Scheme of Instruction and Syllabi

of

ME I to IV SEMESTERS

of

TWO YEAR PG COURSE

in

POWER SYSTEMS & POWER ELECTRONICS
(AICTE Model Curriculum with effect from AY 2020-21)

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY
(Autonomous Institution under UGC, Affiliated to Osmania University)
Department of Electrical and Electronics Engineering

Accredited by NBA and NAAC-UGC,

Chaitanya Bharathi (Post), Gandipet, Hyderabad–500075

Department of Electrical and Electronics Engineering

Chaitanya Bharathi Institute of Technology (A)

Gandipet, Hyderabad-500075

Programme: PG-EEE (Power Systems & Power Electronics)

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 organizations for self-sustained growth of society.

VISION and MISSION of EEE Department

Vision

To achieve Academic and Professional Excellence in Teaching and Research in the frontier areas of Electrical and Electronics Engineering **Vis-a -Vis** serve as a Valuable Resource for Industry and Society.

Mission

Empowering the Faculty and Student Rendezvous to Nurture Interest for Conceptual Keystone, Applied Multidisciplinary Research, Inspiring Leadership and Efficacious Entrepreneurship culture, Impeccable Innovation in frontier areas to be synergetic with Environmental, Societal and Technological Developments of the National and International community for Universal Intimacy.

M1: Emphasis on providing Strong Theoretical Foundation & Engineering Leadership Eminence, infusion of Creativity and Management skill while maintaining Ethics and Moral for Sustainable Development. (Individual development)

M2: Enable the Faculty and Student Interactions to trigger interest for Applied Multidisciplinary Research and Entrepreneurship Culture resulting in Significant Advancement of the field of Specialization with Involvement of Industries and Collaborative Educational Networks. (Sense of Ownership, Networking and Eco system Development).

M3: Extend the Conducive Neighborhoods for Innovation in frontier areas to keep pace with Environmental, Societal and Technological Developments of the National and International Community to Serve Humanity. (Service to Society, Atmanirbhar Bharat)

Programme Educational Objectives are: After the Graduation, students

PEO1: Will excel in Power System and Power Electronics area.

PEO2: Will become successful in executing software related applications.

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

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

Programme Outcomes are: The student is expected to gain an ability:

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

PO2: Ability to write and present a substantial technical report/document.

PO3: Students should be able to demonstrate a degree of mastery in the area of PS & PE.

PO4: Ability to discriminate the capability and knowledge in order to refine the problem formulation and methods of solution which will result into an acceptable outcome.

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY(A)

SCHEME OF INSTRUCTION AND EXAMINATION

OF

MODEL CURRICULUM (R-20)

I-Semester of ME (PS & PE)

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	
THEORY									
1	20EEC101	Real Time Applications for Power Systems	3	-	-	3	40	60	3
2	20EEC102	Power Electronic Converters	3	-	-	3	40	60	3
3	20EEE10X	Program Specific Elective- I	3	-	-	3	40	60	3
4	20EEE10X	Program Specific Elective- II	3	-	-	3	40	60	3
5	20MEC103	Research Methodology and IPR	2	-	-	2	40	60	2
6	AC-1	Audit Course-I	2	-	-	2	0	50	Non-Credit
PRACTICALS									
7	20EEC103	Power Systems Lab	-	-	4	-	50	-	2
8	20EEC104	Power Electronics Simulation Lab	-	-	4	-	50	-	2
TOTAL			16	-	8	-	300	350	18

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

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

SCHEME OF INSTRUCTION AND EXAMINATION

OF

MODEL CURRICULUM (R-20)

II-Semester of ME (PS & PE)

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	
THEORY									
1	20EEC105	Power System Dynamics	3	-	-	3	40	60	3
2	20EEC106	Advanced Power Electronic Circuits	3	-	-	3	40	60	3
3	20EEE10X	Program Specific Elective-III	3	-	-	3	40	60	3
4	20EEE10X	Program Specific Elective-IV	3	-	-	3	40	60	3
5	AC-II	Audit Course-II	2	-	-	2	0	50	Non-Credit
PRACTICALS									
6	20EEC107	Power Electronics Lab	-	-	4	-	50	-	2
7	20EEC108	Power Systems Simulation Lab	-	-	4	-	50	-	2
8	20EEC109	Mini Project with Seminar	-	-	4	-	50	-	2
		TOTAL	**14**	**0**	**12**	**-**	**310**	**290**	**18**

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

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

SCHEME OF INSTRUCTION AND EXAMINATION

OF

MODEL CURRICULUM (R-20)

III-Semester of ME (PS & PE)

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	
THEORY									
1	20EEE10X	Program Specific Elective- V	3	-	-	3	40	60	3
2	OE	Open Elective	3	-	-	3	40	60	3
PRACTICALS									
3	20EEC110	Industrial Project /Dissertation Phase 1		-	20	Viva	100	-	**10**
TOTAL			**6**	**0**	**20**	**-**	**180**	**120**	**16**

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

SCHEME OF INSTRUCTION AND EXAMINATION

OF

MODEL CURRICULUM (R-20)

IV-Semester of ME (PS & PE)

S.No	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination		Credits
			Hours per week			Maximum Marks		
			L	T	P	CIE	SEE	
PRACTICALS								
1	20EEC111	Industrial Project /Dissertation Phase II	-	-	32	100	100	16
TOTAL			**0**	**0**	**32**	**100**	**100**	**16**

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

List of Program Specific Electives/ Open Electives/ Audit Courses

Course Code	Open Electives
20EEE101	Electrical Power Distribution System
20EEE102	Mathematical Methods for Power Engineering
20EEE103	Restructured Power Systems
20EEE107	Renewable Energy System
20EEE109	Digital Protection of Power System
20EEE110	Power Quality
20EEE114	Smart Grids
20EEE115	High Voltage Engineering

Course Code	Program Specific Electives Group-2
20EEE104	Power Semi Conductor devices & Modelling
20EEE105	Electric Drive Systems
20EEE106	HVDC
20EEE108	Artificial Intelligence Techniques for Power Systems
20EEE111	FACTS and Custom power devices
20EEE112	Switch mode & Resonant Converters
20EEE113	Energy Auditing & Management
20EEE116	Electric and Hybrid Vehicles

Course Code	Open Electives
20CSO 101	Business Analytics
20MEO101	Industrial Safety
20MEO 102	Introduction to Optimization Techniques
20MEO 103	Composite Materials
20CEO 101	Cost Management of Engineering Projects
20EEO 101	Waste to Energy

Course Code	Audit Courses – I & II
20EGA 101	English for Research Paper Writing
20EGA 102	Indian Constitution and Fundamental Rights
20EGA 103	Stress Management by Yoga
20EGA 104	Personality Development through Life Enlightenment Skills
20ECA 101	Value Education
20CEA 101	Disaster Mitigation and Management
20ITA 101	Pedagogy Studies
20EEA 101	Sanskrit for Technical Knowledge

With effect from the academic year 2020-2021

20EEC101 REAL TIME APPLICATIONS FOR POWER SYSTEMS

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Course Objectives:

1. To understand the real-time computer operations of power system
2. To understand the importance of contingency analysis at planning stage for secured operation of power system.
3. To understand the concept of load forecasting in real time power system operation

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

1. Understand the study of optimal power flows
2. Acquire knowledge of state estimation required for the real-time operation of power system
3. Describe the importance of contingency analysis at planning stage for secured operation of power system; and simulating the contingency studies with different methods.
4. Discuss the power system security and challenges in secured operation of power system in real-time environment.
5. Explain various methods and models available in power system load forecasting

UNIT-I

Optimal Power Flow: introduction to optimal power flow, Gradient method, Newton's method, Linear sensitivity analysis, linear programming method with only real power variables, linear programming with AC power flow variables and detailed cost functions, security constraint optimal power flow, interior point method, bus incremental costs

UNIT-II

State Estimation: Introduction to power system state estimation, Weighted-Least square state estimation, state estimation of AC networks, state estimation by orthogonal decomposition, Detection and identification of bad Measurements, network observability, pseudo-measurements measurements, application of state estimation.

UNIT-III

Contingency Analysis of Power system: Approximations in Contingency Analysis, Simulation of Addition and Removal of Multiple Lines in a Power System, Simulation of Tie-lines in Interconnected Power Systems, Network Reduction for Contingency Analysis, Contingency Analysis, Approximate Power Flow Method for Simulating Contingencies

UNIT-IV

Power system Security: introduction, factors affecting power system security, generator outages, transmission line outage, linear sensitivity factors, contingency selection, concentric relaxation, bounding, adaptive localization

UNIT-V

Load Forecasting: Introduction, Analytic methods, demand models, price forecasting, forecasting errors, system identification, econometric models, time series, time series model development, demand prediction.

Text Books:

1. Wood, A. J., Wollenberg, B. F., & Sheblé, G. B. 'Power Generation, operation and control', John Wiley &Sons, 2013.
2. T.K.Nagsarkar, M.S.Sukhija, 'Power system analysis', Oxford publications, 2007.

Suggested Reading:

1. J J Grainger and W D Stevenson, Power system Analysis, Mc Graw Hill 2003
2. Debs, Atif S. *Modern power systems control and operation*. Springer Science & Business Media, 2012.

With effect from the academic year 2020-2021

20EEC102 POWER ELECTRONIC CONVERTERS

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 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

20MEC 103 **RESEARCH METHODOLOGY AND IPR**

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	2

Course Objectives: To make the students to

1. Motivate to choose research as career, identify various sources for literature review and report writing
2. Formulate the research problem, prepare the research design and Equip with good methods to analyze the collected data
3. Know about IPR copyrights

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

1. Define research problem, review and asses 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 verses 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

With effect from the academic year 2020-2021

20EEC103 POWER SYSTEMS LAB

Instruction	4 Hours per week
Continuous Internal Evaluation	50 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, **s**tudent 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.
16. Three-phase UPQC for power quality mitigation

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

With effect from the academic year 2020-2021

20EEC104 **POWER ELECTRONICS SIMULATION LAB**

Instruction	4 Hours per week
Duration of Semester End Examination	3 Hours
Continuous Internal Evaluation	50 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. Acquire the knowledge of using simulation tools for power electronic converters modelling.
2. Analyze the performance of phase -controlled converters by simulation
3. Demonstrate the effects of different topologies and voltage control techniquesin inverters.
4. Simulate different dc-dc converter circuits
5. Investigate with ac-ac conversion and reactive power compensation calculations.

List of Experiments

1. Single-phase semi-converter using RL & RLE loads with and without freewheeling diode.
2. Three-phase full converter using RL load with and without LC Filter
3. Three-phase fully controlled converter fed dc drive
4. Performance analysis of phase-controlled rectifiers with source inductance(single phase and three phase)
5. Analysis of Buck and Buck-Boost converters
6. Speed control of dc drive using dc chopper
7. Analysis of single-phase and Three phase IGBT inverters
8. Single, multiple and sinusoidal PWM techniques
9. Voltage control of an inverter using unipolar & bipolar PWM techniques
10. Inverter voltage control using Space Vector Modulation
11. Single-phase current source inverter with RL load
12. Analysis of three phase AC voltage controller with R & RL loads
13. Single-phase Cyclo-converter with R & RL loads
14. Single-phase Dual converter with R & RL loads
15. Reactive power compensation using FACTS controllers
16. Simulation of matrix converter.

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

With effect from the academic year 2020-2021

20EEC105 **POWER SYSTEM DYNAMICS**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Course Objectives:

1. To understand and analyze the various stability concepts of the power system
2. To study the concept of modeling the synchronous machines
3. To understand the phenomenon of SSR oscillations in power system

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

1. Distinguish various stabilities issues in the power system
2. Understand the modeling of synchronous machine
3. Describe the role of Excitation, PSS and Prime Movers in improving the power system performance during disturbances
4. Analyze the small-signal stability of the power system
5. Infer the concepts of LFOs and SSR in detail

UNIT-I

Synchronous Machine Modeling: Introduction, Park's Transformation, Flux Linkage Equations, Voltage Equations, Formulation of State-Space Equations, Current Formulation, Per Unit Conversion, Normalized Voltage and Torque Equations, Torque and Power, Equivalent Circuit of a Synchronous Machine, Flux Linkage State-Space Model

UNIT-II

Stability: Definitions classification of stability, Analysis of Steady state stability, Factors affecting Steady state stability, Transient stability, Equal-area criterion, Factor influencing Transient stability, Numerical Methods for analyzing transient stability,

Definition of voltage stability, voltage security, voltage collapse, Factors contributing and affecting voltage stability and minimization of voltage collapse, analysis of voltage stability/collapse, P-V and Q-V curves

UNIT-III

System performance improvement:

Excitation systems: Requirements, elements of excitation systems, types of excitation systems, modeling of excitation systems

Power system stabilizers: Basic concepts in applying PSS, Structure and tuning of PSS

Load models: Concept of load modeling, static and dynamic load models

Prime Movers: Hydraulic turbine and governing systems, steam turbine and governing system

UNIT-IV

Small-signal stability: Fundamentals of stability of dynamic systems, Modal matrices, free motion of dynamic systems, mode shapes, small-signal analysis of SMIB, synchronizing and damping torque analysis, state equations for small-signal model.

Unit V

Sub-Synchronous Oscillations: Turbine-generator torsional characteristics, Torsional interactions with power system controls, Sub-Synchronous Resonance (SSR), counter-measures for SSR

Text Books:

1. P. M. Anderson & A. A. Fouad "Power System Control and Stability", Wiley 7 Sons, 2003
2. P. Kundur, "Power System Stability and Control", McGraw Hill Inc, 1994
3. K R Padiyar,'power system dynamics: stability and control', BS Publications, 2008

Suggested Reading:-

1. J Machowski, J Bialek& J. R W. Bumby, "Power System Dynamics and Stability", John Wiley & Sons, 1997
2. L. Leonard Grigsby (Ed.); "Power System Stability and Control", Second edition, CRC Press,2007

With effect from the academic year 2020-2021

20EEC106 ADVANCED POWER ELECTRONIC CIRCUITS

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 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.

With effect from the academic year 2020-2021

20EEC107 **POWER ELECTRONICS LABORATORY**

Instruction	4 Hours per week
Duration of Semester End Examination	3 Hours
Continuous Internal Evaluation	50 Marks
Credits	2

Course Objectives:

1. To understand the performance of converters for different loads.
2. To know various methods of speed control of electric drives.
3. To identify different topologies of converters and switching methods.

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

1. Demonstrate the effects of different loads on the performance of various phase-controlled converters and choppers.
2. Understand the various topologies and control techniques used in inverters.
3. Acquire the conversion principles of AC-AC converters
4. Analyze different power electronic based speed control techniques of electric drives
5. Utilize matrix converter for different power conversions and analyze resonant converters.

List of Experiments

1. Three-phase half controlled and full controlled bridge rectifiers withR and RL loads.
2. Analysis of chopper circuit.
3. Analysis of single-phase series-resonant inverter.
4. Three-phase Mc-Murray Bed-Ford inverter with R and RL loads.
5. Three-phase IGBT inverter with R & RL loads.
6. Closed-loop control of permanent magnet dc drive.
7. Three-phase step down cyclo-converter with R and RL loads.
8. Static rotor resistance control of slip-ring induction motor.
9. Operation of two quadrant dc drive.
10. Analysis of ZVS buck converter
11. Design and implementation of ZCS buck converter
12. Obtaining different converters using Matrix converter module
13. Speed control of SRIM using static Kramer's system.
14. Speed control of Three phase induction motor using AC-AC converter.
15. Design of a flyback converter for solar energy powered DC loads
16. Analysis of three phase cascaded multi-level inverter.

Note: At least **TEN** experiments should be conducted

With effect from the academic year 2020-2021

20EEC108 **POWER SYSTEMS SIMULATION LAB**

Instruction	4 Hours per week
Continuous Internal Evaluation	50 Marks
Credits	2

Course Objectives:

1. To Simulate and compare the various aspects economic load dispatch and load flows.
2. To Simulate and observe 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
16. Simulation of UPQC for power quality mitigation

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

with effect from the academic year 2020-2021

20EEC109 **MINI PROJECT WITH SEMINAR**

Instruction	4 Hours per week
Semester End Examination	50 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. Course Outcomes: On successful completion of the course students will be able to:

1. **Organise** the literature review to identify and formulate the engineering problem
2. **Design** engineering solutions to simple problems utilizing modern tools and methods
3. **Demonstrate** a sound technical knowledge of their selected mini project topic
4. **Communicate** with engineers and the community to have the conscious of surroundings
5. **Adapt** the skills and attitudes of a Professional Engineer.

III. General Instructions:

1. 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.

2. Each student will be allotted to a faculty supervisor for mentoring.

IV. 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

V. 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.

with effect from the academic year 2020-2021

20EEC110 INDUSTRIAL PROJECT / DISSERTATION PHASE- I

Instruction	20 Hours per week
Semester End Examination	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.

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

1. **State** research questions related to main problem and identify the Research methods
2. **Identify** literature for review.
3. **Integrate** theory and practice.
4. **Apply** knowledge and understanding in relation to the agreed area of study.
5. **Communicate** in written form by integrating, analysing and applying key texts and practices

Guidelines:

1. 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.
2. Seminar should be based on the area in which the candidate has undertaken the dissertation work.
3. The CIE shall include reviews and the preparation of report consisting of a detailed problem statement and a literature review.
4. The preliminary results (if available) of the problem may also be discussed in the report.
5. The work has to be presented in front of the committee consists of Head, Chairperson-BoS, Supervisor and Project coordinator.
6. 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.

Guidelines for the award of Marks: Max. Marks: 100		
Evaluation by	**Max. Marks**	**Evaluation Criteria / Parameter**
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.

With effect from the academic year 2020-21

20EEC111 INDUSTRIAL PROJECT / DISSERTATION PHASE- II

Instruction	32 Hours per week
Semester End Examination	100 Marks
Continuous Internal Evaluation	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.

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

1. **Contribute** to Research and Development work.
2. **Apply** a holistic view to critically, independently and creatively to identify, formulate and deal with complex issues.
3. **Evaluate** critically different engineering/Technological solutions.
4. **Integrate** knowledge critically and systematically
5. **Develop** the ethical aspects of Research work.

Guidelines:

1. It is a continuation of Project work started in semester III.
2. The student has to submit the report in prescribed format and also present a seminar.
3. Develop strong communication skills to defend their work in front of technically qualified audience
4. 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.
5. 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.
6. The candidate has to be in regular contact with his/her guide/co-guide.

Guidelines for awarding marks in CIE:		Max. Marks: 100
Evaluation by	**Max .Marks**	**Evaluation Criteria / Parameter**
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
	10	Report preparation in a standard format

Evaluation by	**Max .Marks**	**Evaluation Criteria / Parameter**
External and Internal	20	Power Point Presentation
	40	Quality of thesis and evaluation
Examiner(s) together	20	Quality of the project 1. Innovations 2. Applications 3. Live Research Projects 4. Scope for future study 5. Application to society
	20	Viva-Voce

With effect from the academic year 2020-2021

Programme Specific Electives

20EEE101 ELECTRIC POWER DISTRIBUTION SYSTEM

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Course Objectives:

1. To study sub-transmission, Distribution substations
2. To understand the philosophy of Distribution Automation and SCADA
3. To explore with the optimization aspects of distribution system

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

1. Acquire knowledge of sub-transmission, Distribution substations
2. Understand Distribution voltage regulation
3. Discuss the Distribution automation and its application in practice
4. Explain the concept of optimization in distribution automation
5. Demonstrate the need and functioning of SCADA system

UNIT-I

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

UNIT-II

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

Secondary Feeders: Secondary voltage levels, Present design practice, Secondary Banking, Economic design of secondaries, Total annual cost equation.

UNIT-III

Distribution voltage regulation: Three-phase balanced and non-three-phase primary lines, analysis distribution and equipment costs, introduction to Distribution system voltage regulation, voltage standards, voltage control, feeder-voltage regulators, line-drop compensation, capacitor automation, voltage fluctuations

UNIT-IV

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

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

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

Text Books:

1. Turan Gonen, Electric Power Distribution System Engineering, CRC Press, 2nd Edition, 2008
2. A.S. Pabla, Electric Power Distribution, Tata McGraw Hill Publishing Co. Ltd., 5th Edition, 2004

Suggested Reading:

1. M.K. Khedkar, G.M. Dhole, A Text Book of Electric power Distribution Automation, University Science Press, New Delhi,2010
2. Anthony J Pansini, Electrical Distribution Engineering, CRC Press, 1992
3. James Momoh, Electric Power Distribution, automation, protection & control, CRC Press, 2007

With effect from the academic year 2020-2021

20EEE102 MATHEMATICAL METHODS FOR POWER ENGINEERING

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 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

With effect from the academic year 2020-2021

20EEE103 RESTRUCTURED POWER SYSTEMS

Instruction	3 Hour per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 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. understand the operation of power system in de-regulated and competitive environment
2. Discuss operation and planning policies, in deregulated environment.
3. Describe the transmission pricing methodologies.
4. Distinguish different ancillary services provided by the ISO
5. Explain 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 Shahidephpour & 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

With effect from the academic year 2020-2021

20EEE107 RENEWABLE ENERGY SOURCES

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 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 of the course, students 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, Distributes 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, Standalone 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" 2nd 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

With effect from the academic year 2020-2021

20EEE109 DIGITAL PROTECTION OF POWER SYSTEM

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Course Objectives:

1. To study the architecture and the required mathematical background for the design and development of digital relays
2. To Explore the basic elements in digital relays and understand various algorithms used in digital protection
3. To understand the application of various algorithms for the digital protection of practical power system.

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. Describe the importance of every element of digital relay
4. Distinguish various mathematical algorithms used for the estimation of power system parameters
5. Explain various algorithms used for the digital protection of power system.

UNIT-I

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

Mathematical Background: Finite difference techniques, Forward, backward and central difference interpolation, Numerical differentiation, Curve fitting and smoothing, Fourier analysis, Walsh function analysis.

UNIT-II

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 relay subsystem filtering concepts of the digital relay as a unit consisting of hardware and software

UNIT-III

Sinusoidal-Wave-Based Algorithms: sample, first, second derivative techniques, two-sample and three-sample techniques, Fourier-analysis-based algorithms, walsh-function-based techniques

UNIT-IV:

Algorithms based on Least Squares and Differential Equation:

Least Squares-based Algorithm: Integral LSQ fitting, Power series LSQ fitting, Multi-variable series LSQ

Differential Equation-based Algorithm: Representation of Transmission line, differential equation protection, simultaneous equation techniques,

UNIT-V:

Digital Protection:

Digital Protection of Transformers: Principles of protection, FIR-filter based algorithms, Least-square curve fitting based algorithms, Fourier-based Algorithms

Digital Protection Transmission Lines: current-based differential Protection, composite voltage and current-based protection schemes

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. Rebizant, Waldemar, Janusz Szafran, and Andrzej Wiszniewski, "Digital signal processing in power system protection and control" Springer, 2011.
2. A.G. Phadke and J. S. Thorp, “Computer Relaying for Power Systems”, Wiley/Research studiesPress, 2009

With effect from the academic year 2020-2021

20EEE110 **POWER QUALITY**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 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 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’, 3rd Edition,Tata McGraw-Hill, 2012.
4. R.Sastry Vedam, M.Sarma, "Power Quality- Var Compensation in Power Systems ", CRC Press, 2009

With effect from the academic year 2020-2021

20EEE114	**SMART GRIDS**
Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 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 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 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 Prizing, 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. JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, “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.

With effect from the academic year 2020-2021

20EEE115 HIGH VOLTAGE ENGINEERING

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 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 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 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.

With effect from the academic year 2020-2021

20EEE104 POWER SEMICONDUCTOR DEVICES AND MODELING

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 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. Understand, the attributes of an ideal switch and its selection for a Specific Power electronic application.
2. Analyze the static and switching characteristics of different current controlled semiconductor devices
3. Analyze the static and switching characteristics of different voltage controlled semiconductor devices and also to differentiate various voltage controlled devices.
4. Design different firing and protection circuits for power semiconductor devices.
5. Select different heat sinks for power semiconductor 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 hear 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.

With effect from the academic year 2020-2021

20EEE105 **ELECTRIC DRIVE SYSTEM**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 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 semi-conductor 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",2nd 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 3rd edition
3. K. Bose,Modern Power Electronics and AC Drives, Prentice Hall publication, 1st edition, 2001.

With effect from the academic year 2020-2021

20EEE106 **HVDC TRANSMISSION**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Course Objectives:
1. To understand 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 Inderscience, 1971.
2. Erich Uhlmann, "Power Transmission by Direct Current", B.S. Publications, 2004.
3. Arrillaga, "High Voltage Direct Transmission", Peter Peregrinus Ltd. London, 1983.

With effect from the academic year 2020-2021

20EEE108 Artificial Intelligence Techniques for Power Systems

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Course Objectives:
1. To understand concepts of Artificial Neural Networks, Fuzzy logic and Meta-heuristic Techniques
2. To acquire the knowledge of optimization techniques and their hybridization with ANN and Fuzzy
3. To learn the intelligent approaches for the Power systems planning and operation

Course Outcomes: After completion of the subject, students will be able to:
1. Understand the various Artificial Intelligent and Meta-heuristic Techniques
2. Classify the techniques according to their method of approach
3. Select the suitable technique for the given power system problem
4. Implement suitable Intelligent technique for the given power system problem
5. Execute any power system planning and operation using Artificial Intelligent Techniques

UNIT-I
Artificial Neural Network (ANN): Biological foundations to intelligent Systems, Difference between Artificial Neuron and Biological Neuron, Activation functions, Basic Models of ANN, Hebb Rule, Training/Learning of NN, Supervised Learning Algorithms: Perceptron, Adaline, Back propagation algorithm, RBF NN, Associative Memory Networks: BAM NN, Hopfield NN, Unsupervised Learning Networks: LVQ algorithm, ART Network.

UNIT-II
Fuzzy Logic: Introduction to Fuzzy logic, Fuzzy sets, Fuzzy relations, Membership Functions, Defuzzification methods, Fuzzy reasoning, Fuzzy Inference System (FIS), Fuzzy Decision Making

UNIT-III
Meta-heuristic Techniques: Introduction, Genetic Algorithm, Particle Swarm Optimization, Differential Evolution, Simulated Annealing, Ant Colony Optimization, Honey Bee Algorithm, Harmony Search algorithm, Teaching-Learning-based algorithm, JAYA Algorithm.

UNIT-IV:
Hybrid System: characteristics, classification, ANFIS, Genetic-Neuro-Hybrid system: Properties, GA-based BPN, Advantages, Genetic-Fuzzy Hybrid Systems: Genetic-Fuzzy Rule based systems

UNIT-V
Applications:
Applications Artificial Intelligence Techniques in power systems for solving Load flow studies, Fault identification and classification, Load frequency Control, Excitation control, Economic Load Dispatch, Optimal Power Flow.

Text Books:
1. S.N.Sivanandam, S.N.Deepa, 'Principles of soft computing techniques', Wiley publications, 2007.
2. Xin-She Yang, "Nature-inspired optimization algorithms", Elsevier Inc., 2008.
3. S.Rajasekaran and G.A.V.Pai, "Neural Networks, Fuzzy Logic & Genetic Algorithms"- PHI, New Delhi, 2010.

Suggested Reading:
1. Haykin, Simon. *Neural networks: a comprehensive foundation*. Prentice-Hall, Inc., 2007.
2. Ross, Timothy J. *Fuzzy logic with engineering applications*. Vol. 2. New York: wiley, 2004.
3. Goldberg, David E. *Genetic algorithms*. Pearson Education India, 2006.
4. Clerc, Maurice. *Particle swarm optimization*. Vol. 93. John Wiley & Sons, 2010.

With effect from the academic year 2020-2021

20EEE111 FACTS AND CUSTOM POWER DEVICES

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Course Objectives:

1. To introduce 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. Distinguish the performance of Transmission line with and without FACTS Devices
2. Compare the SVC and STATCOM
3. Understand the operation and control of various Static Series Compensators
4. Understand the operation and control of Unified Power Flow Controller
5. Distinguish various power quality issues and how are they mitigated by various FACTS Devices

UNIT-I

Reactive Power Flow Control in Power Systems: 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, New York, 1982

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Vikasa Mantras- Vivekananda Institute of Human Excellence

With effect from the academic year 2020-2021

20EEE112 SWITCH MODE & RESONANT CONVERTERS

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 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-1I

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.
3. Switched Mode Power Supplies, Design and Construction, H. W. Whittington, B. W. Flynnand 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.

With effect from the academic year 2020-2021

20EEE113 ENERGY AUDITING AND MANAGEMENT

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 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: 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
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; 2ndedition, 1994

Suggested Reading:

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

With effect from the academic year 2020-21

20EEE116 **ELECTRIC AND HYBRID VEHICLES**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 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 withPractical 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.

With effect from the academic year 2020-21

Open Electives

20CSO 101 **BUSINESS ANALYTICS**

Instruction	3 Hours per week
Duration of End examination	3 Hours
Semester end examinations	60 Marks
Continuous Internal Evaluation	40 Marks
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:

1. To 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, 1st 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/

With Effect from the Academic Year 2020 – 2021

20MEO 101 **INDUSTRIAL SAFETY**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 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. About wear and corrosion along with preventive steps to be taken. The basic concepts and importance of fault tracing.
3. The steps involved in carrying out periodic and preventive maintenance of various equipments used in industry

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

20MEO 102 INTRODUCTION TO OPTIMISATION TECHNIQUES

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 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. Students will understand the Transportation and Assignment techniques. Students will come to know the procedure of Project Management along with CPM and PERT techniques
3. Students will understand the concepts of sequencing

Course Outcomes: At the end of the course, the students were 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

20MEO 103 **COMPOSITE MATERIALS**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Course Objectives: To make the students to learn the

1. Composite materials and their constituents. Classification of the reinforcements and evaluate the behavior of composites.
2. Fabrication methods of metal matrix composites. Manufacturing of Polymer matrix composites.
3. Failure mechanisms in composite materials.

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 play 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"

20CEO 101 COST MANAGEMENT OF ENGINEERING PROJECTS

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Course Objectives:

1. To enable the students to understand the concepts of Project management. To provide knowledge on concepts of Project Planning and scheduling.
2. To create an awareness on Project Monitoring and Cost Analysis. To provide adequate knowledge to the students on Recourse Management Costing-Variance Analysis
3. To train the students with the concepts of Budgetary Control for cost management and to provide basic platform on Quantitative techniques for cost management.

Course Outcomes: At the end of course students will 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:

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)

Suggested Readings:

1. K. K Chitkara, "*Construction Project Management: Planning, scheduling and controlling*", Tata McGraw-Hill Education. (2004).
2. 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.

With effect from the academic year 2020-21

20EEO 101 **WASTE TO ENERGY**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 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. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.

Suggested Readings:

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

With effect from the academic year 2020-21

Audit Courses

20 EG A 101 **ENGLISH FOR RESEARCH PAPER WRITING**

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

Textbook:

1. C. R Kothari, Gaurav, Garg, **Research Methodology Methods and Techniques,** New Age International Publishers. 4th 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, 7th Edition.
3. Lauri Rozakis, Schaum's, **Quick Guide to Writing Great Research Papers**, Tata McGraw Hills Pvt. Ltd, New Delhi.

Online Resources:

NPTEL: https://onlinecourses.nptel.ac.in/noc18_mg13/preview

With effect from the academic year 2020-21

20EGA 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 he 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.

ÜNIT 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

With effect from the academic year 2020-21

20EGA 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 - Nadanusandhana 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
2. https://freevideolectures.com/course/3539/indian-philosophy/11

With effect from the academic year 2020-21

20EGA 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 (dont'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/

With effect from the academic year 2020-21

20ECA 101 **VALUE EDUCATION**

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

Course Objectives:

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.

UNIT IV: 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.

UNIT V: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.

With effect from the academic year 2020-21

20CEA 101 DISASTER MITIGATION AND MANAGEMENT

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

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. To impart knowledge in students about the nature, causes, consequences and mitigation measures of the various natural disasters

2. To enable the students to understand risks, vulnerabilities and human errors associated with human induced disasters. To enable the students to understand and assimilate the impacts of any disaster on the affected area depending on its position/ location, environmental conditions, demographic, etc.

3. To equip the students with the knowledge of the chronological phases ina disaster management cycle and to create awareness about the disaster management framework and legislations in the context of national and global conventions

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
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

With effect from the academic year 2020-21

20IT A101 **PEDAGOGY STUDIES**

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

Course Objectives:

1. To present the basic concepts of design and policies of pedagogy studies. To provide understanding of the abilities and dispositions with regard to teaching techniques, curriculum design and assessment practices.
2. To familiarize various theories of learning and their connection to teaching practice.
3. To create awareness about the practices followed by DFID, other agencies and other researchers. To provide understanding of critical evidence gaps that guides the professional development.

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. Akyeampong K, "Teacher Training in Ghana – does it count? Multisite teacher education research project (MUSTER)", Country Report 1.London: DFID, 2003.
2. Akyeampong 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
2. 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

With effect from the academic year 2020-2021

20EEA101 SANSKRIT FOR TECHNICAL KNOWLEDGE

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

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 pythogorous 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 yanthram

Text Books:

1. M Krishnamachariar, History of Classical Sanskrit Literature, TTD Press, 1937.
2. 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, AuroPublications, ISBN: 978-8170601821, 2017
2. Science in Sanskrit, Samskrita Bharti Publisher, ISBN-13: 978-8187276333, 2007
3. A Treasury of Indian Wisdom: An Anthology of Spiritual Learn, ISBN: 978-0143426158, 2016.

Industrial Project / Internship

Guide lines:

To develop advanced knowledge and specific skills required for industrial development, CBIT is implementing the AICTE internship policy guidelines for ME/MTech students from the academic year 2020-21 onwards. Students may choose Industrial problem as Dissertation topic. The proposed Credit Framework for the same is as follows:

S. No	Schedule	Activities	Duration	Credits
1	Semester - III	Industrial Project /Dissertation Phase 1	20 weeks	10
2	Semester - IV	Industrial Project/Dissertation Phase 2	32 weeks	16

Guidelines:

- ✓ The student should submit a synopsis of the proposed work to be done during the internship Programme/Industrial Project/Dissertation/Industrial Dissertation which is examined or evaluated by the departmental Project Review Committee to ensure that the proposed work is equivalent to ME/MTech dissertation work. This synopsis should be submitted to the department before the candidate is relieved.
- ✓ Student has to submit the information about the commencement of internship to the HOD before the registration of the courses in that semester (i.e III/IV).
- ✓ Two supervisors will monitor the internship/ Industry project work, one from the department and another from industry.
- ✓ Industry/Educational Organization must submit the month-wise attendance of the students to the department.
- ✓ Student should regularly present his/her project progress report to their respective internal supervisor(s)
- ✓ The final project presentation is evaluated on the basis of the recommendation given by external supervisor, and further can be evaluated by the institute supervisor.
- ✓ If the internship project is not found to be of high quality, then the student will have to reappear in the next semester for their ME/MTech dissertation work.
- ✓ The student is required to publish internship work in conferences and journals with due permission/consent from the organization/Industry where he/she has undergone the internship.
- ✓ If the student feels that the internship work is not of high quality/not related to that field of interest, then the student should submit the application to the department HoD within THREE weeks and can re-join the institute.
- ✓ Industry/Institute should allow producing results obtained during project/internship period in the project report. The written certificate to this effect from the industry/institute is mandatory before consideration of the proposed project/internship.