DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

B.Tech –Electrical and Electronics Engineering (Part Time)
Curriculum and Syllabus
2018 Regulation

I SEMESTER							
S.NO.	**SUBJECT CODE**	**SUBJECT NAME**	**Ty/ Lb/ ETL**	**L**	**T/ SLr**	**P/R**	**C**
1	BMA18011	Numerical Methods for Electrical Engineers	Ty	3	1/0	0/0	4
2	BEE18002	DC Machines and Transformers	Ty	3	1/0	0/0	4
3	BME18I03	Thermodynamics and Fluid Mechanics	Ty	3	0/0	0/0	3
4	BEE18003	Electromagnetic Field Theory	Ty	3	0/0	0/0	3
PRACTICALS*							
1	BEE18L14	Analog and Digital Electronics Lab	Lb	0	0/0	6/0	2

Credits Sub Total: 16

II SEMESTER							
S.NO.	**SUBJECT CODE**	**SUBJECT NAME**	**Ty/ Lb/ ETL**	**L**	**T/ SLr**	**P/R**	**C**
1	BEE18001	Circuit Theory and Network Analysis	Ty	3	1/0	0/0	4
2	BEE18004	Electrical and Electronics Measurements	Ty	3	0/0	0/0	3
3	BEC18I07	Communication Systems and IOT	Ty	3	0/0	0/0	3
4	BEE18ET1	Linear and Digital Integrated Circuits	ETL	1	0/1	3/0	3
PRACTICALS*							
1	BEE18L15	Measurement and Control Lab	Lb	0	0/0	6/0	2

Credits Sub Total :15

C: Credits L: Lecture T: Tutorial S.Lr: Supervised Learning P: Problem / Practical R: Research
Ty/Lb/ETL: Theory /Lab/Embedded Theory and Lab * Internal Evaluation

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III SEMESTER							
S.NO.	**SUBJECT CODE**	**SUBJECT NAME**	**Ty/ Lb/ ETL**	**L**	**T/ SLr**	**P/R**	**C**
1	BEE18006	Power System - I	Ty	3	0/0	0/0	3
2	BEE18008	Control System	Ty	3	0/0	0/0	3
3	BEE18ET2	Design of Electrical Machines	ETL	1	0/1	3/0	3
4	BEE18005	AC & Special Machines	Ty	3	1/0	0/0	4
PRACTICALS*							
1	BEE18L16	Electrical Machines Lab	Lb	0	0/0	6/0	2

Credits Sub Total :15

IV SEMESTER							
S.NO.	**SUBJECT CODE**	**SUBJECT NAME**	**Ty/ Lb/ ETL**	**L**	**T/ SLr**	**P/R**	**C**
1	BEE18007	Power System - II	Ty	3	1/0	0/0	4
2	BEE18010	Power Electronics- I	Ty	3	1/0	0/0	4
3	BXX18EXX	Elective I	Ty	3	0/0	0/0	3
4	BEE18ET3	Energy Utilization and Conservation	ETL	1	0/1	3/0	3
PRACTICALS*							
1	BEE18L17	Power Electronics Lab	2	0	0/0	6/0	Lb

Credits Sub Total :16

C: Credits L: Lecture T: Tutorial S.Lr: Supervised Learning P: Problem / Practical R: Research
Ty/Lb/ETL: Theory /Lab/Embedded Theory and Lab * Internal Evaluation

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V SEMESTER							
S.NO.	**SUBJECT CODE**	**SUBJECT NAME**	**Ty/ Lb/ ETL**	**L**	**T/ SLr**	**P/R**	**C**
1	BEE18009	Power System - III	Ty	3	1/0	0/0	4
2	BEE18ET4	Industrial Drives and Automation	ETL	1	0/1	3/0	3
3	BXX18EXX	Elective II	Ty	3	0/0	0/0	3
PRACTICALS*							
1	BEE18L08	Power System Lab	L	0	0/0	3/0	1

Credits Sub Total :11

VI SEMESTER							
S.NO.	**SUBJECT CODE**	**SUBJECT NAME**	**Ty/ Lb/ ETL**	**L**	**T/ SLr**	**P/R**	
1	BEE18011	Microgrid Technology	Ty	3	1/0	0/0	4
2	BXX18EXX	Elective III	Ty	3	0/0	0/0	3
3	BXX18EXX	Elective IV	Ty	3	0/0	0/0	3
PRACTICALS*							
1	BEE18L12	Project Phase – I	L	0	0/0	3/3	2

Credits Sub Total :12

VII SEMESTER							
S.NO.	**SUBJECT CODE**	**SUBJECT NAME**	**Ty/ Lb/ ETL**	**L**	**T/ SLr**	**P/R**	**C**
1	BEE18012	Power Electronics- II	Ty	3	1/0	0/0	4
2	BEE18013	Smart Grid Technology	Ty	3	0/0	0/0	3
PRACTICALS*							
1	BEE18L13	Project Phase – II	L	0	0/0	12/12	8

Credits Sub Total :15

C: Credits L: Lecture T: Tutorial S.Lr: Supervised Learning P: Problem / Practical R: Research
Ty/Lb/ETL: Theory /Lab/Embedded Theory and Lab * Internal Evaluation

Credit Summary

Semester : 1 : 16

Semester : 2 :15

Semester : 3 : 15

Semester : 4 : 16

Semester : 5 : 11

Semester : 6 :12

Semester : 7 : 15

Total Credits : 100

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

List of Electives

ELECTIVE I							
S.NO.	**SUBJECT CODE**	**SUBJECT NAME**	**Ty/ Lb/ ETL**	**L**	**T/ SLr**	**P/R**	**C**
1	BEE18E01	Wind Energy Conversion Techniques	Ty	3	0/0	0/0	3
2	BEE18E02	IOT Applied to Electrical Engineering	Ty	3	0/0	0/0	3
3	BEE18E11	Material Science in Aviation	Ty	3	0/0	0/0	3
4	BEI18013	Power Plant Instrumentation	Ty	3	0/0	0/0	3

ELECTIVE II							
S.NO.	**SUBJECT CODE**	**SUBJECT NAME**	**Ty/ Lb/ ETL**	**L**	**T/ SLr**	**P/R**	**C**
1	BEE18E05	Solar Energy Conversion Techniques	Ty	3	0/0	0/0	3
2	BEE18E06	Green Building Technology	Ty	3	0/0	0/0	3
3	BEE18E09	Restructuring of Distribution System	Ty	3	0/0	0/0	3
4	BEE18E10	DG and Energy Storage Technology	Ty	3	0/0	0/0	3

ELECTIVE III							
S.NO.	**SUBJECT CODE**	**SUBJECT NAME**	**Ty/ Lb/ ETL**	**L**	**T/ SLr**	**P/R**	**C**
1	BEE18E13	Safety for Electrical Engineers	Ty	3	0/0	0/0	3
2	BEE18E14	Wide Area Monitoring Protection and Control	Ty	3	0/0	0/0	3
3	BEE18E15	Robotics & Automation	Ty	3	0/0	0/0	3
4	BEE18E16	Image Processing	Ty	3	0/0	0/0	3

ELECTIVE IV							
S.NO.	**SUBJECT CODE**	**SUBJECT NAME**	**Ty/ Lb/ ETL**	**L**	**T/ SLr**	**P/R**	**C**
1	BEE18E17	Substation Designing	Ty	3	0/0	0/0	3
2	BEE18E18	Industrial Control and Instrumentation	Ty	3	0/0	0/0	3
3	BEE18E19	Electric Traction	Ty	3	0/0	0/0	3
4	BEE18E20	Electric Transients & High Voltage Engineering	Ty	3	0/0	0/0	3

C: Credits L : Lecture T: Tutorial S.Lr: Supervised Learning P: Problem / Practical R: Research Ty/Lb/ETL : Theory /Lab/Embeddded Theory and Lab * Internal Evaluation

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Subject Code: BMA18011	Subject Name: NUMERICAL METHODS FOR ELECTRICAL ENGINEERS	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 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	Interdiciplinary		
	√											

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

BMA18011 NUMERICAL METHODS FOR ELECTRICAL ENGINEERS 3 1/0 0/0 4

UNIT I BASICS OF NUMERICAL METHODS 12

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

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

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

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

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 No. of Hours : 60

REFERENCE 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).
3. Kandasamy P., Thilagavathy, Gunavathy K., Numerical Methods (Vol.IV), S.Chand & Co., (2008).
4. Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, (2012).

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Subject Code: BEE18002	Subject Name: DC MACHINES AND TRANSFORMERS	T /L/ ETL	L	T / S.Lr	P / R	C
	Prerequisite: Basic Electrical & Electronics Engg	**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	M	H	M	L	H	M	L	H	M	H	M
CO2	H	M	M	L	L	M	L	L	H	M	M	M
CO3	M	L	M	M	M	M	M	M	M	L	M	L
CO4	M	M	M	L	L	M	L	L	M	M	M	L
CO5	L	H	H	M	M	H	M	M	L	H	H	M

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

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

BEE18002 DC MACHINES AND TRANSFORMERS 3 1/0 0/0 4

UNIT I ELECTROMECHANICAL ENERGY CONVERSION 12

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

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

UNIT III DC MOTORS 12

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

UNIT IV TRANSFORMERS 12

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

UNIT V TESTING OF DC MACHINES & TRANSFORMERS 12

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 No. of Hours : 60

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.

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

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Subject Code: BME18I03	Subject Name: THERMODYNAMICS AND FLUID MECHANICS	T /L/ ETL	L	T / S.Lr	P / R	C
	Prerequisite: Basic Mechanical & Civil Engg	**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	M	M	M	H	M	L	L	M	H	M	H	H
CO2	M	L	L	M	H	M	H	H	H	M	H	M
CO3	H	H	H	M	L	M	L	H	H	M	H	L
CO4	M	M	M	H	M	L	L	L	H	M	H	L
CO5	L	H	H	M	L	M	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			
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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

BME18I03 THERMODYNAMICS AND FLUID MECHANICS 3 0/0 0/0 3

UNIT I BASIC CONCEPTS AND FIRST LAW OF THERMODYNAMICS 9

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

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

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

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

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

Total No. of Hours : 45

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

REFERENCE BOOKS:

1. Holman, J.P. (1995) Thermodynamics, McGraw Hill.
2. Yunus A. Cengel, Thermodynamics-An Engineering Approach. ,Tata Mc.Graw Hill.
3. Bansal R.K., A Text Book of Fluid Mechanics and Hydraulic Machines , S.Chand and Co., India

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Subject Code: BEE18003	Subject Name: ELECTROMAGNETIC FIELD THEORY	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 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	M	M	M	H	M	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	L	L	M	M	L	L	L	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	M	H	M	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			
				√								

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

BEE18003 ELECTROMAGNETIC FIELD THEORY 3 0/0 0/0 3

UNIT I ELECTROSTATIC FIELD 9

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

UNIT II ELECTROSTATICS 9

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

UNIT III MAGNETOSTATICS 9

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– Scalar and vector potential – Magnetic force – Torque – Inductance

UNIT IV ELECTRODYNAMIC FIELDS 9

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

UNIT V ELECTROMAGNETIC FIELDS AND WAVE PROPAGATION 9

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

Total No of Hours : 45

TEXT BOOKS:

1. William Hayt, (2005) Engineering Electromagnetics.7th Edn,McGraw Hill.
2. Matthew. N.O. Sadiku,(2007) Elements of Electromagnetics.4th Edn, First Indian Edition,Oxford University Press.
3. Ashutosh Pramanik,(2006)Electromagnetism – theory and application,Prentice Hall of India Private Ltd.

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.

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Subject Code: BEE18L14	Subject Name: ANALOG AND DIGITAL ELECTRONICS LABORATORY	T /L/ ETL	L	T / S.Lr	P / R	C
	Prerequisite:	**L**	**0**	**0/0**	**6/0**	**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 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	H	H	M	L	M
CO2	M	M	M	M	H	H	M	M	M	L	M	H
CO3	H	H	H	M	M	M	H	H	M	H	M	L
CO4	H	H	M	M	L	L	M	H	M	M	H	M
CO5	M	M	M	M	L	M	M	H	M	L	M	M

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

BEE18L14	**ANALOG AND DIGITAL ELECTRONICS LABORATORY**	**0**	**0/0**	**3/0**	**2**

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. Design and Testing of RC Phase shift , LC Oscillators
9. Single phase half wave and full wave rectifiers with inductive and capacitive filters
10. Astable and Monostable Multivibrators

Total No. of Hours: 45

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Subject Code: BEE18001	Subject Name: CIRCUIT THEORY AND NETWORK 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 understand the basics of Electric Circuits
- To impart knowledge on network theorems
- To impart knowledge on the concepts of 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	M	M	L	L	M	H	M	H	M
CO2	M	L	L	M	M	L	L	M	H	M	H	M
CO3	M	L	M	L	L	M	M	L	H	M	H	L
CO4	L	M	L	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	M	M	M		
CO2	M	M	M	M	M		
CO3	H	M	L	H	L		
CO4	H	L	M	M	H		
CO5	M	M	H	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			
				√								

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

BEE18001 CIRCUIT THEORY AND NETWORK ANALYSIS 3 1/0 0/0 4

UNIT I BASIC CIRCUIT CONCEPTS 12

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

UNIT II NETWORK THEOREMS AND COUPLED CIRCUITS 12

Network theorems (Analysis of DC and AC Circuits): Thevenin, Norton, Superposition, Maximum power transfer and Reciprocity.

UNIT III NETWORK TOPOLOGY AND TRANSIENT ANALYSIS 12

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

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 - Filters

UNIT V S-DOMAIN ANALYSIS AND NETWORK SYNTHESIS 12

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

Total No. of Hours : 60

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

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

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Subject Code: BEE18004	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	M	H	M	H		
CO2	M	M	H	M	M		
CO3	H	M	M	H	M		
CO4	H	L	M	L	H		
CO5	M	M	L	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			
				√								

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

BEE18004	**ELECTRICAL AND ELECTRONICS MEASUREMENTS**	**3**	**0/0**	**0/0**	**3**

UNIT I INTRODUCTION **9**

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**

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- Applications

UNIT III METHODS OF MEASUREMENTS **9**

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 - Calibration

UNIT IV TRANSDUCERS AND CONVERTERS **9**

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**

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

Total No. of Hours : 45

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
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

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Subject Code: BEC18I07	Subject Name: COMMUNICATION SYSTEMS & IOT	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 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	M	M	M	L	L	M	M	L	H	M	H
CO2	M	H	H	M	L	L	L	L	M	M	H	H
CO3	L	M	M	M	L	L	M	H	M	L	M	H
CO4	L	M	M	M	M	M	H	H	H	M	M	H
CO5	M	H	H	M	M	L	M	H	M	H	M	M

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

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

BEC18I07 COMMUNICATION SYSTEMS & IOT 3 0/0 0/0 3

UNIT I SIGNALS & NOISE 9

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

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

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

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

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 No. of Hours: 45

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 Hill.
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

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Subject Code: BEE18ET1	Subject Name: LINEAR AND DIGITAL INTEGRATED CIRCUITS	T /L/ ETL	L	T / S.Lr	P / R	C
	Prerequisite:	ETL	1	0/1	3/0	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 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	M	M	M	H	M	L	M	M	L	L	M	M
CO2	H	H	M	M	H	L	M	L	M	M	L	M
CO3	M	M	H	H	M	L	L	L	M	H	M	L
CO4	L	L	M	M	L	M	L	L	M	M	H	M
CO5	M	M	H	H	M	L	L	L	M	H	M	L

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

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

BEE18ET1 LINEAR AND DIGITAL INTEGRATED CIRCUITS 1 0/1 3/0 3

UNIT I IC FABRICATION 9

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

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

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

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

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 No. of Hours : 45

TEXT BOOKS:

1. Ramakant, A. Gayakward, (2003)Op-amps and Linear Integrated Circuits,6th Edn,Pearson Education PHI.
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:

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. Charles H. Roth, (2002) Fundamentals Logic Design, 4th Edn, Jaico Publishing.
3. Floyd,(2003) Digital Fundamentals, 8th Edn, Pearson Education.
4. John F. Wakerly, (2002) Digital Design Principles and Practice,3rd Edn,Pearson Education

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Subject Code: BEE18L15	**Subject Name: MEASUREMENT AND CONTROL LABORATORY**	**T /L/ ETL**	**L**	**T / S.Lr**	**P / R**	**C**
	Prerequisite:	L	0	0/0	6/0	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 understand the Measurement and 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.

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
CO3	The students gets familiarized with the measurement of low resistance, inductance and capacitance-factor using simulation packages etc.
CO4	Attained knowledge on P/I and I/P Converters
CO5	Attained knowledge on Smart Transducers

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**	**H**	**M**	**H**	**M**	**H**	**M**	**H**	**M**	**H**	**H**
CO2	**M**	**L**	**M**	**H**	**H**	**H**	**H**	**M**	**M**	**L**	**H**	**M**
CO3	**L**	**M**	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**L**
CO4	**M**	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**M**
CO5	**H**	**M**	**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 El…	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

BEE18L15 MEASUREMENT AND CONTROL LABORATORY 0 0/0 6/0 2

LIST OF EXPERIMENTS:

1. Study of temperature measuring transducers (Thermocouples).
2. Study of displacement and pressure transducers (LVDT)
3. Measure the stress and strain using strain gauge.
4. AC Bridges.
5. DC Bridges.
6. Calibration of Single phase Energy meter.
7. Calibration of Three-phase Energy meter.
8. Transfer function of self excited DC Generator
9. Transfer function of Armature controlled DC Motor.
10. Transfer function of Field controlled DC Motor.
11. Transfer function of AC Servomotor.

Total No. of Hours: 45

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Subject Code: BEE18006	Subject Name: POWER SYSTEM - I	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 learn about Power system
- To know about transmission line parameters
- To model the transmission lines
- To learn about distribution and substation
- To know about the fault and protection

COURSE OUTCOMES (Cos): (3-5)

CO1	Attain knowledge on the basic of Power system
CO2	Knowledge on transmission line parameter
CO3	Ability to model the transmission lines
CO4	Knowledge on Distribution system
CO5	Ability to recover the faulted line

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	L	H	H	L	H	H	H	H
CO2	M	M	H	M	L	M	M	L	H	M	M	H
CO3	M	M	M	M	M	M	M	M	L	M	M	M
CO4	H	L	M	H	M	H	H	M	M	H	L	M
CO5	M	M	L	M	M	M	M	M	H	M	M	L

Cos / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	H	L	H	M	M		
CO2	M	L	M	L	H		
CO3	M	M	M	M	M		
CO4	H	M	H	M	L		
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	Interdiciplinary		
				√								

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

BEE18006	**POWER SYSTEM - I**	**3**	**0/0**	**0/0**	**3**

UNIT I INTRODUCTION TO POWER SYSTEM 9

Conventional sources of energy – Thermal, Nuclear, Diesel, Gas etc – Non-conventional Sources of Energy – Solar, Wind, Biomass, Geothermal, Tidal – Structure of Electrical Power System – Different operating Voltages

UNIT II TRANSMISSION LINE PARAMETERS 9

Mechanical design of transmission line between towers – sags and tension calculations with the effect of ice and wind - 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 9

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

UNIT IV DISTRIBUTION SYSTEM AND SUBSTATIONS 9

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

UNIT V FAULTS & PROTECTION 9

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 over voltages

Total No. of Hours : 45

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
3. Ravindranath, B. and Chander, N. (1997) Power System Protection and Switchgear, Wiley
4. 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
3. Central Electricity Authority (CEA), ‘Guidelines for Transmission System Planning’, New Delhi

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Subject Code: BEE18008	Subject Name: CONTROL SYSTEM	T /L/ ETL	L	T / S.Lr	P / R	C
	Prerequisite: BMA18001, BMA18003, BEE18002	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:

- 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			
				√								

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

BEE18008	**CONTROL SYSTEM**	**3**	**0/0**	**0/0**	**3**

UNIT I INTRODUCTION TO CONTROL SYSTEMS COMPONENTS 9

Open and closed loop Systems - mathematical models of physical systems - differential equations - transfer function - armature control - field control - block diagram reduction - signal flow graphs

UNIT II TIME RESPONSE ANALYSIS 9

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

UNIT III FREQUENCY RESPONSE AND CONCEPT OF STABILITY 9

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 9

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

UNIT V STATE SPACE REPRESENTATION 9

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

Total No. of Hours: 45

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 BOOKS:

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

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Subject Code: BEE18ET2	Subject Name: DESIGN OF ELECTRICAL MACHINES	T /L/ ETL	L	T / S.Lr	P / R	C
	Prerequisite: BEE18002, BEE18005	**ETL**	**1**	**0/1**	**3/0**	**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 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	**M**	**M**	**M**	**H**	**M**	**M**	**H**	**H**	**H**	**M**	**H**	**H**
CO2	**H**	**H**	**H**	**M**	**L**	**M**	**H**	**M**	**H**	**M**	**H**	**M**
CO3	**M**	**M**	**M**	**H**	**H**	**M**	**L**	**M**	**H**	**L**	**M**	**L**
CO4	**M**	**M**	**H**	**M**	**L**	**L**	**M**	**H**	**H**	**H**	**H**	**H**
CO5	**H**	**H**	**M**	**L**	**M**	**H**	**M**	**H**	**H**	**H**	**H**	**H**

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

BEE18ET2 DESIGN OF ELECTRICAL MACHINES 1 0/1 3/0 3

UNIT I INTRODUCTION 9

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

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 9

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

UNIT IV INDUCTION MOTORS 9

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 9

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 No. of Hours : 45

TEXT BOOKS:

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.

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Subject Code: BEE18005	Subject Name: AC AND SPECIAL MACHINES	T /L/ ETL	L	T / S.Lr	P / R	C
	Prerequisite: BEE17001/ BEE18002	**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:

- 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	M	M	H	M	L		
CO2	M	L	L	M	M		
CO3	L	L	M	M	H		
CO4	H	H	M	L	M		
CO5	M	M	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	Interdiciplinary		
				√								

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

BEE18005	**AC AND SPECIAL MACHINES**	**3**	**1/0**	**0/0**	**4**

UNIT I SYNCHRONOUS GENERATOR 12

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 - Application

UNIT II SYNCHRONOUS MOTOR 12

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 - Application

UNIT III THREE PHASE INDUCTION MOTOR 12

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

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

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 - Application

Total No. of Hours : 60

TEXT BOOKS:

1. Nagrath, I.J. Kothari, D.P. (2005) Electric Machines.7th Ed. New Delhi: T.M.H publishing Co Ltd.
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 co.
2. Stephen J. Chapman, (1985) Electric Machinery Fundamentals. New Delhi : McGraw Hill Book Co.
3. Say, M.G. (1980) Alternating current Machines.4th Ed. ELBS & Pitman. London:
4. Sen, S.K. (1984) Electrical Machinery. New Delhi: Khanna Publishers.

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Subject Code: BEE18L16	Subject Name: ELECTRICAL MACHINES LAB	T /L/ ETL	L	T / S.Lr	P / R	C
	Prerequisite:	**L**	**0**	**0/0**	**3/0**	**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 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 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.

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	Determine the characteristics of transformers and induction motors.
CO5	Understand the basic knowledge of alternators

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	M	L	M	H	M	H	M	H	M
CO2	M	M	H	M	L	H	M	M	H	M	H	M
CO3	H	H	M	M	L	M	H	L	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	M	M	M	M		
CO2	H	M	M	M	M		
CO3	H	M	L	M	M		
CO4	M	H	M	H	H		
CO5	H	M	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	Interdiciplinary		
							√					

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

BEE18L16	**ELECTRICAL MACHINES LAB**	**0**	**0/0**	**6/0**	**2**

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. OC and SC test on Single Phase Transformer
7. Load test on Single Phase Transformer
8. Load Test on Three Phase Alternator
9. Load Test on Three Phase Induction Motor
10. Load Test on Single Phase Induction Motor

Total No. of Hours: 45

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Subject Code: BEE18007	Subject Name: POWER SYSTEM - II	T /L/ ETL	L	T / S.Lr	P / R	C
	Prerequisite: Basic Electrical & Electronics Engg, BEE18006	**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 knowledge about the basic principles of Relay
- To know about the apparatus protection
- To attain knowledge on Numerical relays, Circuit breakers
- To model the power system components

COURSE OUTCOMES (Cos): (3-5)

CO1	Ability to work on Relay
CO2	Attained knowledge on the protection of Apparatus
CO3	Ability to work on Numerical Relays
CO4	Ability to design Circuit breakers
CO5	Ability to model Power System Components

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	L	H	H	L	H	H	H	H
CO2	M	M	H	M	L	M	M	L	H	M	M	H
CO3	M	M	M	M	M	M	M	M	L	M	M	M
CO4	H	L	M	H	M	H	H	M	M	H	L	M
CO5	M	M	L	M	M	M	M	M	H	M	M	L

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

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

BEE18007 POWER SYSTEM - II 3 1/0 0/0 4

UNIT I RELAYS 12

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 II APPARATUS PROTECTION 12

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

UNIT III STATIC AND NUMERICAL RELAYS 12

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

UNIT IV CIRCUIT BREAKERS 12

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

UNIT V: MODELLING OF POWER SYSTEM COMPONENTS 12

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

Total No. of Hours : 60

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
3. Ravindranath, B. and Chander, N. (1997) Power System Protection and Switchgear, Wiley
4. 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 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
3. Central Electricity Authority (CEA), ‘Guidelines for Transmission System Planning’, New Delhi

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Subject Code: BEE18010	Subject Name: POWER ELECTRONICS - I	T /L/ ETL	L	T / S.Lr	P / R	C
	Prerequisite: Basic Electrical & Electronics Engg	**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 Power Electronic Devices and its characteristics.
- To design the triggering of firing circuits.
- To learn the inverters, choppers and Industrial drives.
- To attain knowledge on DC & AC Drives

COURSE OUTCOMES (Cos): (3-5)

CO1	Knowledge on Power Electronic Devices and its characteristics
CO2	Ability to design the triggering of firing circuits
CO3	Knowledge on choppers, inverters
CO4	Knowledge on AC & DC Drives
CO5	Knowledge on Control circuits and Vector control

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	M	M	M	M	M	M	L
CO2	M	H	H	M	M	H	H	H	H	H	H	L
CO3	L	M	H	H	H	M	M	M	M	M	M	M
CO4	H	M	M	M	M	M	M	M	M	M	M	L
CO5	M	M	L	L	L	M	M	M	M	M	M	M

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

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

BEE18010 POWER ELECTRONICS - I 3 1/0 0/0 4

UNIT I POWER SEMICONDUCTOR DEVICES 12

Power semiconductor devices Overview: Characteristics of power Structure, operation, Static characteristics and switching characteristics (Turn on and Turn off) of SCR, TRIAC, BJT, MOSFET and IGBT – Two transistor model of SCR – Series and Parallel operation of SCR – Turn on circuits for SCR – Different techniques of commutation – Protection of Thyristors against over voltage, over current, dv/dt and di/dt

UNIT II PHASE CONTROLLED CONVERTERS 12

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 III INVERTERS 12

Voltage and current source inverters – Single phase and three phase inverters (both 120º mode and 180º mode) inverters – PWM techniques: Sinusoidal PWM, modified sinusoidal PWM - multiple PWM – Resonant series inverter – current Source Inverter – UPS

UNIT IV DC DRIVES 12

Features of armature controlled, field controlled DC drives using conventional rheostat (Shunt and series), conventional Ward-Leonard control, Slow speed operation inching and jogging. Transfer functions of armature controlled, field controlled DC motors.

UNIT V AC DRIVES 12

Induction motor drives- speed control by stator frequency variation – operation of induction motor on variable frequency sources – operation of IM on non sinusoidal waveforms – constant flux operation current fed operation – dynamic and regenerative braking of CSI and vs. drives – slip controlled drives – Introduction to vector control – cycloconverter drives –features

Total No. of Hours : 60

TEXT BOOKS:

1. Rashid, M.H. (2004) Power Electronics - Circuits Devices and Applications.3rd Ed. Prentice Hall of India.
2. Bimbhra, P.S. (1999) Power Electronics.3rd Ed. Khanna Publishers.

REFERENCE BOOKS:

1. Singh, M.D. Kanchandani, (2002) Power Electronics. New Delhi: Tata McGraw Hill & Hill publication Company Ltd.
2. Dubey, G.K. Doradia, S.R. Joshi, A. Sinha, R.M. (1986) Thyristorised Power Controllers. Wiley Eastern Limited.
3. Lander, W. (1993) Power Electronics.3rd Ed. McGraw Hill and Company.

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Subject Code: BEE18ET3	Subject Name: ENERGY UTILIZATION AND CONSERVATION	T /L/ ETL	L	T / S.Lr	P / R	C
	Prerequisite: --	ETL	1	0/1	3/0	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	Ability to perform energy audit
CO5	Ability to find solution for energy conservation

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	H	H	M	L	H	H	M	L	H	H
CO2	M	M	M	M	M	M	M	M	M	M	M	M
CO3	M	L	H	M	M	L	H	M	M	L	H	M
CO4	H	H	H	H	H	H	H	H	H	H	H	H
CO5	M	M	H	H	M	M	H	H	M	M	H	H

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

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

BEE18ET3 ENERGY UTILIZATION AND CONSERVATION 1 0/1 3/0 3

UNITI HEATING AND WELDING 9

Advantages and methods of electric heating, resistance ovens, induction heating, dielectric heating, the arc furnace - heating of building. Electric welding, resistance and arc welding, control devices

UNIT II ILLUMINATION 9

Importance of lighting – properties of good lighting scheme – laws of illumination –photometry - types of lamps – lighting calculations – basic design of illumination schemes for residential, commercial, street lighting and sports ground – energy efficiency lamps.

UNIT III ELECTRIC DRIVES 9

Type of electric drives, choice of motor, starting and running characteristics, speed control, temperature rise, particular applications of electric drives, types of industrial loads, continuous, intermittent and variable loads, load equalization

UNIT IV INTRODUCTION TO ELECTRIC AND HYBRID VEHICLES 9

Configuration and performance of electrical vehicles, traction motor characteristics, tractive effort, transmission requirement and energy consumption

UNITV ENERGY CONSERVATION 9

Principle of energy conservation - waste heat recovery - Heat pump – Economics of energy conservation, cogeneration, combined cycle plants, electrical energy conservation opportunities

Total No of Hours : 45

TEXT BOOKS:

1. Epenshaw Taylor, (2009) Utilization Of Electric Energy. 12th Impression. Universities Press.
2. Mehrdad, Ehsani, Yim in Gao, Sabastien E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles.CRC Press.
3. Wadhwa, C.L. (2003) Generation, Distribution and Utilization of Electrical Energy. NewAge International Pvt. Ltd.
4. Gupta, B.R. (2003) Generation of Electrical Energy. New Delhi: Eurasia Publishing House (P) Ltd.

REFERENCE BOOKS:

1. Soni Gupta, Bhatnager-DhanapatRai& sons A Course in Electrical Power.
2. Uppal, S.L. Electrical Power. Khanna Publications

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Subject Code: BEE18L17	Subject Name: POWER ELECTRONICS LABORATORY	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:	T	0	0/0	6/0	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 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

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			

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

BEE18L17 POWER ELECTRONICS LABORATORY 0 0/0 6/0 2

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
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

Total No of Hours: 45

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Subject Code: BEE18009	Subject Name: POWER SYSTEM - III	T /L/ ETL	L	T / S.Lr	P / R	C
	Prerequisite: BEE18004, BEE18007	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	M	M	H	H		
CO3	H	H	H	M	M		
CO4	H	M	L	H	H		
CO5	H	L	M	M	H		

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

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

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

BEE18009	**POWER SYSTEM - III**	**3**	**1/0**	**0/0**	**4**

UNITI INTRODUCTION TO POWER QUALITY AND SYSTEM OPERATION 12

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

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

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

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

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 No. of Hours : 60

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

Subject Code: BEE18ET4	Subject Name: INDUSTRIAL DRIVES AND AUTOMATION	T /L/ ETL	L	T / S.Lr	P / R	C
	Prerequisite: BEE18009, BEE18010, BEE18005	**ETL**	**1**	**0/1**	**3/0**	**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			
				√								

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

BEE18ET4 INDUSTRIAL DRIVES AND AUTOMATION 1 0/1 3/0 3

UNIT I INTRODUCTION 9

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

UNIT II DC DRIVES 9

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

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

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

UNIT V PLC 9

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

Total No of Hours : 45

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

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Subject Code: BEE18L08	**Subject Name: POWER SYSTEM LAB**	**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 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 Electrical Software

COURSE OUTCOMES (Cos): (3-5)

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**	**M**	**M**	**L**	**L**	**M**	**M**	**L**	**L**	**L**	**M**
CO2	**M**	**M**	**M**	**H**	**H**	**H**	**M**	**M**	**L**	**M**	**H**	**M**
CO3	**M**	**M**	**L**	**L**	**L**	**L**	**H**	**H**	**H**	**M**	**M**	**M**
CO4	**H**	**H**	**M**	**H**	**H**	**M**	**M**	**L**	**H**	**H**	**M**	**M**
CO5	**M**	**M**	**M**	**M**	**M**	**M**	**H**	**H**	**M**	**M**	**M**	**H**

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

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

BEE18L08	**POWER SYSTEM LAB**	**0**	**0/0**	**3/0**	**1**

LIST OF EXPERIMENTS:

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. Transient and Small Signal Stability Analysis: Single-Machine Infinite Bus System
6. To study the performance of an over voltage relay.
7. To study the performance of under voltage relay.
8. To study the performance of Earth fault relay.
9. To perform inter turn protection of transformer.
10. To study flash point test of transformer oil.
11. To study characteristics of MCB & HRC Fuse.
12. To study radial feeder performance when a) fed at one end b) fed at both ends
13. To simulate the SLG fault in a power system network
14. To simulate the DLG fault in a power system network

Total No of Hours: 45

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Subject Code: BEE18011	Subject Name: MICROGRID TECHNOLOGY	T /L/ ETL	L	T / S.Lr	P / R	C
	Prerequisite: BEE18010, BEE18009	**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 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	M	M	M	H	H	M	L	H	H	H	H	H
CO2	L	L	M	H	M	M	H	M	H	M	H	M
CO3	M	M	M	L	M	H	H	M	M	M	H	M
CO4	H	L	M	H	M	M	L	M	M	M	H	M
CO5	H	H	L	L	M	H	H	M	H	M	H	M

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

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

BEE18011 MICROGRID TECHNOLOGY 3 1/0 0/0 4

UNIT I INTRODUCTION 12

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

UNIT II OVER VIEW OF MICROGRID 12

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

UNIT III DISTRIBUTED GENERATION 12

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

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

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

Total No of Hours : 60

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. S.T.Rama, E.Sheeba Percis, A.Nalini, S.Bhuvaneswari, (2017), Handbook on Standalone Renewable Energy Systems, 1st Edn, Research India Publication ISBN No 978-93-87374-12-6
2. David Gao, (2015) Energy Storage for Sustainable Microgrid, 1st Ed , Elsevier
3. Magdi S, Mahmoud , (2017), Microgrid- Advanced Control Methods and Renewable Energy System Integration, Butterworth –Heinemann- Elsevier
4. Chowdhury,S, Chowdhury, SP, Crossley, P, Microgrids and Active Distribution Networks, IET

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Subject Code: BEE18L12	Subject Name: PROJECT PHASE -I	T /L/ ETL	L	T / S.Lr	P / R	C
	Prerequisite:	**L**	**0**	**0/0**	**3/3**	**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		
CO4	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			
							√					

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Subject Code: BEE18012	Subject Name: POWER ELECTRONICS - II	T /L/ ETL	L	T / S.Lr	P / R	C
	Prerequisite: BEE18009, BEE18010	**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 knowledge on HVDC
- To model the HVDC system
- To know abot FACTS Controllers
- To model the Power flow system

COURSE OUTCOMES (Cos): (3-5)

CO1	Attained knowledge about HVDC
CO2	Ability to model the HVDC System
CO3	Knowledge on FACTS
CO4	Attain knowledge on FACTS Controllers
CO5	Ability to model Power flow using STATCOM, TCSC etc

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	H	L	L	M	M	L
CO2	H	H	H	H	M	M	L	L	M	M	H	M
CO3	M	H	H	M	L	L	M	H	M	M	H	H
CO4	M	M	M	M	M	H	H	M	M	L	L	L
CO5	L	H	H	H	H	M	M	H	M	H	H	M

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

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

BEE18012 POWER ELECTRONICS - II 3 1/0 0/0 4

UNIT I INTRODUCTION TO HVDC 12

Introduction of DC Power transmission technology – Classification of HVDC links- Components of HVDC transmission system- Comparison of AC and DC- Planning and Modern trends in DC transmission.

UNIT II HVDC CABLES AND MODELING OF HVDC SYSTEMS 12

Introduction of DC cables – Basic physical phenomenon arising in DC insulation – Practical dielectrics – Dielectric stressconsideration – Economics of DC cables compared with AC cables- Introduction to converter model of HVDC

UNIT III INTRODUCTION TO FACTS 12

The concept of flexible AC transmission - reactive power control in Electrical power transmission lines - uncompensated transmission line – series and shunt compensation. Overview of FACTS devices - Static Var Compensator (SVC) – Thyristors Switched Series capacitor (TCSC) – Unified Power Flow controller (UPFC) - Integrated Power Flow Controller (IPFC).

UNIT IV EMERGING FACTS CONTROLLERS 12

Static Synchronous Compensator (STATCOM) – operating principle – V-I characteristics – Unified Power Flow Controller (UPFC) – Principle of operation - modes of operation – applications

UNIT V POWER FLOW MODELING 12

Power flow modeling of SVC, TCSC, STATCOM and UPFC.

Total No of Hours : 60

TEXT BOOKS:

1. Mohan Mathur, R. Rajiv K. Varma, Thyristor – Based Facts Controllers for Electrical Transmission Systems. IEEE press and John Wiley & Sons, Inc.
2. ACHA etal, E. Power Electronic Control in Electrical Systems. Newness Power Engineering Series.
3. Padiyar, K. R.(1990) HVDC power transmission system.1st Ed. New Delhi: Wiley Eastern Limited.
4. Edward Wilson Kimbark, (1971) Direct Current Transmission. Vol. I. Wiley inter science. New York: London: Sydney:

REFERENCE BOOKS:

1. John, A.T.(1999) Flexible AC Transmission System. Institution of Electrical and Electronic Engineers (IEEE).
2. Narain G. Hingorani, Laszio, Gyugyl, (2001)Understanding FACTS Concepts and Technology of Flexible AC Transmission System. Delhi: Standard Publishers.

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Subject Code: BEE18013	Subject Name: SMART GRID TECHNOLOGY	T /L/ ETL	L	T / S.Lr	P / R	C
	Prerequisite: BEE18009, BEE18010, BEE18011	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 smart grid need and its regulations.
- To provide solution in various levels of smart grid.
- To understand Microgrid, Communication and Measurement technology.

COURSE OUTCOMES (Cos): (3-5)

CO1	Understands the difference between smart grid and traditional grid design a Smartgrid
CO2	Understands the Smartgrid communication and measurement technology
CO3	Ability to design a Smart Grid
CO4	Understands the storage technologies
CO5	Ability to model and apply control for the interoperability state.

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	L	M	L	H	L	M	L	H
CO2	H	H	H	M	M	H	H	H	M	H	H	H
CO3	L	H	H	M	H	M	H	M	H	M	H	M
CO4	M	L	H	H	M	L	H	L	M	L	H	L
CO5	H	H	L	L	L	M	M	H	L	M	M	H

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

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

BEE18013 SMART GRID TECHNOLOGY 3 0/0 0/0 3

UNIT I INTRODUCTION TO SMART GRID 9

Traditional power grid- Smart grid Definition- Need for smart grid- Smart Grid Risks- Smart grid risks vs Benefits- Regulations in smart grid- Privacy information impacts and security standards- Smart grid security strategy- smart grid impact- applying security control and managing the overall risks.

UNIT II SMART GRID COMMUNICATIONS AND MEASUREMENT TECHNOLOGY 9

Functions of Smart grid Component- Communication and measurement- Monitoring Measurement Technologies- WAMS, PMU, Smart meter, AMI etc. GIS and Google Mapping Tools- MAS- Microgrid and Smart grid Comparison.

UNIT III DESIGNING SMART GRID 9

Barriers and solution to smart grid development- General Level Automation- Power System Automation at Transmission Level- Distribution Level Automation- End user level- Applications for adaptive control and optimization.

UNIT IV RENEWABLE & STORAGE 9

Renewable resources- Sustainable energy options for the smart grid-solar Technology- modeling PV- Wind turbine systems- Biomass- Bio-energy- Small and Micro Hydro power- Fuel cell- Geothermal Heat pumps- Penetration and variability issues associated with sustainable energy technology- Demand response issues- Electric Vehicles- PHEV Technology- Environmental implications- Storage Technologies

UNIT V INTEROPERABILITY AND CYBER SECURITY 9

Introduction- Interoperability- State of art- Benefits and challenges- Model- Control- Standards- Cyber security – Risks- Possible operation for improving -Case Study in Smart Grid Activity and Approach for smart grid Application

Total No. of Hours : 45

TEXT BOOKS:

1. Gilbert N. Sorebo, & Michael C. Echols, Smart Grid Security- An end to end view of security in the new Electrical grid. CRC Press.
2. James Momoh, Smart Grid- Fundamentals of Design and Analysis. CRC Press.
3. Janaka B. Ekanayake, Kithsiri Liyanage, Jian zhong Wu, Akihiko Yokoyama, Nick Jenkins Smart Grid Technology & Application. in Wiley.

REFERENCE BOOKS:

1. S.T.Rama, E.Sheeba Percis, A.Nalini, S.Bhuvaneswari, (2017), Handbook on Standalone Renewable Energy Systems, 1st Edn, Research India Publication ISBN No 978-93-87374-12-6

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Subject Code: BEE18L13	Subject Name: PROJECT PHASE - II	T /L/ ETL	L	T / S.Lr	P / R	C
	Prerequisite:	**L**	**0**	**0/0**	**12/12**	**8**

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	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

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		

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			
							√					

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Subject Code: BEE18E01	Subject Name: WIND ENERGY CONVERSION TECHNIQUES	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 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			
					√							

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

BEE18E01 WIND ENERGY CONVERSION TECHNIQUES 3 0/0 0/0 3

UNIT I INTRODUCTION TO WIND SYSTEMS 9

Historical uses of wind – History of wind turbines – Wind characteristics: Meteorology of wind – wind speed distribution across the world – spatial and temporal factors – Eolian features - Biological indicators. Wind measurement: Anemometers – balloon trackers. Wind energy conversion systems (WECS) - classifications

UNIT II WIND ENERGY CONVERSION 9

Meteorology of wind – Wind speed statistics – Aerodynamic design principles; Aerodynamic theories; Axial momentum, blade element and Strip theory; Maximum power coefficient - tip loss correction; Rotor design and characteristics - Power, torque and speed characteristics – Wind turbine performance measurement – Loading analysis

UNIT III WIND TURBINE SUBSYSTEMS & COMPONENTS 9

Design of WECS components – Stall, pitch & yaw control mechanisms – Brake control mechanisms - Theoretical simulation of wind turbine characteristics; Test methods

UNIT IV APPLICATION OF WIND ENERGY 9

Wind pumps - Performance analysis, design concept and testing - Principle of Wind Energy Generators - Stand alone, grid connected and hybrid applications of WECS - Economics of wind energy utilization - Wind energy in India

UNIT V OVERVIEW OF SMALL HYDROPOWER SYSTEM 9

Overview of micro, mini and small hydro systems- Hydrology- Elements of pumps and turbine - Selection and design criteria of pumps and turbines - Site selection and civil works - Speed and voltage regulation - Investment issues load management and tariff collection; Distribution and marketing issues: case studies; Potential of small hydro power in India.

Total No of Hours : 45

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
2. S.T.Rama, E.Sheeba Percis, A.Nalini, S.Bhuvaneswari, (2017), Handbook on Standalone Renewable Energy Systems, 1st Edn, Research India Publication ISBN No 978-93-87374-12-6

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Subject Code: BEE18E02	**Subject Name: IOT APPLIED TO ELECTRICAL 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 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 Smart Space 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			
					√							

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

BEE18E02 IOT APPLIED TO ELECTRICAL ENGINEERING 3 0/0 0/0 3

UNITI INTRODUCTION TO IOT 9

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

Smart Devices – Smart Apps – Wearable Technology – Vehicle Telemetry – Smart Homes and Building Automation – Vehicle Charging Station

UNIT III SMART ENERGY 9

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

Real-Time Monitoring and Control of Processes – Deploying Smart Machine – Smart Sensor – Smart Controllers – SCADA – Proprietary Communication

UNIT V SECURITY MEASURES 9

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 No of Hours : 45

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

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Subject Code: BEE18E11	Subject Name: MATERIAL SCIENCE IN AVIATION	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 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 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			
					√							

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

BEE18E11 MATERIAL SCIENCE IN AVIATION 3 0/0 0/0 3

UNIT I INTRODUCTION TO CRYOGENIC TECHNOLOGY 9

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 9

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

UNIT III FLEXIBLE ELECTRONICS 9

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 9

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 9

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

Total No. of Hours : 45

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

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Subject Code: BEI18013	Subject Name: POWER PLANT INSTRUMENTATION	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:

- 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			
					√							

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

BEI18013 POWER PLANT INSTRUMENTATION 3 0/0 0/0 3

UNIT I OVERVIEW OF POWER GENERATION 9

Brief survey of methods of power generation – hydro, thermal, nuclear, solar and wind power – importance of instrumentation in power generation – thermal power plants – building blocks – details of boiler processes UP&I diagram of boiler – cogeneration.

UNIT II MEASUREMENTS IN POWER PLANTS 9

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 9

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

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

Speed, vibration, shell temperature monitoring and control – steam pressure control – lubricant oil temperature control – cooling system

Total No of Hours : 45

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

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Subject Code: BEE18E05	Subject Name: SOLAR ENERGY CONVERSION TECHNIQUES	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 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	M	H	H	M	M	L	M	M	M	L	M	L
CO2	M	M	M	L	M	H	M	L	M	H	M	H
CO3	L	M	L	M	H	M	L	M	H	M	L	M
CO4	M	H	H	M	L	M	H	M	L	M	H	M
CO5	H	H	H	M	L	M	H	M	L	M	H	M

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

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

BEE18E05 SOLAR ENERGY CONVERSION TECHNIQUES 3 0/0 0/0 3

UNIT I SOLAR RADIATION AND COLLECTORS 9

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

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 9

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 9

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

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 No of Hours : 45

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

REFERENCE BOOKS:

1. Garg H P., Prakash J., (2000), Solar Energy: Fundamentals & Applications, Tata McGraw Hill
2. S.T.Rama, E.Sheeba Percis, A.Nalini, S.Bhuvaneswari, (2017), Handbook on Standalone Renewable Energy Systems, 1st Edn, Research India Publication ISBN No 978-93-87374-12-6
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.

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Subject Code: BEE18E06	Subject Name: GREEN BUILDING TECHNOLOGY	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 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			
					√							

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

BEE18E06 GREEN BUILDING TECHNOLOGY 3 0/0 0/0 3

UNIT I INTRODUCTION TO GREEN BUILDING 9

Basics of Green - Sustainable Design – ecological Design – Green Design – Green Buildings- Progress & Obstacles- High Performance Green Buildings

UNIT II DESIGN OF GREEN BUILDING 9

Foundations of Green Building-Environmental concerns- Assessment- Design process- Green building excecution project- Heat Island Mitigation – Sustainable sites

UNIT III REDUCTION OF CARBON FOOTING 9

Building energy Issues – Design Strategy – Renewable Energy Systems- Smart Building & energy Management Systems - Reducing the Carbon footprint

UNIT IV ENVIRONMENTAL ASPECTS 9

Hydrological cycle - Sustainable storm water management - Construction Operations and commissioning of Green Building – Construction & Demolition Waste management - Indoor Environmental Quality

UNIT V FUTURE TRENDS 9

Economics in Green Building – Managing First costs – Financial barriers - Articulating Performance goals for future Green Buildings – Revamping Ecological Design

Total No of Hours : 45

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
3. S.T.Rama, E.Sheeba Percis, A.Nalini, S.Bhuvaneswari, (2017), Handbook on Standalone Renewable Energy Systems, 1st Edn, Research India Publication ISBN No 978-93-87374-12-6

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Subject Code: BEE18E09	Subject Name: : RESTRUCTURING OF DISTRIBUTION SYSTEM	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 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			
					√							

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

BEE18E09 RESTRUCTURING OF DISTRIBUTION SYSTEM 3 0/0 0/0 3

UNITI INTRODUCTION TO DISTRIBUTION SYSTEM 9

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

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

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

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

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 No of Hours : 45

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

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Subject Code: BEE18E10	Subject Name: DG & ENERGY STORAGE TECHNOLOGY	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 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 various energy resources
CO2	Knowledge on the concept of Distributed generation
CO3	Knowledge on Fuel cells and Batteries
CO4	Ability to analyze 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			
					√							

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

BEE18E10 DG & ENERGY STORAGE TECHNOLOGY 3 0/0 0/0 3

UNIT I INTRODUCTION 9

Conventional Power generation – Advantages and disadvantages – energy crisis – Non- conventional energy resources – review of solar, Wind energy system, biomass, tidal sources

UNITII DISTRIBUTED GENERATION 9

Concept of distributed generation – topologies – selection of sources – regulatory standards – Security issues in DG implementation – Energy storage element - Necessity of energy storage – types of energy storage – comparison of energy storage technologies - Application

UNITIII BATTERIES & FUEL CELL 9

Batteries – Measurement – Storage and types - 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

Flywheel – Super Capacitors – Principles & applications, Compressed Air Energy Storage- Concept of Hybrid Storage – Microgrid economics -Applications

UNIT V ELECTRIC VEHICLE 9

Electric Vehicle – Types – Hybrid Vehicle – Battering Charging – Usage of batteries in Hybrid vehicle – Fundamentals of Electric vehicle modeling – Types of PHEVs and Automotive system

Total No of Hours: 45

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
3. Sumedha Rajakaruna, Farhad Shahnia, Arindham Ghosh, "Plug-in-ElectricVehicles in Smart Grid – Integration Techniques", Springer, 2015

REFERENCE BOOKS:

1. Seth Leitman, Bob Brant (2013) Build Your Own Electric Vehicle, 3rd Ed, McGraw Hill
2. S.T.Rama, E.Sheeba Percis, A.Nalini, S.Bhuvaneswari, (2017), Handbook on Standalone Renewable Energy Systems, 1st Edn, Research India Publication ISBN No 978-93-87374-12-6
3. James larminie, Andrew Dicks, (2003), Fuel Cell Systems Explained, Wiley

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Subject Code: BEE18E13	Subject Name: SAFETY FOR ELECTRICAL ENGINEERS	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 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			
					√							

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

BEE18E13 SAFETY FOR ELECTRICAL ENGINEERS 3 0/0 0/0 3

UNIT I GENERAL PRINCIPLES OF ELECTRIC SAFETY 9

Electricity and Human Body – Earthing – Grounding – General Inspection and testing requirement for electrical safety equipment – Flash and thermal production – head and Eye Protection – Electricians Safety kits

UNIT II HAZARDS IN ELECTRICITY 9

Lighting Hazards - Hazardous area –Hazard Analysis – shock effect - Electrical Insulation – Electrical fires – Arc Flash – Arc energy – arcing voltage – Injury and death – Protective Strategies - Eectrical safety in hospitals

UNIT III REGULATORY OF SAFETY REQUIREMENT AND STANDARDS 9

Risk assessment and Management – Safety against over voltage, extra-low and residual voltages – safety practice – Safety Audits – ANSI-IEEE Electrical safety code – Electrical standards at work place – Accident prevention

UNIT IV SAFETY PROCEDURES 9

Residual current detectors - effects of electric and magnetic fields and electromagnetic radiation – electro surgical hazards – electrical fires and their investigation – Indian electricity safety Act – Area Classification – Safety issues with emerging energy sources

UNIT V SAFETY TRAINING METHODS 9

Introduction – Elements of a Training Program – On the Job Training – Training Consultants and Vendors- Training Program Setup – Step by Step Method electrical safety

Total No of Hours : 45

Text Book:

1. Electrical safety handbook - john cadick - McGRAW-HILL, Third Edition

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Subject Code: BEE18E14	Subject Name: WIDE AREA MONITORING PROTECTION AND CONTROL	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 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			
					√							

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

BEE18E14	**WIDE AREA MONITORING PROTECTION AND CONTROL**	**3**	**0/0**	**0/0**	**3**

UNIT I INTRODUCTION **9**

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**

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**

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**

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**

WAMPAC Application in Frequency Stability, Voltage Stability, Transient Stability, Small Signal Stability

Total No of Hours : 45

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

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Subject Code: BEE18E15	Subject Name: ROBOTICS AND AUTOMATION	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 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			
					√							

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

BEE18E15 ROBOTICS AND AUTOMATION 3 0/0 0/0 3

UNIT I INTRODUCTION 9

Anatomy of robotics – History & Terminology of Robotics – various generations of robots – degrees of freedom – Asimov's laws of robotics

UNIT II SENSORS IN ROBOTICS 9

Position sensors – optical, non-optical, Velocity sensors, Accelerometers, Proximity Sensors – Contact, non-contact, Range Sensing, touch and Slip Sensors, Force and Torque Sensors.

UNIT III MANIPULATORS, ACTUATORS AND GRIPPERS 9

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 ROBOTICS IN MATERIAL HANDLING 9

General considerations in robot material handling – material transfer application – pick & place operations – machine loading & unloading – characteristics of robot application – Robot cell design – processing operations – Spot welding, Spray painting, Plastic moulding, forging

UNIT V ROBOTICS IN FUTURE 9

Robot intelligence, Advanced Sensors, Capabilities, Tele robotics, Mechanical design Features, Mobility, locomotion and Navigation. The universal Hand Systems Integration and Networking

Total No of Hours : 45

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.

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Subject Code: BEE18E16	Subject Name: IMAGE 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 apply transformation techniques in Digital Image Processing
- To apply techniques in image enhancement, restoration, compression, segmentation etc
- To learn image restoration and image compression

COURSE OUTCOMES (Cos): (3-5)

CO1	Capability to transform techniques in Digital image processing
CO2	Capable to apply techniques in image enhancement
CO3	Ability to process and restore images
CO4	Ability to segment the images
CO5	Attain knowledge on implementing various algorithm in image processing

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	M	L	M	H	M	M	M	M	M
CO2	L	M	L	H	M	L	M	L	L	M	L	M
CO3	H	H	H	M	L	H	H	H	H	H	H	H
CO4	H	H	H	H	H	H	H	H	H	H	H	H
CO5	M	M	M	H	H	M	M	M	M	M	M	M

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

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

BEE18E16	**IMAGE PROCESSING**	**3**	**0/0**	**0/0**	**3**

UNIT I DIGITAL IMAGE FUNDAMENTALS AND TRANSFORMS 9

Elements of visual perception – Image sampling and quantization Basic relationship between pixels – Basic geometric transformations-Introduction to Fourier Transform and DFT – properties of 2D Fourier Transform – FFT – Separable Image Transforms -Walsh – Hadamard – Discrete Cosine Transform, Haar, Slant – Karhunen – Loeve transforms.

UNIT II IMAGE ENHANCEMENT TECHNIQUES 9

Spatial Domain methods: Basic grey level transformation – Histogram equalization – Image subtraction – Image averaging –Spatial filtering: Smoothing, sharpening filters – Laplacian filters – Frequency domain filters : Smoothing–Sharpening filters-Homomorphic filtering.

UNIT III IMAGE RESTORATION 9

Model of Image Degradation/restoration process – Noise models – Inverse filtering -Least mean square filtering – Constrained least mean square filtering – Blind image restoration – Pseudo inverse – Singular value decomposition.

UNIT IV IMAGE COMPRESSION 9

Lossless compression: Variable length coding – LZW coding – Bit plane coding- predictive coding-DPCM. Lossy Compression: Transform coding – Wavelet coding – Basics of Image compression standards: JPEG, MPEG, Basics of vector quantization.

UNIT V IMAGE SEGMENTATION AND REPRESENTATION 9

Edge detection – Thresholding - Region Based segmentation – Boundary representation: chair codes- Polygonal approximation – Boundary segments – boundary descriptors: Simple descriptors-Fourier descriptors - Regional descriptors –Simple descriptors- Texture- Implementation of various algorithms in image processing using related simulation packages.

Total No of Hours : 45

TEXT BOOKS:

1. Rafael C Gonzalez, Richard E. Woods, (2003) Digital Image Processing.2nd Ed. Pearson Education.

REFERENCE BOOKS:

1. William K. Pratt, (2001) Digital Image Processing. John Willey..
   ChandaDutta Magundar, (2000) Digital Image Processing and Applications. Prentice Hall of India:
2. Millman Sonka, Vaclav hlavac, Roger Boyle, Broos, colic,(1999) Image Processing Analysis and Machine Vision.Thompson Learning
3. Jain, A.K.(1995) Fundamentals of Digital Image Processing. New Delhi: PHI.

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Subject Code: BEE18E17	Subject Name: SUBSTATION DESIGNING	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 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			
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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

BEE18E17	**SUBSTATION DESIGNING**	**3**	**0/0**	**0/0**	**3**

UNIT I INTRODUCTION TO SUBSTATION AND ITS TYPES 9

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

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

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

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

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 No of Hours : 45

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

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Subject Code: BEE18E18	Subject Name: INDUSTRIAL CONTROL AND INSTRUMENTATION	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 know about force, torque, velocity
- To learn the measurement of acceleration, vibration, density and viscosity
- To understand the Pressure and Temperature measurement

COURSE OUTCOMES (Cos): (3-5)

CO1	Attain knowledge on Power Regulatory systems
CO2	Knowledge on Controllers and converters
CO3	Capable to use the techniques for temperature and pressure measurement
CO4	Attain knowledge on Thermocouple and pyrometers
CO5	Ability to work in an Instrumentation Industry

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	H	M	M	M	L	H	M	M	H	M
CO2	M	L	H	H	L	M	L	H	H	L	H	H
CO3	H	M	H	H	H	H	M	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	H

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

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

BEE18E18 INDUSTRIAL CONTROL AND INSTRUMENTATION 3 0/0 0/0 3

UNIT I REGULATORY POWER SUPPLY 9

Overview of Switching Regulators and switch mode power supplies – Uninterrupted Power Supplies – Solid state circuit breakers - PLC

UNIT II CONTROLLERS AND CONVERTERS 9

Analog Controllers – Proportional controllers – Proportional Integral Controllers – PID Controllers – Feed forward Controllers – Signal Conditioners – Instrumentation Amplifiers – Voltage to Current, Current to Voltage , Voltage to Frequency , Frequency to Voltage Converters – Isolation Circuits

UNIT III PRESSURE MEASUREMENT 9

Units of pressure - Manometers – Different types – Elastic type pressure gauges – Bourdon type bellows – Diaphragms – Electrical methods – Elastic elements with LVDT and strain gauges – Capacitive type pressure gauge – Piezo resistive pressure sensor – Resonator pressure sensor – Measurement of vacuum – McLeod gauge – Thermal conductivity gauges – Ionization gauge, cold cathode and hot cathode types – Testing and calibration of pressure gauges – Dead weight tester.

UNIT IV THERMOCOUPLE 9

Thermocouples – Laws of thermocouple – Fabrication of industrial thermocouples – Signal conditioning of thermocouples output – Thermal block Reference Books functions – Commercial circuits for cold junction compensation – Response of thermocouple – Special techniques for measuring high temperature using thermocouples – Radiation methods of temperature measurement

UNIT V APPLICATION IN INDUSTRIES 9

Stepper Motors and Servo motors – Control and Application – Servo Amplifiers – Selection of Servo motor and Application – Fibre Optics – Barcode Equipment and Application of Barcode in Industry

Total No. of Hours :45

TEXT BOOKS:

1. Doebelin, E.O.(2003) Measurement Systems – Application and Design. Tata McGraw Hill publishing company.
2. Jain, R.K. (1999) Mechanical and Industrial Measurements. New Delhi: Khanna Publishers.
3. Michael Jacob,(1988) 'Industrial Control Electronics – Applications and Design', Prentice Hall
4. Thomas, E.Kissel, (2003) Industrial Electronics, PHI

Reference Bookss

1. Patranabis, D.(1996) Principles of Industrial Instrumentation. Tata McGraw Hill Publishing Company Ltd.
2. Sawhney, A.K. and Sawhney, P.(2004) A Course on Mechanical Measurements, Instrumentation and Control Dhanpath Rai and Co.
3. Nakra, B.C. & Chaudary, B.C.Instrumentation Measurement & Analysis.Tata McGraw Hill Publishing Ltd.
4. Singh, S.K.(2003) Industrial Instrumentation and Control.Tata McGraw Hill.
5. Eckman, D.P. Industrial Instrumentation. Wiley Eastern Ltd.

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Subject Code: BEE18E19	Subject Name: ELECTRIC TRACTION	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 know about traction drive
- To estimate motor rating with Reference Books to Indian Standards
- To apply concepts in electrical Machines

COURSE OUTCOMES (Cos): (3-5)

CO1	Familiarity in Traction drive and its services
CO2	Capable to estimate motor rating with Reference Books to Indian Standards
CO3	Capable to apply concepts in Electrical machines
CO4	Attain knowledge on special electric drive
CO5	Capable to model equivalent system of motor load.

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	M	L	H	M	M	M	L	H	M	M
CO2	M	H	M	L	H	H	L	M	L	H	H	L
CO3	L	H	H	M	H	H	H	H	M	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	H

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

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

BEE18E19 ELECTRIC TRACTION 3 0/0 0/0 3

UNIT I INTRODUCTION 9

Basic drive components , classification and operating modes of electric drive, nature and type of mechanical loads, review of speed torque , characteristics of electric motors and load , joint speed torque characteristics. **Electric Braking:** Plugging , dynamic and regenerative braking of DC and AC motors.

UNIT II DYNAMICS OF ELECTRIC DRIVES SYSTEM 9

Equation of motion , equivalent system of motor load combination, stability considerations, electro mechanical transients during starting and braking , calculation of time and energy losses, optimum frequency of starting.

UNIT III TRACTION DRIVE 9

Electric traction services, duty cycle of traction drives calculations of drive rating and energy consumption, desirable characteristics of traction drive and suitability of electric motors, control of traction drives. Energy Conservation in Electric Drive: Losses in electric drive system and their minimization energy, efficient operation of drives, load equalization.

UNIT IV ESTIMATION OF MOTOR POWER RATING 9

Heating and cooling of electric motors, load diagrams, classes of duty, Reference Books to India standards, estimation of rating of electric motors for continuous, short time and intermittent ratings.

UNIT V SPECIAL ELECTRIC DRIVE 9

Servo motor drive, step motor drive, linear induction motor drive, permanent magnet motor drive. Selection of electric drive: Selection criteria of electric drive for industrial applications, case studies related to steel mills, paper mills, textile mills and machine tool etc.

Total No of Hours : 45

TEXT BOOKS:

1. Dubey, G.K. (1995) Fundamentals of Electric Drive. Narosa Publishing House.
2. Chilkin, M. Electric Drive. Mir Publications.

REFERENCE BOOKS:

1. Pillai, S.K. A first course on Electric Drive. New age international publishers.
2. Dev, N.K. Sen, P.K. (1999) Electric Drives. Prentice Hall of India .
3. Vedam Subhramanyam, (1994) Electric Drive : Concepts and Applications. Tata McGraw Hill.

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Subject Code: BEE18E20	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	M	M	M	H	H	L	H	L	M	L	H	L
CO2	M	M	H	L	M	M	H	M	H	M	H	L
CO3	M	M	L	L	L	L	H	L	H	L	H	L
CO4	H	H	L	M	L	M	H	M	H	M	H	L
CO5	M	M	M	H	M	L	H	L	H	H	H	H

Cos / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	L	H	H	M	M		
CO2	M	M	M	H	L		
CO3	L	L	M	M	H		
CO4	H	H	H	M	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			
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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

BEE18E20 ELECTRIC TRANSIENTS AND HIGH VOLTAGE ENGINEERING 3 0/0 0/0 3

UNIT I OVER VOLTAGE & TRANSIENTS 9

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 9

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 9

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 9

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 9

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 No of Hours : 45

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