study.*

LIST OF EXPERIMENTS

PART A : Simulation

1. Load frequency Control of Single & Two Area System.
2. Economic dispatch in power systems
3. Formation of Z-bus matrix using Building Algorithm.
4. Load Flow Studies using Gauss-Seidel and Newton Raphson method
5. Transient Stability Studies for different faults
6. Short Circuit Analysis
7. Applications of FACTS controllers
8. Distribution load flow studies

PART B: Hardware

1. To measure negative sequence and zero sequence reactance of synchronous machine.
2. To measure direct axis and quadrature axis reactances of synchronous machine
3. To study the single line to ground fault
4. To study line to line fault
5. To study three-phase fault
6. To study microprocessor based over current relay characteristics
7. To study percentage differential relay characteristics
8. To study over voltage relay
9. To study under voltage relay
10. To measure positive and zero sequence reactance's of three-phase transformer

Note: At least **5** experiments should be conducted from **each part.**

16EEC108 Power Electronics Lab

Instruction : 3 Periods / Week
Internal Marks : 50 Marks
Credits : 2

Course Objectives:

1. *To Simulate and compare the characteristics of Inverter .*
2. *To Simulate and compare the characteristics of converters*
3. *To simulate and observe the various speed control methods of IM*
4. *To Conduct experiments on various converters and inverters and observe the differences*
5. *To Conduct experiments on different types of speed control techniques of IM and to observe the adaptability for the given situation.*

Course Outcomes: The student will be able to

1. *Analyze the performance of converters and inverters by simulation results.*
2. *Design a control circuit with different orientations of devices by simulation*
3. *Demonstrate the effects of different loads on various converters and inverters by experimentation.*
4. *Acquainted with the different speed control techniques of IM*
5. *Know how to use the simulation software to design and fabricate different power electronic circuits.*

LIST OF EXPERIMENTS:

Part A: Simulation

1. Single phase and Three phase IGBT inverters.
2. PWM inverters.
3. Buck and Buck-Boost converter.
4. Resonant converter.
5. V/f control of three phase induction motor.
6. Three phase AC voltage controller.
7. Performance of three phase controlled rectifier with source inductance.
8. Reactive power compensation using FACTS controllers.

Part B: Hardware

1. Three phase Mc-Murray Bed-Ford inverter.
2. Three phase IGBT inverter.
3. Closed loop control of permanent magnet DC drive.
4. Single phase dual converter.
5. Three phase controlled rectifier with R & RL-Loads.
6. Three phase half controlled rectifier with R & RL-Loads.
7. Three phase step down Cyclo-Converter.
8. Speed control of SRIM using static Kramer's system.

Note: At least **5** experiments should be conducted from **each part**.

16EEC109 SEMINAR – I

&

16EEC110 SEMINAR – II

Instruction	: 3 Periods / Week
Internal Marks	: 50 Marks
Credits	: 2

Course Outcomes: After completion of this course, the student will be able to:

1. *Acquire knowledge in systematic way of carrying out literate survey and select the topic for seminar.*
2. *Acquire knowledge in preparing detailed summary and to gain in -depth knowledge on the chosen topic.*
3. *Acquire knowledge in preparing summary highlights in the direction in which work has progressed and the gaps.*
4. *Acquire knowledge to fill gaps in highlighting the method of solution.*
5. *Acquire knowledge in communication skills and clarity in expression.*

The student has to give a seminar-I during the first semester and Seminar-II during the second semester, which is evaluated by two faculty members.

The topic for the seminar will be chosen by the student relevant to power electronics or power systems or any other area subjected to the condition of approval by the DRC(Departmental Review Committee).

The student has to submit an abstract on the topic one week before the presentation and a detailed report during the presentation.

16EEC111 Mini Project

Instruction	: 2 Periods / Week
Internal Marks	: 50 Marks
Credits	: 1

I. Course Objectives:

1. *Motivate the students to face the challenges in which demonstration of their competence in research techniques..*
2. *Provide an opportunity to contribute to engineering arena in their own form.*

II. General Instructions:

- Mini Project is of 14 week duration out of which one week prior reading, twelve weeks of active research and final week for presentation of their work for assessment.
- Each student will be allotted to a faculty supervisor for mentoring.

III. Methodology:

1. The student can select either mathematical modeling based / experimental investigations or numerical modeling.
2. All the investigations are clearly stated and documented with reasons / explanations.
3. The project should contain
   i. A clear statement of research objectives
   ii. Background work
   iii. Literature review
   iv. Techniques used
   v. Prospective deliverables
   vi. Benefit from this research
   vii. Detailed discussion on results
   viii. Conclusions and references

IV. Assessment:

1. 50% of the marks for oral presentation which will take place at the end of the semester.
2. Evaluation will be done by a committee consisting of supervisor, one senior faculty and Head of the department or his nominee.
3. Evaluation will be carried out based on 'RUBRIC' (which will be supplied by the dept.)
4. 50% of the marks for scientific report on the project.
5. Report should be written as per standard journal format. The repertoire of the report content can be taken from the department.

16EEC112 PROJECT SEMINAR

Semester Examination : 100 Marks
Credits : 6

Course Outcomes: After completion of the course: the student will be able to:

1. *Develop the skills of analyzing a problem, solving it by different approaches, building interactions with the other organizations.*
2. *Develop the skills of presenting a concept, independent learning and addressing the societal issues, economical outlay*.

The main objective of project seminar is to prepare the students for the project to be executed in 4th semester.

During the third semester, student will deliver a seminar on the progress of the project, which is evaluated for 100 Marks.

The seminar shall be evaluated by the Departmental Review Committee consists of Head of the Department, Programme co-ordinator and Supervisor.

The student will take up project work at the beginning of the third semester, and will continue till the end of the fourth semester.

The project work is carried out for one academic year / two semesters (i.e. 3rd and 4th semesters).

No external examination for Project Seminar.

16EEC113 Project Work & Dissertation

Internal Examination	: 100 Marks
Semester End Examination	: 100 Marks
Credits	: 12

Course Outcomes: After completion of the course the student will be able to:

1. *Acquire knowledge in conducting systematic way the literature Survey by referring to reputed journals/ textbooks etc.*
2. *Acquire knowledge in segregating /Classifying the literature survey paper: Design, Analysis, experimental etc.*
3. *Able to prepare a detailed summary of the paper as per the classification and choose the area and topic fitting in to the classification such as simulation studies, experimentation, preparing prototype etc.*
4. *Acquire knowledge to conduct simulation studies/ experimental studies and tabulate the results and compare the performance and choose the design parameter to improve the performance etc.*
5. *Acquire knowledge in writing the project work report in different chapters: Introduction, back ground, description, problem formulation, Analysis, Discussion, results and suggestions for further studies and conclusions.*

During the fourth semester, student will deliver seminar, which enables to evaluate the preparedness, sufficiency of the work carried out, results etc. On satisfactory recommendation by the Departmental Review Committee, student will prepare the report as per the guidelines issued by the department. The project is evaluated internally for 100 marks and externally for 100 marks.

16EEE101 Machine Modeling and Analysis (Elective)

Instruction	: 3 Periods / Week
Duration of Semester Examination	: 3 Hours
Semester End Examination	: 70 Marks
Sessional	: 30 Marks
Credits	: 3

Course Objectives*:* To understand

1. *The concepts of reference frame theory and basic principles to carryout machine analysis*
2. *The modelling aspects of Synchronous Machine and Study the dynamic performance aspects.*
3. *The modelling aspects of DC Machine and Study the dynamic performance aspects.*
4. *The modelling aspects of Induction Machine and Study the dynamic performance aspects.*

Course Outcomes: After completion of this course, the student will be able to:

1. *Model mathematically all types of DC machine using state variable form*
2. *Obtain stability conditions of all types of DC machines using their characteristic equation deriving from transfer function of the machine.*
3. *Transform variables from one reference frame to another reference frame.*
4. *Model 3Q symmetrical induction machines using reference frame theory under study state condition.*
5. *Analyze the 3Q symmetrical induction motor dynamic performance during transient condition.*
6. *Model 3Q synchronous machines using transformation of reference frames by Park's transformation under steady state and analyze dynamic performance during transient conditions.*

UNIT I

Basic Principles for Electric Machine Analysis: Magnetically coupled circuits, Electro-mechanical energy conversion, Basic Two pole DC Machine, Primitive 2 axis machine, Voltage and Current relationship, Torque equation.

UNIT II

Theory of DC Machines: Mathematical model of separately excited DC Motor, DC Series Motor, DC shunt motor and D.C. Compound Motor in state variable form, Transfer function of the motor.

UNIT III

Reference Frame Theory: Equations of transformation, Change of variables, Stationary circuit variables Transformed to the Arbitrary Reference Frame, Commonly used reference frames, Transformation between reference frames, Transformation of a balanced set, Balanced steady state Phasor, Relationships, Balanced steady state equations, Variables observed from various frames.

UNIT IV

Theory of Symmetrical Induction Machines: Voltage and torque equations in machine variables, Equations of transformation for Rotor circuits, Voltage and torque equations in arbitrary reference frame variables, Analysis of steady state operation, State-space model of induction machine in 'd-q' variables, Free Acceleration Characteristics, Dynamic Performance during sudden changes in load- during a 3 phase fault at the machine terminals.

UNIT V

Theory of Synchronous Machines: Voltage and Torque equations in machine variables, Stator Voltage equations in Arbitrary Reference Frame Variables, Voltage Equations in Rotor Reference Frame Variables: Park's Equations, Torque Equations in Substitute Variables, Analysis of steady state operation, Dynamic performance, During sudden changes in Input Torque, During a 3 phase fault at the machine terminals.

Text Books:

1. C.V. Jones, 'Unified Theory of Electrical Machines' Butterworths Publishers, 1968.
2. P.S. Bhimbra, 'Generalized Theory of Electrical Machines', Khanna publishers,1995.

Suggested Reading:

1. Paul C. Krause, Oleg Wasynczuk, Scott D.Sudhoff, 'Analysis of Electric Machinery and drive systems' John Wiley and Sons, 2013.
2. J. Meisel, 'Principles of Electromechanical Energy Conversion', McGraw Hill, 1984.

16EEE102 Modern Control Theory (Elective)

Instruction	: 3 Periods / Week
Duration of Semester Examination	: 3 Hours
Semester End Examination	: 70 Marks
Sessional	: 30 Marks
Credits	: 3

Course Objectives: The objective of the course is to

1. *Understand state space representation of systems and study controllability, and observability aspects.*
2. *Understand the problem formulation of non-linear systems and Study the performance*
3. *Understand different types of adaptive control systems and its application aspects.*

Course Outcomes: After completion of this course, the student will be able to

1. *Acquire knowledge to represent the system in state space form and analyze controllability and observability aspects*
2. *Have knowledge in problem formulation of non-linear systems and to analyze its performance.*
3. *Acquire knowledge in defining the stability of a non-linear system using Lyapunov stability method*
4. *Acquire knowledge in formulating an optimal control problem and finding its solution using mathematical modeling*
5. *Acquire knowledge pertaining to Adaptive control systems and applications.*

UNIT I

State Space Analysis: Review of state variable representation of systems, controllability and observability, model control of single input, single output systems (siso), controllable and observable companion forms, effect of state feedback on controllability and observability, pole placement by state feedback.

UNIT II

Non Linear Systems: Classification of Non-linearities, Phenomenon exhibited by the nonlinearities, Limit cycles, Jump resonance Sub-harmonic oscillations, Phase plane analysis, Singular points, Construction of phase plane trajectories, Isocline method, Delta method, Measurement of time on phase plane trajectories.

UNIT III

Stability Studies: Concept and definition of stability, Lyapunov stability, Lyapunov's first and second methods, Stability of linear time invariant systems by Lyapunov's second method, Generation of Lyapunov functions, Variable gradient method, Krasooviski's method**.**

UNIT IV

Optimal Control: Formulation of optimal control problems, Calculus of variations, Fundamental concepts, Functionals, Variation of functional, Fundamental theorem of calculus of variations, Boundary conditions,Constrained minimization, Dynamic programming, Hamilton Principle of optimality, Jacobi Bellman equation, Potryagins minimum principle.

UNIT V

Adaptive Control: Introduction to adaptive control, types of adaptive control systems, design of model reference adaptive control systems using m/t rule and lyapunov stability theory.

Text Books:

1. IJ Nagarath , M.Gopal, 'Control Systems Engineering' , New Age International Publishes, Wiley Eastern Ltd., 2006.
2. Ogata K, 'Modern Control Engineering', Prentice Hall, 2010.

Suggested Reading:

1. Donald E Kirk, 'Optimal control theory - An introduction , Dover Publications, 2004.
2. Karl J Astrom Bjron wittenmark, 'Adaptive control', Pearson Education, 1994.

16EEE103 Advanced Power System Protection (Elective)

Instruction	: 3 Periods / Week
Duration of Semester Examination	: 3 Hours
Semester End Examination	: 70 Marks
Sessional	: 30 Marks
Credits	: 3

Course Objectives: *The objective of the course is to*

1. *Study the operating principles and application aspects of static relays*
2. *Learn different types of differential relays and its application to power systems*
3. *Understand the protection philosophy of Generator, Motor, and transformers*
4. *Disseminate with the general principles of pilot protection and travelling wave relays.*

Course Outcomes: *After completion of the course, the student will be able to*

1. *Comprehend the basic components of static relays and their characteristics*
2. *Understand the operating principles of different distance relays.*
3. *Acquaint with the characteristics & application of different protection schemes for AC generators / motors.*
4. *Explicate the principles of transformer protection and auto re-closures.*
5. *Know various types of pilot protection schemes, their adaptability and basic principle of travelling wave relays.*

UNIT I

Static Relays: Advantages and disadvantages, Comparators, Amplitude and Phase comparison schemes, Duality between Amplitude and phase comparators, General equation for comparators for different types of relays, Static comparators, Coincidence circuits, Phase splitting methods, Hall effect comparators, Operating principles, Use of level detectors, Time delay circuits, Filters, Thyristors, Triggering circuits and DC power supplies.

UNIT II

Static Relay Hardware: Operating principles, Static time current relays, Differential relays, Distance relays, Quadrilateral relay, Elliptical relay, Relay response, Principle of R-X diagram, Effect of arc resistance, source impedance and line length on the performance of distance relay, Power swings, Loss of synchronism and its effect on distance relays

UNIT III

Generator and Motor Protection: Generator protection against short circuits using differential relays against inter-phase fault, Combined split-phase and overall differential relays, Protection against stator open circuits, Rotor and Stator overheating, Loss of excitation protection, Field & ground fault protection, Digital protection scheme based upon second harmonic current induced in the rotor field circuit.

UNIT IV

Transformer Differential Protection: Effect of magnetizing inrush currents, Grounding transformers, Bus zone protection with differential relays, 3-zone protection using distance relays, Switched schemes, Auto-reclosing, Single and multi-shot auto reclosing, Single pole and three pole auto reclosing.

UNIT V

Pilot Wire and Carrier Protection: Circulating current scheme, Balanced Voltage scheme, Translay scheme, Half wave comparison scheme, Phase comparison carrier current protection, Carrier transfer scheme, Carrier blocking scheme, Digital protection of EHV/ UHV transmission line based upon traveling wave phenomena.

Text Books:

1. Badriram and Viswakarma D.N., 'Power System Protection and Switchgear', Tata McGraw Hill, April, 2001.
2. Madhavarao T.S., 'Power System Protection Static relays with microprocessor applications', Tata McGraw Hill, 2001.
3. A.T. Johns and S.K. Salman, 'Digital protection for power systems', IEE series, 1989.
4. Stanley H Horowitz, A.G. Phadke, 'Power system relaying', 4th Edition, Wiley publications, 2014.

Suggested Reading:

1. Warrington A.R. Van C, 'Protective Relays', Vol I & II Chapman & Hall, John Wiley & Sons, 1977.
2. Bhuvanesh A OZA, Nirmal kumar C. Nair, Rashesh P Mehta, Vijay H.M., 'Power system protection and Switchgear', Tata McGraw Hill, 2010.
3. J. Lewis Blackburn, Thomas J Domin, 'Protective relaying Principles and Applications', CRC press, 2014.
4. L.P. Singh, 'Digital Protection: Protective Relaying from Electromechanical to Microprocessor', John Wiley & Sons, 1994.

16EEE104 Real Time Applications in Power Systems (Elective)

Instruction	: 3 Periods / Week
Duration of Semester Examination	: 3 Hours
Semester End Examination	: 70 Marks
Sessional	: 30 Marks
Credits	: 3

Course Objectives:

1. *To understand the need for real-time computer control of power system. Functional aspects of Energy control centre and Energy management system.*
2. *To understand the difference between conventional load-flow and State Estimation in power system.*
3. *To understand the importance of contingency analysis at planning stage for secured operation of power system.*
4. *To understand the importance of security analysis in power system for stable operation.*
5. *Understand the concept of operation of power system in de-regulated environment and familiarize with the salient features of Electricity Act 2003 and Indian Electricity Grid code.*

Course Outcomes: After completion of this course, the student will be able to:

1. *Acquire knowledge in real-time computer control of power system and functional aspects of energy control centre and management system.*
2. *Acquire knowledge to distinguish the difference between load-flow studies and state estimation and role of SE in energy control centre.*
3. *Acquire knowledge in studying the importance of contingency analysis at planning stage for secured operation of power system; and simulating the contingency studies with different methods.*
4. *Acquire knowledge in studying the importance of security analysis and challenges in secured operation of power system in real-time environment.*
5. *Acquire knowledge to study the operation of power system in de-regulated environment and grasp the salient features of Electricity Act 2003 and Indian Electricity Grid Code.*

UNIT I

SCADA / EMS: Need for real-time and computer control of power systems, Operating states of power system, Supervisory Control and Data Acquisition (SCADA), Implementation considerations in Energy Control centers, Functional aspects of Energy Management System, Software requirements for implementing the above functions.

UNIT II

State Estimation Techniques: Definition of State Estimation, Difference between Load Flow and State Estimation, Types of measurements, Data acquisition, Role of a state estimator, Rationale of state estimation, Method of least squares for state estimation. Estimation of power system state variables by the Weighted Least Square Estimation (WLSE) technique. Pseudo-measurement**s, S**tatistical errors and bad data recognition, Power system state estimator in noisy environment. Composition of the Jacobian matrix H and the measurement vector Z. Observability in State Estimation. Applications of Power System State Estimation. Role of Phasor Measurement Units (PMU).

UNIT III

Contingency Analysis Techniques: Security in a power system, Approximations in contingency analysis, Simulation of addition and removal of multiple lines in a power system, Simulation of tie lines in inter connected power systems, Network reduction for contingency analysis, Contingency analysis and approximate power flow method for simulating contingencies.

UNIT IV

Power System Security: Introduction. Challenges for secure operation, Methods of enhancing security, Reliability criterion, Enhancement of stability controls, On-line dynamic security assessment, Management of system reliability, Future trends in dynamic security assessment, Real time monitoring and control.

UNIT V

Introduction to Power System Deregulation: Operation of vertically integrated power systems, Models and examples of deregulated operation, New operation and planning policies, Generation scheduling, Independent power producers, Cogeneration, Power wheeling, Salient features of Electricity Act 2003 and Indian Electricity Grid Code.

Text Books:

1. Allen J Wood and Bruce F. Wollenberg, 'Power Generation, operation and control', John Wiley &Sons, 1996.
2. T.K.Nagsarkar, M.S.Sukhija, 'Power system analysis', Oxford publications, 2007.
3. Prabha Kundur, 'Power system stability and control', Tata McGraw /Hill Edition, 1993.

Suggested Reading:

1. J.Arrillaga, C.P.Arnold, 'Computer modeling of electric power systems', John Wiley, 2013.
2. L.P. Singh, 'Advanced Power System Analysis and Dynamics', Wiley eastern Ltd., 2006.
3. C.W. Taylor, 'Power System Voltage Stability', McGraw Hill, 1994.
4. Lai L.L, 'Power system restructuring and deregulation', John Wiley & sons, 2001.
5. Edmund Handschin (Editor), 'Real Time Control of Electric Power Systems', Elsevier Publishing Co., 1976.

16EEE105 Deregulation of Power Systems (Elective)

Instruction	: 3 Periods / Week
Duration of Semester Examination	: 3 Hours
Semester End Examination	: 70 Marks
Sessional	: 30 Marks
Credits	: 3

Course Objectives:

1. *To understand open access and operation of power system in deregulated and competitive environment.*
2. *To understand the role of ISO in pool markets, B*ilateral markets
3. *To understand the transmission pricing methodologies*
4. *To understand different aspects of managing ancillary services.*
5. *To understand the open access same time information system.*

Course Outcomes: After completion of the course, the student will be able to

1. *Have knowledge in analyzing the operation of power system in de-regulated and competitive environment*
2. *Acquire knowledge in operation and planning policies, in deregulated environment.*
3. *Have knowledge of transmission pricing methodologies.*
4. *Know the different ancillary services provided by the ISO*
5. *Acquire the knowledge of open access same time information system.*
6. *Acquire the concepts of available transfer capability and methodologies to calculate ATC*

UNIT I

Introduction to Power System Deregulation : Operation of vertically integrated power systems, Restructuring process, Benefits of deregulation, Power pools, Energy Brokerage system, Electricity market models, Market models based on contractual arrangements, Market architecture, Spot market, Day-ahead market and retail market, Models for trading arrangements.

UNIT II

Power System Operation in Competitive Environment: Operational planning activities of ISO, ISO in pool markets, ISO in bilateral markets, Operational planning activities of a GENCO, Unit commitment in deregulated environment, Competitive bidding.

UNIT III

Transmission Pricing Issues: Power wheeling, transmission open access, cost components in transmission, pricing of power transactions, Transmission cost allocation methods, Postage stamp method, Contract path method, MW-Mile method, MVA-Mile method, Unused transmission capacity method, Comparison of cost allocation methods.

UNIT IV

Ancillary Services Management: Types of ancillary services, classification of ancillary services, load generation balancing related services, frequency regulation, load following, voltage control and reactive power support service, black start capability service, Synchronous generators as ancillary service providers.

UNIT V

Open Access Same-time Information System: Structure of oasis, Posting of information, Transfer capability on oasis, Definitions- atc, ttc, trm, cbm, Methodologies to calculate atc.

Text Books:

1. Lai, L.L. (Editor.), 'Power System Restructuring and Deregulation', John Wiley and Sons Ltd., 2001.
2. Bhattacharya, K., Bollen, M.H.J., and Daalder, J.E., 'Operation of Restructured Power Systems', Kluwer Academic Publishers. 2001.

Suggested Reading:

1. M.Ilic, F.Galiana and L.Fink, 'Power System Restructuring Engineering and Economics', Kluwer Academic Publishers 1998
2. Md Shahidephpour and M. Alomoush, 'Restructured Electrical Power Systems', Marcel Dekker Inc, 2001.

16EEE106 Soft Computing Techniques to Power Systems (Elective)

Instruction	: 3 Periods / Week
Duration of Semester Examination	: 3 Hours
Semester End Examination	: 70 Marks
Sessional	: 30 Marks
Credits	: 3

Course Objectives: The objective of the course is to

1. *Understand basics of advanced optimization algorithms: ANN, FUZZY, Genetic, Particle Swarm Optimization, Ant Colony search algorithms*
2. *Understand the techniques to apply advanced optimization algorithms to power system problems: Reactive power planning, Distribution network expansion, optimal power flow, loss minimization etc.*

Course Outcomes: After completion of this course, the student

1. *Understand the concepts of ANN*
2. *Acquire knowledge of Fuzzy systems.*
3. *Able to understand fundaments and different selection mechanisms in genetic algorithm*
4. *Acquire knowledge of PSO and its variations.*
5. *Capable of applying ANN, Fuzzy, GA, PSO techniques to power system problems.*

UNIT I

ANN: Difference between Artificial Neuron and Biological Neuron, Activation functions, Single layer and Multi layer ANN, Error Calculation, Training of Neural Network, Learning rate, Learning Algorithms, LMS algorithm, Back propagation algorithm, AVQ algorithm.

UNIT II

Fuzzy Logic: Basic concept of Fuzzy logic, Membership Function, Fuzzy Set Operations and its properties, Fuzzy relations, Fuzzy graphs, Fuzzy analysis, Fuzzy Quantifiers, Fuzzy Inference, Rule based system, Defuzzification methods.

UNIT III

Fundamentals of Genetic Algorithms: Introduction to GAs, Encoding, Fitness Function, Premature Convergence, Basic Operators, Selection, Tournament Selection, Truncation Selection, Linear Ranking Selection, Exponential Ranking Selection, Elitist Selection, Proportional Selection, Crossover, Mutation

UNIT IV

Fundamentals of Particle Swarm Optimization Techniques : Introduction, Basic Particle Swarm Optimization, Background of Particle Swarm Optimization, Original PSO, Variations of Particle Swarm Optimization, Discrete PSO, PSO for MINLPs, Constriction Factor Approach (CFA), Hybrid PSO (HPSO), Lbest Model

UNIT V

Applications to Power Systems: Distribution Network Expansion, Dynamic Planning of Distribution System Expansion, Reactive Power Planning, Optimal Power Flow Under Contingent Condition with Line Capacity Limit, Optimal Power Flow for Loss Minimization etc.

Text Books:

1. Kwang Y. Lee and Mohamed A. El-Sharkawi, 'Modern heuristic optimization techniques', IEEE press, Wiley-Interscience Publication, 2007.
2. Soliman, Soliman Abdel-Hady, Mantawy, Abdel-Aal Hassan, 'Modern Optimization Techniques with Applications in Electric Power Systems', Springer publications, 2011.
3. Simon haykin, 'Neural Networks: A comprehensive foundation', Pearson Education, 1994.
4. Zimmermann.H.J, 'Fuzzy Set Theory and Its Applications', Kluwer Academic Publishers, 1985.

Suggested Reading:

1. S.N.Sivanandam, S.N.Deepa, 'Principles of soft computing techniques', Wiley publications, 2007.
2. Kalyanmoy Deb , 'Multi-objective optimization using evolutionary algorithms' ,Wiley publications, 2001.
3. S.Rajsekaram, G.A.Vijayalakshmi Pai, 'Neural Networks, Fuzzy Logic and Genetic Algorithms - Synthesis & Applications', Practice Hall India, 2003.

16EEE107 Renewable Energy Sources (Elective)

Instruction	: 3 Periods / Week
Duration of Semester Examination	: 3 Hours
Semester End Examination	: 70 Marks
Sessional	: 30 Marks
Credits	: 3

Course Objectives:

1. *To understand the working principles and implementation aspects of Solar energy sources.*
2. *To understand the working principles and implementation aspects of Wind energy sources.*
3. *To understand the working principles and implementation aspects of Bio-mass energy sources.*
4. *To understand the working principles and implementation aspects of ocean energy sources.*
5. *To study the advantages, environmental issues and necessity of going in for non-conventional energy sources.*

Course Outcomes*:* The student will be able to

1. *Know the importance of RES for India and know the factors which influence RES selection*
2. *Design solar thermal applications*
3. *Model solar PV system.*
4. *Design WEC system according to the available environmental condition.*
5. *Distinguish between wind and wave energy systems.*
6. *Design suitable OTEC plant and geothermal plant for the available source of heat.*

UNIT I

Principles of Renewable Energy: Introduction, Energy & Sustainable Development, Scientific Principles of RE, Technical Implications, Social Implications, Types of Energy Resources, Basics of Thermal Energy, Hydel Energy, Nuclear Energy, Solar Energy, Wind Energy, Tidal Energy, Geothermal Energy, Ocean Energy, Indian & Global Energy Resources, Environmental Aspects of Energy, Energy Chain, Cost Effectiveness.

UNIT II

Solar Energy: Introduction, Basics of Solar Radiation, Solar Collectors, Classification, Salient Features, Solar Energy Storage, Solar Pond, Solar Water Heater, Solar Furnace, Solar Refrigeration & Cooling System, Solar Cooker, Solar Thermal Power Plants, Solar PV System, Solar Cell Fundamentals, Solar Cell Characteristics, Materials for Solar Cells, Standalone System, Grid Interactive Solar PV System, Hybrid Solar PV System, Design of Solar PV System for Home Lighting.

UNIT III

Wind Energy: Introduction, Wind Flow, Power in the Wind, Types of Wind Turbines, Wind Turbine Sizing and System Design, Energy Derived from Wind Turbine, Estimation of required Wind Turbine Power Rating, Social & Environmental Considerations
Wave Energy: Introduction to Wave energy, Power, Wave energy devices.

UNIT IV

Geo Thermal Energy: Introduction, Resources of Geo thermal energy, Geo thermal Power Plants, Comparison with conventional power plants, Advantages & Disadvantages, Potential of Geo thermal energy in India.
Ocean Thermal Energy: Introduction, Working principle of OTEC, Status of OTEC plants, Merits & De-merits,

UNIT V

Hydrogen Energy: Introduction, Hydrogen as a source of renewable energy, Production of Hydrogen, Hydrogen powered vehicles & storages, Hydrogen as a fuel and safety issues.
Bio-Gas Energy: Introduction, Photo synthesis, Aerobic & Anaerobic processes, Classification of Bio-Gas plants, Location of Bio-Gas plant, Size of Bio-Gas plant, Biomass gasification, Power Generation from Liquid Waste, Biomass Energy Program in INDIA.

Text Books:

1. John Twidell & Tony Weir, 'Renewable Energy Resources', Taylor & Francis., 3rd edition, 2015.
2. G.S.Sawhney, 'Non – Conventional Energy Resources', PHI Learning Pvt. Ltd, 2012

Suggested Reading:

1. Chetan Singh Solanki, 'Renewable Energy Technologies – A Practical Guide for Beginners', PHI Learning Pvt. Ltd., 2008.
2. Ashok V.Desai, 'Non – Conventional Energy', New Age International, United Nations University Tokyo, 1990.

16EEE108 Reliability Modeling in Power Systems (Elective)

Instruction	: 3 Periods / Week
Duration of Semester Examination	: 3 Hours
Semester End Examination	: 70 Marks
Sessional	: 30 Marks
Credits	: 3

Course Objectives: The objective of the course is to

1. *Understand the basic principles of reliability as applied to power systems*
2. *Understand the concepts and evaluation procedures of generator capacity reserves, operating reserves*
3. *Study the reliability evaluation of Generation, Transmission and Distribution through appropriate mathematical models.*

Course Outcomes: After completion of this course, the student will be able to

1. *Have the knowledge of principles of reliability applied to power systems*
2. *Acquire the knowledge to carryout evaluation procedures of generator capacity reserves.*
3. *Illustrate the evaluation of operating reserve of a system.*
4. *Acquire knowledge to formulate mathematical models for reliability evaluation of Generation, Transmission.*
5. *Compare and contrast various techniques of evaluation with regard to distribution systems.*

UNIT I

Introduction: The Concept of reliability, Reliability Indices, Power System Reliability, Component Reliability, Non-repairable components, Hazard Models, System Reliability, Network methods, Logic Diagrams, Monotonic Structures.

UNIT II

Generating Capacity Reserve Evaluation: Planning for reliability, Outage definitions, Construction of reliability models, Probability of capacity deficiency, Loss of load method, Loss of energy method, Frequency and duration method, Two level representation of the daily load, Merging the generation and load models, Multilevel representation of the daily load, Comparison of the reliability indices, Generation expansion planning.

UNIT III

Operating Reserve Evaluation: General concepts, PJM method, Outage replacement rate, Generation model, Unit commitment risk, Modified PJM method, Area risk curves, Modelling rapid start units, Modeling hot reserve units, Unit commitment risk, Security function approach, Security function model, Response risk, Evaluation techniques, Effect of distributing spinning reserve, Effect of Hydro electric units, Interconnected systems

UNIT IV

Generation and Transmission Systems: Introduction, Radial configurations, Conditional probability approach, Network configurations, State selection, Systems and load point indices. Application to practical systems, Data requirements for composite system reliability evaluation concepts. Deterministic data, Stochastic data, Independent outages, Dependent outages, Common mode outages, Station originated outages.

UNIT V

Distribution Systems: Introduction, Basic evaluation techniques, State space diagrams, Approximate methods, Network reduction method, Failure modes and effects analysis, Temporary and transient failures, Concepts, Evaluation techniques, Common mode failures, Evaluation techniques, Sensitivity analysis, Total loss of continuity(TLOC), Partial Loss of Continuity(PLOC), PLOC criteria, Extended load, Duration curve, Effect of transferable loads, General concepts, Evaluation techniques, Economic considerations

Text Books:

1. Roy Billiton, Ronold N.Allan, 'Reliability Evaluation of Power Systems', Plenum press, Springer International Edition, 1996.
2. E.Balaguruswamy, 'Reliability Engineering', Tata McGraw Hill Education Publishers, 1984.

Suggested Reading:

1. Endrenyi, 'Reliability Modeling in Electrical Power Systems', John Wiley & Sons, 1979.
2. Sankar.V "System Reliability Concepts", First edition, Himalaya Publishing House, 2015

16EEE109 Power Quality Engineering (Elective)

Instruction	: 3 Periods / Week
Duration of Semester Examination	: 3 Hours
Semester End Examination	: 70 Marks
Sessional	: 30 Marks
Credits	: 3

Course Objectives:

1. Understand the theoretical concepts and standards of Power Quality (PQ), and methods to calculate and analyse voltage sag in distribution systems.
2. Understand PQ issues and sources in Industrial systems and its mitigation
3. Understand the presence and sources of harmonics in industrial and commercial loads.
4. To know about devices for controlling and mitigating the harmonics.

Course Outcomes: After completion of this course, the student will be able to

1. Have the knowledge of theoretical concepts and standards of Power Quality and issues in industrial systems
2. Have the knowledge to calculate and analyze voltage sag in distribution systems
3. Acquire knowledge in identifying sources of harmonic.
4. Acquire the knowledge in mitigation of harmonics in industrial and commercial loads systems
5. Acquire the knowledge in measurement of PQ problems.

UNIT I

Introduction: Power Quality (PQ), PQ problems, Sags, Swells, Transients, Harmonics, Interruptions, Flicker, Voltage fluctuations, Notch. PQ Issues, Assessing PQ: Remedies, Customer side of meter, Utility side of the meter, Power quality monitoring, Monitoring considerations, Historical Perspective of PQ Measuring Instruments, PQ measurement equipment, Assessment of PQ measurement data, Application of intelligent systems, PQ monitoring standards.

UNIT II

Voltage Sag Analysis: Voltage sag characteristics, Methodology for computation of voltage sag magnitude and occurrence, Accuracy of sag analysis, Duration & frequency of sags, Faults behind transformers, Effect of pre-fault voltage, Simple examples, Voltage dip problems, Fast assessment methods for voltage sags in distribution systems.

UNIT III

PQ Consideration in Industrial Power Systems: Adjustable Speed Drive (ASD) systems and applications, Sources of power system harmonics, Mitigation of harmonics, Characterization of voltage sags experienced by three-phase ASD systems, Types of sags and phase angle jumps, Effects of momentary voltage dips on the operation of induction and synchronous motors .

UNIT IV

Harmonics: Harmonic distortion, Voltage versus current distortion, Harmonics versus Transients, Harmonic Indices, Harmonic sources from commercial loads, Harmonic sources from industrial loads, Locating Harmonic sources, System response characteristics, Effects of Harmonic distortion, Inter harmonics, Devices for controlling harmonic distortion.

UNIT V

Transient Over-voltages: Sources of Transient Over-voltages, Wiring and Grounding, Resources, Definitions, Reasons for Grounding, Typical wiring and grounding problems, Solutions to wiring and grounding problems.

Text Books:

1. C.Sankaran, 'Power Quality', CRC Press, 2002.
2. Bhim Singh, Ambrish Chandra, Kamal Al-Haddad, 'Power quality: problems and mitigation techniques', Wiley publications, 2015.

Suggested Reading:

1. Math H.J. Bollen, '*Understanding Power Quality Problems'*, IEEE Press, 2000.
2. Roger C.Dugan, Mark F.McGranaghan, Surya Santoso, H.Wayne Beaty, '*Electrical Power Systems Quality'*, Tata McGraw-Hill, 2012.

16EEE110 Energy Management (Elective)

Instruction	: 3 Periods / Week
Duration of Semester Examination	: 3 Hours
Semester End Examination	: 70 Marks
Sessional	: 30 Marks
Credits	: 3

Course Objectives: The objective of the course is to

1. *Understand the general principles of energy management and functions of energy manager.*
2. *Understand the objective and types of Energy Audit and Energy Conservation aspects with reference to EC Act 2001 and Electricity Act 2003.*
3. *Understand the methods to improve energy efficiency of industrial equipment by conducting energy audits and suitable methods for energy conservation in domestic and industrial sectors.*
4. *Understand simple methods in Energy Management and benefits in using energy efficient equipment.*

Course Outcomes: After completion of this course, the student will be able to

1. *Acquire knowledge of Energy management principles and the evolution of EC Act 2001 & 2003.*
2. *Familiar with energy audit instruments and Energy Audit case studies*
3. *Identify the need of Demand side management in the Energy conservation aspect.*
4. *Compare and contrast the Energy efficient systems in various sectors.*
5. *Recognize the role of technology in Energy management perspective.*

UNIT I

Essentials of Energy Management: Introduction, Energy Conservation & its need, Energy Management techniques, Importance of Energy Management, Managing the Energy Consumption, Environmental Aspects, Alternate sources of Energy, Energy Efficiency, Energy Scenario in India, National Institutions promoting Energy Conservation.

UNIT II

Energy Auditing: Introduction, Need for Energy Audit, Types of Energy Audit, Energy Audit Methodology, Process Flow Diagram, Energy Audit Reporting Format, Bench marking & Energy performance, Matching Energy usage to requirement, Energy Audit Instruments, Energy Efficiency, Energy Audit Case Studies.

UNIT III

Energy Conservation: Introduction, Energy Conservation Act, Practical aspects for Energy Conservation in Domestic Sector, Energy Conservation opportunities in HVAC Systems, Energy Conservation at Macro Level, Demand Side Management, Benefits of DSM, DSM Implementation Strategy, Electricity Pricing.

UNIT IV

Energy Efficiency: Introduction, Industrial Energy Efficiency, Energy Saving Potential in Industries, Boiler, Furnace, Heat Exchanger, Electrical Drives, Pumps, Fans & Blowers, Energy Conservation in Agriculture Sector, Energy Efficient Motors, BIS Specifications for Energy Efficient Motors.

UNIT V

Application of Technology in Energy Management: Introduction, Power Cables, Amorphous Core Transformer, Intelligent Power factor Controller, Maximum Demand Controller, Soft Starter, Variable Frequency Drives, Energy Management Systems, Industrial Power Management System.

Text Books:

1. W.R.Murphy & G.Mckay, 'Energy Management', Butter worth Heinemann Publications, 2007.
2. Umesh Rathore, 'Energy Management' S.K. Kataria & Sons., 2013.

Suggested Reading:

1. K.V.Sharma, P.Venkataseshaiah, 'Energy Management and Conservation' IK International Publishing House Pvt. Ltd., 2011.
2. Turner W.C., 'Energy Management Handbook', 1982.

16EEE111 Advanced Microprocessor Systems (Elective)

Instruction	: 3 Periods / Week
Duration of Semester Examination	: 3 Hours
Semester End Examination	: 70 Marks
Sessional	: 30 Marks
Credits	: 3

Course Objectives: The objective of the course is to

1. *Understand Architecture features and function of 8086, 80386, 80486, Pentium, Motorola 68000 microprocessors.*
2. *Understand features of MIPS, AMD.*
3. *Understand basics of 68020, 68030 and 68040 Microprocessors*
4. *Understand the features of RISC*
5. *Understand Dec Alpha AXP and Sun SPARC*

Course Outcomes: After completion of this course, the student will be able to

1. *Have knowledge of Architecture features and function of 8086, 80386, 80486, Pentium, Motorola 68000 microprocessors.*
2. *Have knowledge of features of MIPS, AMD,*
3. *Acquire basic knowledge on 68020, 68030 and 68040 Microprocessors*
4. *Acquire knowledge of functional features of RISC, Dec Alpha AXP and Sun SPARC*
5. *To get basic knowledge on Pentium , Pentium pro Pentium II Pentium III features of Pentium series microprocessors*

UNIT I

8086 Microprocessor: Architecture, Segmented Memory, Addressing Modes, Instruction Set, 8086 Assembly Language Programming, 8087 Numerical Data Processor Architectural details, Data types, Floating point Operations, 8087 Instructions.

UNIT II

Architectural details of 80386 Microprocessor: Special registers, Memory management, Operation in protected mode and virtual 80386 mode, Memory paging mechanism, Special instructions of 80386, Architectural details of 80486, Special registers, Additional instructions, Comparison of 80386 and 80486 processors.

UNIT III

Introduction to Pentium Processor: Architectural features, Comparison with the workstations, Branch prediction logic, Cache structure, Special Pentium Registers, Memory management, Virtual mode of operation, Comparison with the previous processors, Features of Pentium-II, Pentium-III and Pentium Pro-processors.

UNIT IV

RISC Microprocessors: RISC Vs CISC, RISC Properties, DEC Alpha AXP Architecture, Power PC, Architecture, Programming Model, Data Types, Addressing Modes, Instruction Set, Sun SPARC, Architecture, Data Types, Instruction Sets, Features of MIPS, AMD Microprocessors.

UNIT V

Motorola Microprocessors: 68000 Microprocessor, Architecture, Registers, Addressing Modes, Features of 68020- 68030- 68040 Microprocessors.

Text Books:

1. Barry B Brey, 'Intel Microprocessors: 8086/88, 80186/188, 80286, 80386, 80486, Pentium, Pentium – II, Pentium – III and Pentium – IV, Architecture, Programming & Interfacing', Pearson Education, 2009.
2. Badri Ram, 'Advanced Microprocessors and Interfacing', Tata McGraw Hill, 2001.

Suggested Reading:

1. A.K. Ray & K.M. Bhurchandi,, 'Advanced Microprocessors & Peripherals, Architecture, Programming & Interfacing', Tata McGraw Hill, 2006.
2. Daniel Tabak, 'Advanced Microprocessors', McGraw Hill, 1991.

16EEE112 Digital Control Systems (Elective)

Instruction	: 3 Periods / Week
Duration of Semester Examination	: 3 Hours
Semester End Examination	: 70 Marks
Sessional	: 30 Marks
Credits	: 3

Course Objectives: The objective of the course is to

1. *Understand the concepts of Z-transforms, System representation in state space form and analyze stability, controllability, observability aspects.*
2. *Study the design methodology of Discrete time control systems through conventional methods.*
3. *Understand the importance of pole placement and design of state feedback controllers.*
4. *Understand the concepts and features of adaptive controls and State Estimation through Kalman filters*

Course Outcomes: After completion of this course, the student will be able to

1. *Acquire knowledge on Z-transforms and their importance in finding Pulse Transfer Function.*
2. *Acquire knowledge on developing a discrete time system in state space form and also to analyze stability, controllability, observability aspects*
3. *Acquire knowledge to design discrete time control systems through conventional methods using compensators and PID controllers*
4. *Have knowledge of pole placement and design of state feedback controllers*
5. *Acquire knowledge of Adaptive controls and State Estimation through Kalman filter*

UNIT I

Review of Z-Transforms: Introduction, Linear difference equations, Pulse response, Z-transforms, Theorems of Z-Transforms, Inverse Z-transforms, Modified Z-Transforms, Z-Transform method for solving difference equations, Pulse transforms function, Block diagram analysis of sampled data systems, Mapping between s-plane and z-plan, Primary strips and Complementary Strips.

UNIT II

State Space Analysis : State Space Representation of discrete time systems, Pulse Transfer Function, Matrix solving discrete time state space equations, State transition matrix and it's Properties, Methods for Computation of State Transition Matrix, Discretization of continuous time state - space equations.

UNIT III

Controllability and Observability: Concepts of Controllability and Observability, Tests for controllability and Observability, Duality between Controllability and Observability, Controllability and Observability conditions for Pulse Transfer Function. Stability Analysis (Discrete), Stability Analysis of closed loop systems in the Z-Plane,Jury stability test, Stability Analysis by use of the Bilinear Transformation and Routh Stability criterion, Stability analysis using Liapunov theorems.

UNIT IV

Design of Discrete Time Control System by Conventional Methods: Design of digital control based on the frequency response method, Bilinear Transformation and Design procedure in the w-plane, Lead, Lag and Lead-Lag compensators and digital PID controllers, Design of digital control through deadbeat response method.

UNIT V

State Feedback Controllers and Observers(Discrete): Design of state feedback controller through pole placement, Necessary and sufficient conditions, Ackerman's formula, State Observers, Full order and Reduced order observers, Min/Max principle, Linear Quadratic Regulators, Kalman filters, State estimation through Kalman filters, Introduction to adaptive controls.

Text Books:

1. K. Ogata, 'Discrete-Time Control systems', Pearson Education/PHI, 1995.
2.M.Gopal , 'Digital Control and State Variable Methods ' , Tata McGraw Hill, 2003.

Suggested Reading:

1. Kuo B.C., 'Digital Control Systems', Oxford University Press, 1977.
2. M. Gopal, 'Digital Control Engineering', New Age International, 1988

16EEE113 HVDC Transmission (Elective)

Instruction	: 3 Periods / Week
Duration of Semester Examination	: 3 Hours
Semester End Examination	: 70 Marks
Sessional	: 30 Marks
Credits	: 3

Course Objectives:

1. *To understand the HVDC converter analysis and its control*
2. *To understand the methods of fault protection in HVDC system*
3. *To understand the AC-DC system interactions and about multi-terminal DC systems*

Course Outcomes: After completion of the course the student will be able to

1. *Acquire knowledge about HVDC converter operation and methods of control*
2. *Acquire knowledge about methods of HVDC converter control*
3. *Acquire knowledge about the protection methods in HVDC system*
4. *Acquire knowledge about AC-DC system interactions*
5. *Acquire knowledge about multi-terminal DC systems*

UNIT I

HVDC Power Transmission Technology: Comparison of AC and DC Transmission system, Applications of DC Transmission, Types of DC links, HVDC converter station, Modern trends in HVDC Technology, Analysis of Graetz circuit neglecting overlap, Analysis of two and three valve conduction mode, Equivalent circuits of Rectifier and Inverter.

UNIT II

HVDC Converter System Control: Principles of DC link control, Individual phase control, Firing angle control, Extinction angle control, Starting and stopping of DC link, Reactive power control using SVC and STATCOM, Characteristics and direction of DC power flow.

UNIT III

Converter Faults and Protection: Types of Converter faults, Over current protection, Over voltages on DC side, Over voltages due to AC disturbances, Transients in DC system, Insulation co-ordination, Smoothing reactors, DC Breakers, Characteristic and Non-characteristic harmonics, Design of AC filters, DC filters.

UNIT IV

Analysis of AC-DC System Interactions: Basic converter model, Power flow analysis with VSC based HVDC system, Modeling of converter controller, Modeling of DC network, Modeling of AC network, Transient analysis of DC and AC networks.

UNIT V

Multi-Terminal DC Systems: Applications of MTDC systems, Types of MTDC systems, Comparison of series and parallel MTDC systems, Control of MTDC systems, Protection of MTDC systems, Multi-infeed DC systems.

Text Books:

1. Padiyar K R., HVDC Power Transmission Systems, New Age International, New Delhi, 2010
2. S.Kamakshaiah,V.Kamaraju,' HVDC Transmission', Tata McGraw-Hill Education Pvt. Ltd., 2011

Suggested Reading:

1. Arrillaga J., High Voltage Direct Current Transmission, Peter Peregrinus Ltd., London. 1983.

16EEE114 Research Methodology & Professional Ethics (Elective)

Instruction	: 3 Periods / Week
Duration of Semester Examination	: 3 Hours
Semester End Examination	: 70 Marks
Sessional	: 30 Marks
Credits	: 3

Course objectives:

1. *To understand research problem formulation and distinguish types of research*
2. *To understand concepts, need and features of research design, developing research plan and get familiar with codes and standards.*
3. *To understand the method of writing research project proposal*
4. *To understand the method of Report writing and technical paper writing*
5. *To understand the importance of professional ethics, IPR issues.*

Course Outcomes: After completion of the course the students will be able to

1. *Acquire knowledge in distinguishing the difference in types of research and formulate area of research in a systematic manner.*
2. *Acquire knowledge to prepare research design, outline important concepts, following relevant standards and codes, and their importance in analysis.*
3. *Acquire knowledge in preparing research project proposal outlining the objectives, deliverables, and beneficiary's financial requirements in preparing the report.*
4. *Acquire the knowledge of report writing, technical paper writing and Journal paper writing.*
5. *Acquire the knowledge of Intellectual property rights, citation etc.*
6. *Acquire the concepts of MOU and MOA.*

UNIT I

Objectives and Types of Research: Motivation and objectives – Research methods vs Methodology. Types of research – Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical, Research process

UNIT II

Research Problem Formulation: Defining and formulating the research problem - Selecting the problem - Necessity of defining the problem.
Importance of literature review in defining a problem – Literature review – Primary and secondary sources – reviews, monographs-patents – web as a source – searching the web - Critical literature review – Identifying gap areas from literature review - Development of working hypothesis.

Unit III

Research Design and Methods: Research design – Basic Principles- Need of research design - Features of good design – Important concepts relating to research design – Observation and Facts, Laws and Theories, Prediction and explanation, Induction, Deduction, Development of Models. Developing a research plan - Exploration, Description, Diagnosis, Experimentation, use of standards and codes. Determining experimental and sample designs

Unit IV

Research Proposal and Report Writing: Writing a research proposal, contents, objectives of study, experimental procedures, Format of the research report, style of writing report , interpretation of results, conclusions, references , bibliography, webiography, technical paper writing, journal paper writing

Unit V

Professional Ethics: Ethical issues, ethical committees,Commercialization,Copy right, royalty, Intellectual property rights and patent law, Trade Related aspects of Intellectual Property Rights, MOU and MOA , Reproduction of published material, Plagiarism, Citation and acknowledgement - Reproducibility and accountability.

Text Books:

1. Ranjit Kumar, 'Research Methodology', SAGE south Asia Edition 2012
2. C. R. Kothari , 'Research Methodology' Methods and Techniques' , New Age Publishers,2004
3. P.Narayanan, 'Intellectual Property law', Eastern law House, 2013
4. R. Subramanian, 'Professonal Ethics', Oxford University Press, 2013.

Suggested Reading:

1. Cronish W.Rt , Intellectual property; Patents, copyright, Trade marks and Allied rights, Sweet & Maxwell, 1993
2. Wadehra, B.L., 'Law relating to patents, trade marks, copyright designs and geographical indications'. Universal Law Publishing, 2000.
3. Fink, A., 'Conducting Research Literature Reviews: From the Internet to Paper'. Sage Publications, 2009.
4. Satarkar, S.V., 'Intellectual property rights and Copy right'. Ess Ess Publications, 2000.

SOFT SKILLS LAB

Code : 16 EG 104

Instruction 2 Periods per week
Duration of Assessment 2 Hours
Final Assessment Satisfactory/Un-Satisfactory

Course Objectives: To help the students

1. *Participate in group discussions and case studies with confidence and to make effective presentations. Also to learn the art of communication.*
2. *With- resume packaging, preparing and facing interviews.*
3. *Build an impressive personality through effective time management, leadership, self-confidence and assertiveness.*
4. *Understand what constitutes proper grooming and etiquette in a professional environment. Also to understand academic ethics and value systems.*
5. *To be competent in verbal aptitude.*

Course Outcomes: The students will be able to

1. *Be effective communicators and participate in group discussions and case studies with confidence. Also be able to make presentations in a professional context.*
2. *Write resumes, prepare and face interviews confidently.*
3. *Be assertive and set short term and long term goals. Also learn to mange time effectively and deal with stress.*
4. *Make the transition smoothly from campus to corporate. Also use media with etiquette and know what academic ethics are.*
5. *Correct and complete sentences, have a good vocabulary and comprehend passages confidently*

EXERCISE 1

Group Discussion & Case studies – dynamics of group discussion, intervention, summarizing, modulation of voice, body language, relevance, fluency and coherence.
Elements of effective presentation – Structure of presentation – Presentation tools – Body language
Creating an effective PPT

EXERCISE 2

Interview Skills – Resume' writing – structure and presentation, planning, defining the career objective, projecting ones strengths and skill-sets
Interview Skills – concept and process, pre-interview planning, opening strategies, answering strategies, mock interviews

EXERCISE 3

Personality Development – Effective Time Management, assertiveness, decision making and problem solving, stress management, team building and leadership.

EXERCISE 4

Corporate Culture – Grooming and etiquette, corporate communication etiquette.
Academic ethics and integrity

EXERCISE 5

Verbal Aptitude – Sentence correction, sentence completion, jumbled sentences and vocabulary.
Reading comprehension

Suggested Reading:

1. Leena Sen , "Communication Skills", Prentice-Hall of India, 2005
2. Dr. Shalini Verma, "Body Language- Your Success Mantra", S Chand, 2006
3. Edgar Thorpe and Showick Thorpe , "Objective English", 2nd edition, Pearson Education, 2007
4. Ramesh, Gopalswamy, and Mahadevan Ramesh, "The ACE of Soft Skills", New Delhi: Pearson, 2010
5. Gulati and Sarvesh, " Corporate Soft Skills", New Delhi: Rupa and Co. , 2006
6. Van Emden, Joan, and Lucinda Becker, "Presentation Skills for Students", New York: Palgrave Macmillan, 2004
7. A Modern Approach to Verbal & Non-Verbal Reasoning by R S Aggarwal
8. Covey and Stephen R, "The Habits of Highly Effective People", New York: Free Press, 1989