

**SCHEME AND SYLLABUS FOR  
TWO YEAR FULL TIME P.G. PROGRAMME  
UNDER AICTE MODEL CURRICULUM**

**M.E  
(Power Systems and Power Electronics)**



**DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING**

**CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)  
HYDERABAD-500 075**

**Department of Electrical and Electronics Engineering  
Chaitanya Bharathi Institute of Technology (A)  
Gandipet, Hyderabad-500075.**

**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

**Quality Policy**

Chaitanya Bharathi Institute of Technology imparts value based technical education and training to meet the requirements of student, industry, trade/profession, research and development organisations for self-sustained growth of society.

**VISION and MISSION of the Department**

**Vision**

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

**Mission**

To solve practical problems through industry institute interaction for implementation and to encourage taking up multidisciplinary research while maintaining ethics and morals for the sustainable development of the society.

**Programme Educational Objectives of PG in EEE (PS & PE ) are:**

- ☀ To excel in power system and power electronics area.
- ☀ To become successful in executing software related applications.
- ☀ To carry out research in new technologies relevant to PS & PE
- ☀ To develop with professional ethics, effective communication skills, and knowledge of societal impacts of computing technologies.

**Programme Outcomes of PG in EEE (PS&PE) are:** The student is expected to gain an ability:

- ☀ To apply knowledge of core subject which is derived ab initio in their four year UG program
- ☀ To stimulate an idea which is thought provoking in formulating engineering requirement
- ☀ To form a problem, analyze, diagnose and arrive for many solutions
- ☀ To design (which is blended with simulation) prototype model which is a primitive.
- ☀ To use digital techniques, program skills & modern simulation tools necessary for soft computing methods
- ☀ To fulfill aphorism “Think locally act Globally” in order to cater to the needs of society such as Cultural and Environmental issues.
- ☀ To maintain the knowledge levels at par with contemporary competencies
- ☀ To comprehend the professional, ethical, legal, security and social responsibilities.
- ☀ To aware that education is possession that cannot be isolated from the individual throughout their life
- ☀ To communicate cogently with people from all walks of life.
- ☀ To demonstrate the capability and knowledge to modify the problem formulation and methods of solution based on the results to arrive at acceptable solution, independently.

**CHAITANYABHARATHI INSTITUTE OF TECHNOLOGY(A)**  
**SCHEME OF INSTRUCTION AND EXAMINATION OF MODEL**  
**CURRICULUM**

**I-Semester of ME (PS & PE)**

**SEMESTER – I**

S.No	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per week			Duration of SEE in Hours	Maximum Marks		
			L	T	P		CIE	SEE	
<b>THEORY</b>									
1	19EE C101	Power System Analysis	3	0	0	3	30	70	3
2	19EE C102	Power Electronic Converters	3	0	0	3	30	70	3
3	19EEE10X	Program Specific Elective- I	3	0	0	3	30	70	3
4	19EEE10X	Program Specific Elective- II	3	0	0	3	30	70	3
5	19ME C103	Research Methodology and IPR	2	0	0	2	25	50	2
6	AC-1	Audit Course-I	2	0	0	2	0	50	0
<b>PRACTICALS</b>									
7	19EE C103	Power Systems Lab	0	0	4	3	25	50	2
8	19EE C104	Power Electronics Simulation Lab	0	0	4	3	25	50	2
<b>TOTAL</b>			<b>16</b>	<b>0</b>	<b>8</b>	<b>-</b>	<b>255</b>	<b>570</b>	<b>18</b>

**L: Lecture    T: Tutorial    P: Practical    D: Drawing**  
**CIE - Continuous Internal Evaluation                      SEE - Semester End Examination**

**CHAITANYABHARATHI INSTITUTE OF TECHNOLOGY (A)**  
**SCHEME OF INSTRUCTION AND EXAMINATION OF MODEL**  
**CURRICULUM**

**II-Semester of ME (PS & PE)**

**SEMESTER – II**

S.No	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per week			Duration of SEE in Hours	Maximum Marks		
			L	T	P		CIE	SEE	
<b>THEORY</b>									
1	19EE C105	Power System Dynamics	3	0	0	3	30	70	3
2	19EE C106	Advanced Power Electronic Circuits	3	0	0	3	30	70	3
3	19EEE10X	Program Specific Elective-III	3	0	0	3	30	70	3
4	19EEE10X	Program Specific Elective-IV	3	0	0	3	30	70	3
5	AC-II	Audit Course-II	2	0	0	2	0	50	0
<b>PRACTICALS</b>									
6	19EE C107	Power Electronics Lab	0	0	4	3	25	50	2
7	19EE C108	Power Systems Simulation Lab	0	0	4	3	25	50	2
8	19EE C109	Mini Project with Seminar	2	0	0	-	100	-	2
<b>TOTAL</b>			<b>16</b>	<b>0</b>	<b>8</b>	<b>-</b>	<b>300</b>	<b>450</b>	<b>18</b>

**L: Lecture    T: Tutorial    P: Practical    D: Drawing**  
**CIE - Continuous Internal Evaluation    SEE - Semester End Examination**

**CHAITANYABHARATHI INSTITUTE OF TECHNOLOGY(A)**  
**SCHEME OF INSTRUCTION AND EXAMINATION OF MODEL**  
**CURRICULUM**

**III-Semester of ME (PS & PE)**

**SEMESTER – III**

S.No	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per week			Duration of SEE in Hours	Maximum Marks		
			L	T	p		CIE	SEE	
<b>THEORY</b>									
1	19EEE10X	Program Specific Elective- V	3	0	0	3	30	70	3
2	OE	Open Elective	3	0	0	3	30	70	3
<b>PRACTICALS</b>									
3	19EE C110	Dissertation / Phase-I	0	0	20	-	100	-	10
<b>TOTAL</b>			<b>6</b>	<b>0</b>	<b>20</b>	<b>-</b>	<b>110</b>	<b>190</b>	<b>16</b>

**L: Lecture T: Tutorial P: Practical D: Drawing**

**CIE - Continuous Internal Evaluation**

**SEE - Semester End Examination**

**SCHEME OF INSTRUCTION AND EXAMINATION OF MODEL**  
**CURRICULUM**

**IV-Semester of ME (PS & PE)**

**SEMESTER – IV**

S.No	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per week			Duration of SEE in Hours	Maximum Marks		
			L	T	p		CIE	SEE	
<b>PRACTICALS</b>									
1	19EE C111	Dissertation / Phase-II	0	0	32	Viva voce	100	100	16
<b>TOTAL</b>			<b>0</b>	<b>0</b>	<b>32</b>	<b>-</b>	<b>100</b>	<b>100</b>	<b>16</b>

**L: Lecture T: Tutorial P: Practical D: Drawing**

**CIE - Continuous Internal Evaluation**

**SEE - Semester End Examination**

Course Code	Program Specific Electives Group-1
19EE E101	Electrical Power Distribution System
19EE E102	Mathematical Methods for Power Engineering
19EE E103	Restructured Power Systems
19EE E107	Renewable Energy System
19EE E109	Digital Protection of Power Systems
19EE E110	Power Quality
19EE E114	Smart Grids
19EE E115	High Voltage Engineering

Course Code	Program Specific Electives Group-2
19EE E104	Power Semi Conductor devices & Modelling
19EE E105	Electric Drive Systems
19EE E106	HVDC
19EE E108	Artificial Intelligence Techniques
19EE E111	FACTS and Custom power devices
19EE E112	Switch mode & Resonant Converters
19EE E113	Energy Auditing & Management
19EE E116	Electric and Hybrid Vehicles

Course Code	Open Electives
19CSO101	Business Analytics
19MEO101	Industrial Safety
16MEO102	Introduction to Optimization Techniques
19MEO103	Composite Materials
19CEO101	Cost Management of Engineering Projects
19EEO101	Waste to Energy

Course Code	Audit Courses – I & II
19EGA101	English for Research Paper Writing
19EGA102	Indian Constitution and Fundamental Rights
19EGA103	Stress Management by Yoga
19EGA104	Personality Development through Life Enlightenment Skills
19ECA101	Value Education
19CEA101	Disaster Mitigation and Management
19ITA101	Pedagogy Studies
19EEA101	Sanskrit for Technical Knowledge

**19EE C101****POWER SYSTEMS ANALYSIS**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

**Course Objectives:**

1. To study various methods of load-flow and types of faults in power systems
2. To Understand power system security concepts and State Estimation techniques
3. To Study voltage instability phenomena

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

1. Calculate voltage phasors at all buses, using various methods of load flow
2. Calculate fault currents in each phase
3. Rank various contingencies according to their severity
4. Estimate closeness to voltage collapse and calculate PV curves using continuation power flow
5. Distinguish between conventional load-flow and state estimation in real-time applications.

**UNIT-I**

**Load–Flow Studies:** Overview of Load-Flow studies, GS, NR and FDC methods, Convergence properties, sparsity techniques, Q-max violation in constant matrix, inclusion in frequency effects, AVR in load-flow, Handling of discrete variable in Load Flow.

**UNIT-II**

**Fault Analysis:** Simultaneous faults, Open conductor faults, generalized method of fault analysis.

**UNIT-III**

**Security Analysis:** Security state diagram, Challenges for secure operation, Methods of enhancing security, Real-Time monitoring and control, Contingency Analysis, Generator shift distribution factor, Line outage distribution factor



(Multiple line outages, overload index ranking), Approximations in contingency analysis.

#### **UNIT-IV**

**State Estimation:** Difference between LF and SE, Types of measurements, Sources of errors in measurements, Virtual and Pseudo, Measurement Observability, Tracking State, Estimator, WLS method, Bad data identification and correction.

#### **UNIT-V**

**Voltage stability–Collapse:** PV and QV curves, Voltage proximity indices, multiple power flow solutions, Continuation of power flow, Optimal multiplies load-flow.

#### **Text Books:**

1. J J Grainger and W D Stevenson, Power system Analysis, Mc Graw Hill 2003
2. A R Bergen and Vijay Vittal, Power system Analysis, Pearson 2009
3. L P Singh, Advanced Power system Analysis and Dynamics, New Age International, 2006

#### **Suggested Reading:**

1. G L Kusic, Computer aided power system analysis, Prentice Hall India, 1986
2. A J Wood, Power generation operation and control, John Wiley, 1994
3. P M Anderson, Faulted power system analysis, IEEE Press 1995

**19EE C102****POWER ELECTRONIC CONVERTERS**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

**Course Objectives:**

1. To understand the concepts and basic operation of transient and steady state analysis of all power electronic converters with passive and active loads.
2. To understand the operation of single phase and Three phase full-wave converters and analyse harmonics in the input current.
3. To analyze the operation of single phase Cyclo-converters, Inverters and dc-dc converters

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

1. Give a systematic approach for transient and steady state analysis of all power electronic converters with passive and active loads.
2. Know and carry out transient and steady state analysis of different power converters of different types of loads and switching sequences.
3. Analyze power electronic devices
4. Analyze and design dc-dc and dc-ac converters.
5. Analyze and design AC regulator and cyclo converter

**UNIT-I**

**Power Semiconductor Switched Circuits:** Analysis of power semiconductor switched circuits with R, L, RL, RC loads and D.C. motor load, Battery charging circuit.

**UNIT-II**

**Phase Controlled Rectifiers:** Single-Phase and Three-Phase AC to DC converters, Single phase half controlled and fully controlled converters, operating domains of three phase full converters and semi-converters. Reactive power considerations.

**UNIT-III**

**Non-Isolated DC-to-DC Converters (Choppers):** Analysis and design of DC to DC converters, Control of DC-DC converters, Buck converters, Boost converters, Buck Boost converters, Cuck converters.

**UNIT-IV**

**Inverters:** Single phase and three phase inverters, Single phase half bridge and full bridge inverters, voltage source and current source inverters, comparison between voltage source and current source inverters, Voltage control and harmonic minimization in inverters.

**UNIT-V**

**AC Voltage Controllers and Cyclo-Converters:** AC to AC power conversion using voltage regulators, Uni-directional and Bi-directional AC voltage controllers, applications of AC voltage controllers, AC Choppers and cyclo-converters, step down and step-up cyclo converters , Consideration of harmonics, introduction to Matrix converters.

**Text Books:**

1. Ned Mohan, Undeland and Robbin, Power Electronics: converters, Application and design, John's Wiley and sons. Inc, Newyork.
2. M.H.Rashid, Power Electronics, Prentice Hall of India 1994.

**Suggested Reading:**

1. Soumitra Kumar Mandal, Power Electronics, McGraw Hill education
2. Dr. P.S. Bimbhra, Power Electronics, Khanna publications
3. M D Singh, K B Khanchandani, Power Electronics, McGraw Hill education

**19ME C103****RESEARCH METHODOLOGY AND IPR**

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
Semester End Examination	50 Marks
CIE	25 Marks
Credits	2

**Course Objectives:** To make the students to

1. Motivate to choose research as career
2. Formulate the research problem, prepare the research design
3. Identify various sources for literature review and data collection report writing

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

1. Define research problem, review and assess the quality of literature from various sources
2. Improve the style and format of writing a report for technical paper/ Journal report, understand and develop various research designs
3. Collect the data by various methods: observation, interview, questionnaires
4. Analyze problem by statistical techniques: ANOVA, F-test, Chi-square
5. Understand apply for patent and copyrights

**UNIT-I**

**Research Methodology:** Research Methodology: Objectives and Motivation of Research, Types of Research, research approaches, Significance of Research, Research Methods versus Methodology, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India, Benefits to the society in general. Defining the Research Problem: Selection of Research Problem, Necessity of Defining the Problem

**UNIT-II**

**Literature Survey Report writing:** Literature Survey: Importance and purpose of Literature Survey, Sources of Information, Assessment of Quality of Journals and Articles, Information through Internet. Report writing: Meaning of interpretation, layout of research report, Types of reports, Mechanics of writing a report. Research Proposal Preparation: Writing a Research Proposal and Research Report, Writing Research Grant Proposal

**UNIT-III**

**Research Design:** Research Design: Meaning of Research Design, Need of Research Design, Feature of a Good Design, Important Concepts Related to Research Design, Different Research Designs, Basic Principles of Experimental Design, Developing a Research Plan, Steps in sample design, types of sample designs.

**UNIT-IV**

**Data Collection and Analysis:** Data Collection: Methods of data collection, importance of Parametric, non parametric test, testing of variance of two normal population, use of Chi-square, ANOVA, Ftest, z-test

**UNIT-V**

**Patents and Copyright:** Patent: Macro economic impact of the patent system, Patent document, How to protect your inventions. Granting of patent, Rights of a patent, how extensive is patent protection. Copyright: What is copyright. What is covered by copyright. How long does copyright last? Why protect copyright? Related Rights: what are related rights? Enforcement of Intellectual Property Rights: Infringement of intellectual property rights, Case studies of patents and IP Protection

**Text Books:**

1. C.R Kothari, “Research Methodology, Methods & Technique”; New Age International Publishers, 2004
2. R. Ganesan, “Research Methodology for Engineers”, MJP Publishers, 2011
3. Y.P. Agarwal, “Statistical Methods: Concepts, Application and Computation”, Sterling Publs., Pvt., Ltd., New Delhi, 2004.

**Suggested Reading:**

1. Ajit Parulekar and Sarita D’ Souza, “Indian Patents Law – Legal & Business Implications”; Macmillan India Ltd , 2006
2. B. L.Wadehra; “Law Relating to Patents, Trade Marks, Copyright, Designs & Geographical Indications”; Universal law Publishing Pvt. Ltd., India 2000.
3. P. Narayanan; “Law of Copyright and Industrial Designs”; Eastern law House, Delhi 2010

*Discussion is an exchange of intelligence, argument is an exchange of ignorance; Discussion is to find out what is right, argument is to find out who is right.*

Vikasa Mantras- Vivekananda Institute of Human Excellence

**19EE C103****POWER SYSTEMS LAB**

Instruction	4 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
CIE	25 Marks
Credits	2

**Course Objectives:**

1. To understand the I-V and P-V characteristics of a PV module
2. To measure the sequence reactance of synchronous machine and 3-phase transformer
3.
  - a) To understand the characteristics of various relays
  - b) To estimate efficiency, regulation and ABCD constants of 3-phase transmission line

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

1. Learn the measurement of sequence reactance of synchronous machine and 3-phase transformer
2. Knowledge about the relay characteristics
3. Acquire Knowledge to estimate efficiency, regulation and ABCD constants of 3-phase transmission line
4. Learn about various types of faults
5. Validate the I-V and P-V characteristics of a PV module

**LIST OF EXPERIMENTS:**

1. Measurement of positive, negative and zero sequence reactance of synchronous machine
2. Measurement of positive and zero sequence reactance of three-phase transformer
3. Determination of Regulation & Efficiency of a three phase transmission line
4. Determination of ABCD constants of a three phase transmission line
5. Inverse time characteristics of over current relay
6. Characteristics of static over current relay
7. Differential protection of single-phase transformer
8. Study of microprocessor based inverse current relay characteristics
9. Study of over voltage and under voltage relays
10. Study of line-to-ground, line-to-line and three-phase faults

11. Single PV module I-V and P-V characteristics with radiation and temperature changing effect.
12. I-V and P-V characteristics with series and parallel combination of modules.
13. Effect of shading and Effect of tilt angle on I-V and P-V characteristics of solar module.
14. Finding MPP by varying the resistive load by varying the duty cycle of DC-DC converter.
15. Observe the output voltage waveform of inverter in auto mode.

Note : At least **TEN** experiments should be conducted in the semester\*

**19EE C104****POWER ELECTRONICS SIMULATION LAB**

Instruction	4 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
CIE	25 Marks
Credits	2

**Course Objectives:**

1. To be acquainted with simulation of different power converters
2. To Simulate and compare the output of single-phase and three-phase converters with R, RL and RLE loads
3. To Simulate single and three-phase Inverters and their voltage control techniques

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

1. Familiar with the usage of software for analysis of power electronic converters.
2. Analyze the performance of converters by simulation
3. Demonstrate the effects of different loads on various converters and inverters by experimentation.
4. Simulate different dc chopper circuits
5. Acquaint with the different speed control techniques of ac and dc drives.

**List of Experiments:**

1. Single-phase semi-converter using RL load with and without freewheeling diode.
2. Single-phase full converter using RL load with and without LC Filter
3. Single-phase full converter using RLE load with and without freewheeling diode
4. Single-phase converter with dc motor load
5. Three-phase fully controlled converter fed dc drive
6. Analysis of Buck and Buck-Boost converter
7. Chopper converter fed dc drive
8. Single-phase and Three phase IGBT inverters
9. Voltage control of an inverter using PWM technique
10. Single-phase current source inverter with RL load
11. Single-phase and three phase AC voltage controller
12. Single-phase Cyclo-converter with R & RL loads
13. Single-phase Dual converter with R & RL loads
14. Reactive power compensation using FACTS controllers

Note: At least **TEN** Experiments should be conducted in the semester



**19EE C105****POWER SYSTEM DYNAMICS**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

**Course Objectives:**

1. To develop mathematical models for Machines for stability studies
2. To study the dynamic analysis of voltage stability and factors affecting voltage stability
3. To understand the 'Low Frequency Oscillation' occurring in Power System and the phenomena of SSR oscillations in series compensated transmission system.

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

1. Acquire knowledge to model the synchronous machine to carry out system studies
2. Acquire knowledge to evaluate performance of power system from steady state stability, transient stability and voltage stability point of view
3. Acquire knowledge to model PS controllers such as: excitation system, Turbine-Governor, FACTS controllers for stability studies
4. Acquire knowledge to mitigate low frequency oscillations in power systems; improving system damping through supplementary excitation control (PSS)
5. Acquire knowledge to analyze SSR oscillations occurring in series compensated network through damping controls and its importance in power transfer and stability of the system

**UNIT-I**

**Synchronous Machine Modeling:** Per Unit System, Park's transformation, Flux linkage equations, Voltage and Current Equations, Formulation of state space equations, Equivalent circuit, Effect of damper windings, Transient and sub-transient inductance (reactance) and Time constants, Simplified models of Synchronous Machine.

**UNIT-II**

**Stability:** Definitions, Rotor angle stability, Frequency stability and Voltage stability. Power system stability: Steady state stability, small signal stability,

Dynamic stability, Transient stability, Improvement of Transient stability, Swing equation for SMIB system, Determination of Critical Time and Critical angle. Factors contributing and affecting voltage stability and minimization of voltage collapse, Dynamic analysis of voltage stability / collapse. P-V and Q-V curves

### UNIT-III

**System performance improvement through Controls:** IEEE excitation, Power System Stabilizer and Load Models, Hydraulic Power and Governor Models

### UNIT-IV

**Low Frequency Oscillations:** Low Frequency Oscillations and supplementary excitation controls PSS, Improving system damping transfer function of LFO studies, State equations for SMIB system, Philips – Heffron Model. Small signal stability (LFO) of unregulated and regulated system, Stability enhancement techniques using PSS, Excitation systems and Phillips – Heffron model.

### Unit V

**Sub Synchronous Resonance (SSR):** SSR in series-compensated transmission system, SSR damping schemes, counter measures, T-G Torsional characteristics, Torsional interaction with PS controls.

### Text Books:

1. P. Kundur, “Power System Stability and Control”, McGraw Hill Inc, 1994
2. J. Machowski, Bialek, Bumby, “Power System Dynamics and Stability”, John Wiley & Sons, 1997
3. L. Leonard Grigsby (Ed.); “Power System Stability and Control”, Second edition, CRC Press, 2007
4. V. Ajjarapu, “Computational Techniques for voltage stability assessment & control”; Springer, 2006

### Suggested Reading:-

1. P. M. Anderson & A. A. Fouad “Power System Control and Stability”, Galgotia, New Delhi, 1981
2. J Machowski, J Bialek & J. R W. Bumby, “Power System Dynamics and Stability”, John Wiley & Sons, 1997
3. E.W. Kimbark, “Power system stability”, Vol. I & III, John Wiley & Sons, New York 2002.

*Working hard for something which we don't like is called stress!; Working hard for something which we love is called passion! It is not hard work really, it is all happy work.*

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**19EE C106****ADVANCED POWER ELECTRONIC CIRCUITS**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

**Course Objectives:** Students will be able to:

1. Understand the operation of advanced power electronic circuit topologies.
2. Understand the load, switch and resonant converters.
3. Understand the modeling and design concepts of various DC-DC converters used in renewable

**Course Outcomes:** After completion of course Student will be able to:

1. Demonstrate the knowledge of DC isolated and non-isolated regulators
2. Demonstrate the knowledge of load and switch resonant converters
3. Demonstrate the knowledge resonant inverters
4. Model and design DC-DC converters for renewable energy conversion.
5. Apply the knowledge of dc-dc converters used in dc drives and renewable energy applications

**UNIT-I**

**DC Regulators-I:** Boost type APFC and control. Three phase utility inter phases and control-Buck, Boost, Buck-Boost SMPS, Topologies

**UNIT-II**

**DC Regulators-II:** Modes of operation –Push-Pull and Forward Converter Topologies - Voltage Mode Control. Half bridge, Full bridge and Fly-back Converters.

**UNIT-III**

**Resonant Converters-I:** Load Resonant Converter. Zero Voltage Switching Clamped Voltage Topologies.

**UNIT-IV**

**Resonant Converters-II:** Resonant DC Link Inverters with Zero Voltage Switching, High Frequency Link Integral Half Cycle Converter

**UNIT-V**

**Application of DC-DC converters:** Modeling and design of DC-DC Converters for various renewable energy conversion, Few power electronic circuits used in DC drives.

**Text Books:**

1. Rashid “Power Electronics” Prentice Hall India 2007.
2. G.K.Dubey et.al “Thyristorised Power Controllers” Wiley Eastern Ltd., 2005, 06.
3. Dewan & Straughen “Power Semiconductor Circuits” John Wiley & Sons., 1975.

**Suggested Reading:**

1. G.K. Dubey & C.R. Kasaravada “Power Electronics & Drives” Tata McGraw Hill, 1993
2. Cyril W Lander “Power Electronics” McGraw Hill., 2005.
3. B. K Bose “Modern Power Electronics and AC Drives” Pearson Education (Asia)., 2007
4. Abraham I Pressman “Switching Power Supply Design” McGraw Hill Publishing Company., 2001.

**19EE C107****POWER ELECTRONICS LABORATORY**

Instruction	4 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
CIE	25 Marks
Credits	2

**Course Objectives:**

1. To obtain and plot the characteristics and operation of different static switches
2. To understand different Converter control techniques.
3. To know various methods of speed control of electric drives.

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

1. Distinguish the characteristics of different controlled switches and their applications.
2. Demonstrate the effects of different loads on the performance of various phase controlled converters and choppers
3. Understand the various control techniques used in inverters.
4. Acquire the conversion principles of DC-DC and AC-AC converters
5. Observe different speed control techniques of electric drives

**List of Experiments**

1. V-I characteristics of SCR and measurement of latching and holding currents.
2. UJT trigger circuit for half wave and full wave control.
3. Single-phase half wave controlled rectified with R & RL load with and without freewheeling diode.
4. Single phase half controlled and full controlled bridge rectifiers with R and RL loads.
5. Three-phase half controlled and full controlled bridge rectifiers with R and RL loads.
6. Single-phase AC voltage regulator with resistive and inductive loads.
7. Analysis of chopper circuit.
8. Analysis of single-phase series-resonant inverter.
9. Analysis of single-phase bridge inverter with R and RL loads.
10. Three-phase Mc-Murray Bed-Ford inverter with R and RL loads.
11. Three-phase IGBT inverter.
12. Closed-loop control of permanent magnet dc drive.
13. Single-phase dual converter with NCC and CC mode of operation.
14. Three-phase step down cyclo-converter with R and RL loads.
15. Static rotor resistance control of slip-ring induction motor.
16. Operation of two quadrant dc drive.

**Note:** At least **TEN** experiments should be conducted in the semester.

**19EEEC108****POWER SYSTEMS SIMULATION LAB**

Instruction	4 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
CIE	25 Marks
Credits	2

**Course Objectives:**

1. To Simulate and compare the various aspects economic load dispatch and load flows.
2. To Simulate and observe stability studies and short-circuit studies
3. To Conduct experiments on modeling of Transmission line

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

1. Validate the adaptability of economic load dispatch and load flow for a given situation by simulation results.
2. Acquire the knowledge about formation of Impedance and Admittance Matrices
3. Acquire the knowledge to analyze the Symmetrical and un-symmetrical fault currents
4. Acquire the knowledge to simulate various types of transmission models
5. Acquire the knowledge about Symmetrical and Unsymmetrical components for a given system.

**List of Experiments:**

1. Single Area and Two Area Load Frequency Control
2. Economic Load 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
6. Short Circuit Analysis for unsymmetrical faults
7. Formation of Bus Admittance Matrix
8. Three Phase Short Circuit Analysis of Synchronous Machine
9. Unsymmetrical Fault Analysis for RLC loads
10. Step Response of Synchronous Machine
11. Determination of Symmetrical Components
12. Simulation of Ferranti Effect
13. Modeling of Transmission Lines
14. Solution of Swing Equation
15. Load flow studies of Distribution Systems

**Note:** At least **TEN** experiments should be conducted in the semester.

**19EE C109****MINI PROJECT WITH SEMINAR**

Instruction	: 2 Hours per Week
Internal Marks	: 100 Marks
Credits	: 2

**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:**

- v 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.
- v 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.

**19EE C110****DISSERTATION PHASE-I**

Instruction	20 Hours per week
CIE	100 Marks
Credits	10

**Course Objectives:** At the end of the course:

1. Students will be exposed to self-learning various topics.
2. Students will learn to survey the literature such as books, national/international refereed journals and contact resource persons for the selected topic of research.
3. Students will learn to write technical reports.
4. Students will develop oral and written communication skills to present.
5. Student will defend their work in front of technically qualified audience.

**Guidelines:**

- + The Project work will preferably be a problem with research potential and should involve scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution.
- + Seminar should be based on the area in which the candidate has undertaken the dissertation work.
- + The CIE shall include reviews and the preparation of report consisting of a detailed problem statement and a literature review.
- + The preliminary results (if available) of the problem may also be discussed in the report.
- + The work has to be presented in front of the committee consists of Head, Chairperson-BoS, Supervisor and Project coordinator.
- + The candidate has to be in regular contact with his supervisor and the topic of dissertation must be mutually decided by the guide and student.

<b>Guidelines for the award of Marks:</b>		<b>Max. Marks: 100</b>
<b>Evaluation by</b>	<b>Max. Marks</b>	<b>Evaluation Criteria / Parameter</b>
Supervisor	30	Project Status / Review(s)
	20	Report
Department Committee	10	Relevance of the Topic
	10	PPT Preparation(s)
	10	Presentation(s)
	10	Question and Answers
	10	Report Preparation

Note : Department committee has to assess the progress of the student for every two weeks.



**19EE C111****DISSERTATION PHASE- II**

Instruction	32 Hours per week
Duration of Semester End Examination	100 Marks
CIE	100 Marks
Credits	16

**Course Objectives:** At the end of the course:

1. Students will be able to use different experimental techniques and will be able to use different software/ computational/analytical tools.
2. Students will be able to design and develop an experimental set up/ equipment/test rig.
3. Students will be able to conduct tests on existing set ups/equipments and draw logical conclusions from the results after analyzing them.
4. Students will be able to either work in a research environment or in an industrial environment.
5. Students will be conversant with technical report writing and will be able to present and convince their topic of study to the engineering community.

**Guidelines:**

- + It is a continuation of Project work started in semester III.
- + The student has to submit the report in prescribed format and also present a seminar.
- + The dissertation should be presented in standard format as provided by the department.
- + The candidate has to prepare a detailed project report consisting of introduction of the problem, problem statement, literature review, objectives of the work, methodology (experimental set up or numerical details as the case may be) of solution and results and discussion.
- + The report must bring out the conclusions of the work and future scope for the study. The work has to be presented in front of the examiners panel consisting of an approved external examiner, an internal examiner (HoD and BoS Chair Person) guide/co-guide.
- + The candidate has to be in regular contact with his/her guide/co-guide.

<b>Guidelines for awarding marks in CIE:</b>		<b>Max. Marks: 100</b>
<b>Evaluation by</b>	<b>Max. Marks</b>	<b>Evaluation Criteria / Parameter</b>
Department Review Committee	05	Review 1
	10	Review 2
	10	Review 3
	15	Final presentation with the draft copy of the report standard format
	10	Submission of the report in a standard format
Supervisor	10	Regularity and Punctuality
	10	Work Progress
	10	Quality of the work which may lead to publications
	10	Analytical / Programming / Experimental Skills Preparation
	10	Report preparation in a standard format

<b>Evaluation by</b>	<b>Max. Marks</b>	<b>Evaluation Criteria / Parameter</b>
External and Internal Examiner(s) together	20	Power Point Presentation
	40	Quality of thesis and evaluation
	20	Quality of the project + Innovations + Applications + Live Research Projects + Scope for future study + Application to society
	20	Viva-Voce

**19EE E101**

**Programme Specific Electives**  
**ELECTRIC POWER DISTRIBUTION SYSTEM**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

**Course Objectives:**

1. To study distribution management system and automation
2. To understand the concepts of SCADA
3. To study the optimization aspects of distribution system and Urban and rural distribution systems

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

1. Acquire the knowledge of power distribution management system
2. Know Distribution automation and its application in practice
3. Acquire the knowledge of SCADA system
4. Acquire the knowledge of optimization aspects of distribution system.
5. Acquire the knowledge of urban, rural distribution systems and application of capacitors in distribution systems

**UNIT-I**

**Distribution Management System:** Distribution of Power, Management, Power Loads, Load Forecasting: Short-term & Long-term, Power System Loading, Technological Forecasting, Distribution Management System (D.M.S.)

**UNIT-II**

**Distribution Automation:** Definition, Benefits, Objectives, Control functions, communication systems, Remote terminal unit, Feeder Automation, Substation automation, Restoration / Reconfiguration of Distribution Network, Consumer Information services, Automatic Meter Reading and its implementation, AI techniques applied to Distribution Automation

**UNIT-III**

**SCADA:** Introduction, Block Diagram, components of SCADA, Functions of SCADA, SCADA applied to distribution automation, Advantages of Distribution Automation through SCADA, Communication protocols in SCADA systems

**UNIT-IV**

**Optimization:** Costing of schemes, Optimal placement of Capacitors, Optimum size of line conductor in Distribution Systems, Restoration and Reconfiguration of network, Economic loading of distribution transformers, Optimal switching device placement.

**UNIT-V**

**Urban and Rural Distribution:** Urban distribution, Objectives, Modernization of distribution systems, Information technology initiatives in electrical distribution, Rural distribution, objectives, Energy Management, Model distribution system, Application of capacitors in distribution system

**Text Books:**

1. A.S. Pabla, Electric Power Distribution, Tata McGraw Hill Publishing Co. Ltd., 5<sup>th</sup> Edition, 2004
2. M.K. Khedkar, G.M. Dhole, A Text Book of Electric power Distribution Automation, University Science Press, New Delhi, 2010

**Suggested Reading:**

1. Anthony J Pansini, Electrical Distribution Engineering, CRC Press, 1992
2. James Momoh, Electric Power Distribution, automation, protection & control, CRC Press, 2007
3. Turan Gonen, Electric Power Distribution System Engineering, CRC Press, 2<sup>nd</sup> Edition, 2008

**19EE E102****MATHEMATICAL METHODS FOR POWER ENGINEERING**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

**Course Objectives:**

1. To understand the relevance of mathematical methods to solve engineering problems.
2. To understand the theoretical workings of the simplex method for linear programming and perform iterations of it by hand.
3. To understand how to model and solve problems using linear and nonlinear programming with and without constraints

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

1. Recognize and identify the nature of the mathematical problems that are commonly encountered in power engineering
2. Knowledge about vector spaces, linear transformation, Eigen values and eigenvectors of linear operators
3. To learn about linear programming problems and understanding the Simplex method for solving linear programming problems in various fields of science and technology
4. Acquire knowledge about nonlinear programming and various techniques used for solving constrained and unconstrained nonlinear programming problems
5. Understanding the concept of random variables, functions of random variable and their probability distribution

**UNIT-I**

Vector spaces, linear transformations, Matrix representation of linear transformation

**UNIT-II**

Eigen values and Eigen vectors of linear operator

**UNIT-III**

Linear Programming Problems, Simplex Method, Duality, Non Linear Programming problems

**UNIT-IV**

Unconstrained Problems, Search methods, Constrained Problems.

**UNIT-V**

Lagrange method, Kuhn-Tucker conditions, random Variables, distributions, Independent Random Variables.

**Text Books:**

1. Kenneth Hoffman and Ray Kunze, Linear Algebra, 2nd Edition, PHI, 1992
2. Erwin Kreyszig, Introductory Functional Analysis with Applications, John Wiley & Sons, 2004
3. Irwin Miller and Marylees Miller, John E. Freund's, Mathematical Statistics, 6th Edn, PHI, 2002
4. J. Medhi, Stochastic Processes, New Age International, New Delhi., 1994

**Suggested Reading:**

1. A Papoulis, Probability, Random Variables and Stochastic Processes, 3rd Edition, McGraw Hill, 2002
2. John B Thomas, An Introduction to Applied Probability and Random Processes, John Wiley, 2000
3. Hillier F S and Liebermann G J, Introduction to Operations Research, 7th Edition, McGraw Hill, 2001
4. Simmons D M, Non Linear Programming for Operations Research, PHI, 1975.

**19EE E103****RESTRUCTURED POWER SYSTEMS**

Instruction	3 Hour per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	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, Bilateral markets and transmission pricing issues
3. To understand different aspects of managing ancillary services and open access same time information system.

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

1. Have knowledge in analyzing the operation of power system in de-regulated and competitive environment
2. Acquire the 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.

**UNIT-I**

**Introduction to Power System Deregulation:** Operation of vertically integrated power systems, Fundamental of Restructured systems, 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. Congestion management.

**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. Risk assessment.

**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. Standard market design.

**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. Developments in India, IT applications in Restructured markets.

**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 Readings:**

1. LorrinPhilipson, H. Lee Willis, "Understanding electric utilities and de- regulation", Marcel Dekker Pub.,1998.
2. Steven Stoft, "Power system economics: designing markets for electricity", John Wiley and Sons, 2002.
3. M.Ilic, F.Galiana and L.Fink, 'Power System Restructuring Engineering and Economics', Kluwer Academic Publishers 1998
4. Md Shahidehpour & M. Alomoush, 'Restructured Electrical Power Systems', Marcel Dekker Inc, 2001.

*Time is what we need most, but what we use worst; Most of the misfortunes in our life are due to misused time.*

Vikasa Mantras- Vivekananda Institute of Human Excellence



**19EE E107****RENEWABLE ENERGY SOURCES**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

**Course objectives:**

1. To learn various renewable energy sources
2. To understand the working principles and implementation aspects of solar and wind energy sources.
3. To understand power electronics interface and power quality problems with grid.

**Course outcomes:** After completion course the student will be able to:

1. Acquire the knowledge on design of solar PV systems
2. Implement the concepts of wind power generation
3. Demonstrate the suitability of non-conventional energy for grid connection
4. Understand the working of distributed generation system in autonomous/grid connected modes
5. Analyze economic aspects of power generation and its power quality issues

**UNIT-I**

**Generation of electrical energy:** Introduction, Conventional and renewable sources of energy, Distributed and central station generation, DG technologies, Advantages and disadvantages of distributed generation, introduction to hydro, tidal, wave, Geothermal and biomass energy.

**UNIT-II**

**Solar Energy Conversion:** Solar radiation and its measurements, Types of solar collectors, Combined heat and power, Solar thermal power plant, Components of solar PV system, Efficiency and limits, Design of solar PV Hybrid system, Stand alone and Grid connected systems

**UNIT-III**

**Wind Energy:** Power in the wind, Types of wind turbines, Components of wind mill, operation of wind turbines, Wind energy extraction, Types and design of

wind turbine rotor, modes of wind power generation, Selection of optimum WEG, Grid interfacing of wind farm, Methods of grid connection, Properties of grid system.

#### **UNIT-IV**

**Integration of grids & Power Quality:** Interface with grid, direct and power electronics coupling, Impact of type of interface, Power Quality issues, Impact of distributed generation, Power Quality disturbances

#### **UNIT-V**

**Economics of power generation:** Transmission system operation, Protection of distributed Generators, Economics of distributed generation, Case studies, solar electricity in Sagar Island, Potential of wind energy in India.

#### **Text Books**

1. RanjanRakesh , D.P.Kothari, Singal K C, “Renewable Energy Sources And Emerging Technologies” 2<sup>nd</sup> Edition Printice Hall Of India 2011
2. Math.H.Bollen, Fainan Hassan, “Integration Of Distributed Generation In The Power System” Wiley IEEE Press, July 2011

#### **Suggested Reading:**

1. Loi Lei Lai, Tze Fun Chan, “ Distributed Generation: Induction And Permanent Magnet Generators” October 2007, Wiley IEEE Press
2. Roger A Messenger, Amir Abtahi, :” Photovoltaic Systems Engineering” 3rd Edition 2010
3. James A Manwell, John G McGowan Antony L Rogers , “Wind Energy Explained: Theory, Design And Application” John Wiley And Sons 2010

**19EE E109****DIGITAL PROTECTION OF POWER SYSTEM**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

**Course Objectives:**

1. To study the architecture of digital relays and developing mathematical approach towards power system protection
2. To understand the basic elements and their function in digital protection
3. To learn different algorithms based on sinusoidal wave for numerical protection, Walsh function and least square based algorithms for numerical protection

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

1. Recognize the need and architecture of digital relays
2. Comprehend the application of mathematics in power system protection
3. Acquainted with the basic blocks and their role in digital protection
4. Attain the knowledge of sinusoidal wave based algorithms
5. Know Walsh functions and least square techniques and their usage in protection

**UNIT-I**

**Digital Relays:** Evolution of digital relays, Advantages, Architecture of digital relays, Performance and operational characteristics of digital protection

**UNIT-II**

**Mathematical Background to Protection Algorithms:** Finite difference techniques, Forward, backward and central difference interpolation, Numerical differentiation, Curve fitting and smoothing, Least squares method, Fourier analysis, Fourier series and Fourier transform, Walsh function analysis.

**UNIT-III**

**Basic Elements of Digital Protection:** Signal conditioning: transducers, surge protection, analog filtering, analog multiplexers, Conversion subsystem: the

sampling theorem, signal aliasing Error, sample and hold circuits, multiplexers, analog to digital conversion,  
Digital filtering concepts of the digital relay as a unit consisting of hardware and software

#### UNIT-IV

**Sinusoidal Wave Based Algorithms:** Sample and first derivative (Mann and Morrison) algorithm, Fourier and Walsh based algorithms, Fourier Algorithm: Full cycle window algorithm, fractional cycle window algorithm,

#### UNIT-V

**Other Algorithms:** Walsh function based algorithm, Least Squares based algorithms, Differential equation based algorithms, Travelling Wave based Techniques.

#### Text Books:

1. A.T. Johns and S. K. Salman, “Digital Protection of Power Systems”, IEEE Press, 1999
2. S.R.Bhide “Digital Power System Protection” PHI Learning Pvt. Ltd. 2014.

#### Suggested Reading:

1. Gerhard Zeigler, “Numerical Distance Protection”, Siemens Publicis Corporate Publishing, 2006
2. A.G. Phadke and J. S. Thorp, “Computer Relaying for Power Systems”, Wiley/Research studies Press, 2009

**19EE E110****POWER QUALITY**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

**Course Objectives:**

1. To understand the theoretical concepts and standards of Power Quality (PQ), and methods to calculate and analyze voltage sag in distribution systems.
2. To have knowledge of Analysis of Voltage Sag
3. To understand PQ issues and sources of harmonics in Industrial systems and its mitigation

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

1. Acquire the knowledge of theoretical concepts and standards of Power Quality issues and its measurement
2. Acquire the knowledge in identifying sources of harmonics
3. Acquire the knowledge to analyze voltage sag in distribution systems
4. Acquire the knowledge Harmonic Filtering Techniques
5. Acquire the knowledge in Solutions to power factor correction, Wiring and Grounding Problems

**UNIT-I**

**Introduction to power quality:** Overview of power quality phenomena, voltage quality, classification of power quality issues, Power quality measures and standards-THD-TIF-DIN-C-message weights. Flicker factor, transient phenomena-occurrence of power quality problems, Power acceptability curves-PQ Measuring Instruments. Standards and recommended practices

**UNIT-II**

**Harmonics:** Harmonic distortion and solutions, Voltage distortion Vs Current distortion, Sources of harmonics, Effect of harmonic distortion, Impact of capacitors, transformers and motors, harmonic sources from commercial and industrial loads, locating harmonic sources of power system.

**UNIT-III**

**Voltage sag Analysis:** Voltage sag Analysis, causes and sources of voltage sags, voltage flow chart, voltage sag magnitude and duration plots, fast

assessment methods for voltage sags in distribution systems, effect of momentary voltage dips on the operation of Induction motor and Synchronous Motors.

#### UNIT-IV

**Harmonic Filtering:** Passive Harmonic Filtering, Three Phase Three-wire Shunt Active Filtering and their control using p-q theory and d-q modeling, Hybrid Filtering using Shunt Active Filters, Dynamic Voltage Restorer and its control, Power Quality Conditioner,

#### UNIT-V

**PQ Consideration in Industrial Power Systems:** Adjustable speed Drives and its applications, Reasons for grounding, typical wiring and grounding problems-solutions.

**Power Factor Correction:** Control Methods for Single Phase APFC, Three Phase APFC and Control Techniques

#### Text Books:

1. G.T. Heydt, “Electric power quality”, McGraw-Hill Professional, 2007
2. Math H. Bollen, “Understanding Power Quality Problems”, IEEE Press, 2000.
3. C.Sankaran, ‘Power Quality’, CRC Press, 2001.

#### Suggested Reading:

1. J. Arrillaga, “Power System Quality Assessment”, John wiley, 2000
2. J. Arrillaga, B.C. Smith, N.R. Watson & A. R. Wood, ”Power system Harmonic Analysis”, Wiley, 1997
3. Roger C.Dugan, Mark F.McGranaghan, Surya Santoso, H.Wayne Beaty, ‘Electrical Power Systems Quality’, 3 rd Edition, Tata McGraw-Hill, 2012.
4. R.Sastry Vedam, M.Sarma, “Power Quality- Var Compensation in Power Systems “, CRC Press, 2009

**19EE E114****SMART GRIDS**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

**Course Objectives:**

1. To Understand concept of smart grid and its advantages and the operation of smart devices such as PMU, IED etc
2. To know smart metering techniques and wide area measurement techniques.
3. To understand the operation of micro grid and its components and the problems associated with integration of distributed generation & its solution through smart grid.

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

1. Appreciate the difference between smart grid & conventional grid.
2. Acquire the knowledge of smart devices such as PMU, IED etc
3. Apply smart metering concepts to industrial and commercial installations.
4. Formulate solutions in the areas of smart substations, distributed generation and wide area measurements.
5. Acquire the knowledge of micro grid and modern communication technologies

**UNIT-I**

**Introduction to Smart Grid:** Evolution of Electric Grid, Concept of Smart Grid, Need of Smart Grid, Concept of Robust & Self-Healing Grid, Present development & International policies in Smart Grid

**UNIT-II**

**Smart Devices-I:** Real Time Pricing, Smart Appliances, Automatic Meter Reading (AMR), Outage Management System (OMS), Plug in Hybrid Electric Vehicles(PHEV), Vehicle to Grid, Smart Sensors, Home and Building Automation, Smart Substations, Substation Automation, Feeder Automation.

**UNIT-III**

**Smart Devices-II:** Geographic Information System (GIS), Intelligent Electronic Devices (IED) & their application for monitoring & protection, Wide Area Measurement System (WAMS), Phase Measurement Unit (PMU).

**UNIT-IV**

**Micro-grid:** Need and applications of micro-grid, Formation of micro-grid, Issues of interconnection, Protection and control of micro-grid, Plastic and Organic solar cells, Thin film solar cells, Variable speed wind generators, fuel-cells, micro-turbines, Captive power plants, Integration of renewable energy sources.

**UNIT-V**

**Communication Systems:** Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighborhood Area Network (NAN), Wide Area Network (WAN), Bluetooth, ZigBee, GPS, Basics of CLOUD computing and Cyber Security for Smart Grid, Broadband over Power line (BPL). IP based protocols.

**Text Books:**

1. Ali Keyhani, Design of smart power grid renewable energy systems, Wiley IEEE, 2011.
2. Clark W. Gellings, The Smart Grid: Enabling Energy Efficiency and Demand Response, CRC Press.

**Suggested Reading:**

1. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, "Smart Grid: Technology and Applications", Wiley 2012.
2. Stuart Borlas'e, "Smart Grid: Infrastructure, Technology and solutions" CRC Press.
3. A.G. Phadke, "Synchronized Phasor Measurement and their Applications", Springer.



**19EE E115****HIGH VOLTAGE ENGINEERING**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

**Course Objectives:**

1. To understand different high voltage measurements and the necessary instruments
2. To know how to measure high voltage AC/DC and impulse voltages and currents
3. To understand the planning, safety principles and layout of HV labs

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

1. Acquire the knowledge about high voltage generation techniques
2. Acquaint with the different methods of generating high voltage AC/DC and impulse voltages and currents
3. Acquire the knowledge of measurement techniques for high voltage AC/DC and impulse voltages and currents
4. Acquire the knowledge about planning and layout of HV labs
5. Attain methods of shielding, grounding and other safety precautions of HV labs

**UNIT-I**

**Generation of High DC& AC voltages:** Half and full wave rectifier circuits, Voltage doubler circuits, Voltage multiplier circuits: Cascaded rectifier circuit, Cockroft Walton voltage multiplier circuit, Electrostatic machines: Van de Graaff Generators, Electrostatic generators, Cascade transformers, Resonant transformers.

**UNIT-II**

**Generation of Impulse voltages and currents:** Impulse generator circuits, Multistage Impulse generator circuit, Generation of switching surges, Generation of impulse currents: Circuit for producing impulse current wave, Generation of high impulse currents, Generation of rectangular current pulses, Tripping and control of impulse generators.

**UNIT-III**

**Measurement of High Voltage and Currents:** Sphere gap, Factors affecting the spark over voltage, Uniform field spark gap, Rod gap, Electrostatic voltmeter, Generating voltmeter, Measurement of electric fields, Potential dividers (Resistive and Capacitive), Series impedance ammeters, Rogowski coils, Hall Effect generators, Digital techniques in HV measurements.

**UNIT-IV**

**Planning and Layout of High Voltage Labs:** Test facilities in HV labs, Classification of HV labs, Voltage and power ratings of test equipment, Layout of HV labs, Clearance, Shielding and Grounding of HV labs, Recent trends in HV engineering.

**UNIT-V**

**High Voltage Safety Principles:** Indian standards for HV clearances, Calibration of HV measuring instruments, Safety earthing, Safety in HV laboratory, Safety regulations for high voltage tests.

**Text Book:**

1. M.S.Naidu and V.Kamaraju, “High Voltage Engineering”, Tata McGraw Hill 2001.
2. C.L. Wadhwa, “High Voltage Engineering”, Wiley Eastern Ltd., New Delhi, 1994

**Suggested Reading:**

1. M. Khalifa, “High Voltage Engineering: Theory and Practise”, Dekker, 1990.
2. E.Kuffel, W.S.Zaengl and J.Kuffel, “High Voltage Engineering Fundamentals”, Newness Publication, 2000.

**19EE E104****POWER SEMICONDUCTOR DEVICES AND MODELING**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

**Course Objectives:**

1. To understand the static and dynamic characteristics of current and voltage controlled power semiconductor devices
2. To enable the selection of devices for different power electronics applications
3. To understand the control, protection and firing circuits for different power devices.

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

1. Select the suitable device for the Specific Power electronic application.
2. Design current controlled semiconductors device and their parameters.
3. Design voltage controlled semiconductors device and their parameters.
4. Design of protection circuits.
5. Design of firing circuits for different power electronic devices.

**UNIT-I**

**Power switching devices overview:** Attributes of an ideal switch, application requirements, circuit symbols; Power handling capability – (SOA); Device selection strategy – On-state and switching losses, EMI due to switching, Power diodes, Types, forward and reverse characteristics, switching characteristics, rating.

**UNIT-II**

**Current Controlled Devices:** BJT's, Construction, static characteristics, switching characteristics; Negative temperature coefficient and secondary breakdown; Power Darlington, Thyristors: Physical and electrical principle underlying operating mode, Two transistor analogy, concept of latching; Gate and switching characteristics; converter grade and inverter grade and other types; series and parallel operation; comparison of BJT and Thyristor, steady state and dynamic models of BJT & Thyristor.

**UNIT-III**

**Voltage Controlled Devices:** Power MOSFETs and IGBTs, Principle of voltage controlled devices, construction, types, static and switching characteristics, steady state and dynamic models of MOSFET and IGBTs - Basics of GTO, MCT, RCT and IGCT, Comparison of all power devices.

**UNIT-IV**

**Firing and Protecting Circuits:** Necessity of isolation, pulse transformer, Opto coupler, Gate drives circuit: SCR, MOSFET, IGBTs and base driving for power BJT.

**Protection:** Voltage protection by Selenium Diodes and Metal-Oxide Varistors, Current Protection, Fusing, Fault Current with AC and DC sources, Design of snubbers.

**UNIT-V**

**Thermal Protection:** Heat transfer, conduction, convection and radiation; Cooling, liquid cooling, vapour phase cooling; Guidance for heat sink selection, Thermal resistance and impedance, Electrical analogy of thermal components, heat sink types.

**Text Books:**

1. B.W Williams, Power Electronics Circuit Devices and Applications, John Wiley & sons, 1987.
2. Rashid M.H., Power Electronics Circuits, Devices and Applications, PHI, Third Edition, New Delhi, 2004
3. Mohan, Undeland and Robins, Power Electronics Concepts, applications and Design, John Wiley and Sons, Singapore, 2000.

**Suggested Reading:**

1. MD Singh and K.B Khanchandani, Power Electronics, Tata McGraw Hill, 2001.
2. Joseph Vithayathil, Power Electronics: Principles and Applications, Delhi, Tata McGrawHill, 2010.

**19EE E105****ELECTRIC DRIVE SYSTEM**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

**Course Objectives:**

1. To understand Basic electrical drives and their analysis.
2. To learn Design of controller for drives.
3. To understand vector control of electrical drives.

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

1. Model the Electric Drive System
2. Design modulation strategies of power electronics converters, for drives application
3. Design appropriate current/voltage regulators for electric drives
4. Select and implement the drives for Industrial Process
5. Implement various variable speed drives in Electrical Energy Conversion System

**UNIT-I**

**Dynamics of Electric Drives:** Fundamentals of torque equation. Speed torque convention and multi-quadrant operation, components of load torques. Classification of load torques steady state stability. Load equation, Speed control and drive classification. Close loop control of drives.

**UNIT-II**

**DC Motor Drives:** Modeling of DC machines. Steady state characteristics with armature and speed control. Phase controlled DC motor drives, chopper controlled DC motor drives.

**UNIT-III**

**Three Phase Induction Motor Drive:** Dynamic modeling of induction machines. Small signal equations, control characteristics of induction machines, Phase-controlled induction machines, Stator voltage control, Static Slip recovery schemes, frequency control and vector control of induction motor drives.

**UNIT-IV**

**Traction Motor:** Review of characteristics of different types of DC & AC motors used for traction and their suitability. Starting and Braking methods of traction motors.

**UNIT-V**

**Industrial Drives:** Digital Control of Electric Drives. Stepper motor. Servo motor and their Applications.

**Text Books:**

1. G.K. Dubey, Power semiconductor controlled Drives, Prentice Hall international, New Jersey, 1989.
2. R.Krishnan, Electric motor drives modelling, analysis and control, PHI-India-2009.
3. G.K.Dubey, "Fundamentals of electric Drives, Narosa Publishing House", 2<sup>nd</sup> edition, 2011

**Suggested Reading:**

1. W. Leonhard, Control of Electrical drives, Springer, 3rd edition, 2001.
2. P.C. Krause, Analysis of Electric Machine, Wiley-IEEE press 3<sup>rd</sup> edition
3. K. Bose, Modern Power Electronics and AC Drives, Prentice Hall publication, 1<sup>st</sup> edition, 2001.

**19EE E106****HVDC TRANSMISSION**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

**Course Objectives:**

1. To understand the state of the art of HVDC technology and converter operation for two and multi- terminal DC systems
2. To acquire knowledge about methods of HVDC converter control
3. To understand the concept of AC-DC system interactions and protection scheme in HVDC system

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

1. Explain state of the art HVDC technology
2. Demonstrate the knowledge of HVDC converter operation and methods of control
3. Demonstrate the knowledge of HVDC converter characteristics and control methods
4. Demonstrate the knowledge of the protection methods and AC-DC system interactions
5. Demonstrate the knowledge of multi-terminal DC systems

**UNIT-I**

**HVDC Power Transmission Technology:** Development of HVDC Technology, DC versus AC Transmission, Selection of converter configuration.

**UNIT-II**

**HVDC Converters:** Rectifier and Inverter operation with and without overlap, comparison between rectifier and inverter mode of operation, Digital Simulation of converters, Control of HVDC converters and Systems.

**UNIT-III**

**Converter Control:** Individual phase control, Equidistant firing controls, higher level controls. Characteristics and non-characteristics harmonics filter design. Fault development and protection.

**UNIT-IV**

**HVDC Systems:** Interaction between AC-DC power systems, over voltages on AC/DC side, multi-terminal HVDC systems, control of MTDC systems.

**UNIT-V**

**Modeling of HVDC Systems:** Per unit system, Representation for power flow solution, representation for stability studies.

**Text Books:**

1. S.Kamakshaiah, V.Kamaraju, "HVDC Transmission", Tata McGraw-Hill Education Pvt. Ltd., 2011.
2. K. R. Padiyar, "HVDC Power Transmission Systems", Wiley Eastern Ltd., 1990.

**Suggested Reading:**

1. E. W. Kimbark, "Direct Current Transmission", Vol. I, Wiley Interscience, 1971.
2. Erich Uhlmann, "Power Transmission by Direct Current", B.S. Publications, 2004.
3. Arrillaga, "High Voltage Direct Transmission", Peter Peregrinus Ltd. London, 1983.



**19EE E108****ARTIFICIAL INTELLIGENCE TECHNIQUES**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

**Course Objectives:**

1. To understand concepts of biological, artificial neural networks and fuzzy logic
2. To acquire the knowledge of GA and ANFIS
3. To learn the intelligent system approaches relevant to Power systems applications

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

1. Apply the concepts of biological and artificial neural networks
2. Acquire the knowledge of fuzzy systems
3. Acquire the knowledge of GA
4. Demonstrate the concepts of ANFIS
5. Integrate the intelligent system approaches relevant to Power systems

**UNIT-I**

**ANN:** Biological foundations to intelligent Systems, Difference between Artificial Neuron and Biological Neuron, Activation functions, Single layer and Multilayer Feed Forward NN, 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 Functions, Fuzzy Sets, Operations on Fuzzy Sets and its properties, Fuzzy relations, Fuzzy graphs, , Fuzzy analysis, Fuzzy Quantifiers, Fuzzy Inference, De-fuzzification methods.

**UNIT-III**

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

**UNIT-IV**

**Hybrid Systems:** Classification, Neuro–fuzzy hybrids, ANFIS Architecture - Fuzzy-Back Propagation Network, ANFIS Learning Algorithms.

**UNIT-V**

**Applications of ANN, Fuzzy logic and GA techniques to practical problems:**

Applications of ANN, Fuzzy logic and GA in power system operation and control for solving voltage control, voltage stability, feeder load balancing, Economic load dispatch, Reactive Power Planning, Optimal Power Flow.

**Text Books:**

1. S.N.Sivanandam, S.N.Deepa, “Principles of soft computing techniques”, Wiley publications, 2007.
2. Timothy Ross, “Fuzzy Logic with Engg. Applications”, McGraw. Hill, 2011.
3. Goldberg, “Genetic Algorithms”, Addison-Wesley Publishing Com, 2008.

**Suggested Reading:**

1. J M Zurada , “An Introduction to ANN”, Jaico Publishing House, 1999.
2. Simon Haykins, “Neural Networks”, Prentice Hall, 2016.
3. Driankov, Dimitra, “An Introduction to Fuzzy Control”, Narosa Publication, 1996.

**19EE E111****FACTS AND CUSTOM POWER DEVICES**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

**Course Objectives:**

1. To understand the concepts of reactive power compensation which can be used for interconnected power transmission and distribution systems
2. To study the principles of operation and control of shunt, series and combined FACTS controllers
3. To study the various types of power quality problems in distribution systems and to know about the filters

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

1. Select the appropriate compensating technique/ device/controller based on the needs of inter connected power transmission systems.
2. Demonstrate the knowledge of shunt compensators (i.e. SVC, STATCOM) for the end of line voltage support and transient stability problems
3. Analyze the operation and control of GCSC, TCSC, TSSC, TCVR, TCPAR and SSSC.
4. Demonstrate the knowledge of operation and control of UPFC
5. Identify the power quality problems and demonstrate the knowledge of various types of filters and UPQC

**UNIT-I**

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

**UNIT-II**

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

**UNIT III**

**Static Series Compensation:** TSSC, SSSC -Static voltage and phase angle regulators, TCVR and TCPAR Operation and Control, Applications, Static series compensation, GCSC, TSSC, TCSC and Static synchronous series compensators and their Control.

**UNIT IV**

**Combined Power Flow Controller:** Circuit Arrangement, Operation and control of UPFC, Basic Principle of P and Q control, Independent real and reactive power flow control- Applications, Introduction to interline power flow controller (IPFC)

**UNIT V**

**Power Quality Problems in Distribution Systems:** harmonics, Loads that create harmonics, harmonic propagation, series and parallel resonances, mitigation of harmonics, passive filters, active filter, shunt, series, hybrid filters and their control.

Voltage swells, sags, flicker, unbalance and mitigation of these problems by unified power quality conditioner (UPQC), IEEE standards on power quality.

**Text Books:**

1. K R Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International Publishers, 2007.
2. N.G. Hingorani, L. Gyugyi, "Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems", IEEE Press Book, Standard Publishers and Distributors, Delhi, 2001.

**Suggested Reading:**

1. X P Zhang, C Rehtanz, B Pal, "Flexible AC Transmission Systems-Modelling and Control", Springer Verlag, Berlin, 2006.
2. K.S.Sureshkumar, S.Ashok, "FACTS Controllers & Applications", E-book edition, Nalanda Digital Library, NIT Calicut, 2003.
3. G. T. Heydt, "Power Quality", McGraw-Hill Professional, 2007.
4. T. J. E. Miller, "Static Reactive Power Compensation", John Wiley and Sons, Newyork, 1982

*Education means transformation, but not information!*

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**19EE E112****SWITCH MODE & RESONANT CONVERTERS**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

**Course Objectives:**

1. To apply the basic concepts of power electronics for designing converters.
2. To understand various types of SMPS design and its control methods
3. To know the stability analysis for the converters using Bode plots.

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

1. Identify different power electronic circuits for designing converters.
2. Design various types of SMPS for electrical applications .
3. Design control methods for SMPS
4. Analyze the stability using Bode plots for the converters.
5. Select different components used in SMPS hardware.

**UNIT-I**

**Basic Converter Circuits:** Buck Regulator, Boost Regulator, Buck Boost Regulator, Cuk Converters, Resonant Converters, Choice of Switching Frequency-Design Aspects

**UNIT-II**

**Isolated SMPS:** Fly back Converters, Forward Converters, Half Bridge and Full Bridge Converters, Push Pull Converters and SMPS with multiple outputs, Choice of Switching Frequency-Design Aspects

**UNIT-III**

**Control Aspects:** PWM Controllers, isolation in feedback loop, Power Supplies with Multiple outputs, Stability analysis using Bode Diagrams.

**UNIT-IV**

**Design Considerations:** Selection of Output Filter Capacitor, Selection of Energy Storage Inductor, Design of High Frequency Inductor and High Frequency Transformer, Selection of Switches, Snubber Circuit Design, Design of Driver Circuits- Power MOSFETS.

**UNIT-V**

**Electromagnet Interference (EMI):** EMI Filter Components, Conducted EMI suppression, Radiated EMI suppression, Measurement. Protection: Over current over voltage protection, inrush current protection

**Text Books:**

- 1 Mohan N. Undeland . T & Robbins W, Power Electronics Converters, Application and Design, John Wiley, 3rd edition, 2002.
2. M.H.Rashid, Power Electronics. Prentice-Hall of India, 2004.
- 3 Switched Mode Power Supplies, Design and Construction, H. W. Whittington, B. W. Flynn and D. E. MacPherson, Universities Press, 2009 Edition.

**Suggested Reading:**

- 1 Umanand L., Bhat S.R., Design of magnetic components for switched Mode Power Converters. , Wiley Eastern Ltd.,1992
- 2 Course Material on Switched Mode Power Conversion, V. Ramanarayanan.

**19EE E113****ENERGY AUDITING AND MANAGEMENT**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

**Course Objectives:**

1. To understand the need for energy auditing
2. To understand of various loads involved based on power consumption for auditing
3. To know about different audit instruments used in practice

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

1. Acquire the background required for engineers to meet the role of energy managers
2. Gain the skills and techniques required to implement energy management
3. Demonstrate energy conservation aspects
4. Apply the energy conservation techniques to industrial loads
5. Perform basic energy audit in an organization

**UNIT-I**

**Energy Auditing:** Energy auditing: Types and objectives, audit instruments. ECO assessment and Economic methods specific energy analysis, Minimum energy paths, consumption models, Case study

**UNIT-II**

**Energy Efficient Motors:** Electric motors, Energy efficient controls and starting efficiency, Motor Efficiency and Load Analysis Energy efficient /high efficient Motors, Case study.

Load Matching and selection of motors, Variable speed drives, Pumps and Fans, Efficient Control strategies, optimal selection and sizing.

**UNIT-III**

**Energy Conservation Aspects:** Transformer Loading/Efficiency analysis, Feeder/cable loss evaluation, Reactive Power management, Capacitor Sizing, Degree of Compensation, Capacitor losses, Location, Placement and Maintenance, Peak Demand controls, Methodologies.

**UNIT-IV**

**Industrial Loads:** Types of Industrial loads, Optimal Load scheduling-case study, Lighting, Energy efficient light sources, Energy conservation in Lighting Schemes, Electronic ballast, Power quality issues, Luminaries, Case study, Cogeneration, Types and Schemes, Optimal operation of cogeneration plants.

**UNIT-V**

**E.C. Measures:** Electric water heating, Geysers, Solar Water Heaters. Power Consumption in Compressors, Energy conservation measures, software, EMS

**Text Books:**

1. Umesh Rathore: Energy Management, S.K.Kataria & sons second edition, 2013.
2. Anthony J. Pansini, Kenneth D. Smalling, .Guide to Electric Load Management. PennwellPub; (1998)
3. Howard E. Jordan, .Energy-Efficient Electric Motors and Their Applications., Plenum Pub Corp; 2nd edition, 1994

**Suggested Reading:**

1. Tanuj Kumar Bishat: SCADA and Energy Management system; S.K.Kataria & sons , second edition, 2013.
2. Giovanni Petrecca, .Industrial Energy Management: Principles and Applications, The Kluwer international series -207, 1999



**19EE E116****ELECTRIC AND HYBRID VEHICLES**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

**Course objectives:**

1. To know the conventional vehicles and their disadvantages
2. To understand the concept hybrid electric vehicles
3. To explore the different energy management strategies.

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

1. Be familiar to the models of describing hybrid vehicles and their performance.
2. Model the electric vehicles with different acceleration and range
3. Design various configuration and control strategies for electric drives
4. Analyze the different possible ways of energy storage
5. Design of a Hybrid Electric Vehicle, Battery Electric Vehicle

**UNIT-I**

**Conventional Vehicles:** Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance, EV System – EV Advantages – Vehicle Mechanics – Performance of EVs.

**UNIT-II**

**Hybrid Electric Vehicles:** Introduction, History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Electric Vehicle Modeling– Consideration of Rolling Resistance – Transmission Efficiency – Consideration of Vehicle Mass – Tractive Effort – Modeling Vehicle Acceleration – Modeling Electric Vehicle Range.

**UNIT-III**

**Electric Trains:** Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive train topologies, fuel efficiency analysis, Basic concept of electric traction, Electric Propulsion unit, Introduction to electric

components used in hybrid and electric vehicles, characteristics and regenerative braking, drive system efficiency.

#### **UNIT-IV**

**Energy Storage Systems:** Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE)

#### **UNIT-V**

**Energy Management Strategies:** Energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies. Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

#### **Text Books:**

1. C. Mi, M. A. Masrur and D. W. Gao, “Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives”, John Wiley & Sons, 2011.
2. S. Onori, L. Serrao and G. Rizzoni, “Hybrid Electric Vehicles: Energy Management Strategies”, Springer, 2015.

#### **Suggested Readings:**

1. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design”, CRC Press, 2004
2. T. Denton, “Electric and Hybrid Vehicles”, Routledge, 2016.

**19CSO 101**

**Open Electives**  
**BUSINESS ANALYTICS**

Instruction	3 Hours per week
Duration of End examination	3 Hours
Semester end examinations	70
CIE	30
Credits	3

**Course Objectives:** The main objectives of this course are to:

1. Understanding the basic concepts of business analytics and applications
2. Study various business analytics methods including predictive, prescriptive and prescriptive analytics
3. Prepare the students to model business data using various data mining, decision making methods

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

1. Understand the basic concepts of business analytics
2. Identify the application of business analytics and use tools to analyze business data
3. Become familiar with various metrics, measures used in business analytics
4. Illustrate various descriptive, predictive and prescriptive methods and techniques
5. Model the business data using various business analytical methods and techniques

**Unit-I**

**Introduction to Business Analytics:** Introduction to Business Analytics, need and science of data driven (DD) decision making, Descriptive, predictive, prescriptive analytics and techniques, Big data analytics, Web and Social media analytics, Machine Learning algorithms, framework for decision making, challenges in DD decision making and future.

**Unit-II**

**Descriptive Analytics:** Introduction, data types and scales, types of measurement scales, population and samples, measures of central tendency, percentile, decile

and quadrille, measures of variation, measures of shape-skewness, data visualization

### Unit-III

**Forecasting Techniques:** Introduction, time-series data and components, forecasting accuracy, moving average method, single exponential smoothing, Holt's method, Holt-Winter model, Croston's forecasting method, regression model for forecasting, Auto regression models, auto-regressive moving process, ARIMA, Theil's coefficient

### Unit-IV

**Decision Trees:** CHAID, Classification and Regression tree, splitting criteria, Ensemble and method and random forest. **Clustering:** Distance and similarity measures used in clustering, Clustering algorithms, K-Means and Hierarchical algorithms, **Prescriptive Analytics-** Linear Programming(LP) and LP model building,

### Unit-V:

**Six Sigma:** Introduction, introduction, origin, 3-Sigma Vs Six-Sigma process, cost of poor quality, sigma score, industry applications, six sigma measures, DPMO, yield, sigma score, DMAIC methodology, Six Sigma toolbox

### Text Books:

1. U Dinesh Kumar, "Data Analytics", Wiley Publications, 1<sup>st</sup> Edition, 2017
2. Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, "Business analytics Principles, Concepts, and Applications with SAS", Associate Publishers, 2015

### Suggested Reading:

1. S. Christian Albright, Wayne L. Winston, "Business Analytics - Data Analysis and Decision Making", 5th Edition, Cengage, 2015

### Web Resources:

1. <https://onlinecourses.nptel.ac.in/noc18-mg11/preview>
2. <https://nptel.ac.in/courses/110105089/>

**19MEO 101****INDUSTRIAL SAFETY**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examinations	70 Marks
CIE	30 Marks
Credits	3

**Course Objectives:** The students will be able to understand

1. Causes for industrial accidents and preventive steps to be taken.
2. Fundamental concepts of Maintenance Engineering.
3. About wear and corrosion along with preventive steps to be taken

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

1. Identify the causes for industrial accidents and suggest preventive measures.
2. Identify the basic tools and requirements of different maintenance procedures.
3. Apply different techniques to reduce and prevent Wear and corrosion in Industry.
4. Identify different types of faults present in various equipments like machine tools, IC Engines, boilers etc.
5. Apply periodic and preventive maintenance techniques as required for industrial equipments like motors, pumps and air compressors and machine tools etc

**UNIT-I**

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

**UNIT-II**

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

**UNIT-III**

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

**UNIT-IV**

**Fault Tracing:** Fault tracing-concept and importance, decision tree concept, need 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, any one machine tool, Pump, Air compressor, Internal combustion engine, Boiler, Electrical motors, Types of faults in machine tools and their general causes.

**UNIT-V**

**Periodic and Preventive Maintenance:** Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of 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 Machine tools, Pumps, Air compressors, Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

**Text Books:**

1. H. P. Garg, "Maintenance Engineering", S. Chand and Company
2. Audels, "Pump-hydraulic Compressors", Mcgraw Hill Publication

**Suggested Readings:**

1. Higgins & Morrow, "Maintenance Engineering Handbook", Da Information Services.
2. Winterkorn, Hans, "Foundation Engineering Handbook", Chapman & Hall London.

*If we have built castles in the air, our work need not be lost; that is where they should be. Now lay the foundation under them. But a fool is one who, having no goal, redoubles his efforts.*

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**16MEO 102****INTRODUCTION TO OPTIMISATION TECHNIQUES**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examinations	70 Marks
CIE	30 Marks
Credits	3

**Course Objectives:**

1. Students will come to know the formulation of LPP models
2. Students will understand the Algorithms of Graphical and Simplex Methods
3. Students will understand the Transportation and Assignment techniques

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

1. Formulate a managerial decision problem into a mathematical model;
2. Apply transportation problems in manufacturing industries;
3. Build and solve assignment models
4. Apply project management techniques like CPM and PERT to plan and execute project successfully
5. Apply sequencing concepts in industry applications

**UNIT-I**

**Introduction:** Definition and Scope of Operations Research.

**Linear Programming:** Introduction, Formulation of linear programming problems, graphical method of solving LP problem, simplex method

**UNIT-II**

**Transportation Models:** Finding an initial feasible solution - North West Corner Method, Least Cost Method, Vogel's Approximation Method, Finding the optimal solution, Unbalanced Transportation problem, Degeneracy in Transportation,

**UNIT-III**

**Assignment Techniques:** Introduction, Hungarian technique of Assignment techniques, unbalanced problems, problems with restrictions, Maximization in Assignment problems.

**UNIT-IV**

**Project Management:** Definition, Procedure and Objectives of Project Management, Differences between PERT and CPM, Rules for drawing Network diagram, Scheduling the activities, Fulkerson's rule, Earliest and Latest times, Determination of critical path, duration of the project

**UNIT-V**

**Sequencing Models:** Introduction, General assumptions, processing 'n' jobs through two machines, processing 'n' jobs through three machines.

**Text Books:**

1. Hamdy, A. Taha, "Operations Research-An Introduction", Prentice Hall of India Pvt. Ltd., 6/e, 1997.
2. S.D. Sharma, "Operations Research", Kedarnath, Ramnath & Co., Meerut, 2009.
3. V.K. Kapoor, "Operations Research", S. Chand Publishers, New Delhi, 2004.

**Suggested Reading:**

1. Harvey M. Wagner, "Principles of Operations Research", Second Edition, Prentice Hall of India Ltd., 1980.
2. R. Paneer Selvam, "Operations Research", Second Edition, PHI Learning Pvt. Ltd., New Delhi, 2008
3. Nita H. Shah, Ravi M. Gor, Hardik Soni, "Operations Research", PHI Learning Private Limited, 2013



**19MEO 103****COMPOSITE MATERIALS**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examinations	70 Marks
CIE	30 Marks
Credits	3

**Course Objectives:** To make the students to learn the

1. Composite materials and their constituents.
2. Classification of the reinforcements and evaluate the behavior of composites.
3. Fabrication methods of metal matrix composites.

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

1. Classify and characterize the composite materials.
2. Describe types of reinforcements and their properties.
3. Understand different fabrication methods of metal matrix composites.
4. Understand different fabrication methods of polymer matrix composites.
5. Decide the failure of composite materials.

**UNIT-I**

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

**UNIT-II**

**Reinforcements:** 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:** 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 Composites:** Preparation of Moulding compounds and prepegs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

#### UNIT – V

**Strength:** Lamina Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first ply failure-insight strength;

#### Text Books:

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

#### Suggested Readings:

1. Ed-Lubin, “Hand Book of Composite Materials”
2. K.K.Chawla, “Composite Materials”.
3. Deborah D.L. Chung, “Composite Materials Science and Applications”
4. Daniel Gay, Suong V. Hoa, and Stephen W. Tsai, “Composite Materials Design and Applications”

*There are only two mistakes one can make along the road to truth; not going all the way, or not starting at all; not doing anything can be worse than doing the wrong thing.*

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*Everyone is gifted! But some people never open their package!*

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*Everybody wants to go to heaven, but nobody wants to die! To everyone is given the key to heaven, but the same key opens the gates of hell!  
May might go to heaven with half the labor they take to go to hell.*

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**19CEO 101****COST MANAGEMENT OF ENGINEERING PROJECTS**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

**Course Objectives:**

1. To enable the students to understand the concepts of Project management.
2. To provide knowledge on concepts of Project Planning and scheduling.
3. To create an awareness on Project Monitoring and Cost Analysis

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

1. Acquire in-depth knowledge about the concepts of project management and understand the principles of project management.
2. Determine the critical path of a typical project using CPM and PERT techniques.
3. Prepare a work break down plan and perform linear scheduling using various methods.
4. Solve problems of resource scheduling and leveling using network diagrams.
5. Learn the concepts of budgetary control and apply quantitative techniques for optimizing project cost.

**UNIT-I**

**Project Management:** Introduction to project managements, stakeholders, roles, responsibilities and functional relationships. Principles of project management, objectives and project management system. Project team, organization, roles, responsibilities. Concepts of project planning, monitoring, staffing, scheduling and controlling.

**UNIT-II**

**Project Planning and Scheduling:** Introduction for project planning, defining activities and their interdependency, time and resource estimation. Work break

down structure. Linear scheduling methods-bar charts, Line of Balance (LOB), their limitations. Principles, definitions of network-based scheduling methods: CPM, PERT. Network representation, network analysis-forward and backward passes.

### UNIT-III

**Project Monitoring and Cost Analysis:** introduction-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, Time cost tradeoff-Crashing project schedules, its impact on time on time, cost. Project direct and indirect costs.

### UNIT-IV

**Resources Management and Costing-Variance Analysis:** Planning, Enterprise Resource Planning, Resource scheduling and levelling. Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis  
**Standard Costing and Variance Analysis.** Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement

### UNIT-V

**Budgetary Control:** Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

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

### Text Books & Suggested Readings :

1. Charles T Horngren “*Cost Accounting A Managerial Emphasis*”, Pearson Education; 14 edition (2012),
2. Charles T. Horngren and George Foster, “*Advanced Management Accounting*” Prentice-Hall; 6th Revised edition (1 February 1987)
3. Robert S Kaplan Anthony A. Atkinson, “*Management & Cost Accounting*”, Pearson; 2 edition (18 October 1996)
4. K. K Chitkara, “*Construction Project Management: Planning, scheduling and controlling*”, Tata McGraw-Hill Education. (2004).

5. Kumar Neeraj Jha “*Construction Project Management Theory and Practice*”, Pearson Education India; 2 edition (2015)

*Running away does not help us with our problems; unless we are overweight! Running away from our problems is a race we will never win. You can't run away from trouble. There is no place that far.*

Vikasa Mantras- Vivekananda Institute of Human Excellence

*To get to heaven, turn right and keep straight.*

Vikasa Mantras- Vivekananda Institute of Human Excellence

**19EEO 101****WASTE TO ENERGY**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

**Course Objectives:**

1. To know the various forms of waste
2. To understand the processes of Biomass Pyrolysis.
3. To learn the technique of Biomass Combustion.

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

1. Understand the concept of conservation of waste
2. Identify the different forms of wastage
3. Chose the best way for conservation to produce energy from waste
4. Explore the ways and means of combustion of biomass
5. Develop a healthy environment for the mankind

**UNIT-I**

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

**UNIT-II**

**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:** 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.

**UNIT-IV**

**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.

#### **UNIT-V**

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

#### **Text Books:**

1. Desai, Ashok V., "*Non Conventional Energy*", Wiley Eastern Ltd., 1990.
2. Khandelwal, K. C. and Mahdi, S. S., "Biogas Technology - A Practical Hand Book - Vol. I & II", Tata McGraw Hill Publishing Co. Ltd., 1983.

#### **Suggested Readings:**

1. Challal, D. S., "Food, Feed and Fuel from Biomass", IBH Publishing Co. Pvt. Ltd., 1991.
2. C. Y. WereKo-Brobby and E. B. Hagan, "Biomass Conversion and Technology", John Wiley & Sons, 1996.

**19 EGA 101**

**Audit Courses**  
**ENGLISH FOR RESEARCH PAPER WRITING**

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
SEE	50 Marks

**Course Objectives:**

1. To understand the nuances of language and vocabulary in writing a Research Paper.
2. To develop the content, structure and format of writing a research paper.
3. To enable the students to produce original research papers without plagiarism.

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

1. Interpret the nuances of research paper writing.
2. Differentiate the research paper format and citation of sources.
3. To review the research papers and articles in a scientific manner.
4. Avoid plagiarism and be able to develop their writing skills in presenting the research work.
5. Create a research paper and acquire the knowledge of how and where to publish their original research papers.

**Unit 1**

**Academic Writing:** Meaning & Definition of a research paper– Purpose of a research paper – Scope – Benefits – Limitations – outcomes.

**Unit II**

**Research Paper Format:** Title – Abstract – Introduction – Discussion – Findings – Conclusion – Style of Indentation – Font size/Font types – Indexing – Citation of sources.

**Unit III**

**Research Methodology:** Methods (Qualitative – Quantitative) Review of Literature. Criticizing, Paraphrasing & Plagiarism.



**Unit IV**

**Process of Writing a Research Paper:** Choosing a topic - Thesis Statement – Outline – Organizing notes - Language of Research – Word order, Paragraphs – Writing first draft –Revising/Editing - The final draft and proof reading.

**Unit V**

**Research Paper Publication :**Reputed Journals – National/International – ISSN No, No. of volumes, Scopus Index/UGC Journals – Free publications - Paid Journal publications – /Advantages/Benefits

**Text books :**

1. C. R Kothari, Gaurav, Garg, Research Methodology Methods and Techniques, New Age International Publishers. 4<sup>th</sup> Edition.

**Suggested Reading:**

1. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
2. MLA Hand book for writers of Research Papers, East West Press Pvt. Ltd, New Delhi, 7<sup>th</sup> Edition.
3. Lauri Rozakis, Schaum's, Quick Guide to Writing Great Research Papers, Tata McGraw Hills Pvt. Ltd, New Delhi.

**Online Resources:**

NPTTEL: [https://onlinecourses.nptel.ac.in/noc18\\_mg13/preview](https://onlinecourses.nptel.ac.in/noc18_mg13/preview)

**19EGA 102****INDIAN CONSTITUTION AND FUNDAMENTAL RIGHTS**

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
Semester End Examination	50 Marks

**Course Objectives:** The course will introduce the students to

1. The history of Indian Constitution and its role in the Indian democracy.
2. Address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement. to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. Have knowledge of the various Organs of Governance and Local Administration.

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

1. Understand the making of the Indian Constitution and its features.
2. Understand the Rights of equality, the Right of freedom and the Right to constitutional remedies.
3. Have an insight into various Organs of Governance - composition and functions.
4. Understand powers and functions of Municipalities, Panchayats and Co-operative Societies.
5. Understand Electoral Process, special provisions.

**UNIT I**

**History of making of the Indian constitutions** - History, Drafting Committee (Composition & Working).

**Philosophy of the Indian Constitution:** Preamble, Salient Features.

**UNIT-II**

**Contours of Constitutional Rights and 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-** Parliament: Composition, Qualifications, Powers and Functions

Union executives : President, Governor, Council of Ministers, Judiciary, appointment and transfer of judges, qualifications, powers and functions

#### **UNIT-IV**

**Local Administration** - District's Administration head: Role and importance. Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Panchayati Raj: Introduction, PRI: Zilla Panchayat, Elected Officials and their roles, CEO Zilla Panchayat: positions 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:** 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

#### **Text 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.

#### **Online Resources:**

1. <http://www.nptel.ac.in/courses/103107084/Script.pdf>

**19EGA 103****STRESS MANAGEMENT BY YOGA**

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
Semester End Examination	50 Marks

**Course Objectives :** The Course will introduce the students to :

1. Creating awareness about different types of stress and the role of yoga in the management of stress.
2. Promotion of positive health and overall wellbeing (Physical, mental, emotional, social and spiritual).
3. Prevention of stress related health problems by yoga practice.

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

1. To understand yoga and its benefits.
2. Enhance Physical strength and flexibility.
3. Learn to relax and focus.
4. Relieve physical and mental tension through asanas
5. Improve work performance and efficiency.

**Unit I**

**Meaning and definition of Yoga** - Historical perspective of Yoga - Principles of Astanga Yoga by Patanjali.

**Unit II**

**Meaning and definition of Stress** - Types of stress - Eustress and Distress. Anticipatory Anxiety and Intense Anxiety and depression. Meaning of Management- Stress Management.

**Unit III**

**Concept of Stress according to Yoga** - Stress assessment methods - Role of Asana, Pranayama and Meditation in the management of stress.

**Unit IV**

**Asanas-** ( 5 Asanas in each posture) - Warm up - Standing Asanas - Sitting Asanas - Prone Asanas - Supine asanas - Surya Namaskar.

**Unit V**

**Pranayama-** Anulom and Vilom Pranayama - Nadishudhi Pranayama – Kapalabhati-Pranayama - Bhramari Pranayama - Nadasandhana Pranayama.

**Meditation techniques:** Om Meditation - Cyclic meditation : Instant Relaxation technique (QRT), Quick Relaxation Technique ( QRT), Deep Relaxation Technique (DRT)

**Text books :**

1. “Yogic Asanas for Group Training - Part-I”: Janardhan Swami Yogabhyasi Mandal, Nagpur.
2. “Rajayoga or Conquering the Internal Nature”by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata.
3. Nagendra H.R nad Nagaratna R, Yoga Perspective in Stress Management, Bangalore, Swami Vivekananda Yoga Prakashan

**Online Resources:**

1. [https://onlinecourses.nptel.ac.in/noc16\\_ge04/preview](https://onlinecourses.nptel.ac.in/noc16_ge04/preview)
2. <https://freevideolectures.com/course/3539/indian-philosophy/11>

**19 EGA 104****PERSONALITY DEVELOPMENT THROUGH  
LIFE'S ENLIGHTENMENT SKILLS**

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
Semester End Examination	50 Marks

**Course Objectives:** The course will introduce the students to :

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

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

1. Develop their personality and achieve their highest goal of life.
2. Lead the nation and mankind to peace and prosperity.
3. To practice emotional self regulation.
4. Develop a positive approach to work and duties.
5. Develop a versatile personality.

**UNIT-I:**

**Neetisatakam – Holistic development of personality** - Verses 19, 20, 21, 22 (Wisdom) - Verses 29, 31, 32 (Pride and Heroism) - Verses 26,28,63,65 (Virtue)

**UNIT-II**

**Neetisatakam – Holistic development of personality (cont'd)** - Verses 52, 53, 59 (don't's) - Verses 71,73,75 & 78 (do's) - Approach to day to day works and duties.

**UNIT-III**

**Introduction to Bhagavadgeetha for Personality Development - Shrimad Bhagawad Geeta:** Chapter 2 – Verses 41, 47, 48 - Chapter 3 – Verses 13,21,27,35 - Chapter 6 – Verses 5,13,17,23,35 - Chapter 18 – Verses 45, 46, 48 Chapter –6: Verses 5, 13, 17, 23, 35; Chapter – 18: Verses 45, 46, 48

**UNIT-IV**

**Statements of basic knowledge - Shrimad BhagawadGeeta:** Chapter 2- Verses 56, 62,68 - Chapter 12 – Verses 13, 14, 15, 16, 17, 18 - Personality of Role model from Shrimad Bhagawat Geeta.

**UNIT-V**

**Role of Bahgavadgeeta in the present scenario** - Chapter 2 – Verses 17 - Chapter 3 – Verses 36, 37, 42 - Chapter 4 – Verses 18, 38, 39 - Chapter 18 – Verses 37, 38, 63.

**Text 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

**Online Courses:**

1. NTPEL: <http://nptel.ac.in/downloads/109104115/>

**19ECA 101****VALUE EDUCATION**

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
SEE	50 Marks
CIE	0
Credits	0

**Course Objectives :** This course aims to:

1. Understand the need and importance of Values for self-development and for National development.
2. Imbibe good human values and Morals
3. Cultivate individual and National character.

**Course outcomes:** After completion of the Course, Students will be able to:

1. Gain necessary Knowledge for self-development
2. Learn the importance of Human values and their application in day to day professional life.
3. Appreciate the need and importance of interpersonal skills for successful career and social life
4. Emphasize the role of personal and social responsibility of an individual for all-round growth.
5. Develop a perspective based on spiritual outlook and respect women, other religious practices, equality, non-violence and universal brotherhood.

**UNIT I**

**Human Values, Ethics and Morals:** Concept of Values, Indian concept of humanism, human values; Values for self-development, Social values, individual attitudes; Work ethics, moral and non- moral behavior, standards and principles based on religion, culture and tradition.

**UNIT II**

**Value Cultivation, and Self-management:** Need and Importance of cultivation of values such as Sense-of Duty, Devotion to work, Self-reliance, Confidence, Concentration, Integrity & discipline, and Truthfulness.

**UNIT III**

**Spiritual outlook and social values:** Personality and Behavior, Scientific attitude and Spiritual (soul) outlook; Cultivation of Social Values Such as Positive



Thinking, Punctuality, Love & Kindness, Avoiding fault finding in others, Reduction of anger, forgiveness, Dignity of labour, True friendship, Universal brotherhood and religious tolerance.

#### **UNITIV**

**Values in Holy Books :** Self-management and Good health; and internal & external Cleanliness, Holy books versus Blind faith, Character and Competence, Equality, Nonviolence, Humility, Role of Women.

#### **UNITV**

**Dharma, Karma and Guna:** Concept of soul; Science of Reincarnation, Character and Conduct, Concept of Dharma; Cause and Effect based Karma Theory; The qualities of Devine and Devilish; Satwic, Rajasic and Tamasicgunas.

#### **Text books :**

1. Chakroborty, S.K. “Values & Ethics for organizations Theory and practice”, Oxford University Press, New Delhi, 1998.
2. Jaya DayalGoyandaka, “Srimad Bhagavad Gita”, withSanskrit Text, Word meaning and Prose meaning, Gita Press, Gorakhpur, 2017.

**19CEA 101****DISASTER MITIGATION AND MANAGEMENT**

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
Semester End Examination	50 Marks
CIE	0 Marks
Credits	0

**Course Objectives:** To enable the student

1. To equip the students with the basic knowledge of hazards, disasters, risks and vulnerabilities including natural, climatic and human induced factors and associated impacts
2. To impart knowledge in students about the nature, causes, consequences and mitigation measures of the various natural disasters
3. To enable the students to understand risks, vulnerabilities and human errors associated with human induced disasters

**Course Outcomes:** At the end of the course the student

1. Ability to analyse and critically examine existing programs in disaster management regarding vulnerability, risk and capacity at different levels
2. Ability to understand and choose the appropriate activities and tools and set up priorities to build a coherent and adapted disaster management plan
3. Ability to understand various mechanisms and consequences of human induced disasters for the participatory role of engineers in disaster management
4. To understand the impact on various elements affected by the disaster and to suggest and apply appropriate measures for the same
5. Develop an awareness of the chronological phases of disaster preparedness, response and relief operations for formulating effective disaster management plans and ability to understand various participatory approaches/strategies and their application in disaster management

**UNIT-I**

**Introduction:** Basic definitions- Hazard, Disaster, Vulnerability, Risk, Resilience, Mitigation, Management; classification of types of disaster- Natural and man-

made; International Decade for natural disaster reduction (IDNDR); International strategy for disaster reduction (ISDR), National disaster management authority (NDMA).

## UNIT-II

**Natural Disasters:** Hydro meteorological disasters: Causes, Early warning systems- monitoring and management, structural and non-structural measures for floods, drought and Tropical cyclones; Geographical based disasters: Tsunami generation, causes, zoning, Early warning systems- monitoring and management, structural and non-structural mitigation measures for earthquakes, tsunami, landslides, avalanches and forest fires. Case studies related to various hydro meteorological and geographical based disasters.

## UNIT-III

**Human induced hazards:** Chemical disaster- Causes, impacts and mitigation measures for chemical accidents, Risks and control measures in a chemical industry, chemical disaster management; Case studies related to various chemical industrial hazards eg: Bhopal gas tragedy; Management of chemical terrorism disasters and biological disasters; Radiological Emergencies and case studies; Case studies related to major power break downs, fire accidents, traffic accidents, oil spills and stampedes, disasters due to double cellar construction in multi-storeyed buildings.

## UNIT-IV

**Disaster Impacts:** Disaster impacts- environmental, physical, social, ecological, economical, political, etc.; health, psycho-social issues; demographic aspects- gender, age, special needs; hazard locations; global and national disaster trends; climate change and urban disasters.

## UNIT-V

**Concept of Disaster Management:** Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; risk analysis, vulnerability and capacity assessment; Post-disaster environmental response- water, sanitation, food safety, waste management, disease control; Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster Management Authority.

**Text Books:**

1. Pradeep Sahni, " *Disaster Risk Reduction in South Asia*", Prentice Hall, 2003.
2. B. K. Singh, " *Handbook of Disaster Management: techniques & Guidelines*", Rajat Publication, 2008.

**Suggested Reading:**

1. Ministry of Home Affairs". Government of India, "National disaster management plan, Part I and II",
2. K. K. Ghosh, " Disaster Management", APH Publishing Corporation, 2006.
3. [http://www.indiaenvironmentportal.org.in/files/file/disaster\\_management\\_india1.pdf](http://www.indiaenvironmentportal.org.in/files/file/disaster_management_india1.pdf)
4. <http://www.ndmindia.nic.in/> (National Disaster management in India, Ministry of Home Affairs)
5. Hazards, Disasters and your community: A booklet for students and the community, Ministry of home affairs.

*All the problems in the life are because of only one reason; We forget what is to be remembered, we often remember what is to be forgotten!*

Vikasa Mantras- Vivekananda Institute of Human Excellence.

*Happiness is nothing more than good health and a bad memory! You never realize what a good memory you have until you try to forget something.*

Vikasa Mantras- Vivekananda Institute of Human Excellence

**19ITA101****PEDAGOGY STUDIES**

Instruction	2 Hours per week
Duration of SEE	2 Hours
SEE	50 Marks
Credits	0

**Course Objectives:**

1. To present the basic concepts of design and policies of pedagogy studies.
2. To provide understanding of the abilities and dispositions with regard to teaching techniques, curriculum design and assessment practices.
3. To familiarize various theories of learning and their connection to teaching practice.

**Course Outcomes:** Upon completing this course, students will be able to:

1. Illustrate the pedagogical practices followed by teachers in developing countries both in formal and informal classrooms.
2. Examine the effectiveness of pedagogical practices.
3. Understand the concept, characteristics and types of educational research and perspectives of research.
4. Describe the role of classroom practices, curriculum and barriers to learning.
5. Understand Research gaps and learn the future directions.

**UNIT-I**

**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**

**Thematic Overview:** Pedagogical practices followed by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

**UNIT-III**

**Evidence on the Effectiveness of Pedagogical Practices:** Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and Practicum) and the school curriculum and guidance material best support effective pedagogy? - Theory of change - Strength and nature of the

body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and pedagogic strategies.

#### UNIT-IV

**Professional Development:** alignment with classroom practices and follow up support - Support from the head teacher and the community – Curriculum and assessment - Barriers to learning: Limited resources and large class sizes.

#### UNIT-V

**Research Gaps and Future Directions:** Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment – Dissemination and research impact.

#### Text Books:

1. Ackers J, Hardman F, “Classroom Interaction in Kenyan Primary Schools, Compare”, 31 (2): 245 – 261, 2001.
2. Agarwal M, “Curricular Reform in Schools: The importance of evaluation”, Journal of Curriculum Studies, 36 (3): 361 – 379, 2004.

#### Suggested Reading:

1. Akyeamong K, “Teacher Training in Ghana – does it count? Multisite teacher education research project (MUSTER)”, Country Report 1.London: DFID, 2003.
2. Akyeamong K, Lussier K, Pryor J, Westbrook J, “Improving teaching and learning of Basic Maths and Reading in Africa: Does teacher Preparation count?, International Journal Educational Development, 33 (3): 272- 282, 2013.
3. Alexander R J, “Culture and Pedagogy: International Comparisons in Primary Education”, Oxford and Boston: Blackwell, 2001.
4. Chavan M, “Read India: A mass scale, rapid, ‘learning to read’ campaign”, 2003.

#### Web Resources:

1. [https://onlinecourses.nptel.ac.in/noc17\\_ge03/preview](https://onlinecourses.nptel.ac.in/noc17_ge03/preview)
2. [www.pratham.org/images/resources%20working%20paper%202.pdf](http://www.pratham.org/images/resources%20working%20paper%202.pdf)

*Keep acquaintance with all, friendship with some, but intimacy with only few. It is hard to find a friend who is highly intelligent, handsome, wise and sweet! So don't lose ME! My friend has the best friend!*

Vikasa Mantras- Vivekananda Institute of Human Excellence

*The reward of patience is patience. Patience is the art of concealing our impatience.*

Vikasa Mantras- Vivekananda Institute of Human Excellence

**19EEA101****SANSKRIT FOR TECHNICAL KNOWLEDGE**

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
Semester End Examination	50 Marks
CIE	0 Marks
Credits	0

**Course Objectives:**

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. To make the novice Learn the Sanskrit to develop the logic in mathematics, science & other subjects
3. To explore the huge knowledge from ancient literature

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

1. Develop passion towards Sanskrit language
2. Decipher the latent engineering principles from Sanskrit literature
3. Correlates the technological concepts with the ancient Sanskrit history.
4. Develop knowledge for the technological progress
5. Explore the avenue for research in engineering with aid of Sanskrit

**UNIT-I**

**Introduction to Sanskrit language:** Sanskrit Alphabets-vowels-consonants-significance of Amarakosa-parts of speech-Morphology-creation of new words-significance of synonyms-sandhi-samasa-sutras-active and passive voice-Past/Present/Future Tense-syntax-Simple Sentences (elementary treatment only)

**UNIT-II**

**Role of Sanskrit in Basic sciences:** Brahmagupthas lemmas (second degree indeterminate equations), sum of squares of n-terms of AP- sulba\_sutram or baudhayana theorem (origination of pythagorous theorem)-value of pie-Madhava's sine and cosine theory (origination of Taylor's series).

The measurement system-time-mass-length-temp, Matter elasticity-optics-speed of light (origination of michealson and morley theory).

**UNIT-III**

**Role of Sanskrit in Engineering-I (Civil, Mechanical, Electrical and Electronics Engineering):** Building construction-soil testing-mortar-town planning-Machine definition-crucible-furnace-air blower- Generation of electricity in a cell-magnetism-Solar system-Sun: The source of energy, the earth-Pingala chandasutram (origination of digital logic system)

**UNIT-IV**

**Role of Sanskrit in Engineering-II (Computer Science Engineering & Information Technology):** Computer languages and the Sanskrit languages-computer command words and the vedic command words-analogy of pramana in memamsa with operators in computer language-sanskrit analogy of physical sequence and logical sequence, programming.

**UNIT-V**

**Role of Sanskrit in Engineering-III (Bio-technology and Chemical Engineering):** Classification of plants-plants, the living-plants have senses-classification of living creatures- Chemical laboratory location and layout-equipment-distillation vessel-kosthi yantram

**Text Books:**

1. M Krishnamachariar, History of Classical Sanskrit Literature, TTD Press, 1937.
2. M.R. Kale, A Higher Sanskrit Grammar: For the Use of School and College Students, Motilal Banarsidass Publishers, ISBN-13: 978-8120801783, 2015
3. Kpail Kapoor, Language, Linguistics and Literature: The Indian Perspective, ISBN-10: 8171880649, 1994.
4. Pride of India, Samskrita Bharti Publisher, ISBN: 81-87276-27-4, 2007
5. Shri Rama Verma, Vedas the source of ultimate science, Nag publishers, ISBN: 81-7081-618-1, 2005

**Suggested Reading:**

1. The Wonder that is Sanskrit, Dr Sampadananda Mishra and Vijay, Auro Publications, ISBN: 978-8170601821, 2017
2. Science in Sanskrit, Samskrita Bharti Publisher, ISBN-13: 978-8187276333, 2007
3. Karan Singh, A Treasury of Indian Wisdom: An Anthology of Spiritual Learn, ISBN: 978-0143426158, 2016.

*Yesterday I was clever, so I wanted to change the world. Today I am wise, so I am changing myself. People laugh at me because I am different, I laugh at them because they are all the same.*

Vikasa Mantras- Vivekananda Institute of Human Excellence

*Dreams are things which we see in sleep, but are things which don't let us sleep. Those who do not dare to dream, probably sleep most of the day.*

Vikasa Mantras- Vivekananda Institute of Human Excellence