Dr.M.G.R. EDUCATIONAL AND RESEARCH INSTITUTE UNIVERSITY
(Declared U/S 3 of the UGC Act 1956)

ELECTRICAL AND ELECTRONICS ENGINEERING DEPARTMENT

CURRICULUM AND SYLLABUS

2017 REGULATION

Semester: 3

Theory:

Course Code	Course Title	C	L	T/SLr	P/R	Ty / Lb/ ETL
BMA17006	Mathematics III For Electrical Engineers	4	3	1/0	0/0	Ty
BEE17001	DC Machines and Transformers	4	3	1/0	0/0	Ty
BEE17002	Circuit Theory and Network Synthesis	4	3	1/0	0/0	Ty
BEE17003	Electrical and Electronics Measurements	3	3	0/0	0/0	Ty
BME17I03	Thermodynamics and Fluid Mechanics	3	3	0/0	0/0	Ty

Practical:

BEE17ET1	Advancement in Electronics *	3	1	0/2	1/1	ETL
BEE17L01	DC Machines and Transformer Laboratory	1	0	0/0	3/0	Lb
BEE17L02	Electric Circuits Laboratory	1	0	0/0	3/0	Lb
BME17IL2	Fluid Mechanics and IC Engine Laboratory	1	0	0/0	3/0	Lb

Credits Sub Total: 24

Semester: 4
Theory:

Course Code	Course Title	C	L	T/SLr	P/R	Ty / Lb/ ETL
BMA17011	Numerical Methods for Electrical Engineers	4	3	1/0	0/0	Ty
BEE17004	AC and Special Machines	4	3	1/0	0/0	Ty
BEE17005	Electromagnetic Field Theory	4	3	1/0	0/1	Ty
BEE17006	Power System Protection and Switchgear	3	3	0/0	0/0	Ty
BEC17I07	Communication Systems and IOT	3	3	0/0	0/0	Ty

Practical:

BSK17ET1	Soft Skill 1	2	1	0/1	1/0	ETL
BEE17ET2	Linear and Digital Integrated Circuits*	3	1	0/2	1/1	ETL
BEE17L03	Power System Protection and Switchgear Laboratory	1	0	0/0	3/0	Lb
BEE17L04	AC and Special Machines Laboratory	1	0	0/0	3/0	Lb
BEC17IL6	Digital Design Laboratory	1	0	0/0	3/0	Lb
BEE17TS1	Technical Skill 1 (Evaluation)	1	0	0/0	2/0	Lb

Credits Sub Total: 27

Semester: 5

Theory:

Course Code	Course Title	C	L	T/SLr	P/R	Ty / Lb/ ETL
BEE17007	Transmission and Distribution System	4	3	1/0	0/0	Ty
BEE17008	Control Systems	4	3	1/0	0/0	Ty
BEE17009	Power Electronics and FACTS Controllers	3	3	0/0	0/0	Ty
BEE17010	Microprocessor, Microcontroller and ARM Processor	3	3	0/0	0/0	Ty
BEC17I08	Fundamentals of Digital Signal Processing	3	3	0/0	0/0	Ty

Practical:

BEE17ET3	Design of Electrical Machines *	3	1	0/2	1/1	ETL
BEE17L05	Microprocessor, Microcontroller and ARM Processor Laboratory	1	0	0/0	3/0	Lb
BEE17L06	Control and Instrumentation Laboratory	1	0	0/0	3/0	Lb
BEC17IL5	Signal Processing and Communication Laboratory	1	0	0/0	3/0	Lb
BEE17TS2	Technical Skill 2 (Evaluation)	1	0	0/0	2/0	Lb
BEE17L07	Inplant Training (Evaluation)	1	0	0/0	2/0	Lb

Credits Sub Total: 25

Semester: 6

Theory:

Course Code	Course Title	C	L	T/SLr	P/R	Ty / Lb/ ETL
BEE17011	Power System Analysis	4	3	1/0	0/0	Ty
BEE17012	Electric Transients and High Voltage Engineering	3	3	0/0	0/0	Ty
BEE17EXX	Elective 1	3	3	0/0	0/0	Ty
BEI17I02	Industrial Drives and Automation	3	3	0/0	0/0	Ty
BEE17OE1	Open Elective (Interdisciplinary)	3	3	0/0	0/0	Ty

Practical:

BSK17ET2	Soft Skill 2	2	1	0/1	1/0	ETL
BEE17L08	Energy Utilization and Conservation Laboratory	1	0	0/0	3/0	Lb
BEE17L09	Power Electronics and Drives Laboratory	1	0	0/0	3/0	Lb
BEE17L10	Power System Simulation Laboratory	1	0	0/0	3/0	Lb
BEE17L11	Mini Project (Evaluation)	1	0	0/0	0/2	Lb
BEE17TS3	Technical Skill 3 (Evaluation)	1	0	0/1	0/1	Lb

Credits Sub Total: 23

Semester: 7
Theory:

Course Code	Course Title	C	L	T/SLr	P/R	Ty / Lb/ ETL
BEE17013	Microgrid Technology	4	3	0/0	0/1	Ty
BEE17014	Power System Operation , Control & Power Quality	4	3	1/0	0/0	Ty
BEE17EXX	Elective 2	3	3	0/0	0/0	Ty
BEE17EXX	Elective 3	3	3	0/0	0/0	Ty
BMG17002	Management Concepts and Organization Behaviour	3	3	0/0	0/0	Ty

Practical:

BEE17ESX	Elective (Special - Based On Current Technology) *	3	1	0/2	1/1	ETL
BEE17L12	Industrial Automation Laboratory	1	0	0/1	1/1	Lb
BEE17L13	Microgrid Laboratory	1	0	0/0	2/1	Lb
BEE17L14	Project Phase – 1	2	0	0/1	0/1	Lb
BFL17001	Foreign Language (Evaluation)	2	1	0/1	0/0	Ty

Credits Sub Total: 26

Semester: 8
Theory:

Course Code	Course Title	C	L	T/S Lr	P/R	Ty / Lb/ ETL
BEE17EXX	Elective 4	3	3	0/0	0/0	Ty
BEE17EXX	Elective 5	3	3	0/0	0/0	Ty
BMG17005	Entrepreneurship Development	3	3	0/0	0/0	Ty

Practical:

BEE17L15	Project (Phase – II)	10	0	0/0	10	

Credits Sub Total: 19

Credit Summary
Semester : 1 : 18
Semester : 2 : 23
Semester : 3 : 24
Semester : 4 : 27
Semester : 5 : 25

Semester : 6 : 23
Semester : 7 : 26
Semester : 8 : 19

Total Credits : 185

Elective-1						
Course Code	**Course Title**	**C**	**L**	**T/S Lr**	**P/R**	**Ty / Lb/ ETL**
BEE17E01	Solar Energy Conversion Systems	3	3	0/0	0/0	Ty
BEE17E02	Advanced Digital Signal Processing	3	3	0/0	0/0	Ty
BEE17E03	Grid Modernization	3	3	0/0	0/0	Ty

Elective-2						
Course Code	**Course Title**	**C**	**L**	**T/S Lr**	**P/R**	**Ty / Lb/ ETL**
BEE17E04	Wind Energy Conversion Systems	3	3	0/0	0/0	Ty
BEE17E05	Artificial Intelligence	3	3	0/0	0/0	Ty
BEE17E06	Substation Designing	3	3	0/0	0/0	Ty

Elective-3						
Course Code	**Course Title**	**C**	**L**	**T/S Lr**	**P/R**	**Ty / Lb/ ETL**
BEE17E07	Restructuring of Distribution System	3	3	0/0	0/0	Ty

BEE17E08	Material Science in Aviation	3	3	0/0	0/0	Ty
BEE17E09	Electrical Safety for Engineers	3	3	0/0	0/0	Ty

Elective-4						
Course Code	**Course Title**	**C**	**L**	**T/S Lr**	**P/R**	**Ty / Lb/ ETL**
BEE17E10	IOT Applied to Electrical Engineering	3	3	0/0	0/0	Ty
BEE17E11	Robotics and Automation	3	3	0/0	0/0	Ty
BEE17E12	Green Building Technology	3	3	0/0	0/0	Ty

Elective-5						
Course Code	**Course Title**	**C**	**L**	**T/S Lr**	**P/R**	**Ty / Lb/ ETL**
BEE17E13	Electrical Storage Technology	3	3	0/0	0/0	Ty
BEE17E14	Wide Area ,Monitoring Protection and Control	3	3	0/0	0/0	Ty
BEE17E15	Power Plant Instrumentation	3	3	0/0	0/0	Ty

MATHEMATICS III FOR ELECTRICAL ENGINEERS

UNIT I LAPLACE TRANSFORMS **12Hrs**

Transforms of simple functions – Properties of Transforms – Inverse Transforms – Transforms of Derivatives and Integrals

UNIT II APPLICATIONS OF LAPLACE TRANSFORMS **12Hrs**

Periodic functions – Initial and final value theorems – Convolution theorem – Applications of Laplace transforms for solving linear ordinary differential equations up to second order with constant coefficients and Linear simultaneous differential equations of first order with constant coefficients

UNIT III FOURIER SERIES **12Hrs**

Dirichlet's conditions – General Fourier series – Half range Sine & Cosine series – Complex form of Fourier series – Parseval's Identity – Harmonic Analysis

UNIT IV FOURIER TRANSFORMS **12Hrs**

Statement of Fourier integral theorem – Fourier transform pairs – Fourier Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's theorem

UNIT V Z TRANSFORMS AND DIFFERENCE EQUATION **12Hrs**

Z-transforms – Elementary properties – Inverse Z transforms – Partial fraction – Residue method – Convolution theorem – Solution of difference equation using Z transform (simple problems)

Total Number of hours: 60Hrs

Text Books:

Subject Code:	Subject Name : MATHEMATICS III FOR ELECTRICAL ENGINEERS	T / L/ ETL	L	T / S.Lr	P/ R	C
BMA17006	Prerequisite:	T	3	1/0	0/0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To understand the basic concepts in Transformer

COURSE OUTCOMES (COs) : (3- 5)

CO1	To understand the Basic concepts in Laplace Transforms
CO2	To understand the Applications of Laplace Transforms
CO3	To understand the Basic concepts in Fourier series
CO4	To understand the Basic concepts in Fourier Transforms
CO5	To understand the Basic concepts in Z Transforms

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	H	L	L	L	L	L	L	M	L	L	M
CO2	L	H	L	L	L	L	L	L	M	L	L	M
CO3	L	H	L	L	L	L	L	L	M	L	L	M
CO4	L	H	L	L	L	L	L	L	M	L	L	M
CO5	L	H	L	L	L	L	L	L	M	L	L	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	M	M	L	L	L			
CO2	M	M	L	L	L			
CO3	M	M	L	L	L			
CO4	M	M	L	L	L			
CO5	M	M	L	L	L			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

1. Veerarajan T., Engineering Mathematics (for first year), Tata McGraw Hill Publishing Co., (2008)
2. Veerarajan T., Engineering Mathematics (for semester III), Tata McGraw Hill Publishing Co., (2005)
3. Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, (2012)

Reference Books:

1. Kreyszig E., Advanced Engineering Mathematics (9 th ed.), John Wiley & Sons, (2011)
2. Singaravelu, Transforms and Partial Differential Equations, Meenakshi Agency, (2017)

DC MACHINES AND TRANSFORMERS

UNIT I ELECTROMECHANICAL ENERGY CONVERSION 12 Hrs

Principles of electromechanical energy conversion – Energy, Co-energy – Elementary concepts of rotating machines — Rotating magnetic field – generated voltage – Torque – Magnetic Leakage

UNIT II DC GENERATORS 12 Hrs

Constructional features of DC machine – Principle of operation of DC generator – EMF equation – Methods of excitation and types of DC generators – Characteristics of Series, Shunt and Compound DC generators – Armature reaction – Commutation – Methods of improving commutation – Parallel operation of DC shunt and compound generators – Applications

UNIT III DC MOTORS 12 Hrs

Principle of operation of DC motors – Back EMF and its significance – Torque equation – Types of DC motors – Voltage Equation – Characteristics of DC series, shunt and compound motors – Starting of DC motors – Types of starter – Speed control of DC series and shunt motors – Power flow, losses and efficiency –Applications

UNIT IV TRANSFORMERS 12 Hrs

Principle of operation – Constructional features of single phase and three phase shell type and core type transformers –EMF equation –Transformer on No load and Load – Phasor diagram –Parameters referred to HV / LV windings – Equivalent circuit – three phase transformers-connections – Scott Connection-Regulation — Auto transformers – Applications

UNIT V TESTING OF DC MACHINES & TRANSFORMERS 12 Hrs

Losses and efficiency in DC Machines and transformers – Condition for maximum efficiency – Testing of DC machines – Brake test, Swinburne's test, Retardation test and Hopkinson's test – Testing of transformers – Polarity test, load test, open circuit and short circuit tests, Sumpner's test – All day efficiency.

Total Number of hours: 60Hrs

Text Books:

1. Kothari, D.P, Nagrath, I.J.(2005) Electrical Machines,7th Edn, Tata McGraw Hill Publishing Co. Ltd, New Delhi
2. Murugesh Kumar, K. (2003) DC Machines & Transformers. Vikas Publishing House Pvt Ltd

3. Theraja, B.L. Chand, S. (2008) Electrical Technology Volume.II AC /DC Machines

Subject Code: BEE17001	**Subject Name : DC MACHINES AND TRANSFORMERS**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	T	3	1/0	0/0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To provide the knowledge on the basic concepts of the rotating circuits.
- To familiarize and understand the working principle of the DC machines, transformers and their performance characteristics
- To provide knowledge on transformer connections
- To provide knowledge on starting and methods of speed control of motors.
- To study the various losses and different testing methods for DC machines and Transformers

COURSE OUTCOMES (COs) : (3- 5)

CO1	Familiar knowledge on the basic concepts of rotating circuits.
CO2	Understand the performance, starting and methods of speed control of the Electrical machines
CO3	Capable of designing different transformer connections
CO4	Incorporate knowledge on different testing methods for DC machines and Transformers
CO5	Perform model and analyze electrical apparatus and their application in power system

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	H	M	M	M	H	M
CO2	H	H	H	H	H	H	H	M	H	H	H	H
CO3	H	H	H	H	H	H	H	M	H	H	H	H
CO4	H	H	H	H	H	H	H	M	H	H	H	H
CO5	H	H	H	H	H	H	H	M	H	H	H	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	H	H	H	H			
CO2	H	H	H	H	H			
CO3	H	H	H	H	H			
CO4	H	H	H	M	H			
CO5	H	H	H	M	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

Reference Books:

1. Fitzgerald, A.E, Charles Kingsley Jr, Stephen, D. Umans (2003) Electric Machinery. 6th Edn, McGraw Hill Companies
2. Hill Stephen, J. Chapman, (2012) Electric Machinery Fundamentals, 5th Edn, McGraw Hill Companies, New Delhi
3. Bimbhra, P.S. (2003) Electrical Machinery. Khanna Publishers
4. Gupta,.J B. (2015) Theory & Performance of Electrical Machine, S.K. Kataria & Sons
5. Bhag, S.Guru, Hüseyin,R , Hiziroglu (1995) Electric Machinery and Transformers, 2nd Edn, Oxford University Press

CIRCUIT THEORY AND NETWORK SYNTHESIS

UNIT I BASIC CIRCUIT CONCEPTS 12 Hrs

Basic circuit elements-Ideal sources-Ohm's law-Kirchoff's laws-Network reduction: Voltage and Current division, Source transformation-Series and Parallel combination of R,L and C – Mesh and Nodal analysis for D.C and A.C. circuits – Phasor Diagram – Power, Power Factor and Energy-Resonance in series and parallel RLC circuit

UNIT II NETWORK THEOREMS AND COUPLED CIRCUITS 12 Hrs

Network theorems (Analysis of DC and AC Circuits): Thevenin, Norton, Superposition, Maximum power transfer and Reciprocity. Magnetically Coupled Circuits: Inductance, Mutual Inductance, Coupling Coefficient, Coils connected in series and parallel, DOT rule

UNIT III NETWORK TOPOLOGY AND TRANSIENT ANALYSIS 12 Hrs

Graph theory-Branch Nodal Analysis-Link loop Analysis-Tie set and Cut set matrices- Duality. Transients: Behavior of circuit elements under switching conditions and their representation- Forced and free Response of RL, RC, RLC circuits with DC and AC excitations

UNIT IV TWO PORT NETWORKS, FILTERS AND ATTENUATORS 12 Hrs

Characterization of two port networks in terms of Z, Y, H and T parameters-network equivalents-Relation between Network parameters- Analysis of T, Ladder , Bridged T and Lattice Networks.

Classification of filters- filter Networks- Design of Constant k, m derived and composite filters. Attenuators: Analysis of T, ∏ Lattice, bridged T, L type

UNIT V S-DOMAIN ANALYSIS AND NETWORK SYNTHESIS 12 Hrs

S-domain network-driving point and transfer impedances and their properties- transform network analysis -Concept of complex frequency- poles and zeros of network functions- time domain response from pole-zero plot- Reliability of one port network- Hurwitz polynomials - Positive real functions - Synthesis of RL,RC and LC one port networks

Total Number of hours: 60Hrs

Text Books:

1. Sudhakar, A. Shyammohan, S. and Palli (2015) Circuits and Networks:Analysis and Synthesis,5th Edn, Tata McGraw-Hill
2. Smith , K.A. and. Alley, R.E (2014) Electrical Circuits, Cambridge University Press
3. Robert L. Boylestad and Louis Nashelsky (2013) Electronic Devices and Circuit Theory,11th Edn, Pearson Education

Subject Code: BEE17002	Subject Name : CIRCUIT THEORY AND NETWORK SYNTHESIS	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:	T	3	1/0	0/0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To understand the basics of Electric Circuits and its analysis
- To impart knowledge on solving circuits using network theorems
- To impart knowledge on the concepts of resonance in coupled circuits and transient response of circuits
- To understand Network graphs, cut sets and Duality of the network
- To Understand and solving the two port networks, various types of filters and Attenuators

COURSE OUTCOMES (COs) : (3- 5)

CO1	Analyze the Electric circuits
CO2	Apply Circuit theorems in analysing problems in power system
CO3	knowledge about Coupled circuits and Transient Response of Circuits
CO4	Familiarization of Network graphs
CO5	Understand and solving the two port networks

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	H	M	H	M	H	M
CO2	H	H	H	H	H	H	H	M	H	M	H	M
CO3	H	H	H	H	H	H	H	L	H	M	H	L
CO4	H	H	H	M	M	M	H	L	M	H	H	L
CO5	H	H	H	H	M	H	M	L	M	M	H	L

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	H	H	H	H			
CO2	H	H	H	H	H			
CO3	H	H	H	H	H			
CO4	H	H	H	M	H			
CO5	H	H	H	M	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

Reference Books:

1. Hyatt, W.H. Jr and Kimmerly, J.E., Engineering Circuits Analysis, McGraw Hill International
2. Edminister, J.A., Theory and Problems of Electric Circuits, Schaum's Outline series McGraw Hill Book Company
3. Paranjothi S.R.(2000)Electric Circuit Analysis, New Age International Ltd., Delhi, 2nd Edition
4. Van Valkenburg, M.E., Network Analysis, Prentice Hall of India Private Ltd., New Delhi
5. Roy Choudhury ,D (2013) Networks and Systems, New Age International Ltd

ELECTRICAL AND ELECTRONICS MEASUREMENTS

UNIT I INTRODUCTION 9 Hrs

Functional elements of Instrument -Static and Dynamic characteristics -Errors in measurement Statistical evaluation of measurement data -Standard and Calibration

UNIT II ELECTRICAL AND ELECTRONICS INSTRUMENTS 9 Hrs

Principle and types of Analog and Digital ammeters and voltmeters –D'Arsonval Galvanometer-Construction, Torque Equation-Single and three phase Wattmeter and Energy meter - magnetic measurements -Instrument Transformers -Instruments for measurement of frequency and Phase angle

UNIT III METHODS OF MEASUREMENTS 9 Hrs

D.C & A.C potentiometers - D.C & A.C bridges- Transformer ratio bridges- self-balancing bridges– PMMC, moving iron- Electrostatic and Electromagnetic interference –Grounding techniques

UNIT IV TRANSDUCERS AND CONVERTERS 9 Hrs

Classification of transducers – Selection of transducers – Resistive, Capacitive & Inductive Transducers – Piezoelectric, Hall effect- Optical and Digital transducers –A/D and D/A conversion Techniques and its Types

UNIT V STORAGE AND DISPLAY DEVICES 9 Hrs

Magnetic disc and Tape Recorders –Digital plotters and printers - CRT displays - Digital CRO – LED, LCD and Dot matrix displays- Data Loggers.

Total Number of hours: 45Hrs

Text Books:

1. Doebelin, E.O.(1990) Measurement Systems – Application and Design,McGraw Hill Publishing Company
2. Sawhney, A.K.(2016) A course in Electrical and Electronic Measurements and Instrumentation, Dhanpat Rai& Sons
3. Kalsi, H.S. (2010) Electronic Instrumentation, 3rd Edn, Tata McGraw-Hill Education Pvt. Ltd

Reference Books:

1. Robert B Northrop (2005) Introduction to Instrumentation and Measurements, Taylor & Francis
2. Stout, M.B. (1986) Basic Electrical Measurement, Prentice Hall of India

Subject Code: BEE17003	Subject Name : ELECTRICAL & ELECTRONICS MEASUREMENTS	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To understand about Instruments and its Calibration.
- To impart knowledge about various types of analog and digital meters
- To understand the various methods of Measurements
- To understand the about different types of Transducers and Converters
- To understand the various types of Storage and display devices.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Gain knowledge about Instruments and its Calibration
CO2	Ability to understand the usage of meters
CO3	Ability to understand the various methods of Measurements
CO4	Ability to understand the application of transducers and Converters
CO5	Gain knowledge about the Storage and display devices

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	H	M	H	H	H	M
CO2	H	H	H	H	M	H	H	H	M	M	H	M
CO3	H	H	H	H	M	H	H	H	H	H	H	L
CO4	H	H	H	H	H	H	H	H	H	H	H	H
CO5	H	H	H	H	H	H	H	L	H	M	H	L

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	H	H	H	H			
CO2	M	H	H	H	H			
CO3	H	H	H	H	H			
CO4	H	H	H	H	H			
CO5	M	H	H	H	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

3. Dalley, J.W. Riley, W.F. Meconnel, K.G(1993) Instrumentation for Engineering Measurement, John Wiley & Sons
4. Moorthy, D.V.S. (1995) Transducers and Instrumentation., Prentice Hall of India Pvt. Ltd

THERMODYNAMICS AND FLUID MECHANICS

UNIT I BASIC CONCEPTS AND FIRST LAW OF THERMODYNAMICS 9 Hrs

Thermodynamics systems, Concepts of continuum, Thermodynamics properties, Equilibrium, Process, Cycle, Work, Heat, Temperature, Zeroth law of thermodynamics. First law of thermodynamics – Applications to closed and open systems – Steady flow Energy Equations – Simple Problems

UNIT II SECOND LAW OF THERMODYNAMICS 9 Hrs

Statements, Reversibility, Causes of irreversibility, Carnot Cycle, Reversed Carnot Cycle, Heat Engines, Refrigerators, Heat Pumps - Clausius Inequality – Entropy - Principles of increase of entropy - Carnot theorem

UNIT III POWER CYCLES 9 Hrs

Air cycles – Assumptions - Otto, Diesel, Dual and Brayton cycle – Air standard efficiency – Mean effective pressure – Working of two stroke and Four Stroke Petrol and Diesel Engines

UNIT IV FLUID MECHANICS 9 Hrs

Fluid properties; fluid statics, manometer, control-volume analysis of mass, momentum and energy; differential equations of continuity and momentum; Bernoulli's equation; viscous flow of incompressible fluids; boundary layer; elementary turbulent flow; flow through pipes, head losses in pipes, bends etc

UNIT V FLUID MACHINERY 9 Hrs

Introduction, types of pumps – reciprocating pump – centrifugal pump - construction details – working principles, Pelton wheel, Francis and Kaplan turbines – construction and working principles

Total Number of hours: 45Hrs

Text Books:

1. Nag, P.K. Engineering Thermodynamics,2nd Edn, Tata McGraw Hill Publishing Company Ltd.
2. Rajput R.K., Fluid Mechanics and Hydraulic Machines, S.Chand and Co., India

References Books:

1. Holman, J.P. (1995) Thermodynamics, McGraw Hill.

Subject Code: BME17I03	**Subject Name : THERMODYNAMICS AND FLUID MECHANICS**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To understand the basic Laws of Thermodynamics and the working principle of IC Engines.
- To understand the design of Turbines and boilers.
- To understand the properties of Fluids and implementation of Hydraulic machinery & Pumps.
- To know the importance, application and inter relationship of various properties of fluid
- To study about various types of pumps and turbines

COURSE OUTCOMES (COs) : (3- 5)

CO1	knowledge on the basic Laws of Thermodynamics and the working principle of IC Engines
CO2	Capable of selecting the suitable turbines and boilers depending upon the applications
CO3	Incorporating the knowledge gained in operating the Hydraulic machinery & Pumps
CO4	knowledge on properties of different fluids and its applications
CO5	Develop knowledge on the working of different types of pumps and turbines

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	L	M	H	M	H	H
CO2	H	H	H	H	H	H	H	H	H	M	H	M
CO3	H	H	H	H	H	H	L	H	H	M	H	L
CO4	H	H	H	H	H	H	L	L	H	M	H	L
CO5	H	H	H	H	H	H	H	L	H	H	H	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	M	M	H	M	H			
CO2	M	H	H	H	H			
CO3	M	M	M	M	M			
CO4	M	M	M	M	M			
CO5	H	H	H	H	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

2. Yunus A. Cengel, Thermodynamics-An Engineering Approach. ,Tata McGraw Hill.
3. Bansal R.K., A Text Book of Fluid Mechanics and Hydraulic Machines , S.Chand and Co., India

ADVANCEMENT IN ELECTRONICS*

UNIT I SEMICONDUCTOR DIODE **9 Hrs**

Theory of p-n junction – p-n junction as diode – p-n diode currents – Volt-ampere characteristics – Diode resistance – Temperature effect of p-n junction – Zener Diode- VI Characteristic- Zener diode Voltage Regulator- Characteristics of SCR, TRIAC, DIAC and LDR

UNIT II TRANSISTORS **9 Hrs**

Transistor construction – Input and output characteristics of CE, CB and CC configurations – Junction field effect transistor – Pinch off voltage – JFET volt-ampere characteristics – JFET small signal model – MOSFETS and their characteristics—Uni-junction transistor

UNIT III FEEDBACK CIRCUITS **9 Hrs**

Introduction-Principle of Feedback Amplifiers-Negative Feedback Circuits –Types of Negative feedback Circuits-Positive Feedback Circuits: Condition for Oscillations ,Barkhausen criterian-Types of Oscillators: RC phase shift ,Wein Bridge,Crystal,Collpitts,Hartley

UNIT IV FUNDAMENTALS & OVERVIEW OF NANO SCIENCE **9 Hrs**

Fundamental concepts- Basic Structure of Nanoparticles -Nanomaterials- scaling -.Approaches-Tools and Techniques

UNIT V NANO MATERIALS **9 Hrs**

Nanomaterials-properties- Nanostructures: Kinetics in Nanostructured Materials- Zero dimensional, size and shape of nanoparticles; one-dimensional and two dimensional nanostructures- clusters of metals and semiconductors, bionano-particles-Carbon Nanotubes, Fullerenes, Nanowires, Quantum Dots-Applications of nanostructures..

Total Number of hours: 45Hrs

Text Books:

1. Jacob Millman, Christos, C. Halkias, (2010) Electronic Devices and Circuits.3rd Edn,Tata McGraw Hill Publishing Limited
2. David, A. Bell(2003) Electronic Devices and Circuit,,Prentice Hall of India Private Limited
3. Chattopadhyay,P.K,,Banerjee,A.N.(2009) Introduction to Nanoscience and Nanotechnology, Prentice Hall India Learning Private Limited

Subject Code: BEE17ET1	Subject Name: ADVANCEMENT IN ELECTRONICS*	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:	ETL	1	0/2	1/1	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To understand the basics of Electronic devices.
- To gain knowledge about the fundamental devices of different circuits, its characteristics and configurations
- To understand the basics of Feedback Circuits
- To impart knowledge on the fundamental concepts of Nanotechnology
- To develop students to gain knowledge on Nano materials

COURSE OUTCOMES (COs) : (3- 5)

CO1	Knowledge on Electronics devices and design different circuits
CO2	Develop knowledge to incorporate the devices and circuits for different applications
CO3	Capable of designing Oscillators and Amplifiers depending upon the applications.
CO4	Students capable of understand the latest technology
CO5	Students capable to gain knowledge in fabricating Electronic devices and other materials

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	M	M	M	M	M	H	M	H	H
CO2	H	H	H	M	H	H	L	L	H	M	H	L
CO3	H	H	H	M	M	H	M	L	H	M	H	L
CO4	H	H	H	H	H	H	H	M	H	M	H	H
CO5	H	H	H	M	M	H	M	M	H	M	H	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	M	H	H	M	M			
CO2	H	H	H	M	M			
CO3	M	H	H	M	H			
CO4	H	H	H	H	H			
CO5	M	H	H	H	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

References Books:

1. Theodre, F. Boghert,(2003) Electronic Devices & Circuits.6th Ed. Pearson Education
2. Ben G. Streetman, Sanjay Banerjee,(2002) Solid State Electronic Devices. Pearson Education.PHI
3. Allen Mottershead(2003) Electronic Devices and Circuits – An Introduction. New Delhi: Prentice Hall of India Private Limited
4. Manasi Karkare(2008)Nanotechnology: Fundamentals and Applications
5. Fuleka ,M H(2010)Nanotechnology: Importance and Applications, I K International Publishing House Pvt. Ltd

DC MACHINES & TRANSFORMER LABORATORY

LIST OF EXPERIMENTS

1. Open Circuit Characteristics Of DC Shunt Generator
2. Load Characteristics of DC Compound Generator
3. Load test on DC Shunt Motor
4. Load test on DC Series Motor
5. Swinburne's Test
6. Speed control of DC Shunt Motor
7. OC and SC test on Single Phase Transformer
8. Hopkinson's test
9. Load test on Single Phase Transformer
10. Separation Of No Load Losses In Single Phase Transformer
11. Sumpner's Test
12. Three Phase Transformer Connection
13. Scott connections
14. Parallel Operation Of Single Phase Transformer
15. Equivalent circuit of a Transformer
16. Load test on DC Shunt Motor
17. Separation Of Losses In A D.C. Shunt Motor
18. Open Circuit Characteristics Of DC Shunt Generator
19. Speed control of DC Shunt Motor
20. Design of Lap Winding and Wave Winding

Total Number of hours: 45Hrs

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Subject Code: BEE17L01	**Subject Name: DC MACHINES & TRANSFORMER LABORATORY**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	L	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To analyze the Internal and External Load Characteristics for DC Generators and Motors
- To determine the speed control using different methods for DC Motor and Generator
- To find the constant loss and copper loss of DC Machines
- To find the equivalent circuit of transformer
- To determine the efficiency and regulation of DC Machines and transformer

COURSE OUTCOMES (COs) : (3- 5)

CO1	Analyze the Load Characteristics of DC Generators and Motors
CO2	Determine different methods of speed control for DC Machines
CO3	Understand the losses incorporated in DC Machines
CO4	Capable of understand the performance of a Transformer
CO5	Compute the efficiency of a D.C. machine without actually loading it.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	H	M	H	M	H	M
CO2	H	H	H	H	H	H	H	M	H	M	H	M
CO3	H	H	H	H	H	H	H	M	H	M	H	H
CO4	H	H	H	M	M	M	H	M	M	M	H	L
CO5	H	H	H	H	H	H	H	M	H	M	H	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	H	H	M	H			
CO2	H	H	H	M	H			
CO3	H	H	H	M	H			
CO4	M	H	H	H	H			
CO5	H	H	H	M	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					

Approval	

ELECTRIC CIRCUITS LABORATORY

LIST OF EXPERIMENTS

1. Experimental verification of Kirchhoff's voltage and current laws
2. Experimental verification of Current and Voltage Division and Source Transformation
3. Experimental verification of network theorems (Thevenin, Norton, Superposition and maximum power transfer Theorem).
4. Determination of average value, rms value, form factor, peak factor of sinusoidal wave, square wave using hard ware and digital simulation.
5. Verification of Nodal and Mesh Analysis
6. Study of CRO and measurement of sinusoidal voltage, frequency and power factor
7. Experimental determination of time constant of series R-C electric circuits
8. Experimental determination of frequency response of RLC circuits.
9. Design and Simulation of series resonance circuit.
10. Design and Simulation of parallel resonant circuits
11. Design and Simulation of Half wave and Full wave Rectifiers
12. Simulation of three phase balanced and unbalanced star, delta networks circuits
13. Experimental determination of power in three phase circuits by two-watt meter method
14. Calibration of single phase energy meter
15. Determination of two port network parameters
16. Design and Simulation of low pass and high pass passive filters
17. Design and Verification of Attenuators
18. Determination of self, mutual inductance and coefficient of coupling.

.

Total Number of hours: 45Hrs

Subject Code: BEE17L02	Subject Name: ELECTRIC CIRCUITS LABORATORY	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:	L	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To provide practical experience of electrical circuits
- To impart practical knowledge on solving circuits using network theorems
- To develop practical knowledge on the concepts of resonance in coupled circuits and transient response of circuits
- To design the two port networks, various types of filters and Attenuators
- To provide knowledge on the measurement of various parameters in power system

COURSE OUTCOMES (COs) : (3- 5)

CO1	Analyze and solve the Electric circuits
CO2	Knowledge in Circuit theorems and apply in analysing problems in power system
CO3	perform analysis of Coupled circuits and Transient Response of Circuits
CO4	Capable of designing various types of filters and Attenuators
CO5	Understand and apply the concepts in engineering applications

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	H	M	H	M	H	M
CO2	H	H	H	H	H	H	H	M	H	M	H	M
CO3	H	H	H	M	M	M	H	M	H	M	H	L
CO4	H	H	H	H	H	H	H	M	H	M	H	L
CO5	H	H	H	H	H	H	H	H	H	H	H	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	H	H	H	H			
CO2	H	H	H	H	H			
CO3	H	H	H	H	H			
CO4	H	H	H	H	H			
CO5	H	H	H	H	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					
Approval												

FLUID MECHANICS AND IC ENGINE LABORATORY

LIST OF EXPERIMENTS

FLUID MECHANICS

1. Measurement of flow using Orificemeter.
2. Measurement of flow using Venturimeter.
3. Measurement of flow using flow through pipes.
4. Measurement of flow using Flow meter.
5. Performance test on Reciprocating pump.
6. Performance test on Centrifugal pump.

IC ENGINES

7. Valve timing and port timing diagrams for IC Engines.
8. Performance test on a Petrol Engine.
9. Performance test on a Diesel Engine.
10. Heat Balance test on an IC Engine.
11. Boiler – performance and Heat Balance Test.
12. Performance test on a Refrigerator (Determination of COP)

Total Number of hours: 45Hrs

Subject Code: BME17IL2	Subject Name: FLUID MECHANICS & IC ENGINE LABORATORY	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:	L	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To analyze performance of flow using various measuring instruments.
- Providing fair knowledge on the working of various Pumps for testing their performance.
- The graduate will learn the valve timing and port timing diagrams for IC Engines.
- To analyze performance and Heat Balance Test of IC Engines.
- To analyze performance and Heat Balance Test of Refrigerator and boilers.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Analyze the performance of flow using various measuring instruments.
CO2	Gain knowledge on the performance and testing of various pumps
CO3	Gain knowledge on the concepts of timing diagrams for IC Engines
CO4	analyze the performance and testing of IC engines
CO5	Analyze the performance and testing of Refrigerator and boilers.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	M	M	H	M	H	L
CO2	H	H	H	M	H	H	L	L	H	M	H	H
CO3	H	H	H	M	M	H	M	L	H	M	H	L
CO4	H	H	H	H	H	H	H	M	H	M	H	M
CO5	H	H	H	M	M	H	M	M	H	M	H	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	M	M	M	M	H			
CO2	H	M	M	M	H			
CO3	M	M	M	M	H			
CO4	H	M	M	M	M			
CO5	M	H	H	M	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					

Approval	

NUMERICAL METHODS FOR ELECTRICAL ENGINEERS

UNIT I BASICS OF NUMERICAL METHODS **12 Hrs**

Curve fitting-Method of group averages-Principle of least square-Method of moments-Finite differences-Operators (Forward, Backward & Shifting) -Relationship between the operators

UNIT II SYSTEM OF LINEAR EQUATIONS **12 Hrs**

Gauss Elimination method – Gauss-Jordan method – Iterative methods – Gauss-Jacobi method – Gauss-Seidel method – Matrix Inversion by Gauss-Jordan method- Eigen value problem-Power method

UNIT III NON LINEAR EQUATIONS **12 Hrs**

Solution of Algebraic and Transcendental equations – Method of false position -Fixed point iteration method (single and multi variables)- Newton-Raphson method (single and multi variables)

UNIT IV INTERPOLATION **12 Hrs**

Newton forward and backward differences – Central differences – Stirling's and Bessel's formulae – Interpolation with Newton's divided differences – Lagrange's method

UNIT V NUMERICAL DIFFERENTIATION AND INTEGRATION **12 Hrs**

Numerical differentiation with interpolation polynomials – Numerical integration by Trapezoidal and Simpson's (both 1/3 rd & 3/8 th) rules – Two and three point Gaussian Quadrature formulae – Double integrals using Trapezoidal and Simpson's rules

Total Number of hours: 60Hrs

Text Books:

1. Veerarajan T., Numerical Methods, Tata McGraw Hill Publishing Co., (2007)
2. Sastry S.S., Introductory Methods of Numerical Analysis, Prentice Hall of India, (2012)

Reference Books:

1. Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, (2012)

Subject Code:	**Subject Name : NUMERICAL METHODS FOR ELECTRICAL ENGINEERS**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
BMA17011	Prerequisite:	T	3	1	0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To develop the ability in Numerical Skills

COURSE OUTCOMES (COs) : (3- 5)

CO1	To understand the Basic concepts in Numerical Analysis
CO2	To understand the Basic concepts in System of Linear Equations
CO3	To understand the Basic concepts in Non Linear Equations
CO4	To understand the Basic concepts in Interpolation
CO5	To understand the Basic concepts in Numerical Differentiation and Integration

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	H	L	L	L	L	L	L	M	L	L	M
CO2	L	H	L	L	L	L	L	L	M	L	L	M
CO3	L	H	L	L	L	L	L	L	M	L	L	M
CO4	L	H	L	L	L	L	L	L	M	L	L	M
CO5	L	H	L	L	L	L	L	L	M	L	L	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	M	M	L	L	L			
CO2	M	M	L	L	L			
CO3	M	M	L	L	L			
CO4	M	M	L	L	L			
CO5	M	M	L	L	L			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

2. Kandasamy P., Thilagavathy, Gunavathy K., Numerical Methods (Vol.IV), S.Chand & Co., (2008)

AC AND SPECIAL MACHINES

UNIT I SYNCHRONOUS GENERATOR **12 Hrs**

Types & Constructional Features of Synchronous Generators– EMF Equation – Synchronous reactance – Armature reaction – Voltage regulation – EMF, MMF and ZPF methods – Change of excitation and mechanical input

UNIT II SYNCHRONOUS MOTOR **12 Hrs**

Principle of operation – Construction – Equivalent Circuit and phasor diagram – Power and Torque – Power flow – Power developed by synchronous motors – Speed-Torque characteristics – Effect of change in excitation – V curves and inverted V curves – Hunting & suppression

UNIT III THREE PHASE INDUCTION MOTOR **12 Hrs**

Construction – Types of rotors – Cage and wound rotor machines – Principle of operation – Production of rotating magnetic field – Equivalent circuit – Torque and Power output – Torque-slip characteristics – Condition for maximum efficiency – Testing – Load Test – No load and Blocked rotor test – Circle diagram

UNIT IV STARTING & SPEED CONTROL OF INDUCTION MOTORS **12 Hrs**

Necessity for Starters – Starting methods of three phase induction motor – Types of Starters – Stator resistance and reactance – Rotor resistance starter- **s**tar-delta starter – Cogging & Crawling – Speed control – Voltage control –Rotor resistance control

UNIT V SPECIAL MACHINE **12 Hrs**

Single phase induction motor – Constructional details – Double revolving field theory – Equivalent circuit –Speed-torque characteristics – Starting methods – Split-phase motor - shaded-pole induction motor – Universal motor – Variable Reluctance motor, Switched Reluctance Motor, Stepper Motor, Permanent Magnet Motors

Total Number of hours: 60Hrs

Text Books:

1. Nagrath, I.J. Kothari, D.P. (2005) Electric Machines.7th Ed. New Delhi: T.M.H publishing CoLtd
2. Bhimbhra, P.S. (2003) Electrical Machinery. Khanna Publishers

Reference Books:

1. Fitzgerald,Kingsley, Umans, (1990) Electric Machinery. 5th Ed. New Delhi: McGraw Hill Books

2. Stephen J. Chapman, (1985) Electric Machinery Fundamentals. New Delhi : McGraw Hill Book

Subject Code: BEE17004	**Subject Name: AC & SPECIAL MACHINES**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	L	3	1/0	0/0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- Understands the construction and operation of Synchronous generator
- Acquires Knowledge about synchronous motors used in the Power system
- Able to learn about three phase induction motor and to draw the circle diagram of Induction machine
- Gains knowledge in starting and speed control of three phase induction motor
- Understand the concepts of various special machines involved in the power system network

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understand the concepts of synchronous generator
CO2	Capable knowledge about synchronous motors and its performance characteristics
CO3	Can draw the circle diagram of Induction machine
CO4	Knowledgeable in starting and speed control of three phase induction motor
CO5	Acquire knowledge in special electrical machines

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	H	M	H	M	H	H
CO2	M	M	M	M	M	M	M	M	M	L	H	L
CO3	H	H	H	H	H	H	H	M	M	M	H	L
CO4	M	M	M	M	M	M	M	M	M	M	M	H
CO5	H	H	H	H	H	H	H	M	H	M	H	L

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	H	H	H	H			
CO2	H	H	H	H	H			
CO3	H	H	H	H	H			
CO4	H	H	H	H	H			
CO5	H	H	H	H	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

3. Say, M.G. (1980) Alternating current Machines.4th Ed. ELBS & Pitman. London
4. Sen, S.K. (1984) Electrical Machinery. New Delhi: Khanna Publishers

ELECTROMAGNETIC FIELD THEORY

UNIT I ELECTROSTATIC FIELD **12 Hrs**

Introduction - Concepts of different co-ordinate systems – Electric field intensity – Electric flux density -electric fields due to charge distributions – Electric potential – potential gradient - Gauss law & Coulomb's law with Application –Poisson's and Laplace equations

UNIT II ELECTROSTATICS **12 Hrs**

Field due to dipoles – Dipole moment – Current and Current density Boundary conditions at dielectric and conductor surfaces – Capacitor - Capacitance– Energy stored and energy density – Capacitance due to Spherical shell, Coaxial cable– Electrostatic potential energy

UNIT III MAGNETOSTATICS **12 Hrs**

Introduction to Magnetic materials- Magnetic field intensity- Magnetic flux density (B) – B in free space, conductor, magnetic materials. Magnetization and Permeability – Boundary conditions- Lorentz Law of force,– Biot-Savart Law – Ampere's Law –Magnetic field due to straight conductors, circular loop, infinite sheet of current – Scalar and vector potential – Magnetic force – Torque – Inductance – Energy density – Magnetic circuits

UNIT IV ELECTRODYNAMIC FIELDS **12Hrs**

Faraday's law, induced EMF – transformer and motional EMF, Maxwell's equations (differential and integral forms)- Displacement current – Applications - Relation between field theory and circuit theory

UNIT V ELECTROMAGNETIC FIELDS AND WAVE PROPAGATION **12Hrs**

Generation – electromagnetic wave equations – Wave parameters- velocity, intrinsic impedance, propagation constant – Wave propagation in free space, loss and lossless dielectrics, conductors – skin depth, Poynting vector – Plane wave reflection and refraction

Total Number of hours: 60Hrs

Text Books:

1. William Hayt, (2005) Engineering Electromagnetics.7th Edn,McGraw Hill

2. Matthew. N.O. Sadiku,(2007) Elements of Electromagnetics.4th Edn, ,Oxford University Press
3. Ashutosh Pramanik,(2006)Electromagnetism – theory and application,Prentice Hall of India Private Ltd

Subject Code: BEE17005	**Subject Name: ELECTROMAGNETIC FIELD THEORY**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	L	3	1/0	0/1	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To acquire knowledge in Electromagnetic field theory
- To provide a solid foundation in Electrostatics such as Dipole, Capacitance
- To attain familiarity in Boundary conditions and Magnetic field
- To understand the relation between field theory and circuit theory
- To identify the electromagnetic wave propagation in medium

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understand the fundamentals in Electromagnetic field theory
CO2	Foundation in Electrostatics such as Dipole, Capacitance
CO3	Familiarity in Boundary conditions and Magnetic field
CO4	Understand the relation between field theory and circuit theory
CO5	Determine the electromagnetic wave propagation in medium

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	H	M	H	M	H	M
CO2	H	M	H	M	M	M	M	M	H	M	H	M
CO3	H	H	H	H	H	H	H	M	H	M	H	M
CO4	M	M	M	M	M	M	M	L	M	M	M	L
CO5	H	H	H	H	H	H	H	M	H	M	H	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	H	H	H	H			
CO2	H	H	H	H	H			
CO3	M	M	M	M	M			
CO4	M	H	H	H	H			
CO5	H	M	M	M	L			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								

Approval	

Reference Books:

1. David K. Cheng, (2004) Field and Wave Electromagnetics,2nd Edn, Pearson Education
2. William H. Hayt Jr, John A. Buck, (2006) Engineering Electromagnetics,7th Edn,Tata McGraw Hill Publishing Company Ltd
3. Edminister, J.A. Schaum's, (2006) Theory and problems of Electromagnetics,2nd Edn,Special Indian Edition, Tata McGraw hill

POWER SYSTEM PROTECTION AND SWITCHGEAR

UNIT I SCHEMES OF PROTECTION **9 Hrs**

Need and principles of protection – Nature, Causes and Consequences of faults - symmetrical components and fault calculation – Methods of Neutral grounding – Zones of protection and essential qualities of protection – Protection schemes – Protection against overvoltages

UNIT II RELAYS **9 Hrs**

Operating Principles of relays - Common relay terms - Universal Torque Equation.– Electromagnetic relays, Induction relays – Over current relays - Directional, Distance, Differential and negative sequence relays

UNIT III APPARATUS PROTECTION **9 Hrs**

Generator Protection - Motor protection - Bus bar protection and Transmission line and Feeder protection - CT and PT protection

UNIT IV STATIC AND NUMERICAL RELAYS **9 Hrs**

Static relays - **c**omponents of static relays – over current relays, differential protection and distance protection – Microprocessor based relays - Block diagram of Numerical relays

UNIT V CIRCUIT BREAKERS **9 Hrs**

Arc phenomena – arc interruption – Current zero interruption theories – recovery voltage and restriking voltage - RRRV – current chopping – Resistance switching- Various types of circuit breakers – selection and Testing of circuit breakers – Fuses – HRC fuses

Total Number of hours: 45Hrs

Text books:

1. Ravindranath, B. and Chander, N. (1997) Power System Protection and Switchgear, Wiley
2. Chakrabarti, A. Soni, M.L.Gupta, P.V. Bhatnagar, U.S. (2002) A Text Book on Power System Engineering. Dhanpat Rai & Co. Pvt. Ltd

Reference Books:

1. Patra, S.P. Basu, S.K. and Chowduri, S. (1983) Power systems Protection. Oxford and IBH
2. Sunil S. Rao, (1986) Switchgear and Protection. New Delhi: Khanna Publishers

Subject Code: BEE17006	Subject Name: POWER SYSTEM PROTECTION AND SWITCHGEAR	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:	L	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To impart knowledge on faults, lightning and switching surges occurring in the power system network
- To introduce the concepts of different types relays and its functioning
- To educate about the different protection schemes of apparatus.
- To acquire knowledge on static and numerical relays
- To educate about the circuit breakers

COURSE OUTCOMES (COs) : (3- 5)

CO1	Can able to analyze about the different types of faults
CO2	Analyse the relays and circuit breakers
CO3	Familiar to different protection schemes of apparatus.
CO4	Knowledge on static and numerical relays
CO5	Acquire knowledge on circuit breakers

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	M	H	H	H	M	H	M	H	M
CO2	H	H	H	H	H	H	H	M	H	M	H	H
CO3	H	H	H	H	H	H	H	M	H	M	H	L
CO4	H	H	H	H	H	H	H	M	H	M	H	H
CO5	H	H	H	H	H	H	H	M	H	M	H	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	H	H	H	H			
CO2	H	H	H	H	H			
CO3	H	H	H	H	H			
CO4	H	H	H	H	H			
CO5	H	H	H	H	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								

Approval	

COMMUNICATION SYSTEMS & IOT

UNIT I SIGNALS & NOISE **9 Hrs**

Periodic & Aperiodic Signals – Noise - External Noise – Thermal Agitation – Shot Noise – Noise Figure – Signal to Noise ratio – Equivalent Noise resistance

UNIT II INTRODUCTION TO COMMUNICATION **9 Hrs**

Basic Communication systems – Need for Modulation in communication systems – Amplitude Modulation – Double Side Band amplitude Modulation – Single sideband and VSB modulation – modulators. AM Transmitter and Receiver, FM transmitter and Receiver

UNIT III MODULATION TECHNIQUES AND PULSE MODULATION **9 Hrs**

Phase modulation – Noise triangle – Pre-emphasis and de-emphasis – Stereophonic FM multiplex system – comparison of wideband and narrow band FM – AFC – Sampling theorem –Quantization, Quantization Error, PAM, PWM, PPM, PCM

UNIT IV DIGITAL MODULATION & INFORMATION THEORY **9 Hrs**

ASK, FSK, PSK, Transmitter and Receiver. Introduction-Information & Entropy, Source Coding Theory, Discrete Memory less Channel, Mutual Information Channel Capacity, Channel Coding Theory

UNIT V INTERNET OF THINGS **9 Hrs**

Introduction – Block diagram of IoT- IoT Architecture – Communication Technologies in IoT – Cloud Storage in IoT-Data Storage in IoT – Applications of IoT – Smart Home, Smart City, Smart Agriculture, Health Monitoring System

Total Number of hours: 45Hrs

Text Books:

1. Roy Blake, (2002) Electronic Communication systems. 2nd Edn,Thomson Learning
2. George Kennedy, (1992) Electronic communication systems,Tata McGraw Hill publications
3. Michael Miller,(2015) The Internet of Things, Que Publishing

Reference Books:

1. Bruce Carlson,A.Taub & Schilling,(1986) Principles of Communication Systems,Tata McGraw
2. Simon Haykins, (2001) Principles of Communications,Prentice Hall of India
3. Arshdeep Bahga,Vijay Madisetti(2015)Internet of Things – A hands-on approach, Universities Press

Subject Code: BEC17I07	**Subject Name: COMMUNICATION SYSTEMS & IOT**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	L	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To understand the Analog & Digital Communication.
- To study about the methods to convert Analog to Digital communication using code theory.
- To study about different modulation techniques
- To introduce various media for digital communication
- To apply the concept of Internet of Things in the real world scenario

COURSE OUTCOMES (COs) : (3- 5)

CO1	Capable of understanding the concepts of Analog and Digital communication circuits
CO2	Gain knowledge about the Communication conversion methods
CO3	Gain knowledge about the different concepts of modulation techniques
CO4	Develop knowledge about the various digital communication media
CO5	Understand and incorporate the concepts of IOT in different fields.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	H	H	H	H	H	H
CO2	H	H	H	H	H	H	H	H	H	H	H	H
CO3	H	H	H	H	H	H	H	H	H	H	H	H
CO4	H	H	H	H	H	H	H	H	H	H	H	H
CO5	H	H	H	H	H	H	H	H	H	H	H	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	L	H	H	H	H			
CO2	L	H	H	H	H			
CO3	H	H	H	H	H			
CO4	L	H	H	H	H			
CO5	M	H	H	H	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								

Approval	

SOFT SKILLS I

UNIT I **6 Hrs**

Creation of awareness of top companies / improving skill set matrix / Development of positive frame of mind / Creation of self-awareness

UNIT II **6 Hrs**

Group discussions / Do's and don'ts – handling group discussions / what evaluators look for interpersonal relationships / Preparation of Curriculum Vitae / Resume

UNIT III **6 Hrs**

Interview – awareness of facing questions – Do's and don'ts of personal interview / group interview, enabling students to prepare for different proce3dures such as HR interviews and Technical Interviews / self-introductions

UNIT IV **6 Hrs**

Verbal aptitude, Reading comprehension / narration / presentation / Mock Interviews

UNIT V **6 Hrs**

Practical session on Group Discussion and written tests on vocabulary and reading comprehension

Total Number of Hours: 30 Hrs

Subject Code: BSK17ET1	**Subject Name :SOFT SKILLS – I CAREER & CONFIDENCE BUILDING**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite: None	ETL	1	0/1	1/0	2

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To create awareness in students, various top companies helping them improve their skill set matrix, leading to develop a positive frame of mind.
- To help students be aware of various techniques of candidate recruitment and help them prepare CV's and resume.
- To help student how to face various types of interview, preparing for HR, technical interviews.
- To help students improve their verbal reading, narration and presentation skills by performs various mock sessions.

COURSE OUTCOMES (COs) : (3- 5)

Students will be able to

CO1	Be aware of various top companies leading to improvement in skills amongst them.
CO2	Be aware of various candidate recruitment techniques like group discussion, interviews and be able to prepare CV's and resumes.
CO3	Prepare for different types of interviews and be prepared for HR and technical interviews.
CO4	Improve their verbal, written and other skills by performing mock sessions.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	L	L	L	L	M	M	H	M	H	M	H
CO2	L	L	L	L	L	M	M	H	M	H	M	H
CO3	L	L	L	L	L	M	M	H	M	H	M	H
CO4	L	L	L	L	L	M	M	H	M	H	M	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	L	L	H	L	L			
CO2	L	L	H	L	L			
CO3	L	L	H	L	L			
CO4	L	L	H	L	L			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			

			✓						✓			
Approval												

LINEAR AND DIGITAL INTEGRATED CIRCUITS*

UNIT I IC FABRICATION **9 Hrs**

IC classification, fundamental of monolithic IC technology, epitaxial growth, masking and etching, diffusion of impurities - Realization of monolithic ICs and packaging - Fabrication of diodes, capacitance, resistance and FETs

UNIT II CHARACTERISTICS AND APPLICATIONS OF OP AMP **9 Hrs**

Ideal OP-AMP characteristics, offset voltage and current, differential amplifier; frequency response of OP-AMP; Basic applications of op-amp – summer, differentiator and integrator - Instrumentation amplifier, comparators, multivibrators, waveform generators, clippers, clampers, peak detector, S/H circuit

UNIT III SPECIAL IC'S **9 Hrs**

555 Timer circuit – Functional block, characteristics & applications; 566-voltage controlled oscillator circuit; 565-phase lock loop circuit functioning and applications, Analog multiplier ICs

UNIT IV BOOLEAN ALGEBRA **9 Hrs**

Deriving a Boolean equation from truth table-simplification of Boolean functions using K-map & Quine Mc Cluskey method, Implementation of a Boolean function using Logic gates and universal gates

UNIT V COMBINATIONAL CIRCUITS AND SEQUENTIAL CIRCUITS **9 Hrs**

Design of adder, subtractor, comparators, code converters, encoders, decoders, multiplexers and de-multiplexers- Function realization multiplexers - Latches-Flip flops - Mealy and Moore Models- Design of Shift Registers and counters(Synchronous and Asynchronous Sequential Circuits) - Hazards

Total Number of hours: 45Hrs

Text Books:

1. Ramakant, A. Gayakward, (2003)Op-amps and Linear Integrated Circuits,6th Edn,Pearson Education P
2. Roy Choudhary, D. Sheil B. Jani, (2003) Linear Integrated Circuits,2nd Edn, New Age
3. Morris Mano, M. (2002) Digital Logic and Computer Design,Prentice Hall of India

Reference Books:

Subject Code: BEE17ET2	**Subject Name: LINEAR AND DIGITAL INTEGRATED CIRCUITS***	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	ETL	1	0/2	1/1	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To study the IC fabrication procedure.
- To study characteristics, realize circuits and design for signal analysis using Op-amp ICs.
- To study internal functional blocks and the applications of special ICs like Timers, PLL circuits, regulator Circuits, ADC
- Familiarity of different types of gates using truth table with logic circuits.
- Familiarity to use logic gates in sequential and combinational circuits.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Capable of understanding the concepts of IC fabrication
CO2	Realization of Circuits using Op-amps
CO3	knowledge about Special IC's and apply in designing logic circuits
CO4	knowledge about the basic gates
CO5	Capable to design logic Circuits using gates

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	H	M	H	M	H	M
CO2	H	H	H	H	H	H	H	M	H	M	H	M
CO3	H	H	H	H	H	H	H	M	H	M	H	L
CO4	H	H	H	H	H	H	H	M	H	M	H	L
CO5	H	H	H	H	H	H	H	M	H	M	H	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	M	H	M	M	H			
CO2	M	H	M	M	H			
CO3	M	H	M	M	H			
CO4	L	H	M	M	H			
CO5	L	H	M	M	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					
Approval												

1. Jacob Milman, Christos C. Halkias, (2003)Integrated Electronics - Analog and Digital circuits system, Tata McGraw Hill
2. Robert F. Coughlin, Fredrick F. Driscoll, (2002)Op-amp and Linear ICs. 4th Edn,Pearson Education/ PHI
3. Charles H. Roth, (2002) Fundamentals Logic Design, 4th Edn, Jaico Publishing
4. Floyd,(2003) Digital Fundamentals, 8th Edn, Pearson Education
5. John F. Wakerly, (2002) Digital Design Principles and Practice,3rd Edn,Pearson Education

POWER SYSTEM PROTECTION AND SWITCHGEAR LABORATORY

LIST OF EXPERIMENTS

1. To draw the operating characteristics of IDMT relay.
2. To study the performance of an over voltage relay.
3. To study the performance of under voltage relay.
4. To study the performance of Earth fault relay.
5. To perform inter turn protection of transformer.
6. Testing of breakdown strength of transformer oil.
7. To study flash point test of transformer oil.
8. To study characteristics of MCB & HRC Fuse.
9. To study radial feeder performance when a) fed at one end b) fed at both ends
10. To simulate the SLG fault in a power system network
11. To simulate the DLG fault in a power system network
12. To simulate the earth fault in a power system network

Total Number of hours: 45Hrs

Subject Code: BEE17LO3	Subject Name: POWER SYSTEM PROTECTION AND SWITCHGEAR LABORATORY	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:	L	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To understand operating characteristics of IDMT relay
- To perform performance of an over and under voltage relay
- To study the characteristics of MCB & HRC Fuse
- To perform the simulation for SLG and DLG fault in a power system network
- To perform the testing of breakdown strength of transformer oil.
-

COURSE OUTCOMES (COs) : (3- 5)

CO1	Capable of understand the operating characteristics of IDMT relay
CO2	Obtain the performance of an over and under voltage relay
CO3	Gain the knowledge of MCB & HRC Fuse characteristics
CO4	Understand the simulation concepts for SLG and DLG fault in a power system network
CO5	Familiar to the testing of breakdown strength of transformer oil.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PLO9	PO10	PO11	PO12
CO1	H	H	H	H	M	M	M	L	L	M	H	L
CO2	H	H	H	H	M	M	M	L	L	M	H	L
CO3	H	H	H	H	M	M	M	L	L	M	H	L
CO4	H	H	H	H	M	M	M	L	L	M	H	L
CO5	H	H	H	H	M	M	M	L	L	M	H	L

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	H	H	H	H			
CO2	H	H	H	H	H			
CO3	H	H	H	H	H			
C04	H	H	H	H	H			
CO5	H	H	H	H	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					
Approval												

AC AND SPECIAL MACHINES LABORATORY

LIST OF EXPERIMENTS

1. Regulation of Three Phase Alternator By EMF and MMF Methods
2. Regulation of Three Phase Alternator By ZPF and ASA Methods
3. Regulation of Salient pole Alternator- Slip Test
4. Load Test on Three Phase Alternator
5. Synchronizing and Parallel operation of Alternators
6. Performance Characteristics Of Synchronous Motor (V And Inverted V Curve) And Simulation Using Matlab/Labview
7. Load Test on Three Phase Induction Motor And Simulation Using Matlab
8. No load and blocked rotor test on three-phase induction motor
9. Load Test on Single Phase Induction Motor And Simulation Using Matlab
10. Speed Control of Three Phase Induction Motor And Simulation Using Matlab
11. Separation of losses in Three Phase Induction Motor
12. Equivalent circuit and pre-determination of performance characteristics of Single- Phase Induction Motor
13. Determination of Basic Step Angle Measurement Of Stepper Motor
14. Speed and Direction Control Of Stepper Motor
15. Determination of the Characteristics Of Repulsion Motor
16. Determination of the Characteristics of Universal Motor and simulation using Matlab/Labview
17. Speed Control of BLDC Motor Using Dsp28335 And Simulation Using Matlab

18. Speed Control of SR Motor Using FPGA Spartan6

Subject Code: BEE17L04	**Subject Name: AC & SPECIAL MACHINES LABORATORY**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	L	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To analyze the Load Characteristics of Synchronous machines
- To find Voltage Regulation of Synchronous machines.
- To study the effect of frequency and voltage control action of Three phase induction machines.
- To be familiar with the equivalent circuit of single phase induction machines.
- To study the Performance Characteristics of Special Machines

COURSE OUTCOMES (COs) : (3- 5)

CO1	Determine the characteristics of transformers and induction motors.
CO2	Understand the basic knowledge of alternators
CO3	Analyze the effect of frequency and voltage control action of Three phase induction machines.
CO4	familiar with the equivalent circuit of single phase induction machines
CO5	Analyze the Performance Characteristics of Special Machines

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	H	M	H	M	H	H
CO2	M	M	M	M	M	M	M	M	M	L	H	L
CO3	H	H	H	H	H	H	H	M	M	M	H	H
CO4	M	M	M	M	M	M	M	M	M	M	M	H
CO5	H	H	H	H	H	H	H	M	H	M	H	L

Cos / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	H	H	H	H			
CO2	H	H	H	H	H			
CO3	H	H	H	H	H			
CO4	H	H	H	H	H			
CO5	H	H	H	H	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			

							✓					
Approval												

Total Number of hours: 45Hrs

DIGITAL DESIGN LABORATORY

LIST OF EXPERIMENTS

1. Study of Logic Gates & Digital Logic families
2. Implementation of Boolean functions
3. Adders & Subtractors
4. Multiplexers and de-multiplexers
5. Study of Flip-flops
6. Study of Registers
7. Study of Counters
8. Implementation of any general combinational / sequential logic circuits
9. Design and testing of following circuits using Verilog HDL
    (a) Half Adder & Full Adder
    (b) Half Subtractor & Full Subtractor
    (c) Multiplexers and de-multiplexers
    (d) Counters
    (e) Magnitude Comparators
    (f) Registers

Total Number of hours: 45Hrs

Subject Code: BEC17IL6	**Subject Name: DIGITAL DESIGN LABORATORY**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	L	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To know the basic knowledge of logic gates
- Design knowledge on implementation of Boolean Function
- Students able to design Counters, Registers using flip-flops
- Students acquire knowledge in programming of verilog HDL
- To study about multiplexers and demultiplexers

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understand the basic concepts of logic gates
CO2	Familiarization to the Design and implementation of Boolean Function
CO3	Understand about Counters, Registers using flip-flops
CO4	Understand the concepts in programming of verilog HDL
CO5	Capable to understand about multiplexers and demultiplexers

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	M	M	M	L	M	M	M	L
CO2	M	M	M	M	M	M	M	L	M	M	M	L
CO3	H	H	H	M	M	M	M	L	M	M	M	L
CO4	H	H	M	M	M	M	M	L	M	M	M	L
CO5	M	M	M	M	M	M	M	L	M	M	M	L

Cos / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	H	L	L	L	H		
CO2	H	L	L	L	H		
CO3	H	L	L	L	H		
CO4	H	L	L	L	H		
CO5	H	L	L	L	H		

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					
Approval												

TRANSMISSION & DISTRIBUTION SYSTEM

UNIT I INTRODUCTION **12 Hrs**

Structure of electric power system - different operating voltages of generation, transmission and distribution – advantage of higher operating voltage for AC transmission – Comparison between EHVAC & HVDC transmission

Mechanical design of transmission line between towers – sags and tension calculations with the effect of ice and wind

UNIT II TRANSMISSION LINE PARAMETERS **12 Hrs**

Parameters of Resistance, Inductance and Capacitance calculations - Single and three phase transmission lines - Single and Double circuits - Solid, Stranded and Bundled Conductors - Symmetrical and Unsymmetrical Spacing – Transposition of Lines - Concepts of GMR and GMD - Skin and Proximity Effects

UNIT III MODELLING AND PERFORMANCE OF TRANSMISSION LINES **12Hrs**

Classification of lines – short line, medium line and long line – equivalent circuits, phasor diagram, attenuation constant, phase constant, surge impedance; transmission efficiency and voltage regulation, real and reactive power flow in lines, Power – circle diagrams, surge impedance loading, methods of voltage control; Ferranti effect

Subject Code: BEE17007	Subject Name: TRANSMISSION AND DISTRIBUTION SYSTEM	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:	T	3	1/0	0/0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

Subject Code: BEE17 TSX	Subject Name : TECHNICAL SKILL 1	T / L/ ETL	L	T / S.Lr	P/ R	C
		0	0	0	1	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : The objective is to develop the technical skill of the students

COURSE OUTCOMES (COs) : (3- 5)

CO1	Develop the technical skills required in the field of study.
CO2	Bridge the gap between the skill requirements of the employer or industry and the competency of the students.
CO3	Enhance the employability of the students.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	M	M	H	M	H	M
CO2	H	H	M	H	H	H	M	M	H	H	H	H
CO3	H	H	H	H	H	M	H	L	L	M	M	M
CO4	H	H	H	H	H	M	H	L	L	M	L	L
CO5	H	H	H	H	H	H	H	L	L	M	M	L
	H	H	H	H	H	H	H	L	L	M	M	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	H	H	M
CO2	H	H	H	H	H
CO3	H	H	H	H	H
CO4	H	H	H	H	H
CO5	H	H	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L- Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

UNIT IV INSULATORS AND CABLES **12 Hrs**

Classification of insulators – voltage distribution in insulator string - improvement of string efficiency - Underground cables - Types of cables, Capacitance of Single-core cable, Grading of cables, Power factor and heating of cables, Capacitance of 3- core belted cable, D.C cables

UNIT V DISTRIBUTION SYSTEM AND SUBSTATIONS 12 Hrs

Feeders, distributors and service mains – DC distributor – 2-wire and 3-wire, radial and ring main distribution - AC distribution – single phase and three phase 4-wire distribution – Substation - Classification, functions and major components - sample substation layout

Total Number of hours: 60Hrs

Text Books:

1. V. K. Mehta, "Principles of Power Systems" , S. Chand, New Delhi, 2005
2. S.N. Singh, 'Electric Power Generation, Transmission and Distribution', Prentice Hall of India Pvt. Ltd, New Delhi, 2002

Reference Books:

1. Luces M. Fualkenberry, Walter Coffer, 'Electrical Power Distribution and Transmission', Pearson Education, 1996
2. Central Electricity Authority (CEA), 'Guidelines for Transmission System Planning', New Delhi

CONTROL SYSTEMS

UNIT I INTRODUCTION AND CONTROL SYSTEMS COMPONENTS 12 Hrs

Open loop-closed loop control-mathematical models of physical systems-differential equations-transfer function-armature control-field control-block diagram reduction-signal flow graphs - Control system components-DC servomotors-AC servomotor--synchronous-stepper motor

UNIT II TIME RESPONSE ANALYSIS 12 Hrs

Standard test signals-time response of first order - second order systems-steady state errors and error constant

UNIT III FREQUENCY RESPONSE AND CONCEPT OF STABILITY 12 Hrs

Bode plot, polar plot, Nyquist stability- Concept of stability-necessary conditions- Hurwitz stability criterion- Routh stability criterion-relative stability analysis

UNIT IV INTRODUCTION TO DESIGN OF COMPENSATORS 12 Hrs

Realization of basic compensators-lag , lead, lag-lead- Introduction to P, PI, PD, PID controllers, tuning of PID controllers

UNIT V STATE SPACE REPRESENTATION 12 Hrs

Concept of state- State Variable-State Equations- Sampling theorem- Controllability and observability

Total Number of hours: 60Hrs

Subject Code: BEE17008	**Subject Name: CONTROL SYSTEMS**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	T	3	1/0	0/0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- Understand the basic components of control systems.
- Capable to solve problems in time domain & frequency domain.
- Understand the frequency response for the stability of the system.
- Understand the concept of Compensators
- Understand the State space Analysis of different variables

COURSE OUTCOMES (COs) : (3- 5)

CO1	The students understand the basic components of control systems.
CO2	The students are capable to solve problems in time domain & frequency domain
CO3	The students understand the frequency response for the stability of the system.
CO4	The students understand the concept of Compensators
CO5	The students understand the State space Analysis of different variables

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	M	H	H	M	M	L	M	M	H	L
CO2	H	M	H	H	H	M	H	M	M	M	H	L
CO3	H	H	H	H	H	H	H	L	M	H	H	M
CO4	M	H	L	M	L	L	L	L	M	L	L	L
CO5	H	H	H	H	H	L	L	L	M	L	H	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	H	H	H	M	H		
CO2	H	H	H	H	H		
CO3	H	H	H	M	H		
CO4	L	L	M	L	M		
CO5	M	H	H	M	H		

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

Text Books:

1. Nagrath, L.J. Gopal, M. Control System Engineering.4th Ed. New age International (P) Ltd Publishers
2. Ogata, K. Modern Control Engineering-analysis of system dynamics, system design using Root Locus. 4th Ed. Prentice Hall for practice and solutions

Reference Books:

1. www.GaliLMc.com - GALIL we move the world-featured tutorials – motion controllers, tuning servo systems, adjustment of PID filter

POWER ELECTRONICS AND FACTS CONTROLLERS

UNIT I PHASE CONTROLLED CONVERTERS 9 Hrs

Single Phase and Three Phase Half Controlled and Fully Controlled Rectifiers with R, RL and RLE loads – Waveforms of Load Voltage and Line Current – Inverter Operation of Fully Controlled Converter – Harmonic Factor, Power Factor, Ripple Factor, Distortion Factor – Operation with Freewheeling Diode – Effect of Source Inductance – Dual Converter

UNIT II INVERTERS & CYCLO-CONVERTERS 9 Hrs

Voltage and Current Source Inverters – Single Phase and Three Phase Inverters (both 120^{o} mode and 180^{o} mode) Inverters – PWM Techniques: Sinusoidal PWM, Modified Sinusoidal PWM - Multiple PWM – Resonant Series Inverter – Current Source Inverter – Single Phase & Three Phase Cycloconverters

UNIT III CHOPPERS & AC VOLTAGE CONTROLLERS 9 Hrs

DC Choppers – Step-Down and Step-Up Chopper – Time Ratio Control and Current Limit Control – Various Classes of Operation – Buck, Boost and Buck – Boost Type Choppers – Merits and Applications – Concept of Resonant Switching – SMPS & UPS-1ϕ & 3ϕ AC Voltage Controllers – Sequence Control of Voltage Controllers – Multistage Sequence Control

UNIT IV SERIES CONTROLLERS 9 Hrs

The Concept of Flexible AC Transmission - Reactive Power Control in Electrical Power Transmission Lines – Objectives of Series Compensation - Variable Impedance Type Series Compensators - Switching Converter Type Series Compensators

UNIT V SHUNT CONTROLLERS **9 Hrs**

Subject Code: BEE17009	**Subject Name: POWER ELECTRONICS AND FACTS CONTROLLERS**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To understand the operation of Phase Controlled Converters
- To understand the operation of Inverters & Cycloconverters
- To understand the operation of Choppers & AC Voltage Controllers
- To understand the operation of Series Controllers
- To understand the operation of Shunt Controllers

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understanding of Phase Controlled Converters
CO2	Capable of understand operation of Inverters & Cycloconverters
CO3	Capable of understand operation of Choppers & AC Voltage Controllers
CO4	Capable of understand operation of Series Controllers
CO5	Capable of understand operation of Shunt Controllers

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	H	M	M	M	H	M
CO2	H	H	H	H	H	H	H	M	M	L	H	M
CO3	H	H	H	H	M	H	H	M	L	M	H	M
CO4	H	H	H	M	M	M	M	L	M	M	M	L
CO5	H	H	H	M	M	M	M	L	M	M	M	L

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	H	H	H	H			
CO2	H	H	H	H	H			
CO3	H	H	H	H	M			
CO4	M	M	M	M	M			
CO5	M	M	M	M	M			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								

Approval	

Objectives of Shunt Compensation - Methods of Controllable VAR Generation - Static VAR Compensators: SVC and STATCOM

Total Number of hours: 45Hrs

Text Books:

1. Rashid, M.H. (2004) Power Electronics - Circuits Devices and Applications.3rd Ed. Prentice Hall of India
2. Narain G. Hingorani, Laszlo Gyugyi, (2000) Understanding FACTS Concepts & Technology of Flexible AC Transmission System. IEEE Press

Reference Books:

1. Bimbhra, P.S. (1999) Power Electronics.3rd Ed. Khanna Publishers
2. Bimal K. Bose,(2002) Modern Power Electronics and AC Drives. Pearson Education. Asia

MICROPROCESSOR, MICROCONTROLLER AND ARM PROCESSOR

UNIT I 8085 PROCESSOR 9Hrs

Functional block diagram - Signals – Memory interfacing – I/O ports and data transfer concepts – Timing Diagram – Interrupt structure Instruction format and addressing modes – Assembly language format – Data transfer, data manipulation & control instructions, subroutine and stack

UNIT II PERIPHERAL INTERFACING 9Hrs

Study of Architecture and programming of ICs: 8255 PPI, 8259 PIC, 8251 USART, 8279 Key board display controller and 8253 Timer/ Counter – Interfacing with 8085 - A/D and D/A converter interfacing

UNIT III MICRO CONTROLLER 8051 9Hrs

Functional block diagram - Instruction format and addressing modes – Interrupt structure – Timer –I/O ports – Serial communication. Data Transfer, Manipulation, Control & I/O instructions

UNIT IV MICRO CONTROLLER PROGRAMMING & APPLICATIONS 9Hrs

Simple programming exercises key board and display interface- interfacing an LCD- interfacing to ADC interfacing a DAC, Sensors – Closed loop control of servo motor- interfacing a stepper motor

UNIT V INTRODUCTION TO ARM PROCESSORS 9Hrs

Subject Code: BEE17010	**Subject Name: MICROPROCESSOR, MICROCONTROLLER AND ARM PROCESSOR**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr: Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

> To understand programming in different processors and controllers.
> To study the Architecture of 8085, 8051 , ARM Processor
> To understand interfacing using processors.
> To known the applications of Processors.
> To understand applications of Microcontroller

COURSE OUTCOMES (COs) : (3- 5)

CO1	Familiarize with programming in different processors and controllers.
CO2	Acquire the knowledge on Architecture of 8085, 8051 , ARM Processor
CO3	Capable of understands interfacing using processors
CO4	Understand the applications of processors
CO5	Understand the applications of microcontroller

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	H	L	H	M	H	M
CO2	H	H	H	H	H	H	M	M	H	M	H	M
C03	H	H	H	M	M	L	L	L	M	L	M	L
CO4	H	H	H	H	H	M	M	M	H	M	H	M
CO5	H	H	H	H	H	M	M	M	H	M	H	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	M	H	H	M	M			
CO2	M	H	H	H	M			
CO3	L	H	H	M	L			
C04	L	M	M	M	L			
CO5	M	H	H	M	M			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

Basic ARM architecture – ARM assembly language program – ARM organization and implementation– The ARM instruction set - The thumb instruction set – ARM CPU cores

Total Number of hours: 45Hrs

Text books:

1. Gaonkar, R.S (2006) Microprocessor Architecture Programming and Application. New Delhi: Wiley Eastern Ltd
2. Muhammad Ali Mazidi, & Janice Gilli Mazidi, (2003) The 8051 Micro Controller and Embedded Systems. 5th Indian reprint, Pearson Education
3. Steve Furber,(2000) ARM System –On –Chip architecture. Addison Wesley

Reference books:

1. William Kleitz, (2006) Microprocessor and Micro Controller Fundamental of 8085 and 8051 Hardware and Software. Pearson Education
2. Daniel Tabak, Advanced Daniel Microprocessors. McGraw Hill Inc

FUNDAMENTALS OF DIGITAL SIGNAL PROCESSING

UNIT I DISCRETE TIME SIGNALS AND SYSTEMS 9Hrs

Periodic and pulse signals – examples of sequences – pulse step, impulse, ramp, sine and exponential – differential equations – linear time invariant – stability, causality – DT systems – time domain analysis

UNIT II Z- TRANSFORM AND DFT 9Hrs

Z-transform and its properties – convolution – inverse Z-transform – discrete Fourier series – properties – sampling the Z-transform – Discrete Fourier Transform – properties for frequency domain analysis – linear convolution using discrete Fourier transform – overlap add method, overlap save method

UNIT III FAST FOURIER TRANSFORM (FFT) 9Hrs

Introduction to Radix 2 FFT's – decimation in time FFT algorithm – decimation in frequency FFT algorithm – computing inverse DFT using FFT – mixed radix FFT algorithm

UNIT IV IIR AND FIR FILTER DESIGN 9Hrs

Classification – reliability constrains – IIR design – bilinear transform method – impulse invariant method – step – invariance method – FIR design – Fourier series method – window function method

UNIT V PROGRAMMABLE DSP CHIPS 9Hrs

Architecture and features of TMS 320C50, TMS3201and ADSP 2181signal processing chips

Subject Code: BEC17I08	**Subject Name: FUNDAMENTALS OF DIGITAL SIGNAL PROCESSING**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To understands the fundamentals of signals & systems.
- Impart knowledge on Z- transform concepts.
- To Understand the Designing of signals using filters.
- To avail the knowledge on design IIR and FIR filters with Fourier series method
- To understand the Architecture and features of various signal processing chips

COURSE OUTCOMES (COs) : (3- 5)

CO1	Acquire knowledge in fundamentals of signals & systems.
CO2	Capable of solving problems using Z- transform
CO3	Familiar to design of signals using filters.
CO4	Capable of design IIR and FIR filters with Fourier series method
CO5	Incorporate the knowledge in development of projects.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	M	M	M	L	L	L	L	L	M	L
CO2	H	H	L	H	M	L	L	L	H	L	M	L
CO3	H	H	H	H	H	M	H	M	H	M	H	M
CO4	H	H	H	H	H	H	H	M	H	M	H	M
CO5	H	H	H	H	H	H	H	M	H	H	H	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	L	H	H	H	H			
CO2	L	L	L	L	L			
CO3	M	H	H	H	H			
CO4	H	H	H	H	H			
CO5	H	H	H	H	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

Total Number of hours: 45Hrs

Text Books :

1. Openheim A.V., and Schafer R.W., Discrete Time Signal Processing, Prentice Hall of India, New Delhi, 1992
2. Proakis J.G. and Manolakis, D.G., Digital Signal Processing Principles, Algorithms and Applications, Prentice Hall of India, New Delhi, 1997

Reference Books:

1. Antonian A., Digital Filters analysis and Design, Tata McGraw-Hill Publishing Co., New Delhi, 1988
2. Stanley W.D., Digital Signal Processing, Restion Publishing House, 1989.ADSP2181 Datasheet

DESIGN OF ELECTRICAL MACHINES *

UNIT I INTRODUCTION 9Hrs

Major considerations – Limitations– Space factor temperature gradient – Heat flow in two dimensions – Thermal resistivity of winding – Temperature gradient in conductors placed in slots

UNIT II DC MACHINES 9 Hrs

Magnetic circuit calculations –Net length of Iron –Real & Apparent flux densities– D.C machines output equations –Design of shunt and series field windings– Design of Commutator and brushes

UNIT III TRANSFORMERS 9Hrs

KVA output for single and three phase transformers – Window space factor – Temperature rise of Transformers – Design of Tank with & without cooling tubes

UNIT IV INDUCTION MOTORS 9Hrs

Magnetic leakage calculations – Leakage reactance of poly-phase machines- Output equation of Induction motor — circle diagram – Dispersion co-efficient – relation between D & L for best power factor

UNIT V SYNCHRONOUS MACHINES 9Hrs

Runaway speed – construction – output equations – choice of loadings – Design of salient pole machines – Short circuit ratio – Introduction to computer aided design – Program to design main dimensions of Alternators

Total Number of hours: 45Hrs

Subject Code: BEE17ET3	**Subject Name: DESIGN OF ELECTRICAL MACHINES @**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	ETL	1	0/2	1/1	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- The graduate will be capable of designing the transformers
- To understand the designing the rotor bars & slots.
- The graduate will be capable of designing machine parameters related to the Industrial needs.
- The graduate will be capable of designing the Electrical machines
- To understand the characteristics like speed, torque etc. of different electrical machines.

COURSE OUTCOMES (COs) : (3- 5)

CO1	capable of designing the transformers
CO2	Ability to design the rotor bars and slots
CO3	Capable of designing machine parameters related to the Industrial needs.
CO4	Familiar with design of Electrical machines
CO5	understand the characteristics like speed, torque etc. of different electrical machines

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	H	H	H	M	H	H
CO2	H	H	H	H	H	H	H	M	H	M	H	M
CO3	H	H	H	H	H	H	H	M	H	L	M	L
CO4	H	H	H	H	H	H	H	H	H	H	H	H
CO5	H	H	H	H	H	H	H	H	H	H	H	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	M	H	H	H	H			
CO2	H	H	H	H	H			
CO3	M	H	H	H	H			
CO4	H	H	H	H	H			
CO5	H	H	H	H	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓			✓					

Approval	

Text Book:

1. Sawhney, A.K. Dhanpat Rai & Sons, (1984) A Course in Electrical Machine Design. New Delhi

Reference Books:

1. Sen, S.K. (1987) Principles of Electrical Machine Designs with Computer Programmes. New Delhi: Oxford and IBH Publishing Co. Pvt. Ltd

MICROPROCESSOR, MICROCONTROLLER AND ARM PROCESSOR LABORATORY

LIST OF EXPERIMENTS

1. Multi precision addition / subtraction / multiplication / division.
2. Programming with control instructions:
3. Increment / Decrement.
4. Ascending / Descending order.
5. Maximum / minimum of numbers.
6. A/D Interfacing.
7. D/A Interfacing.
8. Traffic light controller.
9. Stepper motor
10. Keyboard display
11. Programming practice on assembler and simulator tools using keil micro software.
12. Demonstration of basic instructions of 8051 Micro controller.
13. Parallel port programming with 8051 using port 1 facility:
14. Stepper motor and D / A converter.
15. Programming practice using simulation tools and C - compiler
16. Initialize timer, Enable interrupts.
17. Simple Arithmetic Operations using ARM processor
18. Programming with control instructions using ARM processor
19. Seven segment display interfacing using ARM processors. (ARM926 kit)
20. LED display Interfacing using ARM processors.(ARM926 kit)

Subject Code: BEE17L05	**Subject Name: MICROPROCESSOR, MICROCONTROLLER AND ARM PROCESSOR LABORATORY**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	T	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To understand program the Assembly language in Microprocessor
- Interfacing of peripheral devices using 8085.
- To know the program Assembly language in Microcontroller
- To understand simple programming using ARM processor
- To make program using KEIL software.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Capable of programming the Assembly language in Microprocessor
CO2	Familiar with Interfacing of peripheral devices using 8085
CO3	Capable of understand the program Assembly language in Microcontroller
CO4	Capable of understand simple programming using ARM processor
CO5	Understand the program using KEIL software.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	H	L	H	M	H	M
CO2	H	H	H	M	M	L	L	L	M	L	M	L
CO3	H	H	H	H	H	H	M	M	H	M	H	M
CO4	H	H	H	H	H	M	M	M	H	M	H	M
CO5	H	H	H	H	H	M	M	M	H	M	H	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	L	M	M	L	M			
CO2	M	M	M	M	H			
CO3	M	M	M	M	H			
CO4	M	M	M	L	H			
CO5	L	M	M	M	M			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					

Approval	

Total Number of hours: 45Hrs

CONTROL AND INSTRUMENTATION LABORATORY

LIST OF EXPERIMENTS

1. Transfer function of self excited DC Generator
2. Transfer function of Armature controlled DC Motor.
3. Transfer function of Field controlled DC Motor.
4. Transfer function of AC Servomotor.
5. Frequency response of Lag, Lead & Lag – Lead networks.
6. Study of DC Position Control system.
7. Study of P, PI and PID Controllers (First Order).
8. Study of temperature measuring transducers (Thermocouples).
9. Study of displacement and pressure transducers (LVDT).
10. AC Bridges.
11. DC Bridges.
12. Calibration of Single phase Energy meter.
13. Calibration of Three-phase Energy meter.
14. Measurement of Three-phase power and power factor.
15. Response of First order system for a step input using MATLAB/ LABVIEW
16. Response of First order system for a Ramp input using MATLAB/ LABVIEW
17. Response of Second order system for a step input using MATLAB/ LABVIEW
18. Response of Second order system for a ramp input using MATLAB/ LABVIEW

Subject Code: BEE17L06	Subject Name: CONTROL AND INSTRUMENTATION LABORATORY	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:	T	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To understand the Measurement and to control concepts
- Students will obtain knowledge about different types of Transducers, bridges and its characteristics.
- To calibrate energy meters in single phase, three phase and measure the power , iron loss and power factor .
- To familiarize the students with the measurement of low resistance, inductance and capacitance-factor using simulation package such as LABVIEW /MATLAB etc.
- To familiarize the students with the concept of DC motor, AC servomotor, AC tachometer and its characteristics practically. Students will gain knowledge about effect of controllers (P, PI, PID)

COURSE OUTCOMES (COs) : (3- 5)

CO1	Students get familiarized about different types of Transducers, bridges and its characteristics.
CO2	Understands the concept of calibration of energy meters in single/three phase and measure the power etc
CO3	The students gets familiarized with the measurement of low resistance, inductance and capacitance-factor using simulation package such as LABVIEW /MATLAB etc.
CO4	The students get familiarized with the concept of DC motor, AC servomotor, AC tachometer and its characteristics practically. Students gain knowledge about effect of controllers (P, PI, PID)
CO5	The students get familiarized with digital simulation of first order and second order systems, root locus, Routh-Hurwitz stability.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	M	H	M	H	M	H	M	H	H
CO2	H	H	M	H	H	H	H	M	M	L	H	M
CO3	H	H	H	H	H	H	H	H	H	H	H	L
CO4	H	H	H	H	H	H	H	H	H	H	H	M
CO5	H	H	H	H	H	L	H	L	H	M	H	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	M	H	H	H	H			
CO2	H	H	H	H	H			
CO3	H	H	H	H	H			
CO4	H	H	H	H	H			
CO5	L	M	HM	M	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					
Approval												

Total Number of hours: 45Hrs

SIGNAL PROCESSING AND COMMUNICATION LABORATORY

LIST OF EXPERIMENTS

SIGNAL PROCESSING :

1. Implementation of Sampling & Waveform Generation
2. Implementation of FIR & IIR Filters
3. Implementation of Fast Fourier Transforms
4. Implementation of Adaptive Filters
5. Implementation of Multirate Signal Processing Measurement On Signal Parameters In Time Domain & Frequency Domain.
6. Determination Of The Individual Amplitudes Of The Different Dominate Harmonics Of A Composite Signal (Example; Square Wave Signals) Using Spectrum Analyzer
7. Determination Of The Phase Difference Between Two signals (Derived From The Same Source (Say 1Khz Square Wave Signal) Using Two Different Paths, One Of
Which Contains A Delay Unit) Using CRO and A Phase Detector Circuitry,
8. Representation Of Time Series; Computation Of Convolution Using Matlab
9. Dft Computation Using Matlab

10. Computational Experiments With Digital Filtering Dsp Using Matlab .

COMMUNICATION :

Subject Code: BEC17IL5	**Subject Name: SIGNAL PROCESSING AND COMMUNICATION LABORATORY**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	T	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- Analyze and implement digital signal processing systems in time domain.
- Understand the implementation of the DFT in terms of the FFT, as well as some of its application
- Use MATLAB for DSP system analysis and design.
- To implement the various analog and digital modulation and demodulation Techniques.
- Students will be able to determine the suitability of a particular communication system to a given problem.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Acquired knowledge DFT and FFT
CO2	Ability to design linear digital filters both FIR and IIR using different techniques.
CO3	Ability to understand the concept of Multi-rate signal processing and sample rate conversion.
CO4	Acquired knowledge of analog and digital communication.
CO5	Acquired knowledge different Modulation Techniques.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	H	M	H	M	H	L
CO2	H	H	H	H	M	M	M	M	H	H	H	L
CO3	H	H	H	H	H	H	H	H	H	H	H	L
CO4	H	H	H	H	H	H	H	H	H	H	H	H
CO5	H	H	H	H	H	H	H	M	H	L	H	L

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	L	H	H	H	H			
CO2	L	H	H	H	H			
CO3	M	H	H	H	H			
CO4	M	H	H	H	H			
CO5	M	H	H	H	M			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					
Approval												

1. Design and Testing Of Amplitude Modulation
2. Design and Testing Of Amplitude Demodulation

3. Design and Testing Of Frequency Modulation
4. Design and Testing Of Frequency Demodulation (Any One Method)
5. Design and Testing Of Pulse Amplitude Modulation & Demodulation
6. Design and Testing Of Ask, Fsk and Psk
7. Study of Line Coding and Decoding Techniques
8. Study of Sampling
9. Study of Pulse Code Modulation
10. Design & Testing Of Eye Pattern

Total Number of hours: 45Hrs

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Subject Code: BEETS17X	Subject Name : TECHNICAL SKILL 2	T / L/ ETL	L	T / S.Lr	P/ R	C
		0	0	0	1	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

Subject Code: BEE17L07	Subject Name : INPLANT TRAINING	T / L/ ETL	L	T / S.Lr	P/ R	C
OBJECTIVE :	The objective is to develop the technical skill of the students.	0	0	0	1	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : The main objective of the inplant training is to provide a short-term work experience in an Industry/ Company/ Organization

COURSE OUTCOMES (COs) : (3- 5)

CO1	Develop the technical skills required in the field of study
CO2	Bridge the gap between the skill requirements of the employer or industry and the competency of the students.
CO3	Enhance the employability of the students.

COURSE OUTCOMES (COs) : (3- 5)

CO1	To get an insight of an industry / organization/ company pertaining to the domain of study.
CO2	To acquire skills and knowledge for a smooth transition into the career.
CO3	To gain field experience and get linked with the professional network.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	M	M	H	M	H	M
CO2	H	H	M	H	H	H	M	M	H	H	H	H
CO3	H	H	H	H	H	H	M	M	H	H	H	H

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	L	L	L	H	H	H	H	H	H	H
CO2	H	M	H	H	M	H	H	H	H	H	H	M
CO3	H	H	H	H	M	H	H	H	H	H	H	M

COs/PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	H	H	H
CO2	H	H	H	H	H
CO3	H	H	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internship / Technical Skill	Soft Skills			
Category								✓				
Approval												
								✓				
Approval												

POWER SYSTEM ANALYSIS

UNIT I INTRODUCTION **12 Hrs**

Modern Electric Power System and its component -Modelling of Generator, Transformer, Transmission System and Load Representation in Single line diagram – per phase and per unit representation – change of base - Analysis for system planning and operational studies

UNIT II POWER FLOW ANALYSIS **12 Hrs**

Subject Code: BEE17011	**Subject Name: POWER SYSTEM ANALYSIS**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	T	3	1/0	0/0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To learn the fundamentals of Power System and the importance of system planning
- To build the Algorithm for Y-Bus and Z-Bus matrix and derive the power flow equation
- To study and analyse the Balanced and Unbalanced Faults
- To Examine the Stability and its classification
- To determine the critical clearing angle and to improve Stability

COURSE OUTCOMES (COs) : (3- 5)

CO1	Knowledge on Basics of Power system Components
CO2	Familiarize the concepts of base values and per unit values with Single line diagram, Z-bus & Y-Bus
CO3	Familiarity to various load flow problems
CO4	Capable of analyzing the balanced & unbalanced fault
CO5	Stability analysis of the power system network

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	H	M	M	M	H	H
CO2	H	H	H	H	H	H	H	M	L	L	H	L
CO3	M	M	M	M	H	H	H	M	M	L	M	M
CO4	H	H	H	H	H	H	H	M	M	M	H	L
CO5	H	H	H	H	H	H	H	L	H	M	H	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	H	H	H	H			
CO2	M	H	H	H	H			
CO3	H	H	H	H	H			
CO4	H	H	H	H	H			
CO5	H	H	H	H	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

Importance -Simple building algorithms for the formation of Y-Bus matrix and Z-Bus matrix-Problem definition – Bus classification –Derivation of power flow equation –Solution by Gauss–Seidel, Newton-Raphson methods and FDLF - Computation of slack bus power, transmission loss and line flows

UNIT III FAULT ANALYSIS – BALANCED 12 Hrs

Importance of short circuit - basic assumptions -Symmetrical (or) balanced three phase faults – problem formulation – fault analysis using Z-bus matrix – algorithm and flow chart - Computations of short circuit capacity, post fault voltage and currents

UNIT IV FAULT ANALYSIS – UNBALANCED 12 Hrs

Introduction to symmetrical components – sequence impedances – sequence networks – representation of single line to ground, line to line and double line to ground fault conditions - Unbalanced fault analysis - problem formulation – analysis using Z-bus impedance matrix – algorithm and flow chart

UNIT V STABILITY ANALYSIS 12 Hrs

Importance of stability analysis in power system planning and operation - classification of power system stability - angle and voltage stability –Stability and Stability limit, Steady state stability study, derivation of Swing equation, transient stability studies by equal area criterion and step-by-step method. Factors affecting steady state and transient stability and methods of improvement

Total Number of hours: 60Hrs

Text Books:

1. HadiSaadat, (2002) Power System Analysis. New Delhi: Tata McGraw Hill Publishing Company
2. Olle I. Elgerd, (2003) Electric Energy Systems Theory – An Introduction. 2nd Ed. New Delhi: Tata McGraw Hill Publishing Company Limited
3. John, G., William Stevenson Jr., (1994)., "Power System Analysis", Irwin Electronics & Computer Engg

Reference Books:

1. Kundur, P. (1994) Power System Stability and Control. Tata McGraw Hill, Publications
2. John J. Grainger, W.D. Stevenson Jr, (1994) Power System Analysis. McGraw Hill International Book Company
3. Nagrath, I.J. Kothari, D.P. (1990) Modern Power System Analysis. New Delhi:Tata McGraw-Hill Publishing Company
4. J. Duncan Glover, M.S.Sarma & Thomas J. overbye, 'Power system analysis and design',5th Edition, 2011
5. J.C.Das, 'Power System Analysis', Short-Circuit Load Flow and Harmonics', 1st Edition, 2002
6. Arthur R. Bergen, 'Power System Analysis', Peterson Education India, 2nd Edition, 2009

ELECTRIC TRANSIENTS AND HIGH VOLTAGE ENGINEERING

UNIT I OVER VOLTAGE & TRANSIENTS 9Hrs

Power System Transients – Types - Over Voltage due to Lightning– Characteristics – Theory of Formation of Cloud – Mechanism of Lighting – Over Voltage due to Switching Surge – Characteristics – Current Suppression – Current Chopping – Capacitance Switching – Multiple Re-striking Transients – Ferro Resonance- Tower Footing Resistance

UNIT II TRAVELLING WAVES & TRANSIENTS ON TRANSMISSION LINES 9Hrs

Subject Code: BEE17012	Subject Name: ELECTRIC TRANSIENTS AND HIGH VOLTAGE ENGINEERING	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To understand and gain knowledge on sources of Over Voltage and Transients
- To impart knowledge on Travelling waves and the switching operation in Transmission lines
- To provide strong knowledge on Generation and Measurement of High DC, AC, Impulse voltages
- To attain familiarity about the Insulators and analyze the various types of Insulators for coordination
- To acquire knowledge on testing of various Electrical Apparatus

COURSE OUTCOMES (COs) : (3- 5)

CO1	Acquire knowledge on sources of Over Voltage and Transients
CO2	Familiar to Travelling waves and the switching operation in Transmission lines
CO3	Acquire knowledge on Generation and Measurement of High DC, AC, Impulse voltages
CO4	Familiarity to Insulators and analyze the various types of Insulators for coordination
CO5	knowledge on testing of various Electrical Apparatus

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	H	L	M	L	H	L
CO2	H	H	H	H	H	H	H	M	H	M	H	L
CO3	H	H	H	H	H	H	H	L	H	L	H	L
CO4	H	H	H	H	H	H	H	M	H	M	H	L
CO5	H	H	H	H	H	H	H	L	H	H	H	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	H	H	H	H	H		
CO2	L	H	H	H	H		
CO3	H	H	H	H	H		
CO4	H	H	H	H	H		
CO5	H	H	H	H	H		

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

Circuits with Distributed Constants – Wave Equation – Reflection & Refraction of Travelling waves – Behavior of Travelling waves at Line Terminations – lattice Diagrams – Attenuation and Distortion of Travelling waves – Switching Operation involving Transmission lines – Multi conductor systems and Multi velocity waves – Switching Surges on an Integrated System

UNIT III GENERATION OF HIGH VOLTAGE 9Hrs

Generation of Direct Voltages – AC to DC Conversion- Electrostatic Generators – Alternating Voltages – Testing Transformers – Series Resonant Circuits- Impulse Voltages – Impulse Voltage Generator Circuits-operation, Design & Construction of Impulse Generators- Control Systems

UNIT IV MEASUREMENT OF HIGH VOLTAGES 9Hrs

Measurement of AC, DC, Impulse Voltage, Switching Surge Voltages-Peak Voltage Measurements by Spark Gap- Electrostatic Voltmeter- Generating Voltmeter- Measurement of Peak Voltmeters – Voltage Dividing System- Impulse voltage measurement- Fast Digital Transient recorders for impulse measurements

UNIT V INSULATION COORDINATION & APPARATUS TESTING 9Hrs

Insulation Characteristics- Types of Insulation- Insulation Level- Statistical Approach to Insulation Coordination – HV Testing Lab – Classification- Testing of Insulators – Bushing – Cables – Transformers – Surge Diverters

Total Number of hours: 45Hrs

Text Books:

1. Kuffel,E, Zaengl, WS, Kuffel,J, (2000) High Voltage Engineering Fundamentals, 2nd Ed
2. Naidu, MS, Kamaraju, V, High Voltage Engineering, Tata Mc Graw Hill
3. Allan Greenwood, (2012) Electrical Transients in Power Systems, John Wiley

Reference Books:

1. Wadhwa, CL, High Voltage Engineering, New Age International Publishers
2. Akihiro Ametani, Naoto Nagaoka, Yoshihiro Baba, Teruo Ohno, (2013) Power System Transients: Theory and Applications, CRC Press.
3. Dieter Kind, Kurt Feser, (1999), High Voltage Test Techniques, SBA Electrical Engineering Series, New Delhi
4. Gallagher, T.J, and Pearmain A, (1983), High Voltage Measurements, Testing and Design, John Wiley & Sons

INDUSTRIAL DRIVES AND AUTOMATION

UNIT I INTRODUCTION 9 Hrs

Definition, block diagram and types of Electric Drives – dynamics of electric drives – torque equations – speed torque characteristics of DC and AC motors – components of load torque – load equalization – steady

state stability – heating and cooling curves – loading conditions and classes of duty – Selection of power rating for drive motors

Subject Code: BEI17I02	**Subject Name : INDUSTRIAL DRIVES AND AUTOMATION**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To develop Introduction to Industrial Drives
- To develop knowledge on DC DRIVES
- To develop knowledge on Energy Conservation And Special Class Of Drives
- To gain Knowledge on SCADA
- To gain knowledge on PLC

COURSE OUTCOMES (COs) : (3- 5)

CO1	To develop Introduction to Industrial Drives
CO2	To develop knowledge on DC DRIVE
CO3	To develop knowledge on Energy Conservation And Special Class Of Drives
CO4	To gain Knowledge on SCADA
CO5	To gain knowledge on PLC

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	L	L	M	M	L	H	H	H	L	M	M
CO2	H	H	M	M	M	L	L	H	M	H	L	M
CO3	M	M	L	M	M	M	H	L	M	M	H	L
CO4	H	M	M	L	L	M	H	M	H	M	H	M
CO5	M	H	M	H	M	L	H	M	H	M	H	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	L	H	M	L	L			
CO2	M	H	M	H	M			
CO3	H	L	L	M	H			
CO4	L	M	H	M	L			
CO5	M	M	L	L	M			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

UNIT II DC DRIVES **9 Hrs**

Speed control of DC series and shunt motors – concepts of constant torque and constant power control – concepts of Armature and field control, Ward Leonard control system – Speed control Using single phase controlled rectifiers – fully controlled – half controlled – speed control using 3 phase fully controlled rectifier – control using DC choppers – multi quadrant operation – electric braking – closed loop control of DC drives

UNIT III ENERGY CONSERVATION AND SPECIAL CLASS OF DRIVES **9 Hrs**

Need for energy conservation in electrical drives – improvement of power factor , improvement of quality supply – solar and battery powered drives – Drives used for traction – Control of fractional hp motors

UNIT IV SCADA **9 Hrs**

SCADA-Direct digital control-AI and except control system-Case studies on computer control for industrial process

UNIT V PLC **9 Hrs**

Evaluation of PLC's- Sequential and programmable controllers-Architecture-Relay logic-Applications of PLC-Bottle fielding system

Total Number of hours: 45Hrs

Text Books:

1. Dubey. G.K., "Power Semiconductor Controlled Drives", Prentice Hall International, 1989
2. B. K.Bose, "Modern Power Electronics and AC Drives", Prentice Hall Onglewood cliffs, New Jersey, 2002
3. D. Patranabis, Principle of industrial instrumentation, Tata MCgrahills publishers company ltd, 1996
4. Prof. Rajesh Mehra, DLC-Theory and Practical, Lakshmi Publications 2016

Reference Books:

1. E.O Doubelin, " Measurement System"- Application Tata- MCgrahills 2004
2. Kevin collis, " PLC programming for In Industrial Automation, Diggory Press Publishers, 2007
3. Vedam Subrahmanyam, "Electric drives concepts and applications", TMH Pub. Co.Ltd. 1994

Subject Code:	Subject Name : SOFT SKILLS – II	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Soft Skills - I	ETL	1	0/1	1/0	2

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : The main objective is to strengthen the logical and arithmetic reasoning skills of the students.

COURSE OUTCOMES (Cos) : (3- 5)

CO1	Recognize and apply arithmetic knowledge in a variety of contexts.
CO2	Ability to identify and critically evaluate philosophical arguments and defend them from criticism.
CO3	Define data and interpret information from graphs.

Mapping of Course Outcomes with Program Outcomes (Pos)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	L	L	H	M	H	H
CO2	M	M	M	H	L	H	L	H	H	H	H	L
CO3	H	H	H	H	H	H	M	M	H	H	H	H

Cos / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	M	M	M	M	M			
CO2	M	M	M	M	M			
CO3	M	M	M	M	M			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
									✓			
Approval												

SOFT SKILLS II

UNIT I Logical Reasoning I **6 Hrs**

Logical Statements – Arguments – Assumptions – Courses of Action

UNIT II Logical Reasoning II **6 Hrs**

Logical conclusions – Deriving conclusions from passages – Theme detection

UNIT III Arithmetical Reasoning I **6 Hrs**

Number system – H.C.F & L.C.M – Problem on ages – Percentage – Profit & Loss – Ratio & Proportion – Partnership

UNIT IV Arithmetical Reasoning II **6 Hrs**

Time & Work – Time & Distance – Clocks – Permutations & Combinations – Heights & Distances – Odd man out and Series

UNIT V Data Interpretation **6 Hrs**

Tabulation – Bar graphs – Pie graphs – Line graphs

Reference Books:

1. R.S.Agarwal, A modern approach to Logical Reasoning, S.Chand & Co., (2017)
2. R.S.Agarwal, A modern approach to Verbal and Non verbal Reasoning, S.Chand & Co., (2017)
3. R.S.Agarwal, Quantitative Aptitude for Competitive Examinations, S.Chand & Co., (2017)
4. A.K.Gupta, Logical and Analytical Reasoning, Ramesh Publishing House, (2014)
5. B.S.Sijwali, Indu sijwali, A new approach to Reasoning (Verbal and Non verbal), Arihant Publishers (2014).

Total Number of hours: 30Hrs

ENERGY UTILIZATION AND CONSERVATION LABORATORY

LIST OF EXPERIMENTS

1. Energy conservation in building heating and lighting.

Subject Code: BEE17L08	**Subject Name: ENERGY UTILIZATION AND CONSERVATION LABORATORY**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To study the energy conservation on buildings
- The analyse the heating and cooling of buildings
- Understand the energy efficient equipments
- Understands and analyse energy auditing
- Design the house wiring

COURSE OUTCOMES (COs) : (3- 5)

CO1	Can able to study the energy conservation on building
CO2	Can analyse the heating and cooling of building
CO3	Can able to analyse the energy efficient equipments
CO4	Can understand energy audit
CO5	Can able to design house wiring

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	H	H	H	H	H	H	M	L	H	H
CO2	M	M	H	H	H	M	H	M	M	M	M	M
CO3	H	H	H	H	H	H	H	H	M	L	H	M
CO4	H	H	H	H	H	H	H	H	H	H	H	H
CO5	H	H	H	H	H	H	H	H	M	M	H	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	H	H	H	H			
CO2	H	H	H	H	H			
CO3	M	H	H	H	H			
CO4	M	H	H	H	H			
CO5	H	H	H	H	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					
Approval												

2. Performance characteristics of energy efficient motors.
3. Tariff calculation for home and commercial buildings.
4. Power factor improvement for electrical systems.
5. Energy audit report for commercial space.
6. Energy audit report for home.
7. Energy conservation using solar heating cooling of building.
8. Energy conservation and pricing policy.
9. Calculation of efficient energy lighting using simulation package
10. Design of domestic electrical wiring.

Total Number of hours: 45Hrs

POWER ELECTRONICS AND DRIVES LABORATORY

LIST OF EXPERIMENTS

1. Characteristics of SCR, MOSFET, IGBT and TRIAC
2. Gate Pulse Generation using R, RC and UJT

3. Single phase half controlled and fully controlled bridge converter with R load and RL loads

Subject Code: BEE17L09	**Subject Name: POWER ELECTRONICS AND DRIVES LABORATORY**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	T	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE:

- To obtain an overview of different types of power semiconductor devices and their switching characteristics with different triggering methods.
- To understand the operation , characteristics and performance parameters of controlled Rectifiers and Inverters.
- To understand the techniques to control the speed of Brushless DC Motor and SR Motor
- To understand the operation of AC Voltage Controllers
- To understand the applications of Power Electronic devices and Electric drives in Power System

COURSE OUTCOMES (COs) : (3- 5)

CO1	Students will understand the operation of power electronics devices and gain knowledge of the comparative study of different devices based on their switching characteristics .
CO2	Students will understand the operation , characteristics and performance parameters of controlled Rectifiers and Inverters
CO3	Students capable to understand the techniques to control the speed of Brushless DC Motor and SR Motor
CO4	Students able to understand the operation of AC Voltage Controllers
CO5	Students able to understand the operation of different converters and incorporate in designing the HVDC transmission System

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	M	M	H	L	H	M	H	L
CO2	H	H	H	H	M	M	H	L	M	M	H	L
CO3	H	H	H	H	H	M	H	L	M	M	H	L
CO4	H	H	H	H	H	H	H	M	H	M	H	L
CO5	H	H	H	H	H	H	H	M	H	M	H	L

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	H	H	H	H			
CO2	H	H	H	H	H			
CO3	H	H	H	L	M			
CO4	H	H	H	H	H			
CO5	M	H	H	H	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					

Approval	

4. Single phase AC voltage controller using TRIAC,DIAC with R AND RL loads
5. IGBT based Chopper
6. IGBT Based PWM Inverter
7. Single phase parallel inverter
8. Single phase Series inverter
9. Forced commutation circuits (Class A, Class B, Class C, Class D & Class E).
10. Single phase cyclo-converter with R and RL loads
11. Step down and step up MOSFET based choppers
12. Speed Control of DC Shunt Motor using three phase Rectifier
13. Microprocessor based three phase Converter
14. Simulation of Single Phase and Three Phase cyclo-converter
15. Simulation of the techniques to control the speed of Brushless DC Motor and SR Motor
16. Simulation of steady-state and transient performance of a HVDC transmission system

Total Number of hours: 45Hrs

POWER SYSTEM SIMULATION LABORATORY

LIST OF EXPERIMENTS

Subject Code: BEE17L10	Subject Name: POWER SYSTEM SIMULATION LABORATORY	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:	T	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE:

- To know about the transmission lines
- To understand Load Flow Analysis
- To understand about Fault Analysis
- To gain knowledge on Power Electronic Circuits
- To familiar about Simulation of Electrical drives using MATLAB, PSCAD

CO1	Students will know about the transmission lines
CO2	Students will understand Load Flow Analysis
CO3	Students will understand Load Fault Analysis
CO4	Students will have knowledge on Power Electronic Circuits
CO5	Students will understand Simulation of Electrical drives using MATLAB, PSCAD

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	M	M	L	H	H	H	L
CO2	H	H	H	H	H	M	M	L	M	H	M	L
CO3	H	H	H	M	H	M	M	L	M	H	M	L
CO4	H	H	H	H	H	M	M	L	M	M	M	L
CO5	H	H	H	H				L	M		M	L

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	H	H	H	H			
CO2	H	H	H	H	H			
CO3	H	H	H	H	H			
CO4	H	H	H	H	H			
CO5	H	H	H	H	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					
Approval												

1. Computation of Parameters and Modeling of Transmission Lines
2. Formation of Bus Admittance and Impedance Matrices and Solution of Networks.
3. Load Flow Analysis - I : Solution of Load Flow And Related Problems Using Gauss-Seidel Method
4. Load Flow Analysis - II: Solution of Load Flow and Related Problems Using Newton-Raphson and Fast-Decoupled Methods
5. Fault Analysis
6. Transient and Small Signal Stability Analysis: Single-Machine Infinite Bus System
7. Power Electronic Circuits, design and simulation using Pspice
8. Simulation of Electrical drives using MATLAB, PSCAD

Total Number of hours: 45Hrs

Subject Code: BEE17L11	**Subject Name : MINI PROJECT**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite: NIL	L	0	0/0	0/2	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To acquire hands-on experience in converting a novel idea / technique into a working model / prototype involving multi-disciplinary skills and / or knowledge and working in at team.

COURSE OUTCOMES (COs) : (3- 5)

CO1	To conceptualize a novel idea / technique into a product
CO2	To develop a multi-disciplinary thinking and enable teamwork
CO3	Ideate and develop a prototype

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	M	M	H	H	H	M	L	H	M
CO2	H	H	H	M	H	M	M	M	H	H	H	H
CO3	H	H	H	H	H	H	M	H	H	M	H	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	H	H	H	H			
CO2	H	H	H	H	H			
CO3	H	H	H	H	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					
Approval												

MICROGRID TECHNOLOGY

UNIT I INTRODUCTION **12 Hrs**

Conventional and Non-Conventional Power Generation - Advantages & Disadvantages – Energy Crisis – Review of Solar, Wind, Fuel Cells, Biomass, Tidal- Thermal, Hydel, Nuclear- Microturbine

Subject Code: BEE17013	**Subject Name: MICROGRID TECHNOOGY**	**T / L/ ETL**	**L**	**T / S.L r**	**P/ R**	**C**
	Prerequisite:	Ty	3	0/0	0/1	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To study about various conventional & Nonconventional source of energy resources
- To study the concept of Microgrid and the control modes
- To impart knowledge on Distributed Generation
- To analyse the impact of Grid Integration.
- To understand various power quality issues and the protection schemes for Microgrid.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understanding of various conventional and Nonconventional source of energy resources
CO2	Familiar to Microgrid and the control modes
CO3	knowledge on Distributed Generation
CO4	Familiar to Grid Integration
CO5	Acquire knowledge on various power quality issues and the protection schemes for Microgrid.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	H	H	H	H	H	H
CO2	H	H	H	H	H	H	H	M	H	M	H	M
CO3	H	H	H	H	H	H	H	M	M	M	H	M
CO4	H	H	H	H	H	H	H	M	M	M	H	M
CO5	H	H	H	H	H	H	H	M	H	M	H	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	H	H	H	H			
CO2	H	H	H	H	H			
CO3	H	H	H	H	H			
CO4	H	H	H	H	H			
CO5	H	H	H	H	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

UNIT II OVER VIEW OF MICROGRID **12 Hrs**

Composition of Microgrid-Striucture-Operation Modes-Control Modes–Three state control of independent microgrid-Inverter Control – Grid Connection and separation control

UNIT III DISTRIBUTED GENERATION **12 Hrs**

Concept- Topologies- Selection of Sources- Standards for interconnecting Distributed resources to Power System- Energy Storage Systems- Market Design Issues – Distributed Generation Optimization and Energy Management

UNIT IV IMPACT OF GRID INTEGRATION **12 Hrs**

Requirements for Grid Connection- Limits on operational parameters-Voltage-Frequency-THD Response to grid abnormal operating conditions- islanding issues - Integration with NCE sources – Reliability

UNIT V POWER QUALITY ISSUES AND PROTECTION IN MICROGRID **12 Hrs**

Issues in Microgrid – Modelling and Stability Analysis – Economics in Microgrid- Operation and Protection strategies – Protection scheme for Distribution network connected with Microgrid

Total Number of hours: 60Hrs

Text Books:

1. Fusheng Li, Ruisheng Li, Fengquan Zhou (2015), Microgrid Technology and Engineering Application, 1st Ed, Elsevier
2. Nikos Hatziagyriou (2013), Microgrids: Architectures and Control, Wiley

Reference Books:

1. David Gao, (2015) Energy Storage for Sustainable Microgrid, 1st Ed , Elsevier
2. Magdi S, Mahmoud , (2017), Microgrid- Advanced Control Methods and Renewable Energy System Integration, Butterworth –Heinemann- Elsevier
3. Chowdhury,S, Chowdhury, SP, Crossley, P, Microgrids and Active Distribution Networks, IET

UNITI INTRODUCTION TO POWER QUALITY AND SYSTEM OPERATION 12 Hrs

Subject Code: BEE17014	Subject Name: **POWER SYSTEM OPERATION, CONTROL AND POWER QUALITY**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	T	3	1/0	0/0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE:

- To attain basic knowledge on Power Quality and power System operation
- To plot load duration curve and understand the need for regulation
- To impart knowledge on Frequency control and Voltage Control
- To study the economic operation of power system and Unit commitment
- To know the importance of System Monitoring and Power Quality Measurement Equipments

COURSE OUTCOMES (COs) : (3- 5)

CO1	Acquire knowledge on Power Quality and power System operation
CO2	Understanding of load duration curve and regulation needs
CO3	Familiar to Frequency control and Voltage Control
CO4	knowledge on economic operation of power system and Unit commitment
CO5	Understand the importance of System Monitoring and Power Quality Measurement Equipments

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	H	H	H	H	H	H
CO2	H	H	H	H	H	H	H	L	M	L	H	L
CO3	H	H	H	H	H	H	H	L	M	L	H	L
CO4	M	M	M	M	M	M	H	L	M	M	H	H
CO5	H	H	H	H	H	H	H	M	H	H	H	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	H	H	H	H			
CO2	H	H	H	H	H			
CO3	H	H	H	H	H			
CO4	H	H	H	H	H			
CO5	H	H	H	H	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								

Approval	

Power Quality Terms- Overloading- Under Voltage- Over Voltage-Voltage Sag- Voltage Swell – Voltage imbalance- Voltage fluctuation-Power Frequency Variation – Harmonics - System load Characteristics– load curves and load-duration curve - load factor - diversity factor - Need for Voltage regulation and frequency regulation in power system - Basic P-F and Q-V control loops

UNIT II REAL POWER - FREQUENCY CONTROL 12 Hrs

Fundamentals of AGC-Fundamentals of Speed Governing mechanisms and modeling - Speed-Load characteristics-regulation of two Synchronous Machines in parallel - Control areas - LFC of single & Multi areas Static & Dynamic Analysis of uncontrolled and controlled cases –Tie line with frequency bias control – Steady state instabilities

UNIT III REACTIVE POWER–VOLTAGE CONTROL 12 Hrs

Excitation system Modeling - Static & Dynamic Analysis - stability Compensation-Principles of transmission line compensation - Effect of Generator loading – static VAR System Modeling - System Level Voltage control

UNIT IV ECONOMIC DISPATCH AND UNIT COMMITMENT 12 Hrs

Need for Economic Dispatch-Characteristics curve for Steam and hydroelectric Units - Co-ordination Equation with Loss and without losses- Base point and Participation Factor- Constraints and solutions in Unit Commitment -Priority List methods-Forward Dynamic Programming approach

UNIT V MONITORING & COMPUTER CONTROL OF POWER SYSTEMS 12 Hrs

Need of computer control of power systems. Concept of energy control centre (or) load dispatch centre and the functions - system monitoring - data acquisition and control. System hardware configuration – SCADA and EMS functions-Control Strategies – Power quality Measurement Equipment – Harmonic Analyser – Flicker meter

Total Number of hours: 60Hrs

Text Books:

1. Allen. J. Wood and Bruce F. Wollenberg,(2003) Power Generation, Operation and Control. John Wiley & Sons. Inc
2. Chakrabarti & Halder,(2004) Power System Analysis: Operation and Control. Ed. Prentice Hall of India
3. Kundur, P,(1994) Power System Stability and Control. USA: MCGraw Hill Publisher

Reference Books:

1. Kothari, D.P. and Nagrath, I.J. (2003) Modern Power System Analysis.3rd .Tata McGraw Hill Publishing Company Limited
2. Grigsby, L.L. (2001) The Electric Power Engineering, Hand Book. CRC Press & IEEE Press
3. Hadi Saadat, (2007) Power System Analysis.11th Reprint
4. N.V.Ramana, (2011)Power System Operation and Control," Pearson
5. C.A.Gross, (2011)Power System Analysis," Wiley India

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

MANAGEMENT CONCEPTS AND ORGANIZATION BEHAVIOUR

Subject Code: BMG17002	Subject Name: MANAGEMENT CONCEPTS AND ORGANISATION BEHAVIOUR	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:	L	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- This course is aimed at addressing the contemporary issues, which fall under the broad title of management, and its functions.
- There will also be an attempt to analyze the behavior of individuals within an organization and the issues of working with other group or teams.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Effective leadership skills
CO2	Accommodating with co workers and at Work environment
CO3	Enhanced leadership skills
CO4	Understanding and implementing good policies for the welfare of management and workers

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	L	M	L	M	L	L	L	M	L	L	L
CO2	M	M	L	L	L	M	L	H	M	M	L	H
CO3	L	L	H	H	M		M	H	M	L	M	L
CO4	M	L	L	L	L	M	L	L	M	L	L	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	L	L	L	L	L			
CO2	L	L	L	L	L			
CO3	L	L	L	L	L			
CO4	L	L	L	L	L			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
			✓									

Approval	

UNIT I INTRODUCTION **9 Hrs**

Management – definition, evolution – nature of management – distinction between administration and management, MBO, Management functions – planning, organization, motivating, control and functions Areas -operations – marketing, finance, HR

UNIT II ORGANIZING **9 Hrs**

Organizing definitions – process of organization – importance of organization – organization structure – organizational chart - and managing HR and communicating- types of communication – formal communication – features of formal communication , motivating and leading

UNIT III INDIVIDUAL AND GROUP BEHAVIOUR **9 Hrs**

Behavior of an individual in an organization – attitude, value, job satisfaction, personality, perception, concepts of learning, motivation, theories and application. Group behavior – structure process, decision making, work team – different from group

UNIT IV POWER AND POLITICS **9 Hrs**

Power and politics, directing – characteristics of directing – importance of directing – principles of directing – techniques of directing, organizational culture, organizational work culture and work design

UNIT – V HR policies and practices **9 Hrs**

HR policies and practices, Definitions of supervision – qualities of a good supervisor- responsibilities or functions of a supervisor, appraisal of performance – span of supervision managing the future – new worker / new organization etc.

Total Number of hours: 45Hrs

Reference Books:

1. Stephen P Robbins, Organizational Behavior, PHI, 15th edition, 2012 ISBN 10: 0132834871/0-13-283487-1 ISBN 13: 9780132834872
2. Koontz O'Dannel, Principles of Management – Mc Graw Hill Publishing Co.LTD, 5th edition, 2008
3. Peter Drunker, The practice of management – Allied Publications. 2010, ISBN: 0062005448, 9780062005441
4. L M Prasad, Principles and Practice of Management, Sultan Chand & Sons., 7th edition, 2007, ISBN: 818054575X, 9788180545757
5. Steward Black & Lyman W Porter, Management – Meeting new challenges, Prentice Hall, October 1st 2004, ISBN: 0131430084 (ISBN13: 9780131430082)

INDUSTRIAL AUTOMATION LABORATORY

Subject Code: BEE17L12	Subject Name: INDUSTRIAL AUTOMATION LABORATORY	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:	L	0	0/0	1/1	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To understand calibration of pressure gauge.
- To understand the programming in PLC.
- The students will be able to understand various faults using SCADA.
- The graduates shall be able to understand the characteristics of control valves.
- The graduates shall understand the closed loop responses of different processes.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Familiar to calibration of pressure gauge.
CO2	Acquire programming knowledge in PLC
CO3	Student can understand various faults using SCADA
CO4	Familiar to the control valve characteristics
CO5	Understand the closed loop responses of different processes.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	L	L	H	L	H	L
CO2	H	H	H	H	H	H	M	L	H	L	H	L
CO3	H	H	H	H	H	H	M	L	H	L	H	L
CO4	M	M	M	M	H	H	M	M	H	M	H	L
CO5	H	H	H	H	H	H	H	M	H	H	H	L

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	L	H	M	L	H			
CO2	H	H	H	H	H			
CO3	H	H	H	H	H			
CO4	H	H	H	M	H			
CO5	H	H	H	H	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					
Approval												

LIST OF EXPERIMENTS

1. Calibration of Pressure gauge using Dead Weight Tester
2. Characteristics of control valves.
3. Characteristics of I to P and P to I converters.
4. Characteristics of RTD
5. Verification of logic gates using PLC
6. Automatic Solid State Relay using PLC.
7. Automatic Object Sensing with Counter using PLC
8. Automatic Traffic Light Control System using PLC
9. PLC based automatic Bottle Filling System
10. Responses of Level Process Control Loop
11. Responses of Temperature Process Control Loop
12. Responses of Pressure Process Control Loop
13. Responses of Cascade Process Control Loop
14. Fault Analysis using SCADA
15. Study of Transmission and Distribution Modes using SCADA
16. Calibration of Thermocouple

Total Number of hours: 45Hrs

MICROGRID LABORATORY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

LIST OF EXPERIMENTS

Subject Code: Bee17lL3	Subject Name: MICROGRID LABORATORY	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:	Ty	0	0/0	2/1	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- Students can obtain knowledge about specific wind power, calculate the wind frequency, turbines characteristics, time period and frequency of the rotating turbine at different speeds.
- To understand the concept of semiconductors and p-n junction energy band, Illumination effect on PV Modules, effect of Temperature, Effect of Shading on PV Modules and Effect of Angle of Inclination of Solar Modules.
- To understand the Characteristics of Solar Modules when connected in series and parallel
- To help the students to understand the modelling, simulation, implementation and performance characteristics of solar photovoltaic and wind turbine.
- To help the students to design and simulate the performance characteristics of a Micro-grid

COURSE OUTCOMES (COs) : (3- 5)

CO1	Students can obtain knowledge about generated wind power, turbines characteristics, performance of turbine at different speeds.
CO2	Students can understand the concept of semiconductors and p-n junction energy band, Illumination effect on PV Modules, effect of Temperature, Effect of Shading on PV Modules, Effect of Angle of Inclination of Solar Modules.
CO3	Capable of understanding the concept of the Characteristics of Solar Modules when connected in series and parallel
CO4	Students will be able to model, simulate, implement and perform the characteristics of solar photovoltaic and wind turbine.
CO5	Students will be able to design and simulate the performance characteristics of a Micro-grid

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	H	M	H	M	H	L
CO2	H	H	H	H	H	H	H	M	H	M	H	L
CO3	M	M	H	H	H	H	H	M	H	M	H	L
CO4	H	H	H	H	H	H	H	H	H	H	H	H
CO5	H	H	H	H	H	H	H	L	H	H	H	L

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	H	H	H	H	H		
CO2	M	H	H	H	H		
CO3	H	H	H	H	H		
CO4	H	H	H	H	H		
CO5	M	H	H	H	H		

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					

Approval	

1. Characteristics of PV Modules
2. Characteristics of Series connection PV Modules
3. Characteristics of Parallel Connection PV Modules
4. Effect of Shading in the PV Characteristics
5. Effect of Tilting in PV Characteristics
6. Evaluation of cut-in and start up speed of Wind Turbine
7. Evaluation of efficiency of charge controller
8. Evaluation of Tip Speed Ratio (TSR) of Wind Turbine
9. Evaluation of co-efficient of performance of Wind Turbine
10. Evaluation of Turbine Power and Wind Speed
11. Evaluation of TSR and Co-efficient of Power
12. Simulation of Characteristics Of PV Module.
13. Simulation of Characteristics Of Wind Turbine
14. Simulation of Characteristics Of PV Modules Connected in Parallel
15. Simulation of Characteristics Of PV Modules Connected in Series
16. Design of a Micro-grid using Matlab/PSCAD/ETAP

Total Number of hours: 45Hrs

Subject Code: BEE17I14	**Subject Name : PROJECT PHASE - 1**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite: NIL	L	2	0/1	0/1	2

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : The objective of the Main Project is to culminate the academic study and provide an opportunity to explore a problem or issue , address through focused and applied research under the direction of a faculty mentor. The project demonstrates the student's ability to synthesize and apply the knowledge and skills acquired to real-world issues and problems. This project affirms the students to think critically and creatively, find an optimal solution, make ethical decisions and to present effectively.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Apply the knowledge and skills acquired in the course of study addressing a specific problem or issue.
CO2	To encourage students to think critically and creatively about societal issues and develop user friendly and reachable solutions
CO3	To refine research skills and demonstrate their proficiency in communication skills.
CO4	To take on the challenges of teamwork, prepare a presentation and demonstrate the innate talents.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	M	H	H	L	M	M	H	H
CO2	H	H	H	H	H	H	H	M	M	M	H	H
CO3	H	H	H	H	H	H	H	M	M	H	H	M
CO4	H	M	H	H	H	H	M	H	H	H	H	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	H	H	H	H			
CO2	H	H	H	H	H			
CO3	H	H	H	H	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					
Approval												

Subject Code: BFL17001	**Subject Name : FOREIGN LANGUAGE**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite: NIL	Ty	1	0/1	0/0	2

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : To recognize the cultural values, practices, and heritage of the foreign country, communicate effectively in a foreign language and interact in a culturally appropriate manner with native speakers of that language.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Achieve functional proficiency in listening, speaking, reading, and writing.
CO2	Develop an insight into the nature of language itself, the process of language and culture acquisition.
CO3	Decode, analyze, and interpret authentic texts of different genres.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	L	L	L	L	H	L	H	M	H	H	L
CO2	M	L	L	L	L	H	L	H	H	H	H	L
CO3	L	L	M	M	L	H	M	H	M	H	H	L

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	L	L	L	L	L			
CO2	L	L	L	L	L			
CO3	L	L	L	L	L			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
			✓									
Approval												

ENTREPRENEURSHIP DEVELOPMENT

UNIT I INTRODUCTION **9 Hrs**

Nature and Development of Entrepreneurship; Entrepreneurial Decision Process; Role of entrepreneurship in economic development; Entrepreneurial process; managerial vs. entrepreneurial approach and

Subject Code:	**Subject Name : ENTREPRENEURSHIP DEVELOPMENT**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite: NIL	T	0	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE

- The course aims to acquaint the students with challenges of starting new ventures and enable then to investigate, understand and internalize the process of setting up a business

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understand the basics of entrepreneurial development
CO2	Explain the requisites of starting a small scale industry
CO3	Propose a plan for new venture
CO4	Comprehend role of government in entrepreneurship

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M	H	L	L	M	L	H	L	H	H	H
CO2	L	H	L	L	L	L	L	M	L	M	H	M
CO3	H	H	H	L	L	M	L	M	M	H	M	M
CO4	L	M	L	M	L	L	H	L	L	M	L	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	L	L	L	L	L			
CO2	L	L	L	L	L			
CO3	L	L	L	L	L			
CO4	L	L	L	L	L			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
			✓				✓					

emergence of entrepreneurship - Entrepreneurial background; Skills and characteristics of successful entrepreneurs; Motivation; Role Models and Support Systems

Approval	

UNIT II BUSINESS IDEA **9 Hrs**

Generating business idea – sources of new ideas, methods of generating ideas, creative problem solving, opportunity recognition; Environmental scanning, competitor and industry analysis; Feasibility study – market feasibility, technical/operational feasibility, financial feasibility; Drawing a business plan; Using and Implementing the Business plan

UNIT III MARKETING PLAN **9 Hrs**

Marketing plan – Marketing research for the new venture; Steps in preparing marketing plan; Contingency planning; Organizational plan – Forms of Business; Designing the organization; Building management team and Successful Organizational Culture; Role of Board of Directors; Board of Advisors; Financial plan – Operating and capital Budgets; Pro forma income statements; Pro forma cash flow; Pro forma balance sheet; Break even analysis; Pro forma Sources and Applications of Funds

UNIT IV ASSESSMENT OF RISK **9 Hrs**

Assessment of Risk; Sources of finance – Debt or Equity Financing, Internal or External Funds; Personal Funds, Family and Friends; Commercial Banks – types of loans, Cash flow financing, Bank lending decisions; Venture Capital – Nature, overview, process, locating and approaching Venture Capitalists

UNIT V ENTREPRENEURIAL STRATEGY FOR GENERATING AND EXPLOITING NEW ENTRIES; STRATEGIES FOR GROWING THE VENTURE **9 Hrs**

Entrepreneurial strategy for generating and exploiting new entries; Strategies for growing the venture; Growth implications on Economy, Firm and Entrepreneur - Other routes for growth – Franchising, Joint Ventures, Acquisitions and Mergers: Going Public – Advantages & Disadvantages, Alternatives to Going Public

Total Number of hours: 45Hrs

Reference Books:

1. Hisrich, Robert D., Michael Peters and Dean Shephered, Entrepreneurship, Tata McGraw Hill, New Delhi., 9th Edition, 2012, ISBN-13: 978-0078029196, ISBN-10: 0078029198
2. Vasant Desai, The Dynamics of Entrepreneurial Development and Management, Himalaya Publishing House., 11th Edition, 2005, ISBN: 8178660598
3. Prasana Chandra, Projects – planning, analysis selection, Implementation and reviews, Tata McGraw-Hill Publishing Company, 7th Edition, 2009, ISBN-10: 0070077932, ISBN-13, 9780070077935
4. Charantimath, Poornima, Entrepreneurship Development and Small Business Enterprises, Pearson Education, New Delhi, 5th Edition, 2009, ISBN: 978-81-7758-260-4
5. K.Ramachandran, Essentials of Business Communication, McGraw Hill Education (India) Private Limited, 9th Edition, 2013, ISBN-13: 978-1-111-82122-7, ISBN-10: 1-111-82122-4

Subject Code: BEE17E01	Subject Name: SOLAR ENERGY CONVERSION SYSTEM	T / L/ ETL	L	T / SLr	P/ R	C
	Prerequisite: NIL	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To study about Solar Radiation and the collector types
- To impart knowledge on the Application of Solar thermal Technology
- To understand the fundamentals of Solar Photovoltaic cells
- To design the Solar cells in cost effective manner.
- To learn about the solar passive Architecture

COURSE OUTCOMES (COs) : (3- 5)

CO1	Students understand Solar Radiation and the collector types
CO2	Acquire knowledge on the Application of Solar thermal Technology
CO3	Understand the fundamentals of Solar Photovoltaic cells
CO4	Familiar to design the Solar cells in cost effective manner
CO5	Incorporate the knowledge about the solar passive Architecture

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	H	M	H	H	H	H
CO2	H	H	H	H	H	H	H	M	H	H	H	H
CO3	H	H	H	H	H	H	H	M	H	H	H	H
CO4	H	H	H	H	H	H	H	M	H	H	H	H
CO5	H	H	H	H	H	H	H	M	H	H	H	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	H	M	M
CO2	H	H	H	M	M
CO3	M	H	H	M	M
CO4	M	H	H	H	M
CO5	M	H	H	H	M

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills
Approval				✓					

Subject Code: BEE17L13	Subject Name : PROJECT PHASE - 2	T / L/ ETL	L	T / SLr	P/ R	C
	Prerequisite: NIL	L	0	0/0	0/0	10

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : The objective of the Main Project is to culminate the academic study and provide an opportunity to explore a problem or issue , address through focused and applied research under the direction of a faculty mentor. The project demonstrates the student's ability to synthesize and apply the knowledge and skills acquired to real-world issues and problems. This project affirms the students to think critically and creatively, find an optimal solution, make ethical decisions and to present effectively.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Apply the knowledge and skills acquired in the course of study addressing a specific problem or issue.
CO2	To encourage students to think critically and creatively about societal issues and develop user friendly and reachable solutions.
CO3	To refine research skills and demonstrate their proficiency in communication skills.
CO4	To take on the challenges of teamwork, prepare a presentation and demonstrate the innate talents.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	H	M	H	H	H	H
CO2	H	H	H	H	H	H	H	M	H	H	H	H
CO3	H	H	H	H	H	H	H	M	H	H	H	H
CO4	H	H	H	H	H	H	H	M	H	H	H	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	H	M	M
CO2	H	H	H	M	M
CO3	M	H	H	H	M
CO4	M	H	H	H	M

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills
Approval							✓		

Approval

SOLAR ENERGY CONVERSION SYSTEM

UNIT I SOLAR RADIATION AND COLLECTORS 9 Hrs

Solar Radiation- Solar angles - Sun path diagrams - shadow determination – Solar Collectors - flat plate collector thermal analysis - heat capacity effect - testing methods-evacuated tubular collectors - concentrator collectors – classification - tracking systems - compound parabolic concentrators - parabolic trough concentrators - concentrators with point focus - Heliostats – performance of the collectors

UNIT II APPLICATIONS OF SOLAR THERMAL TECHNOLOGY 9 Hrs

Principle of working, types - design and operation of - solar heating and cooling systems - solar water heaters – thermal storage systems – solar still – solar cooker – domestic, community – solar pond – solar drying

UNIT III SOLAR PV FUNDAMENTALS 9Hrs

Solar cells - p-n junction: homo and hetro junctions - metal-semiconductor interface - dark and illumination characteristics - efficiency limits - variation of efficiency with band-gap and temperature - efficiency measurements - high efficiency cells - preparation of metallurgical, electronic and solar grade Silicon - production of single crystal Silicon: Czokralski (CZ) and Float Zone (FZ) method

UNIT IV SOLAR PHOTOVOLTAIC SYSTEM DESIGN AND APPLICATIONS 9Hrs

Solar cell array system analysis and performance prediction- Shadow analysis: reliability - solar cell array design concepts - PV system design - design process and optimization -voltage regulation - maximum tracking – use of computers in array design - quick sizing method - array protection and troubleshooting - stand alone - hybrid and grid connected system - System installation - operation and maintenances - field experience - PV market analysis and economics of SPV systems

UNIT V SOLAR PASSIVE ARCHITECTURE 9 Hrs

Thermal comfort - heat transmission in buildings- bioclimatic classification – passive heating concepts: direct heat gain - indirect heat gain - isolated gain and sunspaces - passive cooling concepts: evaporative cooling - application of wind, water and earth for cooling; shading - paints and cavity walls for cooling - roof radiation traps - earth air-tunnel. – energy efficient landscape design - thermal comfort – concept of solar temperature and its significance - calculation of instantaneous heat gain through building envelope

Total Number of hours: 45Hrs

Text Books:

1. Sukhatme S P, (1984), Solar Energy, Tata McGraw Hill
2. Kreider, J.F. and Frank Kreith, (1981), Solar Energy Handbook, McGraw Hill
3. Goswami, D.Y., Kreider, J. F. and & Francis.,(2000),Principles of Solar Engineering

Reference Books:

1. Garg H P., Prakash J., (2000), Solar Energy: Fundamentals & Applications, Tata McGraw Hill
2. Duffie, J. A. and Beckman, W. A., (1991), Solar Engineering of Thermal Processes, John Wiley
3. Alan L Fahrenbruch and Richard H Bube, (1983), Fundamentals of Solar Cells: PV Solar Energy Conversion, Academic Press
4. Larry D Partain,(1995), Solar Cells and their Applications, John Wiley and Sons, Inc.

Subject Code: BEE17E02	Subject Name: ADVANCED DIGITAL SIGNAL PROCESSING	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To Understand the concepts of filters, algorithm and its applications.
- To study adaptive filters
- To design multirate signal processing using I and D factor.
- To study about speech signal processing.
- To apply Wavelet transforms

COURSE OUTCOMES (COs) : (3- 5)

CO1	Ability to understand the concepts of filters, algorithm and its application
CO2	Attained the knowledge about Adaptive filters
CO3	Ability to design the multirate signal processing
CO4	Knowledge on Speech Signal
CO5	Capable to apply the wavelet Transform

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	M	L	L	H	L	H	H	H	M	H
CO2	M	M	M	L	L	H	L	M	M	M	H	M
CO3	M	H	H	M	H	H	M	M	L	H	H	M
CO4	M	L	M	L	L	H	M	L	M	H	H	L
CO5	L	H	H	M	M	H	L	L	H	M	H	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	M	M	M	L			
CO2	M	M	H	M	M			
CO3	H	H	H	H	H			
CO4	H	M	H	H	H			
CO5	H	H	H	H	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					√							
Approval												

ADVANCED DIGITAL SIGNAL PROCESSING

UNIT I PARAMETRIC METHODS FOR POWER SPECTRUM ESTIMATION 9 Hrs

Relationship between the auto correlation and the model parameters – The Yule – Walker method for the AR Model Parameters – The Burg Method for the AR Model parameters – unconstrained least-squares method for the AR Model parameters – sequential estimation methods for the AR Model parameters – selection of AR Model order

UNIT II ADAPTIVE SIGNAL PROCESSING 9 Hrs

FIR adaptive filters – steepest descent adaptive filter – LMS algorithm – convergence of LMS algorithms – Application: noise cancellation – channel equalization – adaptive recursive filters – recursive least squares

UNIT III Multi rate Signal Processing 9 Hrs

Decimation by a factor D – Interpolation by a factor I – Filter Design and implementation for sampling rate conversion: Direct form FIR filter structures – Poly phase filter structure

UNIT IV Speech Signal Processing 9 Hrs

Digital models for speech signal : Mechanism of speech production – model for vocal tract, radiation and excitation – complete model – time domain processing of speech signal:- Pitch period estimation – using autocorrelation function – Linear predictive Coding: Basic Principles – autocorrelation method – Durbin recursive solution

UNIT V Wavelet Transforms 9 Hrs

Fourier Transform : Its power and Limitations – Short Time Fourier Transform – The Gabor Transform - Discrete Time Fourier Transform and filter banks – Continuous Wavelet Transform – Wavelet Transform Ideal Case – Perfect Reconstruction Filter Banks and wavelets – Recursive multi-resolution decomposition – Haar Wavelet – Daubechies Wavelet-Familiarization of related simulation package

Total Number of hours: 45Hrs

Text Books:

1. John G. Proakis, Dimitris G. Manobakis (2000) Digital Signal Processing, Principles, Algorithms and Applications.3rd Ed. PHI
2. Monson H. Hayes, (2002) – Statistical Digital Signal Processing and Modeling. Wiley

Reference Books:

1. Rabiner, L.R. Schaber, R.W. (1979) Digital Processing of Speech Signals. Pearson Education
2. Roberto Crist, (2004) Modern Digital Signal Processing. Thomson Brooks/Cole
3. Raghuveer M. Rao, Ajit S. Bopardikar, (2000) Wavelet Transforms, Introduction to Theory and applications. Asia : Pearson Education

Subject Code: BEE17E03	Subject Name: GRID MODERNIZATION	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To know the basics of Power Grid
- To attain Familiarity on Power Tariff
- To attain confidence and knowledge on Generation Planning
- To have wide spread of knowledge on Transmission Planning
- To obtain knowledge on Distibution Planning

COURSE OUTCOMES (COs) : (3- 5)

CO1	Attained knowledge on Power Grid
CO2	Familiarity on the different types of Power Tariff
CO3	Ability to plan for Load forecasting based on Weather and load conditions
CO4	Attained knowledge on various types of power and energy markets
CO5	Attained knowledge on Primary and secondary systems

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	L	M	H	M	L	M	L	H	M	M	M
CO2	H	M	M	M	H	L	M	H	H	M	M	H
CO3	M	M	M	M	H	L	M	M	M	H	M	M
CO4	M	L	L	M	H	M	H	L	M	M	H	M
CO5	M	M	H	L	M	H	M	M	L	L	L	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	M	M	M	H			
CO2	H	M	M	H	M			
CO3	H	M	L	M	L			
CO4	H	M	M	L	M			
CO5	M	H	H	M	M			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

GRID MODERNIZATION

Approval	

UNITI INTRODUCTION TO GRID **9 Hrs**

Power Grid – Traditional & Modern Grid – Main Features of the Grid – Market and Trading Models – GenCo, Trans Co, DisCo, Retail Co- Power Market Types – Energy market – Ancillary Service Market – Transmission market – Forward and Real Time Markets- Market Power

UNITII POWER TARIFF **9 Hrs**

Tariff Principle – Consumer Tariff Structure –Different Consumer Category – Fixed and Variable charges- Subsidy and Cross Subsidy – Life line tariff – Structures for different load patterns – Government Policies – Effect of Renewable Energy and Captive Power Generation

UNITIII GENERATION PLANNING **9 Hrs**

Long and short term planning – Load forecasting – Load growth patterns – Weather sensitive load forecasting - Reliability concepts – Generator reliability analysis – Models for Generators and loads- Determination of LOLP – Determination of isolated and interconnected Generation system

UNIT IV TRANSMISSION PLANNING **9 Hrs**

Transmission planning – Different Methods of transmission pricing – Congestion issues and Management – Transmission cost allocation methods –Locational Marginal Price- Transmission Ownership and control – Role of Load Dispatch Centre – Constrained Unit commitment

UNIT V DISTRIBUTION PLANNING **9 Hrs**

Sub-Transmission lines – Distribution Substation – Modern Distribution – Design of Primary and Secondary systems – Feeders and types – Protection and coordination of Distribution system

Total Number of hours: 45Hrs

Text Books:

1. Sullivan R.L, Power System Planning, McGaw Hill
2. Roy Billington, Allan Ronald, Power System Reliability

Reference Books:

1. Turan Gonen, 1986, Electric Power Distribution System Engineering, Mc Graw Hill, 1986
2. Kundur. P, Power System Stability & Control, Mc Graw Hill

Subject Code: BEE17E04	**Subject Name: WIND ENERGY CONVERSION SYSTEMS**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To know the basics of Wind Energy Conversion System
- To solve the Energy crisis.
- To know the Power Electronic Devices and its characteristics.
- To understand different converters
- To design wind Energy conversion system such as subsystems and its components

COURSE OUTCOMES (COs) : (3- 5)

CO1	Knowledge on Wind Energy Systems
CO2	Capability to find solution for Energy Crisis
CO3	Attained knowledge on various types of converters
CO4	Familiarity in Power Electronics Devices and its performance.
CO5	Ability to design Electrical Machines for Wind Energy Conversion System

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	L	L	M	M	H	M	L	L	H	H	L
CO2	M	H	H	H	H	H	H	H	M	M	H	H
CO3	H	M	M	H	M	H	M	M	M	L	H	M
CO4	M	M	M	M	L	H	M	M	H	M	H	L
CO5	H	H	H	H	H	H	M	H	H	M	H	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	M	L	L	M	L			
CO2	L	H	M	H	L			
CO3	L	M	H	M	L			
CO4	M	M	H	M	L			
CO5	H	H	H	H	M			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

WIND ENERGY CONVERSION SYSTEMS

UNIT I INTRODUCTION TO WIND SYSTEMS 9 Hrs

Historical uses of wind – History of wind turbines – Horizontal axis wind turbines – Darreius Wind Turbines – Innovative wind turbines – Components of the wind energy conversion system – Power output from an ideal wind turbine – Power output from practical wind turbines

UNIT II WIND CHARACTERISTICS & MEASUREMENTS 9 Hrs

Meteorology of wind – Wind speed statistics – Weibull Statistics – Rayleigh and normal distribution – Wind measurements – Eolian features – Biological Indicators – Types of anemometers and their operation – Wind direction – Wind measurements with balloons

UNIT III WIND TURBINE SUBSYSTEMS & COMPONENTS 9 Hrs

Rotor – Blades – Aerodynamic design – Structural Design – Fabrication – Aerodynamic Control Surfaces – Hub – Types- Drive Train – Coupling – Gearbox – Brake – Types – Main frame & Nacelle – Tower

UNIT IV ELECTRICAL MACHINES FOR WECS 9 Hrs

Induction Machine – Theory of IM operation - Dynamic dq Modeling - Doubly fed Induction Generator – Synchronous Machines – Theory of operation – Starting wind turbines with IG - Variable Reluctance Machine – Effect of Harmonics

UNIT V OVERVIEW OF CONVERTERS 9 Hrs

Six Pulse Converter – 12 Pulse Converter – Sequential control of converters – Converter Control – EMI and Power Quality Problems – Control of Cycloconverter – Matrix Converters – High Frequency Cycloconverter, VFC and CFC

Total Number of hours: 45Hrs

Text books:

1. Manwell, J.F. Mcgowan, J.G. Rogers, A.L.(2002) Wind Energy Explained – Theory, Design & Application. John Wiley & Sons
2. Gray L. Johnson,(1985) Wind Energy Systems. Prentice Hall Inc
3. Bose, B.K. (2001) Modern Power Electronics & AC Drives. Prentice Hall

Reference Books:

1. Vaughn Nelson, (2009) Wind Energy – Renewable Energy & the Environment. CRC Press

Subject Code: BEE17E05	**Subject Name: ARTIFICIAL INTELLIGENCE**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To attain familiarity in Artificial Intelligence
- To study about Fuzzy System.
- To acquire knowledge of ANN
- To study about genetic algorithm
- To do programming using optimization techniques.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Familiarity in Artificial Intelligence
CO2	Acquired knowledge on Fuzzy System
CO3	Acquired knowledge on Neural Network
CO4	Familiarity in Genetic Algorithm
CO5	Capable to solve issues with optimization techniques

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	L	H	H	L	H	L	L	M	M	H	M
CO2	H	M	M	H	H	M	H	H	H	H	H	H
CO3	M	M	L	H	M	H	M	M	H	M	H	M
CO4	M	H	M	H	L	M	M	M	M	L	H	M
CO5	H	H	M	H	M	H	H	H	H	H	H	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	M	M	M	L	M			
CO2	M	L	H	M	M			
CO3	L	L	H	L	L			
CO4	M	M	M	L	L			
CO5	H	M	H	H	M			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

ARTIFICIAL INTELLIGENCE

UNIT I INTRODUCTION TO ARTIFICIAL INTELLIGENCE 9Hrs

Computational Intelligence Paradigms - Heuristic Search – Techniques for heuristic search and classification, State Space Search – Strategies for implementation of Graph search based on Recursion patent – directed search production system and learning

UNIT II FUZZY SYSTEMS 9 Hrs

Fuzzy Sets: Definitions - Membership Functions-Operators - Fuzzy Set Characteristics - Fuzziness and Probability. Fuzzy Logic and Reasoning: Fuzzy Logic - Linguistics Variables - Fuzzy Rules Fuzzy Inferencing - Fuzzification - Inferencing - Defuzzification - Fuzzy Controllers : Components of Fuzzy Controllers- Types - Mamdani Fuzzy Controller

UNIT III ARTIFICIAL NEURAL NETWORKS 9 Hrs

Calculating the Net Input Signal - Activation Functions - Artificial Neuron Learning .Supervised Learning Neural Networks: Neural Network Types Feed forward Neural networks Supervised Learning Rules-Gradient Descent Optimization. Unsupervised Learning Neural Networks: Hebbian Learning Rule - Learning Rule -Stochastic Training Rule

UNIT IV EVOLUTIONARY ALGORITHM 9 Hrs

Particle Swarm Optimization: Basic Particle Swarm Optimization -Global Best PSO-Local Best PSO. Genetic Algorithms: Canonical Genetic Algorithm -Crossover -Mutation - Control Parameters. Ant colony Algorithms: Ant Colony Optimization -Foraging Behaviour of Ants-Simple Ant Colony Optimization

UNIT V APPLICATION OF COMPUTATIONAL INTELLIGENCE 9 Hrs

Study the Algorithm and Code for travel salesman problems, Traffic monitoring problems, transportations problems, fault diagnosis problems with computational intelligence

Total Number of hours: 45Hrs

Textbooks:

1. Simon Haykin, (1994) Neural Networks: A Comprehensive Foundation, Macmillan College Publishing Company
2. Goldberg D.E. (2002) Genetic Algorithms in Search, Optimization and Machine Learning. Pearson Education Asia
3. Timothy. J. Ross, (2000) "Fuzzy Logic with Engineering Applications

Reference Books:

1. Andries P.Engelbrecht, (2000) Computational intelligence. University of Pretoria-South Africa
2. Singiresus. Rao, Engineering optimization. West Lafayette. Indiana
3. J. Yen and R. Langari, "Fuzzy Logic: Intelligence, Control, and Information" , Prentice-Hall, 1999
4. Sudhir K., " Fuzzy Sets And Applications "
5. Bhargava A.K. " Fuzzy Set Theory Fuzzy Logic and their Applications

Subject Code: BEE17E06	Subject Name: SUBSTATION DESIGNING	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To study about the importance of Substation and its types
- To impart knowledge on Gas Insulated Substation and its working Principle
- To know the working principle and characteristics of Air-Insulated Substations
- To have a wide spread knowledge about High voltage Power Electronics Substation such as HVDC station
- To understand the Integration and Automation of Substations

COURSE OUTCOMES (COs) : (3- 5)

CO1	Attained the knowledge about the importance of Substation and its types
CO2	Attained familiarity about the Gas insulated substations and its principles
CO3	Familiarity in the working of Air-insulated Substations
CO4	Knowledge on High voltage Power Electronics Substation
CO5	Knowledge on the integration of Substation

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	L	M	M	M	H	M	L	M	M	H	L
CO2	M	M	M	L	M	H	M	H	M	M	H	M
CO3	H	L	L	L	L	H	M	L	M	M	M	M
CO4	H	M	M	H	M	H	H	M	M	M	M	L
CO5	M	M	L	H	L	H	H	M	H	M	H	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	M	H	M	L			
CO2	M	M	H	M	L			
CO3	M	H	H	M	M			
CO4	M	M	H	M	L			
CO5	L	M	H	M	M			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

SUBSTATION DESIGNING

UNIT I INTRODUCTION TO SUBSTATION AND ITS TYPES 9 Hrs

Need for Substation – Budgeting – Traditional & Innovative Substation Design – Site Selection and Acquisition- Station Design – Station Construction – Station Commissioning- bas bar arrangements in Switchyard

UNIT II GAS INSULATED SUBSTATION 9 Hrs

Sulfur Hexafluoride – Construction – Circuit Breaker – Current and Voltage Transformers – Disconnect and Ground Switches – Interconnecting Bus – Air, Power Cable and Direct Transformer Connections – Surge Arrester – Control System – Gas monitoring System – Gas compartments and Zones – Electrical & Physical Arrangement – Grounding – Testing – Installation – Operation and Interlocks – Economics.

UNIT III AIR-INSULATED SUBSTATIONS 9 Hrs

Introduction – Single and Double Bus Arrangement – Main and Transfer Bus Arrangement – Double Bus-Single Breaker Arrangement – Ring Bus Arrangement – Breaker and a Half Arrangement – Comparison of Configurations

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UNIT IV HIGH VOLTAGE POWER ELECTRONIC SUBSTATION 9 Hrs

High Voltage Power Equipments - Converter Station(HVDC) – FACTS Controllers – Control & Protection System – Losses and cooling – Civil works – Reliability and Availability – Future Trends

UNIT V SUBSTATION INTEGRATION AND AUTOMATION 9 Hrs

Definitions and Terminology – Open Systems- Architecture Functional Data paths – Substation Integration and Automation Systems – New Vs Existing Substations – Equipment conditioning Monitoring – Substation Integration and Automation Technical issues – Protocol Fundamentals and Considerations – Communication Protocol Application Areas

Total Number of hours: 45Hrs

Text Books:

1. John D, Mc Donald (2007), Electric Power Substations Engineering, 2nd Ed, CRC Press
2. Sunil, S, Rao (2010), Switchgear Protection and Power Systems, 4th Ed. Khanna Publishers

Reference Books:

1. Khedkar, MK , Dhole, GM, Electric Power Distribution Automation, University Science Press
2. Satnam, PS and Gupta PV, Substation Design & Equipment, Dhanpat Rai Publications

Subject Code: BEE17E07	Subject Name: RESTRUCTURING OF DISTRIBUTION SYSTEM	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To study about Distribution system and Load Pattern
- To impart knowledge on the Distribution feeder
- To restructure the Distribution network and extent control for Low voltage network
- To understand the self healing control techniques
- To attain confidence on Automation in Distribution field

COURSE OUTCOMES (COs) : (3- 5)

CO1	Knowledge on the Distribution System and the load pattern.
CO2	Attained knowledge on the Distribution feeder
CO3	Ability to restructure the Distribution network
CO4	Knowledge on self healing control techniques
CO5	Attained confidence on Automation of Distribution network.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	M	H	M	M	M	L	M	L	M	M
CO2	H	M	H	M	M	M	H	M	M	M	M	M
CO3	M	H	M	L	H	H	M	M	H	L	H	H
CO4	M	M	H	M	M	H	H	H	M	M	M	M
CO5	L	L	M	M	H	H	M	M	L	H	H	L

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	L	M	M	M			
CO2	H	M	M	M	M			
CO3	M	M	H	H	H			
CO4	H	L	M	M	M			
CO5	M	M	L	L	L			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

RESTRUCTURING OF DISTRIBUTION SYSTEM

UNITI INTRODUCTION TO DISTRIBUTION SYSTEM 9 Hrs

Development of Power Distribution Network –Load Growth and Diversified Demands – Load Modeling- Load Demand Forecasting - Self healing Techniques – Line parameters- Overhead lines, Insulators and Supports- Cables- Insulation Resistance – Voltage drop and Power loss in Conductor

UNITII DISTRIBUTION FEEDER 9 Hrs

Primary Distribution system – Secondary Distribution system – Design Considerations - Substation location and planning – Feeder Loading – Voltage drop considerations – Drop with different loadings –Voltage drop constant with different loading

UNITIII RESTRUCTURING THE NETWORK 9 Hrs

Design of Network – Voltage selection – Sizing –Voltage control- Current loading- Earthing –Cost Factor - LV Distribution Networks – Switchgear for Distribution Substation and LV Networks – Extended Control of Distribution Substations and LV Network

UNIT IV SELF HEALING CONTROL 9 Hrs

Self Healing –Principle –Characteristics- Control method – Urban Distribution network self-healing control method based on Quantity of State – Based on Distributed Power and Microgrid- Based on Coordination Control model

UNIT V AUTOMATION IN DISTRIBUTION SYSTEM 9 Hrs

Implementation of Distribution Network self-healing – Relay Protection Units – Basic Requirements – Self Adapttion – SCADA / RTU- History and Development of SCADA -Principle and Operation – Automation of Distribution System – PMU /WAMS and SCADA /EMS – Application of PMU or WAMS

Total Number of hours: 45Hrs

Text Books:

1. Kamaraju, V (2009), Electrical power Distribution System, Tata McGraw Hill
2. Abdelhay A, Sallam, Om, P, Malik, (2011), Electric Distribution Systems, Wiley

Reference Books:

1. Xinxin Gu, Ning Jiang (2017), Self Healing Control Technology for Distribution Networks, Wiley
2. James Northcote-Green, Robert Wilson, Control and Automation of electrical Power Distribution Systems, Taylor & Francis

Subject Code: BEE17E08	**Subject Name: MATERIAL SCIENCE IN AVIATION**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To gain basic knowledge on Cryogenic Technology
- To impart knowledge on Super Alloy and its Applications
- To know the importance of Flexible Electronics
- To have a wide spread knowledge about Nanoscience and nano material
- To learn about Drone

COURSE OUTCOMES (COs) : (3- 5)

CO1	Attained basic knowledge on Cryogenic Technology
CO2	Knowledge on Super Alloy and its application
CO3	Knowledge on Flexible Electronics
CO4	Attained knowledge on nano science and nano material
CO5	Knowledge on Drone

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	M	L	L	M	M	M	H	M	M	M
CO2	H	M	M	L	L	H	M	H	H	H	M	M
CO3	H	H	L	M	M	M	M	M	M	M	H	M
CO4	M	M	M	M	M	L	H	L	L	L	M	H
CO5	H	L	H	H	H	M	M	M	M	M	L	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	M	M	H	L			
CO2	H	L	M	M	M			
CO3	M	M	L	H	L			
CO4	H	H	M	M	M			
CO5	M	M	H	L	H			

H/M/L indicates SLtrength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

MATERIAL SCIENCE IN AVIATION

UNIT I INTRODUCTION TO CRYOGENIC TECHNOLOGY 9 Hrs

Terms & Phenomena associated with Cryogenic Systems – Prominent contributors- Critical Aspects and Issues involved – Benefits from Integration – Early applications of Cryogenic Technology- Gas Separation process – Industrial Applications of Cryogenic fluid technology

UNIT II SUPER ALLOY 9Hrs

Introduction- Basic Metallurgy – characteristics & Facts –Properties – Microstructure – Strengthening – Melting & Conversion – Investment casting- Corrosion & Protection of Super Alloy - Applications

UNIT III FLEXIBLE ELECTRONICS 9Hrs

History – Materials for Flexible Electronics – Degrees – Substrates – Backplanes Electronics – Frontplane Technologies – Encapsulation - Fabrication Technology – Sheets by batch Processing and Web by Roll to Roll Processing

UNIT IV NANOSCIENCE AND NANO TECHNOLOGY 9Hrs

Nano – Current Technologies – Energetics – Implications – Electron Microscopes – Optical Microscopes – Photoelectron Spectroscopy for the study of nano materials – Metal clusture and nano particles – nano crystals – Raman Scattering – Basics of nanomaterials

UNIT V DRONE AND AIR VEHICLE 9Hrs

Introduction – Types of flying drones – Current Uses – Drone Components – Concepts and Systems – Regulations & Safety – Applications – Future Trends

Total No. of Hours: 45 Hrs

Text Books:

1. Jha, AR, (2006), Cryogenic Technology and Applications, Elsevier
2. John, K Tien, Superalloys, Supercomposites and Superceramics, Elsevier
3. William S, Wong, Alberto Salleo, Flexible Electronics: Materials and Applications, Springer
4. Pradeep, T, (2012) Nanoscience and Nanotechnology , Mc Graw Hill

Reference Books:

1. Mattew, JD, Stephen JD, Superalloys, A Technical guide, 2nd Ed, ASM International.
2. Murty, BS, Shankar, P, Baldev Raj, BB Rath, James Murday, Nanoscience and Nanotechnology, Springer
3. Robokingdom LLC, (2016)Drone Book

Subject Code: BEE17E09	Subject Name: ELECTRICAL SAFETY FOR ENGINEERS	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To attain knowledge on Electrical Safety
- To know about the operation of Electrical Safety Equipments
- To learn about the safety procedures
- To know about the electrical safety codes
- To train the students on the Safety training.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Attained knowledge on the basics of Electrical Safety
CO2	Knowledge about the operation of the Safety equipments
CO3	Knowledge on the safety procedures
CO4	Familiarity on the electrical safety codes
CO5	Ability to become consultant and to attend the Vendors.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	L	M	H	H	H	M	M	L	M	M
CO2	H	H	L	M	M	H	H	H	M	M	H	H
CO3	M	M	M	H	L	M	M	M	H	M	M	L
CO4	H	L	H	M	M	L	L	L	L	H	L	M
CO5	L	M	M	L	H	M	M	M	M	M	M	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	M	M	M	H			
CO2	H	M	M	M	H			
CO3	M	H	H	L	M			
CO4	H	M	M	M	L			
CO5	M	L	M	M	M			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

ELECTRICAL SAFETY FOR ENGINEERS

UNIT I HAZARDS OF ELECTRICITY **9 Hrs**

Introduction – Hazards Analysis – Shock – Shock Effect – Arc –arc energy release-Arc energy-Arcing voltage-Arc surface Area-Incident Energy-Arc Flash Effect – Blast – Affected body parts – Summary of causes –Injury and Death – Protective Strategies.

UNIT II ELECTRICAL SAFETY EQUIPMENT **9 Hrs**

General Inspection and Testing Requirement for Electrical Safety Equipment – Flash and Thermal Production – Head and Eye Protection – Rubber Insulating Equipment –Hot Sticks-Barrier and signs-Insulated Tools –Safety Grounding Equipment – Electricians Safety Kit.

UNIT III SAFETY PROCEDURES AND ORGANIZATIONAL METHODS **9 Hrs**

Six Step Safety Methods – Safe Switching of Power System – Voltage measurement Techniques – Placement of Safety Grounds – Tools And Test Equipment – One Minute Safety Audit-Electrical Safety program Development – Employee Electrical Safety Teams – Safety Meetings – Outage Reports – Safety Audits.

UNIT IV REGULATORY AND LEGAL SAFETY REQUIREMENTS AND STANDARDS 9 Hrs

Regulatory Bodies-ANSI-IEEE-Electrical safety code –Standards for Electrical safety in the workplace-Accident prevention-first aid –Rescue Techniques-accident invention.

UNIT V SAFETY TRAINING METHODS AND SYSTEMS **9 Hrs**

Introduction – Elements of a good Training Program – On the Job Training – Training Consultants and Vendors- Training Program Setup – Step by Step Method

Total Number of hours: 45Hrs

Text Book:

1. Electrical safety handbook - john cadick - McGRAW-HILL, Third Edition

Subject Code: BEE17E10	Subject Name: IoT FOR ELECTRICAL ENGINEERING	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To study IoT in Electric Engineering
- To study Telematics Devices
- To Study IoT Sensors
- To Study Smart grid and Micro grid
- To Study Smart Space Security System

COURSE OUTCOMES (COs) : (3- 5)

CO1	Knowledge of IoT in Electrical Engineering
CO2	Attain knowledge on Telematic Devices
CO3	Ability to work on IoT sensors
CO4	Knowledge on Smart grid and Micro grid
CO5	Knowledge on SmartSpace Security System

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	M	H	L	H	M	H	M	H	M	L
CO2	M	H	M	H	L	M	M	M	M	M	M	M
CO3	M	M	M	H	L	M	H	M	H	M	M	M
CO4	L	M	M	M	H	M	M	H	M	H	L	M
CO5	M	H	H	L	M	L	M	L	M	M	M	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	M	M	M	M			
CO2	H	M	M	H	M			
CO3	M	L	H	M	H			
CO4	L	M	M	M	M			
CO5	M	M	M	M	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

IoT FOR ELECTRICAL ENGINEERING

UNITI INTRODUCTION TO IoT **9 Hrs**

Introduction – Need of IoT in Electrical Engineering – Challenges in Implementation of IoT – Trends in Electrical Engineering – Configuration and Scalability – Efficiency – Quality of Service

UNIT II TELEMATICS **9 Hrs**

Smart Devices – Smart Apps – Wearable Technology – Vehicle Telemetry – Smart Homes and Building Automation – Vehicle Charging Station

UNIT III SMART ENERGY **9 Hrs**

Generation – Transmission – Distribution and Metering – Storage – Smart Monitoring and Diagnostics System at Major Power Plants –Micro grid and Virtual Power

UNIT IV INDUSTRIAL IOT **9 Hrs**

Real-Time Monitoring and Control of Processes – Deploying Smart Machine – Smart Sensor – Smart Controllers – SCADA – Proprietary Communication

UNIT V SECURITY MEASURES **9 Hrs**

Securing Smart Spaces and Smart Grid – Smart Grid – Service that need to be Secure - Security Requirement – Security Smart Spaces – Smart Tracking Firewall – Cryptographic Key in the IoT

Total Number of hours: 45Hrs

Text Books:

1. George Mastorakis , (2016), Internet of Things (IoT) in 5G Mobile Technologies, 1st ed. Edition, , Publisher SPRINGER

Reference Books:

1. Enterprise IoT: Strategies and Best Practices for Connected Products and Services, Dirk Slama, Frank Puhlmann, Jim Morrish, Rishi M Bhatnagar, Publisher O'REILLY

Subject Code: BEE17E11	Subject Name: ROBOTICS AND AUTOMATION	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To introduce the basic concepts and parts of robots.
- To understand the working of robots and various types of robots.
- To make the students familiar with the various drive systems of robots, sensors and their applications in robots and programming of robots.
- To discuss the various application of robots, justification and implementation of robots.
- To study about the manipulators, activators and grippers and their design considerations

COURSE OUTCOMES (COs) : (3- 5)

CO1	Knowledge on Robots
CO2	Ability to understand the working of robots and various types of robots.
CO3	Knowledge on various drive systems of robots, sensors and their applications in robots and programming of robots.
CO4	Knowledge on various application of robots, justification and implementation of robots.
CO5	Attained knowledge on manipulators, activators and grippers and their design considerations

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	L	M	H	L	L	M	M	L	M	H	L
CO2	H	M	H	M	M	L	M	L	M	M	M	M
CO3	H	M	M	H	M	L	H	M	H	H	M	M
CO4	M	H	L	M	L	M	M	L	M	M	L	L
CO5	L	M	M	M	M	M	L	M	M	M	M	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	M	L	M	M			
CO2	M	M	M	H	H			
CO3	M	H	M	M	M			
CO4	M	M	H	L	L			
CO5	H	M	M	L	M			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

Approval	

ROBOTICS AND AUTOMATION

UNIT I BASIC CONCEPTS **9 Hrs**

Definition and origin of robotics – different types of robotics – various generations of robots – degrees of freedom – Asimov's laws of robotics – dynamic stabilization of robots

UNIT II POWER SOURCES AND SENSORS **9 Hrs**

Hydraulic, pneumatic and electric drives – determination of HP of motor and gearing ratio – variable speed arrangements – path determination – micro machines in robotics – machine vision – ranging – laser – acoustic–magnetic, fiber optic and tactile sensors

UNIT III MANIPULATORS, ACTUATORS AND GRIPPERS **9 Hrs**

Construction of manipulators – manipulator dynamics and force control – electronic and pneumatic manipulator control circuits – end effectors – U various types of grippers – design considerations

UNIT IV KINEMATICS AND PATH PLANNING **9 Hrs**

Solution of inverse kinematics problem – multiple solution Jacobian work envelop – hill climbing techniques – robot programming languages

UNIT V CASE STUDIES **9 Hrs**

Mutiple robots – machine interface – robots in manufacturing and non- manufacturing applications – robot cell design – selection of robot

Total Number of Hours: 45 Hrs

Textbooks:

1. Mikell P. Weiss G.M., Nagel R.N., Odraj N.G., Industrial Robotics, McGraw-Hill Singapore,
2. Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers, Chennai, 1998.

Reference Books:

1. Deb.S.R., (1992), Robotics technology and flexible Automation, John Wiley.
2. Asfahl C.R., (1992), Robots and manufacturing Automation, John Wiley.
3. Klafter R.D., Chimielewski T.A., Negin M., (1994)., Robotic Engineering – An integratedapproach, Prentice Hall of India.
5. Mc Kerrow P.J. (1991)., Introduction to Robotics, Addison Wesley.
6. Issac Asimov (1986.), I Robot, Ballantine Books, New York.

Subject Code: BEE17E12	Subject Name: GREEN BUILDING TECHNOLOGY	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To educate the concept of Green Building
- To understand the Design concepts of Green Building
- To attain knowledge on reduction of carbon footing
- To impart the importance of Environmental issues
- To explore the future trends in Green Building and to revamp the ecological design.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Knowledge on Green building
CO2	Ability to understand the Design concepts of Green building
CO3	Attained knowledge on reduction of Carbon footing
CO4	Acquired knowledge on the importance of Environmental issues
CO5	Ability to explore the future trends on Green building

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	H	M	M	L	L	M	M	L	L	H
CO2	M	L	M	M	H	M	M	H	M	L	M	M
CO3	M	M	L	M	M	L	M	M	M	M	L	L
CO4	M	H	L	H	H	M	H	M	H	M	M	M
CO5	M	M	L	M	L	H	M	H	M	L	M	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	M	H	L	M			
CO2	M	H	H	M	H			
CO3	H	M	M	H	L			
CO4	M	M	M	M	M			
CO5	M	M	H	H	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

GREEN BUILDING TECHNOLOGY

UNIT I INTRODUCTION TO GREEN BUILDING 9Hrs

Basics of Green - Sustainable Design – ecological Design – Green Design – Green Buildings- Progress & Obstacles- High Performance Green Buildings

UNIT II DESIGN OF GREEN BUILDING 9Hrs

Foundations of Green Building-Environmental concerns- Assessment- Design process- Green building excecution project- Heat Island Mitigation – Sustainable sites

UNIT III REDUCTION OF CARBON FOOTING 9Hrs

Building energy Issues – Design Strategy – Renewable Energy Systems- Smart Building & energy Management Systems - Reducing the Carbon footprint

UNIT IV ENVIRONMENTAL ASPECTS 9Hrs

Hydrological cycle - Sustainable storm water management - Construction Operations and commissioning of Green Building – Construction & Demolition Waste management - Indoor Environmental Quality

UNIT V FUTURE TRENDS 9Hrs

Economics in Green Building – Managing First costs – Financial barriers - Articulating Performance goals for future Green Buildings – Revamping Ecological Design

Total Number of Hours: 45 Hrs

Text Books:

1. Charles J.Kibert Sustainable Construction: Green Building Design and Delivery, 3rd Edition Wiley Publisher, (2012)ISBN :978-0-470-90445-9
2. Francis D, K, Ching, Ian M, Shapiro, Green Building Illustrated, Wiley

Reference Books:

1. Sam Kubba, Handbook of Green Building Design, and Construction, Elsevier Publisher(2012) ISBN: 978-0-12-385128-4
2. Charles J.Kibert, Martha C.Monroe, Anna L.Peterson, Richard R.Plate, Leslie Paul Thiele ,Working Toward Sustainability: Ethical Decision –Making in a Technological World, Wiley Publisher, ISBN : 978-0-470-53972-9

Subject Code: BEE17E13	**Subject Name: ENERGY STORAGE TECHNOLOGY**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To study about the Energy Storage Technology
- To know the working Principle of Batteries and its types
- To impart knowledge on Fuel Cells along with its advantage and disadvantages
- To analyse various types of energy storage devices.
- To have a wide spread knowledge on Electric Vehicle

COURSE OUTCOMES (COs) : (3- 5)

CO1	Attain Knowledge on Energy Storage Technology
CO2	Knowledge on the working principle of batteries and its types
CO3	Knowledge n Fuel cells
CO4	Ability to analyse various types of energy storage devices
CO5	Knowledge on Electric vehicles

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	H	M	H	M	M	M	L	H	H	M
CO2	H	M	M	M	M	M	M	M	M	H	M	M
CO3	H	H	M	M	M	M	M	M	M	M	M	L
CO4	M	L	L	L	M	H	M	H	L	L	M	L
CO5	H	L	M	M	L	L	H	M	H	M	H	L

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	H	M	L	L			
CO2	M	M	L	M	M			
CO3	M	L	M	H	H			
CO4	M	M	M	M	H			
CO5	M	H	H	M	M			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

ENERGY STORAGE TECHNOLOGY

UNITI INTRODUCTION TO ENERGY STORAGE **9 Hrs**

Energy storage – Utilization of Energy storage devices - Need for Energy Storage – Types of energy Storage – Comparison of Energy Storage technologies – Applications.

UNITII ELECTRICAL ENERGY STORAGE **9 Hrs**

Concept of batteries – Measurement of Battery performance – Charging and Discharging- Storage Density – Safety issues. Types of Batteries – Lead Acid, Nickel-Cadmium, Zinc manganese dioxide and modern batteries- Zinc Air, Nickel Hydride, lithium battery.

UNITIII FUEL CELL **9 Hrs**

Fuel Cell – History of fuel cell – Principle of electrochemical Storage – Types – Hydrogen oxygen cells, Hydrogen air cell – Hydrocarbon air cell –alkaline fuel cell – detailed analysis – advantage and drawback of each cell.

UNIT IV ALTERNATE ENERGY STORAGE TECHNOLOGIES **9 Hrs**

Solar Photovoltaics – Wind Power - Flywheel – Super Capacitors – Principles & applications, Compressed Air Energy Storage- Concept of Hybrid Storage - Applications

UNIT V ELECTRIC VEHICLE **9 Hrs**

Electric Vehicle – Types – Hybrid Vehicle – Battering Charging – Usage of batteries in Hybrid vehicle – Fundamentals of Electric vehicle modeling - EV and the Environment – Pollution effect.

Total Number of Hours: 45 Hrs

Text Books:

1. Ibrabim Dincer, marc A,Rosen, (2011) Thermal Energy Storage Systems and Applications, 2nd Ed, John Wiley
2. James Larminie, John Lowry (2003), Electric Vehicle Technology Explained, John Wiley & Sons

References

1. Seth Leitman, Bob Brant (2013) Build Your Own Electric Vehicle, 3rd Ed, McGraw Hill
2. James larminie, Andrew Dicks, (2003), Fuel Cell Systems Explained, Wiley

Subject Code: BEE17E14	**Subject Name: WIDE AREA MONITORING PROTECTION AND CONTROL**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To know about the Phasor Measurement Unit and its importance
- To impart knowledge on State Estimation and the Optimal placement of PMU
- To attain familiarity on Wide Area Measurement System
- To have a wide spread knowledge about the Protection schemes and the Dynamic model of Power System
- To apply the learnt concept for the real time issues.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Familiarity in PMU
CO2	Acquired knowledge in State estimation and the Optimal Placement of PMU
CO3	Familiarity on Wide Area Measurements
CO4	Attained a wide spread knowledge about the Protection Schemes
CO5	Ability to apply the concepts for real time

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	M	L	M	H	L	H	M	L	H	M
CO2	H	M	H	M	H	M	L	M	L	M	M	L
CO3	H	H	H	H	L	M	H	H	M	M	H	M
CO4	H	H	M	M	L	M	M	M	L	H	M	L
CO5	H	M	M	L	M	M	H	M	L	M	M	L

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	L	H	L	L			
CO2	H	L	H	L	M			
CO3	H	L	M	L	M			
CO4	H	H	H	H	M			
CO5	H	H	H	M	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

WIDE AREA MONITORING PROTECTION AND CONTROL

UNIT I INTRODUCTION **9 Hrs**

PMU – History of PMU – Basic definition of Synchrophasor, Frequency, Accuracy Indexes – Sensors of PMUs – PMU Architecture- Data Acquisition System – Communication & Data Collector- Distributed PMU- International Standards.

UNIT II STATE ESTIMATION AND PMUS **9 Hrs**

Introduction – Formulation of the SE problem – SE measurement Model – SE Classification – Role & Impact of PMU in SE – PMU based Transmission System SE and Distribution SE - Optimal PMU Placement – SE Applications – Automation Architecture with integrated PMU Measurement for SE

UNIT III WIDE AREA MEASUREMENT SYSTEMS **9 Hrs**

WAMS – Definition, Data resource, Communication Systems, Applications- Monitoring System Components – Substation Configuration and Communication – Substation Monitoring System- Voltage Stability Assessment – Adaptive load shedding -

UNIT IV SMART GRID **9 Hrs**

Smart Transmission grid – Demands & Requirement– Wide Area Disturbances – SIPS Architecture – Components and Applications - Dynamic Model of large Power system- Eigen Values & Eigen vectors – Optimization model for equilibrium tracing – Q-V Sentivity – Small Signal Stability Analysis

UNIT V WAMPAC APPLICATION **9 Hrs**

WAMPAC Application in Frequency Stability, Voltage Stability, Transient Stability, Small Signal Stability

Total Number of Hours: 45 Hrs

Text Books:

1. Antonello Monti, Carlo Muscas, Ferdinanda Ponci, Phasor Measurement Units and Wide Area Monitoring Systems, Elsevier
2. Alfredo Vaccaro, Ahmed Faheem Zobaa, Wide Area Monitoring, Protection and Control Systems, IET

Reference Books:

1. Begovic, Miroslav,M, Electrical Transmission Systems and Smart Grids, Springer
2. Fahd Hashiesh, Mansour,MM, Hossam E Mostafa (2011), Wide Area Monitoring, Protection and Control, Lambert

POWER PLANT INSTRUMENTATION

Subject Code: BEE17E15	Subject Name: POWER PLANT INSTRUMENTATION	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- Familiarity to Building blocks and boilers.
- Capable to measure Electrical parameters.
- Capable to analyse various parameters in power plants
- Understand the control loops in boiler
- Capable to monitor and control the renewable energy systems.

COURSE OUTCOMES (COs) : (3- 5)

CO1	The students get familiarized to Building blocks and boilers.
CO2	The student becomes capable to measure Electrical parameters
CO3	The student will be able to analyse various parameters in pwer plants
CO4	The students understand the control loops in boiler
CO5	The student becomes Capable to monitor and control the renewable energy systems

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	M	L	L	L	L	L	M	M	H	L
CO2	M	M	L	L	H	L	L	M	M	L	H	M
CO3	H	H	H	H	H	M	M	M	H	M	H	H
CO4	H	M	L	M	L	L	L	M	M	M	H	M
CO5	H	H	M	H	H	M	H	M	H	M	H	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	L	L	M	L			
CO2	H	L	M	M	M			
CO3	H	H	M	H	M			
CO4	M	M	H	M	M			
CO5	H	H	H	M	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

UNIT I BUILDING BLOCKS AND BOILERS 9 Hrs

building blocks – details of boiler processes UP&I diagram of boiler – cogeneration- Combined heat and power System – sub critical and supercritical boilers-flue gas dew point control – Trimming of combustion air – Soot blowing.

UNIT II MEASUREMENTS IN POWER PLANTS 9 Hrs

Electrical measurements – current, voltage, power, frequency, power factor etc. – non electrical parameters – flow of feed water, fuel, air and steam with correction factor for temperature – steam pressure and steam temperature – drum level measurement – radiation detector – smoke density measurement – dust monitor.

UNIT III ANALYZERS IN POWER PLANTS 9Hrs

Flue gas oxygen analyzer – analysis of impurities in feed water and steam – dissolved oxygen analyzer – chromatography – PH meter – fuel analyzer – pollution monitoring instruments.

UNIT IV CONTROL LOOPS IN BOILER 9 Hrs

Combustion control – air/fuel ratio control – furnace draft control – drum level control – main stem and reheat steam temperature control – super heater control – attemperator – de aerator control – distributed control system in power plants – interlocks in boiler operation.

UNIT V TURBINE – MONITORING AND CONTROL 9 Hrs

Speed, vibration, shell temperature monitoring and control – steam pressure control – lubricant oil temperature control – cooling system

Total Number of Hours: 45 Hrs

Text Books:

1. Sam G. Dukelow, (1991) *The control of Boilers, instrument* .Society of America
2. (1971) *Modern Power Station Practice*.Vol.6.Instrumentation, Controls and Testing. Pergamon Press. Oxford

Reference Books:

1. Elonka, S.M. and Kohal, A.L. (1994) *Standard Boiler Operations.* New Delhi: McGraw-Hill
2. Jain, R.K.(1995) *Mechanical and industrial Measurements*. Delhi: Khanna Publishers

TECHNICAL SKILLS – 1, 2, & 3 LIST

1. BEE17TS1 LabVIEW

2. BEE17TS2 PSCAD
3. BEE17TS3 MATLab
4. BEE17TS4 PLC
5. BEE17TS5 SCADA
6. BEE17TS6 IoT
7. BEE17TS7 Embedded (Kiel)
8. BEE17TS8 ETAP
9. BEE17TS9 Microsoft Robotics Developer Studio (Robot Control & Simulator)
10. BEE17TS10 Data Structure and C++
11. BEE17TS11 JAVA
12. BEE17TS13 Auto CAD for Electrical

OPEN ELECTIVES LIST (SEMESTER 6)

1. AUTOMOTIVE ENGINEERING
2. ELECTRIC AND HYBRID VEHICLES
3. BOUNDARY LAYER THEORY
4. COMPUTATIONAL FLUID DYNAMICS
5. FINITE ELEMENT ANALYSIS
6. ARTIFICIAL INTELLIGENCE/EXPERT SYSTEMS IN DESIGN AND MANUFACTURING
7. CREATIVITY, INNOVATION AND NEW PRODUCT DEVELOPMENT
8. COMPOSITE MATERIALS AND STRUCTURES
9. MACHINE LEARNING IN BIOINFORMATICS
10. PRINCIPLES AND APPLICATIONS OF BIOINFORMATICS
11. BIOSIMULATIONS USING MATLAB
12. DATA MINING IN BIOINFORMATICS
13. BIOINFORMATICS FOR BIOENGINEERS
14. INTRODUCTION TO BIOMEDICAL DEVICES
15. FUNDAMENTALS OF BIOSIGNAL PROCESSING
16. BIOREFINERY
17. DIGITAL IMAGE PROCESSING
18. WATER POLLUTION AND ITS MANAGEMENT
19. LOBAL WARMING AND CLIMATE CHANGE
20. DISASTER MANAGEMENT AND MITIGATION
21. ENERGY ENGINEERING TECHNOLOGY AND MANAGEMENT
22. RENEWABLE ENERGY TECHNOLOGY
23. INDUSTRIAL POLLUTION PREVENTION AND CONTROL
24. PETROLEUM TECHNOLOGY
25. INTRODUCTION TO TRANSPORT PROCESSES
26. DATA STRUCTURES
27. DATABASE CONCEPTS
28. SOFT COMPUTING
29. WEB DESIGN
30. ELECTRONIC CIRCUITS AND SYSTEMS
31. TELECOMMUNICATION SYSTEMS
32. POWER PLANT INSTRUMENTATION
33. BIOMEDICAL INSTRUMENTATION
34. RENEWABLE ENERGY RESOURCES
35. MICROCONTROLLERS AND THEIR APPLICATIONS
36. ELECTRICAL MACHINES AND DRIVES
37. FUNDAMENTALS OF ELECTRIC POWER UTILIZATION
38. INDUSTRIAL ELECTRONICS
39. REAL-TIME EMBEDDED SYSTEMS
40. CONTROLLER BASED SYSTEM DESIGN
41. INSTRUMENTATION ENGINEERING
42. HUMAN NUTRITION AND HEALTH
43. TECHNOLOGY OF BAKERY AND CONFECTIONERY PRODUCTS
44. FOOD PROCESSING AND PRESERVATION TECHNOLOGY
45. DISASTER MANAGEMENT
46. CYBER SECURITY
47. DAY-TO-DAY BIOLOGY
48. INTRODUCTION TO AUTOMATION

49. VIRTUAL INSTRUMENTATION
50. FUNDAMENTALS OF MEMS
51. INFORMATION SECURITY
52. INTRODUCTION TO DATABASE MANAGEMENT SYSTEM
53. PROFICIENCY IN ENGLISH AND ACCENT TRAINING
54. CREATIVE WRITING
55. INDIAN WRITING IN ENGLISH
56. SCIENCE FICTION
57. INTELLECTUAL PROPERTY RIGHTS , INNOVATION AND TECHNOLOGY
58. PRINCIPLES OF TECHNOLOGY AND INNOVATION MANAGEMENT
59. MARKETING MANAGEMENT
60. INDUSTRIAL MARKETING
61. STRESS MANAGEMENT
62. BASICS OF BANKING AND CAPITAL MARKETS
63. FINANCE FOR NON FINANCE EXECUTIVES
64. FUNDAMENTALS OF ENTREPRENEURSHIP
65. OPERATIONS RESEARCH
66. ETHICAL VALUES FOR BUSINESS
67. INFORMATION SYSTEMS FOR ENGINEERS
68. DATA WAREHOUSING AND DATA
69. LEGAL ASPECTS OF BUSINESS
70. INDUSTRIAL ENGINEERING AND MANAGEMENT
71. BUSINESS ENVIRONMENT
72. CONCURRENT ENGINEERING
73. MEMS AND NANO MANUFACTURING
74. NON DESTRUCTIVE TESTING
75. NANO PROCESSING
76. LOW COST AUTOMATION
77. MANUFACTURING COST ESTIMATION
78. MICRO ELECTRO MECHANICAL SYSTEMS
79. INTRODUCTION TO HYDRAULICS AND PNEUMATICS
80. PLASTIC ENGINEERING
81. INTRODUCTION TO ROBOTICS
82. BASIC THERMODYNAMICS AND HEAT TRANSFER
83. RENEWABLE AND SUSTAINABLE ENERGY
84. ENERGY AUDITING
85. ENERGY CONSERVATION
86. SOLAR ENERGY UTILIZATION
87. HUMAN COMPUTER INTERFACE
88. ARTIFICIAL INTELLIGENCE AND NEURAL NETWORKS
89. APPLICATIONS OF NANOTECHNOLOGY
90. SOFTWARE DEVELOPMENT AND MANAGEMENT
91. TELECOM BILLING
92. Fire and Safety
93. NSS

S.No.	Course Work- Subject Area	Range of Total Credits (%) Min	Max	Suggested Breakdown on Credits (for Total 176)	**Dr.MGR E&R Inst University credits**
1	Humanities and Social Sciences (HS), including Management;	5(9.25)	10(18.5)	14	**13**
	TECHNICAL ENGLISH - I				**2**
	TECHNICAL ENGLISH - II				**2**
	ENVIRONMENTAL SCIENCE				**3**
	MANAGEMENT PAPER 1				**3**
	MANAGEMENT PAPER 2				**3**

S.No.	Course Work- Subject Area	Range of Total Credits (%) Min	Max	Suggested Breakdown on Credits (for Total 176)	**Dr.MGR E&R Inst University credits**
2	Basic Sciences(BS) including Mathematics, Physics, Chemistry, Biology;	15(27.75)	20(37)	30	**30**
	MATHS - I				**4**
	ENGINEERING PHYSICS				**3**
	MATERIAL SCIENCE				**3**
	ENGINEERING CHEMISTRY - I				**3**
	ENGINEERING CHEMISTRY - II				**3**
	MATHS - II				**4**
	PHYSICS LAB				**1**
	CHEMISTRY LAB				**1**
	MATHS - III				**4**
	MATHS - IV				**4**

S.No.	Course Work- Subject Area	Range of Total Credits (%) Min	Max	Suggested Breakdown on Credits (for Total 176)	**Dr.MGR E&R Inst University credits**
3	Engineering Sciences (ES), including Materials, Workshop, Drawing, Basics of Electrical/Electronics/Mechanical/Computer Engineering, Instrumentation;	15(27.75)	20(37)	30	**29**
	BASIC ELECTRICAL & ELECTRONICS ENGINEERING				**3**
	BASIC MECHANICAL & CIVIL ENGINEERING				**3**
	BASIC ENGINEERING GRAPHICS				**2**

	WORKSHOP & PROJECT LAB				**1**
	PROGRAMMING LAB				**2**
	BASIC ENGINEERING SCIENCE				**3**
	INTER DISCIPLINARY THEORY (4 PAPERS)				**12**
	INTER DISCIPLINARY LAB (3 LABS)				**3**

S.No.	Course Work- Subject Area	Range of Total Credits (%) Min	Max	Suggested Breakdown on Credits (for Total 176)	**Dr.MGR E&R Inst University credits**
4	Professional Subjects-Core (PC), relevant to the chosen specialization/branch; (May be split into Hard (no choice) and Soft (with choice), if required;)	30(55.5)	40(74)	50	**68**
	4 CREDIT DEPT CORE PAPER (9 papers)				**36**
	3 CREDIT DEPT CORE PAPER (7 papers)				**21**
	DEPARTMENT CORE LABS				**11**

S.No.	Course Work- Subject Area	Range of Total Credits (%) Min	Max	Suggested Breakdown on Credits (for Total 176)	**Dr.MGR E&R Inst University credits**
5	Professional Subjects – Electives (PE), relevant to the chosen specialization/ branch;	10(18.5)	15(27.75)	20	**15**
	DEPT CORE ELECTIVES (5 PAPERS)				**15**

S.No.	Course Work- Subject Area	Range of Total Credits (%) Min	Max	Suggested Breakdown on Credits (for Total 176)	**Dr.MGR E&R Inst University credits**
6	Open Subjects- Electives (OE), from other technical and/or emerging subject areas;	5(9.25)	10(18.5)	12	**10**

	OPEN ELECTIVE (Inter Disciplinary No Prerequisite)				**3**
	SPECIAL ELECTIVE (Emerging Technology Syllabus to be framed)				**3**
	SOFT SKILL 1				**2**
	SOFT SKILL 2				**2**

S.No.	Course Work- Subject Area	Range of Total Credits (%) Min	Max	Suggested Breakdown on Credits (for Total 176)	**Dr.MGR E&R Inst University credits**
7	Project Work, Seminar and/or Internship in Industry or elsewhere.	10(18.5)	15(27.75)	20	**20**
	TECHNICAL SKILLS (3)				**3**
	INPLANT TRAINING				**1**
	PROJECT PHASE – 1 & 2				**12**
	FOREIGN LANGUAGE				**2**
	MINI PROJECT				**1**
	ENTREPRENEURAIL SKIL DEVELOPMENT & PROJECT LAB				**1**

Credits Distribution

S. No	**Description**	**No. of Papers**	**Credits**
1	Department Core (3 credits) Inclusive of 3 ETL subjects	7	21
2	Department Core (4 credits)	9	36
3	Department Core Electives	5	15
4	Open Elective	1	3
5	Special Elective (ETL)	1	3
6	Management Papers	2	6
7	Core Department Lab	11	11
8	Interdisciplinary Theory	4	12
9	Interdisciplinary Lab	3	3
10	Mathematics	4	16
11	Basic Humanities & Sciences	6	16
12	Environmental Science	1	3
13	Basic Engineering Science	4	11
14	Basic Engineering & Science Labs	4	5
15	Technical Skills	3	3
16	Soft Skills	2	4

17	Foreign Language	1	2
18	Mini Project	1	1
19	Project (Phase 1 & 2)	2	12
20	In Plant Training	1	1
21	Entrepreneurial Skill Development & Project Lab	1	1
	Total	**73**	**185**

Note:

Revision-2 curriculum modified with the following changes

- In the 2nd semester curriculum, Entrepreneurial Skill Development and Project lab courses included with one credit weightage.

- Total number of Credits for the 1st year program has been increased to 41 credits and the overall credit has been increased to 185 credits.