GALGOTIAS UNIVERSITY

(Established under Galgotias University Uttar Pradesh Act No. 14 of 2011)

School of Electrical Electronics and Communication Engineering

Program: B. Tech Electrical and Electronics Engineering

Scheme: 2017 – 2021

Curriculum

Semester 1

Sl. No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BECE1001	Introduction to Electrical Engineering	0	0	2	1	20	30	50
2	BCSE1002	Computer Programming and Problem Solving	0	0	4	2	20	30	50
3	MATH1001	Multivariable Calculus	3	0	0	3	20	30	50
4	MATH1002	Exploration with CAS-I	0	0	2	1	50	-	50
5	PHYS1001	Engineering Physics	3	0	0	3	20	30	50
6	PHYS1002	Engineering Physics Lab	0	0	2	1	50	-	50
7	CHEM1001	Engineering Chemistry	3	0	0	3	20	30	50
8	CHEM1002	Engineering Chemistry Lab	0	0	2	1	50	-	50
9	BEEE1002	Basic Electrical and Electronics Engineering	2	1	0	3	20	30	50
10	SLBT1001	Basic English	0	0	2	1	20	30	50
	JAPA1001	Japanese-I					20	30	50
	FREN1001	French-I					20	30	50
	GERN1001	German-I					20	30	50
		Total	**11**	**1**	**14**	**19**			

Semester II

Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BCSE1003	Application Oriented Programming using Python	0	0	4	2	20	30	50
2	PSSO1001	Psychology and Sociology	2	0	0	2	20	30	50
3	ENVS1001	Environmental Science	3	0	0	3	20	30	50
4	MATH1003	Matrices and Differential Equations	3	0	0	3	20	30	50
5	MATH1004	Exploration with CAS-II	0	0	2	1	50	-	50
6	PHYS1004	Physics of Semiconductor Devices	3	0	0	3	20	30	50
7	PHYS1005	Advanced Physics Lab	0	0	2	1	50	-	50
8	BTME1002	Product Design using Graphics	0	0	4	2	20	30	50
9	BTME1003	Product Manufacturing	0	0	2	1	50	-	50
10	UHVE1001	Universal Human Values and Ethics	0	0	4	2	20	30	50
11	SLBT1002	English Proficiency and Aptitude Building-1	0	0	4	2	20	30	50
12	SLBT1002	Basic English	0	0	2	1	20	30	50
	JAPA1002	Japanese-I					20	30	50
	FREN1002	French-I					20	30	50
	GERN1002	German-I					20	30	50
		Total	**11**	**0**	**24**	**23**			

Semester III

Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1.	BECE2001	Electrical Measurement and Instrument	3	0	0	3	20	30	50
2.	MATH2002	Numerical Methods	3	0	0	3	20	30	50
3.	BEEE2027	Electrical and Electronics Engineering Project Based Learning -1	0	0	2	1	50	-	50
4.	BECE2003	Network Analysis and Synthesis Lab	0	0	2	1	50	-	50
5.	BECE2002	Network Analysis and Synthesis	3	0	0	3	20	30	50
6.	BECE2016	Signals and Systems	3	0	0	3	20	30	50
7.	BECE2010	Digital Electronics	3	0	0	3	20	30	50
8.	BTME2001	Engineering Mechanics	3	0	0	3	20	30	50
9.	SLBT2001	English Proficiency and Aptitude Building – 2	0	0	4	2	20	30	50
		Total	**18**	**0**	**8**	**22**			

Semester IV

Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1.	MATH2004	Probability and Stochastic processes	3	0	0	3	20	30	50
2.	BEEE2009	EEE Project Based Learning -2	0	0	2	1	50	-	50
3.	BTEE2006	Electrical Machine-I	3	0	0	3	20	30	50
4.	BTEE2007	Electrical Machine-I Lab	0	0	2	1	50	-	50
5.	BECE2012	Electromagnetic Field Theory	3	0	0	3	20	30	50
6.	BEEE6003	Renewable Energy	3	0	0	3	20	30	50
7.	SLBT2002	English Proficiency and Aptitude Building – 3	0	0	4	2	50	-	50
8.	BTME2002	Engineering Thermodynamics	3	0	0	3	20	30	50
		Total	**15**	**0**	**8**	**19**			

Semester V

Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1.	BEEE3002	Control system	3	0	0	3	20	30	50
2.	BEEE3003	Control system Lab	0	0	2	1	50	-	50
3.	BTEE3004	Electrical Machine-II	3	0	0	3	20	30	50
4.	BTEE3005	Electrical Machine-II Lab	0	0	2	1	50	-	50
5.	BEEE3021	Analog Electronics Circuit	3	0	0	3	20	30	50
6.	BEEE3022	Analog Electronics Circuit Lab	0	0	2	1	50	-	50
7.	BEEE3006	EEE Project Based Learning-3	0	0	2	1	50	-	50
8.	SLBT3001	English Proficiency and Aptitude Building – 4	0	0	4	2	50	-	50
9.	BECE2015	Electronics Devices and circuits	3	0	0	3	20	30	50

10.	BEEE3008	ITS-1 PLC/SCADA	0	0	2	1	50	-	50
11.	BEEE3011	Fundamental of power system	3	0	0	3	20	30	50
		Total	**15**	**0**	**14**	**22**			

Semester VI

Sl.No	**Course Code**	**Name of the Course**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1.	SLBT3002	Campus to Corporate	0	0	4	2	50	-	50
2.	BEEE9004	Minor Project	0	0	2	1	50	-	50
3.	BTEE3009	Power system Analysis	3	0	0	3	20	30	50
4.	BECE3022	Embedded and IoT Systems	3	0	0	3	20	30	50
5.	BECE3023	Embedded and IoT Systems Lab	0	0	2	1	50	-	50
6.	BECE2008	Integrated Circuits	3	0	0	3	20	30	50
7.	BECE2009	Integrated Circuits Lab	0	0	2	1	50	-	50
8.	BEEE5005	Operation and control in power system	3	0	0	3	20	30	50
9.	BEEE3015	ITS-2(Simulation using MATLAB)	3	0	0	3	20	30	50
10	BECE9005	Machine Learning by Python Programming	0	0	2	1	50	-	50
11	BTEE9009	Disruptive Technologies	0	0	2	1	50	-	50
		Total	**15**	**0**	**14**	**22**			

Semester VII

Sl No	**Course Code**	**Name of the Course**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1.	BEEE9998	Capstone Design – 1	0	0	6	3	50	-	50
2.	BECE4002	Electric Drives	3	0	0	3	20	30	50
3.	BEEE4002	Power Electronics and Drives Lab	0	0	2	1	50	-	50
4.	BTEE4003	Power system protection and Switchgear	3	0	0	3	20	30	50
5.	BEEE4003	Analog and Digital Communication	3	0	0	3	20	30	50
6.	BEEE4004	Analog and Digital Communication Lab	0	0	2	1	50	-	50
7.	BEEE4010	Industrial Internship for Electrical and Electronics Engineering	0	0	2	1	50	-	50
8.	MGT302	Industrial Economics and Management	3	0	0	3	20	30	50
9.	BEEE4011	Power Electronics	3	0	0	3	20	30	50
10.	BEEE4012	Smart Grid and Energy Management	3	0	0	3	20	30	50
		Total	**18**	**0**	**12**	**24**			

Semester VIII

Sl No	**Course Code**	**Name of the Course**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**

1	BEEE9999	Capstone Design – 2	0	0	18	9	50	-	50
		Total	**0**	**0**	**18**	**9**			

List of Electives

Basket-1

Sl No	Course Code	Name of the Electives					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BECE3013	VLSI Design	3	0	0	3	20	30	50
2	BECE3101	Data Base concepts	3	0	0	3	20	30	50
3	BECE3103	Satellite Communication	3	0	0	3	20	30	50
4	BECE3301	Digital Image Processing	3	0	0	3	20	30	50
5	BECE3105	Computer Network	3	0	0	3	20	30	50
6	BECE4401	Soft Computing	3	0	0	3	20	30	50
7	BECE3019	Embedded System Design	3	0	0	3	20	30	50
8	BECE3202	Neural Networks and Fuzzy Control	3	0	0	3	20	30	50
9	BEEE2010	Renewable Energy Sources	3	0	0	3	20	30	50

Basket-1

Sl No	Course Code	Name of the Elective					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BEEE2019	Electrical Engineering Materials	3	0	0	3	20	30	50
2	BEEE2018	Non-Conventional Energy Resources	3	0	0	3	20	30	50
3	BEEE2020	High Voltage Engineering	3	0	0	3	20	30	50
4	BEEE5005	Operation and Control in Power System	3	0	0	3	20	30	50
5	BEEE2020	Power Electronics Applications in Power Systems	3	0	0	3	20	30	50

Detailed Syllabus

Name of The Course	Basic Electrical and Electronics Engineering			
Course Code	BEEE1002			
Prerequisite	Physics			
Corequisite				
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Objectives:

After the completion of course the students will

1. Get the exposure to basics of electrical and electronics engineering.
2. Understand the importance of theorems, transient analysis and phasor diagram analysis.

Course Outcomes:

CO1	Solve complex electrical network by using basic theorems.
CO2	Sketch phasor diagram of different AC circuits.
CO3	Understand transient DC analysis of different networks.
CO4	Reduce complexity of digital circuit by using Boolean algebra.
CO5	Understand construction, working, operating principle of different electrical machinesUnderstand the principle of switchgear and protection schemes

Text Book (s)

1. D.P. Kothari and I.J. Nagrath , "Basic Electrical Engineering", 2nd Edition, Tata McGraw-Hill, 2002.
2. V.Mittle, ArvindMittle, "Basic Electrical Engineering", McGraw Hill, 2005.

Reference Book (s)

1. D.C.Kulshreshtha,"Basic Electrical Engineering", Tata McGraw Hill, 2009.
2. J. Edminister and M. Nahvi , "Electric Circuits", 3rd Edition, Tata McGraw-Hill, New Delhi, 2002.
3. Jacob Millman, Christos C.Halkias, SatyabrataJit, "Electronics Devices and Circuits", 3rd Edition, Tata McGraw Hill, 2008.
4. Morris Mano, "Digital Computer Design", PHI, 2003

Course Content:

UNIT I Elementary Circuit Analysis **9 Hours**

Ohm's law, KCL, KVL, node voltage analysis, mesh current, circuits with independent sources, Thevenin's& Norton's equivalent, maximum power transfer and superposition theorem.

UNIT IIAnalysis of DC and AC Circuits **9 Hours**

RL and RC transients in circuits with DC source, RMS values, the use of phasors for constant frequency sinusoidal sources, steady state AC analysis of a series circuit, parallel circuits, AC power calculations.

UNIT IIIDigital Systems **9 Hours** Basic logic circuit concepts, Basic Gates and Universal Gates, representation of numerical data in binary form – Binary to decimal, Octal, Hexadecimal, Boolean algebra, combinational logic circuits- Half adder, full adder, synthesis of logic circuits, minimization of logic circuits
UNT IV Semiconductor Devices **8 Hours** Basic diode concepts, ideal diode model, rectifier and wave-shaping circuits, zener diode voltage regulator concepts, bipolar junction transistors, current and voltage relationship, common emitter characteristics.
UNIT V Electro mechanics **10 Hours** Transformers-Ideal and real transformers, Construction, Principle of operation of transformer, E.M.F Equation, Phasor diagram of transformer, Losses, efficiency. D.C Machines-Construction, principles of rotating DC machines, Types of Excitations-separately excited and self excited (shunt, series and compound) DC machines. Three phase induction motors-Construction, Principle of operation, synchronous speed, slip, and frequency of rotor emf. Synchronous Machines- construction, principle of operation of synchronous motor and applications.

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Exam (MTE)**	**End Term Exam (ETE)**	**Total Marks**
20	30	50	100

Course Name	Introduction to Electrical Engineering				
Course Code	BECE1001				
Pre-requisite	Physics				
Co-requisite					
Anti-requisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Outcomes

CO1	Understand the knowledge of elements and Identification of electric tools for the physical operation.
CO2	To apply the knowledge of Magnetic circuits Concepts and Basic laws and rules.
CO3	To develop the knowledge for utilize of the instrument measuring the ac/dc voltage, current and power.
CO4	To construct the connection of the electricalwiring and domestic equipments
CO5	To develop a knowledge of appropriate Electrical Power system and Electrical Safety

Text Book (s)

1."Basic Electrical Engineering", D P Kothari, I.J. Nagarath; Tata McGraw Hill.
2."Principles of Electrical Engineering", V. Del Toro,; Prentice Hall International.
3. " Electrical Power", Dr. S.L.Uppal, Khanna Publications

Reference Book (s)

1."Electrical Engineering", U A Bakshi, V U Bakshi: Technical Publication

2"A Course in Electrical Power", Soni Gupta and Bhatnager-Dhanapat Rai & sons.

Course Content:

Unit-1 **5 hours**
Briefing about Invention of electricity. Basic electron theory. Introduction to current flow, voltage buildup, power supply and power consumption. Identification of hand tools, their specifications and purpose, identification, specification of various types of resistors, capacitors, inductors, diodes, zener diodes, transistors, thyristors
Unit-2 **9 Hours**
Magnetic circuits concepts, analogy between electric and magnetic-circuits, Basic laws and rules, B-H curve, hysteresis and eddy current losses, Mutual coupling with dot convention.
Unit-3 **8 Hours**
Types of instruments, Construction and working principles of PMMC and moving iron type voltmeters & ammeters, Single phase dynamometer wattmeter, Different methods of power measurement.
Unit-4 **7 Hours**
S Introduction of different types of electrical wiring and wiring diagrams, selection (gauges, size etc.) and ratings of wires. Introduction to domestic and industrial wiring installations, Fabrication of different types of extension board. Study and wiring of a tube light circuit. Connection of fan, tubelight/LED and others home appliances. Star and delta connections.
Unit-5 **8 Hours**
Brief of conventional and non conventional electrical power generation. A typical transmission and distribution scheme, Single line diagram of power system, Components of distribution. Need of Earthing of equipment and devices, important electrical safety issues. Safety measures regarding electric fire. Safety precautions, first aid for electric.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	Electrical Measurements and Instrumentation				
Course Code	BECE2001				
Prerequisite	Basic Electrical and Electronics Engineering				
Corequisite	EMFT				
Antirequisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives:

1. To know the necessity of different measuring instruments and their design principle
2. To understand the working principle of different measuring instruments and technical solutions to handle different errors.
3. To learn the architecture and working principle of advanced measuring instrument and their applications.

Course Outcomes

CO1	Apply physical principles to study the construction and working principle of different analog instruments and analyze the errors takes place in measurements.**(K3- Apply)**
CO2	Apply the physical principle to study the working of instrument transformers and measurement of speed, frequency and power factor. **(K3- Apply)**
CO3	**Model the solar and wind energy system for standalone and grid integration system.** (Apply-KL-3)
CO4	**Demonstrate the principle of operation of other renewable energy sources(ocean thermal, geo-thermal and micro hydro power) also importance of its role.** (Understanding-KL-2)
CO5	Examine the waveforms usinganalyzers and oscilloscopes. **(K3- Apply)**

Text Book (s)

1. A Course in Electrical and Electronics Measurement and Instrumentation, "A K Shawney", Publisher: Dhanpat Rai & Co
2. Electrical Measurements and Measuring Instruments, E.W Golding, F.C Widdis, Publisher: Reem Publications
3. Electronic Instrumentation and Measurements- David A Bell, Oxford University Press, 2006

Reference Book (s)

1. Basic Electrical Measurements: M B Stout
2. **Electronic Instrumentation: H S Kalsi, Tata- Mc-Graw Hill Publication, Second Edition.**

Course Content:

Unit-1Philosophy of Measurement & Analog Measurement of Electrical Quantities 9 hours
Unit& dimensions, standards, Errors, Characteristics of Instruments and measurement system, basics of statistical analysis. PMMC instrument, DC ammeter, DC voltmeter, Ohm meter, Moving Iron instrument, Electrodynamic Wattmeter, errors and remedies, Three Phase Wattmeter, Power in three phase system, Energy meter.
Unit-2Measurement: Instrument Transformer 6 hours
Instrument Transformer and their applications in the extension of instrument range, Introduction to

measurement of speed, frequency and power factor.
Unit-3Measurement of Parameters 10 hours
Different methods of measuring low, medium and high resistances**,** measurement of inductance & capacitance with the help of AC Bridges- Wheatstone, Kelvin, Maxwell, Hay's, Anderson, Owen, Heaviside, Campbell, Schering, Wien bridges, Wagner Earthing device, Q Meter.
Unit-4AC Potentiometer & Magnetic Measurement 8 hours
Polar type & Co-ordinate type AC potentiometers, application of AC Potentiometers in electrical measurement. Ballistic Galvanometer, Flux meter.
Unit-5Digital Measurement of Electrical Quantities & Cathode Ray Oscilloscope 7 hours
Concept of digital measurement, Digital voltmeter, Frequency meter, Power Analyzer and Harmonics Analyzer, Electronic Multimeter. CRT, wave form display, time base, dual trace oscilloscope, Measurement of voltage, frequency and phase by CRO, Oscilloscope probes, Sampling Oscilloscope, DSO, DSO applications.

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	Network Analysis and Synthesis				
Course Code	BECE2002				
Prerequisite	Basic Electrical and Electronics Engineering				
Corequisite	Signals and systems				
Antirequisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives:

1. To learn the concepts of network analysis in electrical and electronics engineering.
2. To learn linear circuit analysis, graph theory and network theorems.
3. Analyze two port networks using Z, Y, ABCD and h parameters

Course Outcomes

CO1	Apply the knowledge of graph theory with basic circuital laws and simplify the network using reduction techniques
CO2	Analyze the circuit using Kirchhoff's law and Network simplification theorems
CO3	Infer and evaluate transient response, Steady state response, network functions
CO4	Evaluate two-port network parameters and explain the inter-relationship among parameters for network analysis.
CO5	Synthesize one port network using Foster and Cauer Forms and examine active filter configurations for possible applications in network theory.

Text Book (s)

1. M.E. Van Valkenburg, "Network Analysis", Prentice Hall of India
2. A C.L Wadhwa, "Network Analysis and Synthesis" New Age International Publishers, 2007,
3. D.RoyChoudhary, "Networks and Systems" Wiley Eastern Ltd.
4. A.Chakrabarti, "Circuit Theory" DhanpatRai& Co
5. M.E. Van Valkenburg, "An Introduction to Modern Network Synthesis",Wiley Eastern Ltd.

Reference Book (s)

3. Hayt, W., Engineering Circuit Analysis, Tata McGraw□Hill (2006)
4. Hussain, A., Networks and Systems, CBS Publications (2004).
5. Sudhakar, A., Circuits and Networks, Tata McGraw□Hill (2006).
6. Suresh Kumar, K.S. Electrical circuits and Networks, Pearson Education, (2009).

Unit-1Graph Theory **6 hours**
Graph of a Network, definitions, tree, co tree , link, basic loop and basic cut set,Incidence matrix, cut set matrix, Tie set matrix Duality, Loop and Nodal methods of analysis.
Unit-2Network Theorems (Applications to ac networks) **9 hours**
Super-position theorem, Thevenin's theorem, Norton's theorem, maximum power transfer theorem, Reciprocity theorem. Millman'stheorem, compensation theorem, Tellegen's theorem.
Unit-3Network Functions and Transient analysis **11 hours**
Transform Impedances Network functions of one port and two port networks, concept of poles and zeros, properties of driving point and transfer functions, time response and stability from pole zero plot, transient analysis of ac & dc systems.
Unit-4Two Port Networks **10 hours**
Characterization of LTI two port networks ZY, ABCD and h parameters, reciprocity and symmetry.

Inter-relationships between the parameters, inter-connections of two port networks, T & Π Representation.
Unit-5Network Synthesis & Filters **9 hours**
Positive real function; definition and properties; properties of LC, RC and RL driving point functions, synthesis of LC, RC and RL driving point immittance functions using Foster and Cauer first and second forms. Image parameters and characteristics impedance, passive and active filter fundamentals, low pass, high pass, (constant K type) filters, and introduction to active filters.

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	Network Analysis and Synthesis Lab				
Course Code	BECE2003				
Prerequisite	Basic Electrical Engineering lab				
Corequisite					
Antirequisite					
	L	**T**	**P**	**C**	
	0	0	2	1	

Course Objectives:

After the completion of course the students will

1. To introduce the concept of circuit elements lumped circuits, circuit laws and reduction.
2. To study the transient response of series and parallel A.C. circuits.
3. To study the concept of coupled circuits and two port networks.
4. To study the two port networks.

Course Outcomes

CO1	To introduce the concept of circuit elements lumped circuits, circuit laws and reduction.
CO2	To study the transient response of series and parallel A.C. circuits.
CO3	To study the concept of coupled circuits and two port networks.
CO4	To study the two port networks.
CO5	To introduce the concept of short circuit and opencircuit.

Network Analysis and Synthesis Lab

1.	To verify Thevenin's theorem in a.c.	**CO1**
2.	To verify Norton's theorem in a.c.	**CO2**
3.	To verify Superposition theorem in a.c.	**CO3**
4.	To verify the Maximum Power Transfer Theorem.	**CO4**
5.	Determination of Z-parameters of a two-port network.	**CO5**
6.	To verify and determination of y-parameters of a parallel connected two-port network.	**CO2**
7.	Determination of h-parameters of a two-port network.	**CO1**
8.	To verify and determination of ABCD-parameters of a cascade interconnected two-port network.	**CO2**
9.	Determination of characteristics impedance of a symmetrical T-network using S/C and O/C test.	**CO4**

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Exam (MTE)**	**End Term Exam (ETE)**	**Total Marks**
50	**-**	**50**	**100**

Name of The Course	Signals and Systems				
Course Code	BECE2016				
Pre-requisite	Engineering Mathematics				
Co-requisite					
Anti-requisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives:

This subject is about the mathematical representation of signals and systems. The most important representations we introduce involve the *frequency domain* – a different way of looking at signals and systems, and a complement to the time-domain viewpoint. Indeed engineers and scientists often think of signals in terms of frequency content, and systems in terms of their effect on the frequency content of the input signal. Some of the associated mathematical concepts and manipulations involved are challenging, but the mathematics leads to a new way of looking at the world.

Course Outcomes:

CO1	Understand about various types of signals, classify them, analyze them, and perform various operations on them.
CO2	Understand about various types of systems, classify them, analyze them and understand their response behaviour
CO3	Appreciate use of transforms in analysis of signals and system.
CO4	Carry simulation on signals and systems for observing effects of applying various properties and operations.
CO5	Create strong foundation of communication and signal processing to be studied in the subsequent semester

Text Book:

1. P. Ramakrishna Rao, `Signal and Systems' 2008 Ed., Tata McGraw Hill, New Delhi, ISBN 1259083349, 9781259083341

Reference Books

1. Signals and Systems by Oppenheim & Wilsky Millman

Unit I: Introduction to Signals **9 Hours**
Definition, types of signals and their representations: continuous-time/discrete-time, periodic/non-periodic, even/odd, energy/power, deterministic/ random, one dimensional/ multidimensional; commonly used signals (in continuous-time as well as in discrete-time): unit impulse, unit step, unit ramp (and their inter-relationships),exponential, rectangular pulse, sinusoidal; operations on continuous-time and discrete-time signals (including transformations of independent variables)
Unit II :Introduction to Systems **8 Hours**
Classification, linearity, time-invariance and causality, impulse response, characterization of linear time-invariant (LTI) systems, unit sample response, convolution summation, step response of discrete time systems, stability, convolution integral, co-relations, signal energy and energy spectral density, signal power and power spectral density, properties of power spectral density.
Unit III: Fourier Transforms (FT) **10 Hours**
Definition, conditions of existence of FT, properties, magnitude and phase spectra, Some important FT theorems, Parseval's theorem, Inverse FT, relation between LT and FT, Discrete time Fourier transform (DTFT), inverse DTFT, convergence, properties and theorems, Comparison between continuous time FT and DTFT.
Unit IV: Laplace-Transform (LT) and Z-transform (ZT) **10 Hours**
One-sided LT of some common signals, important theorems and properties of LT, inverse LT, solutions of differential equations using LT, Bilateral LT, Regions of convergence (ROC), One sided and Bilateral Z-transforms, ZT of some common signals, ROC, Properties and theorems, solution of difference equations using one-sided ZT, s- to z-plane mapping

Unit V: Time and frequency domain analysis of systems	**8 Hours**
Analysis of first order and second order systems, continuous-time (CT) system analysis using LT, system functions of CT systems, poles and zeros, block diagram representations; discrete-time system functions, block diagram representation, illustration of the concepts of system bandwidth and rise time through the analysis of a first order CT low pass filter.	

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	Digital Electronics				
Course Code	BECE2010				
Prerequisite	BEEE				
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives:

1. Understanding the different number systems used in computerized system and codes used to represent the digits and fundamental of arithmetic operation using each number system and codes.
2. Understanding the minimization of logic expression and designing combinational and sequential digital circuits
3. Analyzing the operation and design constraints of CMOS and TTL circuit for logic fabrication.

Course Outcomes

CO1	Verify and analyze the input/output data of each logic gate and circuits such as adders, counters, coders, etc,.
CO2	Analyze the basic operation of memory cell and its limitations in circuit designing.
CO3	Apply the digital circuit design concept in developing basic component of computer organization, projects or experiments.
CO4	Verifying and analyzing the practical digital circuits.
CO5	Enabling students to take up application specific sequential circuit to specify the finite state machine and designing the logic circuit.

Text Book (s)

1. Mano, Morris. "Digital logic." *Computer Design. Englewood Cliffs Prentice-Hall* (1979).
2. Kumar, A. Anand. *Fundamentals Of Digital Circuits 2Nd Ed*. PHI Learning Pvt. Ltd., 2009.
3. Taub, Herbert, and Donald L. Schilling. *Digital integrated electronics*. New York: McGraw-Hill, 1977.

Reference Book (s)

1. Floyd, Thomas L. *Digital Fundamentals, 10/e*. Pearson Education India, 1986.
2. Malvino, Albert Paul, and Donald P. Leach. *Digital principles and applications*. McGraw-Hill, Inc., 1986.
3. Jain, Rajendra Prasad. *Modern Digital Electronics 3e*. Tata McGraw-Hill Education, 2003.

Unit I: Number System and Boolean Algebra **9 Hours**
Review of number system; types and conversion, codes. Boolean algebra: De-Morgan's theorem, switching functions, Prime Implicants and Essential Prime Implicants definition and simplification using K-maps upto 5 variables &QuineMcCluskey method.
Unit II: Combinational Circuits **8 Hours**
Introduction to Logic Gates: AND, OR, NOT, NAND, NOR, EX-OR, EX-NOR and their combinations. Design of adder, subtractors, comparators, code converters, encoders, decoders, multiplexers and de-multiplexers, Function realization using gates & multiplexers.

Unit III: Synchronous Sequential Circuits	**9 Hours**
Introduction to Latches and Flip flops - SR, D, JK and T. Design of synchronous sequential circuits – Counters, shift registers. Finite State Machine Design, Mealy, Moore Machines, Analysis of synchronous sequential circuits;, state diagram; state reduction; state assignment with examples.	
Unit IV: Asynchronous Sequential Circuits	**7 Hours**
Analysis of asynchronous sequential machines, state assignment, asynchronous design problem.	
Unit V: PLD, Memories and Logic Families	**7 Hours**
Memories: ROM,RAM, PROM, EPROM, Cache Memories, PLA, PLD, FPGA, digital logic families: TTL, ECL, CMOS.	

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	Electromagnetic Field Theory				
Course Code	BECE2012				
Pre-requisite	Engineering Mathematics				
Co-requisite					
Anti-requisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives:

- To gain conceptual and basic mathematical understanding of electric and magnetic fields in free space and in materials
- To understand the coupling between electric and magnetic fields through Faraday's law, displacement current and Maxwell's equations
- To understand wave propagation in lossless and in lossy media
- To be able to solve problems based on the above concepts

Course Outcomes:

CO1	Apply coordinate systems and transformation techniques to solve problems on Electromagnetic Field Theory
CO2	Apply the concept of static electric field and solve problems on boundary value problems.
CO3	Analyze the concept of static magnetic field and solve problems using Biot - Savart's Law, Ampere's circuit law, Maxwell's equation.
CO4	Understands magnetic forces, magnetic dipole and magnetic boundary conditions.
CO5	Understands the time-varying Electromagnetic Field and derivation of Maxwell's equations.

Reference Books

1. Principles of Electromagnetics N. O. Sadiku, Oxford University Press Inc
2. Engineering Electromagnetics W H Hayt, J A Buck, McGraw Hill Education
3. Electromagnetic Waves, R.K. Shevgaonkar, Tata McGraw Hill India, 2005
4. Electromagnetics with Applications, Kraus and Fleish, Edition McGraw Hill International Editions, Fifth Edition, 1999Syllabus

UNIT I STATIC ELECTRIC FIELDS **9 Hours**
Introduction to Co-ordinate System – Rectangular –Cylindrical and Spherical Co- ordinate System – Introduction to line, Surface and Volume Integrals – Definition of Curl, Divergence and Gradient – Meaning of Stokes theorem and Divergence theorem Coulomb's Law in Vector Form – Definition of Electric Field Intensity – Principle of Superposition – Electric Field due to discrete charges – Electric field due to continuous charge distribution – Electric Field due to charges distributed uniformly on an infinite and finite line – Electric Field on the axis of a uniformly charged circular disc – Electric Field due to an infinite uniformly charged sheet.Electric Scalar Potential – Relationship between potential and electric field – Potential due to infinite uniformly charged line – Potential due to electrical dipole – Electric Flux Density – Gauss Law – Proof of Gauss Law – Applications
UNIT II: STATIC MAGNETIC FIELDS **8Hours**
The Biot-Savart Law in vector form – Magnetic Field intensity due to a finite and infinite wire carrying a current I –Magnetic field intensity on the axis of a circular and rectangular loop carrying a current I – Ampere's circuital law and simple applications. Magnetic flux density The Lorentz force equation for a moving charge and applications, Force on a wire carrying a current I placed in a magnetic field – Torque on a loop carrying a current I – Magnetic moment – Magnetic Vector Potential.
UNIT III: ELECTRIC AND MAGNETIC FIELDS IN MATERIALS **9 Hours**

Poisson's and Laplace's equation – Electric Polarization-Nature of dielectric materials- Definition of Capacitance – Capacitance of various geometries using Laplace's equation– Electrostatic energy and energy density – Boundary conditions for electric fields – Electric current – Current density – point form of ohm's law – continuity equation for current.Definition of Inductance – Inductance of loops and solenoids – Definition of mutual inductance – simple examples. Energy density in magnetic fields – Nature of magnetic materials – magnetization and permeability – magnetic boundary conditions

UNT IV: TIME VARYING ELECTRIC AND MAGNETIC FIELDS 8 Hours

Faraday's law – Maxwell's Second Equation in integral form from Faraday's Law – Equation expressed in point form.Displacement current – Ampere's circuital law in integral form – Modified form of Ampere's circuital law as Maxwell's first equation in integral form – Equation expressed in point form. Maxwell's four equations in integral form and differential form.Poynting Vector and the flow of power – Power flow in a co-axial cable – Instantaneous Average and Complex Poynting Vector.

UNIT V: ELECTRO MAGNETIC WAVES 9 Hours

Derivation of Wave Equation – Uniform Plane Waves – Maxwell's equation in Phasor form – Wave equation in Phasor form – Plane waves in free space and in a homogenous material.Wave equation for a conducting medium – Plane waves in lossy dielectrics –Propagation in good conductors – Skin effect. Linear, Elliptical and circular polarization – Reflection of Plane Wave from a conductor – normal incidence – Reflection of Plane Waves by a perfect dielectric – normal and oblique incidence. Dependence on Polarization, Brewster angle.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	Electrical Machine-I				
Course Code	BTEE2006				
Prerequisite	Basic Electrical Engineering				
Corequisite					
Antirequisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives:

1. To acquaint the students with the principle of operation and performance of transformers and DC machines.
2. To familiarize students with the parameter estimation of electrical machines
3. To learn the mathematical models and equations related to electrical machines.

Course Outcomes

CO1	Apply the knowledge of circuit analysis and electromagnetic principles of electric machines
CO2	Analyse the electrical machines performance.
CO3	Test and estimate the parameter of the electrical machine.
CO4	Analysis the numerical problems associated with transformer and DC machines.
CO5	Make use of application of the subject topic with industries and day to day life

Text Book (s)

1. I.J. Nagrath& D.P. Kothari, “Electrical Machines”, Tata McGraw Hill.
2. P S Bimbhra, “Generalized Theory of Electrical Machines”, Khana Publisher.
3. P S Bimbhra, “Electrical Machinery”, Khana Publisher.

Reference Book (s)

1. A. E. Fitzgerald, C. Kingsley, and S. D. Umans, *Electric Machinery,* 6th ed., New York: McGraw-Hill, 2003.
2. Vincent Del Toro, “Electrical Machine and Power System”, PHI.

Unit-1 Introduction **8 hours**
Flow of Energy in Electromechanical Devices,Magnetic Circuit, Analogy b/w Electric and magnetic Ckt, B-H Curve, Hysteresis and eddy current losses, Mutual Coupling with dot convention, Energy in magnetic systems(defining energy & Co-energy) , Singly Excited Systems and Doubly excited Systems, Generated emf in machines; torque in machines with cylindrical air gap.
Unit-2 Single Phase Transformer
Construction- Core and Shell type, Basic principle of Operation, Phasor diagram, efficiency and voltage regulation, all day efficiency. Testing of Transformers: O.C. and S.C. tests, Sumpner’s test, polarity test. Auto Transformer: Single phase and three phase auto transformers, volt-amp, relation, efficiency, merits & demerits and applications.
Unit-3 Three Phase Transformers

Construction, three phase transformer phasor groups and their connections, open delta connection, choice of transformers for three phase circuits, three phase to 2 phase, 6 phase or 12 phase connections, and their applications, parallel operation and load sharing of single phase and three phase transformers, excitation phenomenon and harmonics in transformers, three winding transformers.
Unit-4 D.C. Machines
Construction of DC Machines, Armature winding, Emf and torque equation, Armature Reaction, Commutation, Interpoles and Compensating Windings, Methods of improving commutation, Performance Characteristics of D.C. generators, Voltage Regulation, Parallel operation of DC generator (shunt, series and compound machine).
Unit-5 D.C. Machines (Contd.)
Performance Characteristics of D.C. motors, Starting of D.C. motors ; 3 point and 4 point starters, Speed control of D.C. motors: Field Control , armature control and Voltage Control (Ward Lenonard method); Efficiency and Testing of D.C. machines (Hopkinson's and Swinburn's Test), Electric braking

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Electrical Machine-I lab				
Course Code	BTEE2007				
Prerequisite	Basic Electrical Engineering lab				
Corequisite					
Antirequisite					
	L	**T**	**P**	**C**	
	0	0	2	1	

Course Objectives:

After the completion of course the students will

1. This lab gives the chance to get friendship with Electrical machines.
2. To acquaint the students with the principle of operation and performance of transformers and DC machines.
3. To familiarize the students with the parameter estimation of electrical machines.
4. To compare the mathematical models and equations related to electrical machines.
5. The lab instills in the students the awareness and practice of safety.

Course Outcomes

CO1	Apply the knowledge of circuit analysis and electromagnetic principles for the physical operation of electric machines.
CO2	Analysis the electrical machine performance through experiments.
CO3	Estimate the parameter of the transformer, DC machines.
CO4	Test the transformer, DC machines with various loads.
CO5	Make use of application of the subject topic with industries and day to day life.

List of Experiments of Electrical Machine –I

10.	Efficiency and regulation of single phase transformer by Sumpner's back to back test.	**CO1**
11.	Efficiency of DC shunt motor by Swinburne's test	**CO2**
12.	Open circuit and short circuit test on single phase transformer.	**CO3**
13.	3-phase to 2-phase conversion with two single phase transformers by Scott connection.	**CO4**
14.	Speed control of DC motor by Armature and Field Control.	**CO5**
15.	Load characteristics of DC shunt generator and plot load voltage Vs load current.	**CO2**
16.	Magnetization characteristics of DC shunt generator.	**CO1**
17.	Load characteristics of DC compound generator and plot load voltage Vs load current.	**CO2**
18.	Losses and efficiency of DC machine by Hopkinson's test.	**CO4**

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Exam (MTE)**	**End Term Exam (ETE)**	**Total Marks**
50	**-**	**50**	**100**

Name of The Course	Renewable Energy				
Course Code	BEEE2010				
Prerequisite	Basic Electrical and Electronics Engineering				
Corequisite	Physics				
Antirequisite					
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives:

The course aims to impart in depth knowledge of various types of renewable energy sources.

Course Outcomes

CO1	**Summarize and generally explain the main sources of energy and their primary applications in India and the world and list the challenges and issues associated with the use of various energy sources, including fossil fuels, with regard to future supply and the environment.**(Understanding-KL-2)
CO2	**Outline the principle of operation and analyse the model's solar energy and Wind energy conversion systems.** (Understanding-KL-2)
CO3	**Model the solar and wind energy system for standalone and grid integration system.** (Apply-KL-3)
CO4	**Demonstrate the principle of operation of other renewable energy sources(ocean thermal, geo-thermal and micro hydro power) also importance of its role.** (Understanding-KL-2)
CO5	**Understand the importance of energy storage and develop the model for energy storage configurations.**(Understanding-KL-2)& (Apply-KL-3)

Text Book (s)

1. Renewable energy technologies - R. Ramesh, Narosa Publication
2. Non-conventional Energy Systems – Mittal, Wheelers Publication.

Reference Book (s)

3. John F Walker &Jekins. N, Wind Energy Technology., John Wiley and Sons, chichester, UK, 1997.
4. Van Overstra ,Mertens, R.P, Physics, Technology and use of Photovoltaics, Adam Hilger, Bristol, 1996.

Course Content:

Unit-1Energy Scenario 6 hours
Classification of Energy Sources, Energy resources (Conventional and nonconventional), Energy needs of India, and energy consumption patterns. Worldwide Potentials of these sources. Energy efficiency and energy security. Energy and its environmental impacts. Global environmental concern, Kyoto Protocol, Concept of Clean Development Mechanism (CDM) and Prototype Carbon Funds(PCF). Factors favoring and against renewable energy sources, IRP.
Unit-2Solar Energy 9 hours
Solar thermal Systems: Types of collectors, Collection systems, efficiency calculations, applications. Photo voltaic (PV) technology: Present status, - solar cells, cell technologies,characteristics of PV systems, equivalent circuit, array design, building integrated PV

system, its components, sizing and economics. Peak power operation. Standalone and grid interactive systems.
Unit-3Wind Energy **10 hours**
wind speed and power relation, power extracted from wind, wind distribution and wind speed predictions. Wind power systems: system components, Types of Turbine, Turbine rating, Choice of generators, turbine rating, electrical load matching, Variable speed operation, maximum power operation, control systems, system design features, stand alone and grid connected operation.
Unit-4 Other energy sources **8 hours**
Biomass – various resources, energy contents, technological advancements, conversion of biomass in other form of energy – solid, liquid and gases. Gasifiers, Biomass fired boilers, Cofiring, Generation from municipal solid waste, Issues in harnessing these sources. Hydro energy – feasibility of small, mini and micro hydel plants scheme layout economics. Tidal and wave energy,Geothermal and Ocean-thermal energy conversion. (OTEC) systems – schemes, feasibility and viability.
Unit-5 Energy storage and hybrid system configurations **7 hours**
Energy storage: Battery – types, equivalent circuit, performance characteristics, battery design, charging and charge regulators. Battery management. Fly wheel-energy relations, components, benefits over battery. Fuel Cell energy storage systems. Ultra Capacitors.

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	Fundamental of Power systems			
Course Code	BEEE3011			
Prerequisite	Basic Electrical			
Corequisite				
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Objectives:

1. To develop solid foundation for further study of power system courses.
2. To develop the analytical skills for solving problems related to power system.
3. To familiarize students of the basics of power system components, transmission parameters and losses in the transmission line etc.

Course Outcomes

CO1	Exposure to the modeling of individual power system components like transmission lines and generators
CO2	To analyze the overhead transmission line
CO3	To analyze the corona and interference
CO4	To analyze the mechanical design
CO5	Understand the neutral grounding

Text Book (s)

1. C. L. Wadhwa, "Electrical Power Systems" New age international Ltd. Third Edition
2. AsfaqHussain, "'Power System", CBS Publishers and Distributors.

Reference Book (s)

1. W. D. Stevenson, "Element of Power System Analysis", McGraw Hill
2. B. R. Gupta, "Power System Analysis and Design" Third Edition, S. Chand & Co.

Course Content:

Unit-1 Power System Components **6 hours**
Single line Diagram of Power system Brief description of power system Elements: Synchronous machine, transformer, transmission line, bus bar, circuit breaker and isolator Calculation of single and Three phase Power Choice of transmission voltage Transmission line types of conductors and resistance Skin effect Proximity effect Kelvin's law
Unit-2: Over Head Transmission Lines **6 hours**
Calculation of inductance single phase, three phase and double circuit Transmission line Calculation of capacitance single phase, three phase and double circuit Transmission line Transmission line classification Representation and performance of short Transmission line Representation and performance of medium nominal T and Nominal Pi Transmission line Representation and performance of long Transmission line Surge impedance loading Ferranti effect
Unit 3 Corona and Interference **9 hours**

Phenomenon of corona and its formation Calculation of potential gradient Corona loss, factors affecting corona and methods of reducing corona Electrostatic and electromagnetic interference with communication lines Type of insulators and their applications Potential distribution over a string of insulators String efficiency and Methods of equalizing the potential
Unit-4Mechanical Design of transmission line 9 hours
Catenary curve of transmission line Sag and tension Affect due to ice and wind on sag Types of insulated cables and its construction Dielectric stress and Insulation resistance Capacitance measurement of a single phase and three phase cables Dielectric loss and loss trangle
Unit-5Neutral grounding and HVDC/HVAC 9 hours Necessity and its methods of neutral grounding Earthing transformer and Grounding practices. Design consideration of EHV transmission lines Choice of voltage Number of circuits Conductor configuration Insulation design and Selection of ground wires Introduction to EHV AC and HVDC transmission Their comparison Use of bundle conductors Kinds of DC links Use of HVDC system in AC transmission system

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Exam (MTE)**	**End Term Exam (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	Control systems				
Course Code	BEEE3002				
Prerequisite	Signals and Systems				
Corequisite	None				
Antirequisite	None				
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives:

1. To understand and develop the Mathematical Modelingof dynamic systems using classical and state-space techniques.
2. To apply analytical /graphical techniques in time/frequency domain to determine stability.
3. To understand and use applications of feedback control theory to a variety of real world problems.

Course Outcomes

CO1	Understand mathematics modeling of control systems sand solve it using transfer function, block diagram and signal flow diagram reduction techniques.
CO2	Design and analyze control system engineering problems in time response of first and second order systems.
CO3	Analyze the concept and stability of servo systems using algebraic stability criteria with necessary conditions.
CO4	Understand and analyze the stability analysis using the polar, inverse polar, Bode, and Nyquist stability criterion of control systems
CO5	Understand and design of lead, lag and lead-lag compensator of the control process in time and frequency domains.

Text Book (s)

1. Nagrath& Gopal, "Control System Engineering", 4th Edition, New age International
2. K. Ogata, "Modern Control Engineering", Prentice Hall of India.

Reference Book (s)

1. B.C. Kuo& Farid Golnaraghi, "Automatic Control System" Wiley IndiaLtd, 2008.
2. D.Roy Choudhary, "Modern Control Engineering", Prentice Hall of India.

Course Content:

Unit-1 Introduction **8 hours**
Feedback Control: Open loop and closed control system, servomechanism, Physical examples. Transfer functions of linear time-invariant systems, Block diagram algebra, and Signal flow graph, Mason's gain formula Reduction of parameter variation and effects of disturbance by using negative feedback.
Unit-2
Standard test signals, time response of first and second order systems, time response specifications, steady state errors and error constants. Design specifications of second order systems: Error analysis. P, PI, PD, PID controllers, design considerations for higher order systems, performance indices.
Unit-3

Concept of Stability. Routh-Hurwitz Criteria. Relative Stability analysis, Routh-Hurwitz criteria and limitations, root locus concepts, construction of root locus. Design of controllers using root-locus. Pole placement with state feedback, controllability.
Unit-4
Frequency response, correlation between time and frequency responses, polar and inverse polar plots, Bode plots Stability in Frequency Domain: Nyquist stability criterion, assessment of relative stability: gain margin and phase margin, constant M&N circles.
Unit-5
Application of Proportional, Integral and Derivative Controllers, Lead and Lag compensation in designs in time domain and frequency domain. Review of state variable technique: Review of state variable technique, conversion of state variable model to transfer function model and vice-versa, diagonalization, Controllability and observability and their testing.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	**Electrical Machine-2**				
Course Code	**BTEE3004**				
Prerequisite	**Electrical Machine-1**				
Co requisite					
Antirequisite					
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives:

4. To acquaint the students with the principle of operation and performance of AC machines.
5. To familiarize students with the parameter estimation of electrical machines
6. To learn the mathematical models and equations related to electrical machines.
7. To familiarize students with the other special machines.

Course Outcomes

On completion of this course, the students will be able to

CO1	Understand the knowledge of Three phase Induction Machine circuit and characteristics,	K2
CO2	Analyze the operation, controlling and braking of Three phase Induction Machine .	K2 & K4
CO3	Make use of application of the motors with industries and day to day life.	K2 & K3
CO4	Test and Analyze the parameter of the Synchronous Machine from different methods	K4
CO5	Evaluate the operating characteristics of the Synchronous Machine	K5

Text Books

4. I.J. Nagrath& D.P. Kothari, “Electrical Machines”, Tata McGraw Hill.
5. P S Bimbhra, “Generalized Theory of Electrical Machines”, Khana Publisher.
6. P S Bimbhra, “Electrical Machinery”, Khana Publisher.
7. M.G. Say, “Alternating Current Machines”,Pitman Publishing Ltd. 1976**.**

Reference Books

3. A. E. Fitzgerald, C. Kingsley, and S. D. Umans, *Electric Machinery*, 6th ed., New York: McGraw-Hill, 2003.
4. Vincent Del Toro, “Electrical Machine and Power System”, PHI.

Course Content:

Unit-1 Three phase Induction Machine – I **7 Hours**
Constructional features, Rotating magnetic field, Principle of operation Phasor diagram, equivalent circuit, torque and power equations, Torque- slip characteristics, no load & blocked rotor tests, efficiency, Induction generator: Generator action, methods of excitation & applications.
Unit-2 Three phase Induction Machine- II **8 Hours**
Starting, Deep bar and double cage rotors, Speed Control (with and without emf injection in rotor

circuit.), Electrical braking, operation on unbalanced supply voltage, effect of slot harmonics and space harmonics, merits , demerits and introduction of linear induction motor.
Unit-3 Single phase Induction Motor 7 Hours
Double revolving field theory, Equivalent circuit, No load and blocked rotor tests, Starting methods, Repulsion motor, other Motors: Universal motor, Hysteresis motor, stepper motors, switched reluctance motor, BLDC, brushless dc motor
Unit-4 Synchronous Machine I 8 Hours
Constructional features, EMF Equation, Armature winding, Winding coefficients, equivalent circuit and phasor diagram, Armature reaction, O. C. & S. C. tests, Voltage Regulation using Synchronous Impedance Method, MMF Method, Potier's Triangle Method, Parallel Operation of synchronous generators, operation on infinite bus, synchronizing power and torque co-efficient.
Unit-5 Synchronous Machine II 8 Hours
Two Reaction Theory, Power flow equations of cylindrical and salient pole machines, operating characteristics. Synchronous Motor: Starting methods, Effect of varying field current at different loads, V- Curves, concepts of synchronous machine reactances, Synchronizing, Electrical braking, Hunting & damping, synchronous condenser.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Electrical Machine-II lab				
Course Code	BTEE3005				
Prerequisite	Electrical Machine-I and BEEE Lab				
Corequisite					
Antirequisite					
	L	**T**	**P**	**C**	
	0	0	2	1	

Course Objectives:

After the completion of course the students will

1. This lab gives the chance to get friendship with Electrical machines.
2. To acquaint the students with the principle of operation and performance of AC machines.
3. To familiarize the students with the parameter estimation of AC machines.
4. To compare the mathematical models and equations related to AC machines.
5. The lab instills in the students the awareness and practice of safety.

Course Outcomes

CO1	Apply the knowledge of circuit analysis and electromagnetic principles for the physical operation of Single and three phase Induction machines and three phase Synchronous machines.
CO2	Analysis the AC machines performance through experiments
CO3	Estimate the parameter of the Induction machines and Synchronous machines
CO4	Test Induction and Synchronous machines with various loads
CO5	Make use of application of the subject topic with industries and day to day life

List of Experiments of Electrical Machine –II

1.	Perform no load and blocked rotor test on a single phase induction motor.	**CO1**
2.	Determine performance characteristic of a three phase squirrel cage induction motor.	**CO2**
3.	No load and blocked rotor test on three phase induction motor.	**CO3**
4.	Load test on three phase squirrel cage induction motor.	**CO4**
5.	Break test on three phase induction motor.	**CO5**
6.	Separation of no load losses of three phase induction motor.	**CO2**
7.	Perform open and short circuit test on a 3-phase alternator	**CO1**
8.	Regulation of a three phase alternator by ZPF and ASA method.	**CO2**
9.	Determination of Xd and Xq of a Salent pole synchronous machine.	**CO4**
10.	Determine the characteristic of field current with armature current of the synchronous machine	**CO2**

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Exam (MTE)**	**End Term Exam (ETE)**	**Total Marks**
50	**-**	**50**	**100**

Name of The Course	Analog Electronics Circuit				
Course Code	BEEE3021				
Prerequisite	Basic Electronics				
Co requisite					
Antirequisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives:

1. To learn different biasing techniques and behavior of BJT, FET at low and high frequencies.
2. To understand the principle of operation of different amplifier circuits like feedback amplifiers, power amplifiers.
3. To understand the principle of operation of different oscillators circuits.

Course Outcomes

On completion of this course, the students will be able to

CO1	Explain the methods of biasing transistors & design of simple amplifier circuits and to develop the ability to analyze and design analog electronic circuits using discrete components..	K2
CO2	Observe the amplitude and frequency responses of common amplification circuits and utilize the data for designing.	K2 & K4
CO3	Design, construct, and take measurement of various analog circuits to compare	K2 & K3
CO4	Design, construct, and take measurement of various analog circuits to compare	K4
CO5	Experimental results in the laboratory with theoretical analysis.	K5

Text Books

1. Jacob. Millman, Christos C.Halkias, 'Electronic Devices and Circuits', Tata McGraw Hill Publishing Limited, New Delhi, 2008, ISBN 0070634556, 9780070634558.
2. Jacob Millman and C. Halkias, 'Integrated Electronics – Analog and Digital Circuits and Systems', Tata McGraw Hill, 2001, ISBN 0074622455, 9780074622452.

Reference Books

1. Jacob Millman and Arvin Grabel, 'Microelectronics', McGraw Hill, 2001, ISBN 0074637363, 9780074637364.
2. Electronic Devices & Circuits – David. A. Bell, 3rd Edition, Prentice – Hall, 1986 ISBN 083591559X, 9780835915595.
3. Electronic Devices & Circuits – Allen Mottershead –Gale Group, 1992, ISBN 0023839902, 9780023839900.
4. Electronic Devices & Circuits Theory – Robert Boylestad and Louis Nashelsky, 10thEditionPrentice Hall, 2009,
ISBN 0135026490, 9780135026496

Course Content:

Unit I: BJT at low and high frequencies **12 Hours**
Millers theorem and its dual – cascading transistor amplifier – Hybrid models of CE, CB, CC, configurations – Study of the effect of emitter by- pass condenser at low frequencies - Hybrid – π common emitter transistor model – hybrid π conductance and capacitance – CE short circuit current

gain – current gain with resistive load – gain bandwidth product – Study of the effect of un bypassed emitter resister on amplifier performance, cascode amplifier. HF & LF compensation of RC coupled amplifier.
Unit II: FET amplifiers and Power Amplifiers **8 Hours**
FET Amplifiers: Common source, Common gate and Common drain Amplifiers – problems. VMOS & CMOS Concepts.Power Amplifiers: Classification of amplifiers – class A large signal amplifiers – second harmonic distortion – higher order harmonic generations – computation of Harmonic distortion – Transformer coupled audio power amplifier – efficiency – push - pull amplifier – class B amplifier – class AB operation – Push-Pull circuit with Transistors of Complimentary Symmetry.
Unit III: Feedback Amplifiers **6 Hours**
The feedback concept – Transfer gain with feedback – general characteristics and advantages of negative feedback– analysis of voltage series, Voltage shunt, current series and current shunt feedback amplifiers – Study of the effect of Negative feedback on Gain, Bandwidth, Noise, Distortion, Input and Output impedances with the help of Block Schematic and Mathematical Expressions.
Unit IV: Oscillators **8 Hours**
Sinusoidal oscillators –phase shift oscillator – Wien bridge oscillator – Hartley oscillator – Colpits oscillator – frequency stability, inclusive of design, Crystal oscillators. FET Amplifiers: Common source, Common gate and Common drain Amplifiers – problems. VMOS & CMOS Concepts.
Unit V: Tuned Amplifiers **6 Hours**
Characteristics of Tuned amplifiers – Analysis of Single tuned, Doubled tuned and stagger tuned amplifiers, Gain – bandwidth product – High frequency effect – neutralization.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Analog Electronics Circuit Lab				
Course Code	BEEE3022				
Prerequisite	Semiconductor Devices and Circuits				
Corequisite					
Antirequisite					
	L	**T**	**P**	**C**	
	0	0	2	1	

Course Objectives:

1. To learn different biasing techniques and behavior of BJT, FET at low and high frequencies.
2. To understand the principle of operation of different oscillators circuits.

Course Outcomes

CO1	Design, construct, and take measurement of various analog circuits to compare
CO2	Experimental results in the laboratory with theoretical analysis.
CO3	Explain the methods of biasing transistors & design of simple amplifier circuits and to develop the ability to analyze and design analog electronic circuits using discrete components..
CO4	Observe the amplitude and frequency responses of common amplification circuits and utilize the data for designing.
CO5	Design, construct, and take measurement of various analog circuits to compare

List of Experiments of Analog Electronics Circuit Lab

1	1. To study RC coupled amplifier	**CO1**
2	2. To study darlington emitter follower	**CO2**
3	3. To study voltage series feedback amplifier	**CO3**
4	4. To study RC phase shift oscillator	**CO4**
5	5. To study Hartley and colpitt's oscillator	**CO5**
6	6. To study clipping circuits	**CO2**
7	7. To study clamping circuits	**CO1**
8	8. To study Op-amp application	**CO2**
9	9. To study voltage regulator	**CO4**
10	10. To study analog to digital converter	**CO2**

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Exam (MTE)**	**End Term Exam (ETE)**	**Total Marks**
50	**-**	**50**	**100**

Name of The Course	**Electronics Devices and Circuits**				
Course Code	BECE2015				
Prerequisite					
Corequisite					
Antirequisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives:

1. Apply concepts of semiconductor devices to design and analyze circuits.
2. To prepare students to know the characteristics of different semiconductor devices.

Course Outcomes

CO1	Identify different electronic devices, apply subject knowledge and solve electronic device problems.
CO2	Design a device/equipment such as amplifier, power supply and SMPS for the given parameters.
CO3	Apply BJT and FET fundamentals for transistors related analysis.
CO4	Apply fundamentals of semiconductor devices in electronics projects in circuit design, evaluation and analysis.
CO5	Explain the fundamental principles necessary for the analysis and design of analog integrated circuits at transistor level.

Text Book (s)

1. Jacob. Millman, Christos C.Halkias, 'Electronic Devices and Circuits', 2nd Edition, Tata McGraw Hill Publishing Limited, New Delhi, 2008, ISBN 0070634637, 9780070634633

2. David A.Bell, 'Electronic Devices and Circuits', Prentice Hall of India Private Limited, New Delhi, 2003, ISBN 013253147X, 9780132531474

Reference Book (s)

1.Theodre F. Boghert, 'Electronic Devices & Circuits',6th Edition, Pearson Education 2004 ISBN 8177588877, 9788177588873.

2. Ben G. Streetman and Sanjay Banerjee, 'Solid State Electronic Devices', 6th Edition, PHI 2009, ISBN 0132454793, 9780132454797

Course Content:

Unit I:PN Diodes and Rectifiers **11 Hours** Semiconductor Devices: Intrinsic, Extrinsic, Drift and diffusion currents – PN junction – PN junction Diode – VI characteristics – Diode equation– Diffusion and Transition Capacitances- Equivalent circuit – Half wave rectifier – Full – Wave rectifiers – Filters (C,L,LC,π &RC) – PN Diode clippers & clampers and – Avalanche and Zener breakdown – Zener diode - Varactor diode – Tunnel diode – PIN diode – Photo diode photo voltaic cells – LED – LCD. Introduction to Special Diodes: UJT, SCR, DIAC and TRIAC.
Unit II: Bipolar Junction Transistors **9 Hours**

Transistor action – current components – I/o characteristics of CB, CE, CC configuration – Transistor Biasing – Bias stability– operating point – Load line analysis – Bias compensation – Thermal run-away in Transistor – Use of heat sinks – Transistor equivalent circuits – Analysis of BJT amplifiers in CB, CE, CC using Hybrid parameters .
Unit III: Field Effect Transistors and special diodes 8 Hours Constructional features of JFET and MOSFET – handling precautions of MOSFET – FET Biasing methods – MOSFET biasing methods – Small signal analysis of JFET and MOSFET amplifiers.
Unit IV:Amplifiers & Switches 7 Hours Transistor as a switch (Inverter Circuit) using BJT & MOS switching circuits. Classification of Amplifiers - Multistage amplifiers – Analysis of RC coupled amplifiers – frequency response - overall Gain BW product – effect of cascading on Gain and BW. Analysis of Transformer coupled amplifier .DC amplifier.
Unit V: Power Supply 4 Hours Voltage regulators – current regulator protection circuit for DC power suppliers SMPS – Analysis and Design.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Power System Analysis				
Course Code	BTEE3009				
Prerequisite	Fundamental of power system				
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives:

1. To introduce fundamental concepts relating to the analysis of electrical power systems
2. To understand the fault condition inside transmission line and the generating system.
3. To analyze of load flow equations and representation of power system components

Course Outcomes

CO1	Exposure to the modeling of individual power system components like transmission lines and generators
CO2	To analyze the unsymmetrical faults
CO3	Enable the students to do load flow and short circuit calculations
CO4	To analyze the power system stability
CO5	Understand the travelling waves concept

Text Book (s)

1. C. L. Wadhwa, "Electrical Power Systems" New age international Ltd. Third Edition
2. AsfaqHussain, "'Power System", CBS Publishers and Distributors.

Reference Book (s)

1. W. D. Stevenson, "Element of Power System Analysis", McGraw Hill
2. B. R. Gupta, "Power System Analysis and Design" Third Edition, S. Chand & Co.

Course Content:

Unit-1 Representation of Power System Components **9 hours**

Synchronous machines, Transformers, Transmission lines, One line diagram, Impedance and reactance diagram, per unit System. *Symmetrical components:* Symmetrical Components of unbalanced phasors, power in terms of symmetrical components, sequence impedances and sequence networks.

Symmetrical fault analysis, Transient in R-L series circuit, calculation of 3-phase short circuit current and reactance of synchronous machine, internal voltage of loaded machines under transient conditions.

Unit-2: Unsymmetrical faults **6 hours**

Analysis of single line to ground fault, line-to-line fault and Double Line to ground fault on an unloaded generators and power system network with and without fault impedance. Formation of Z-bus using singular transformation and algorithm, computer method for short circuit calculations.

Unit-3Load Flow Analysis **9 hours**

Introduction, bus classifications, nodal admittance matrix (*bus y*), development of load flow

equations, load flow solution using Gauss Siedel and Newton-Raphson method, approximation to N-R method, line flow equations and fast decoupled method, **Comparison of load flow methods**.
Unit-4Power System Stability **9 hours** Stability and Stability limit, Steady state stability study, derivation of Swing equation, transient stability studies by equal area criterion, synchronizing power coefficient, critical clearing angle and critical clearing time. Factors affecting steady state and transient stability and methods of improvement.
Unit-5Traveling Waves **9 hours** Wave equation for uniform Transmission lines, velocity of propagation, surge impedance, reflection and transmission of traveling waves under different line loadings. Bewlay's lattice diagram, protection of equipments and line against traveling waves.

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Exam (MTE)**	**End Term Exam (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	Integrated circuit			
Course Code	BECE2008			
Prerequisite	Analog electronics circuits			
Corequisite				
Antirequisite				
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives:

Course Outcomes

CO1	. Demonstrate the ability to apply the practice of Analog Integrated Circuits in real-world problems.
CO2	Design, layout, and testing of Op Amps and other analog circuits.
CO3	. Identify, formulate, and solve engineering problems in Analog Integrated Circuit Design
CO4	To give knowledge about various fabrication technologies of VLSI**.**
CO5	To impart knowledge about IC fabrication techniques.

Text books:

1. Sergio Franco, " Design with operational amplifiers and analog integrated circuits ", McGraw Hill, 2002, ISBN 0070530440, 9780070530447

2. Ramakant A. Gayakwad, " OP - AMP and Linear IC's ", 4th Edition, Prentice Hall, 2000, ISBN 0132808684, 9780132808682

Reference Book (s)

1. Botkar K.R., " Integrated Circuits ", Khanna Publishers, 1996.

2. Taub and Schilling, " Digital Integrated Electronics ", Tata McGraw-Hill Education, 2004, ISBN 0070265089, 9780070265080

3. Millman J. and Halkias C.C., " Integrated Electronics ", McGraw Hill, 2001, ISBN 0074622455, 9780074622452

Unit I:Operational Amplifiers **9 Hours**

Analysis of difference amplifiers, Monolithic IC operational amplifiers, specifications, frequency response of op-amp,, slew rate and methods of improving slew rate, Linear and Nonlinear Circuits using operational amplifiers and their analysis, Inverting and Non inverting Amplifiers.

Unit II: Applications of Operational Amplifiers **8 Hours**

Differentiator, Integrator, Voltage to Current convertor, Low pass, high pass, band pass filters, comparator, Multivibrator and Schmitt trigger, Triangle wave generator, Precision rectifier, Log and Antilog amplifiers, Non-linear function generator,Sine wave Oscillators.

Unit III: Analog Multiplier and PLL **9 Hours** Analysis of four quadrant and variable trans-conductance multipliers, Voltage controlled Oscillator, Closed loop analysis of PLL, Frequency synthesizers, Compander ICs.
Unit IV: D/A and D/A Converters **8 Hours** Analog switches, High speed sample and hold circuits and sample and hold IC's, Types of D/A converter- Current driven DAC, Switches for DAC, A/D converter, Flash, Single slope, Dual slope, Successive approximation, Voltage to Time and Voltage to frequency converters.
Unit V: Signal generators & Waveform shaping Circuits **8 Hours** Wave shaping circuits, Multivibrator- Monostable &Bistable, Schmitt Trigger circuits, IC 555 Timer, Application of IC 555, Switched capacitor filter, Frequency to Voltage converters.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Operation and Control in Power System				
Course Code	BEEE5005				
Pre-requisite	Power system				
Co-requisite					
Anti-requisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives:

1. To introduce fundamental concepts relating to the analysis of electrical power systems.
2. To understand the fault condition inside transmission line and the generating system.
3. To analyse of load flow equations and representation of power system components

Course Outcomes

CO1	construct mathematical models for computing the steady state performance, andbasic unbalanced performance of power systems
CO2	Overcome upon the challenges associated with generation and measurement of high voltages and currents apply different methods,
CO3	Use the concepts of load flows for power system network solutions Understand the significance high voltage engineering and its implementation in power system.
CO4	To compute, analyze, and reflect on the performance of a power system under steady state and transient conditions.
CO5	To analyse of load flow equations and representation of power system components

Text Book (s)

1. Allen. J. Wood and Bruce F. Wollenberg, "Power Generation, Operation and Control", John Wiley & Sons, Inc., 2003.
2. D.P. Kothari and I.J. Nagrath, „Modern Power System Analysis", Third Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2003

Reference Book (s)

1.Chakrabarti&Halder, "Power System Analysis: Operation and Control", PHI, 2004 Edition.

2L.L. Grigsby, „The Electric Power Engineering, Hand Book", CRC Press & IEEE Press, 2001.

3. Olle. I. Elgerd, "Electric Energy Systems theory: An introduction", Tata McGraw Hill Publishing Company Ltd. New Delhi, Second Edition 2003

Course Content:

Unit I: Introduction	**7 Hours**
System load – variation, load characteristics – load curves and load-duration curves, load factor, diversity factor, load forecasting, simple techniques of forecasting, basics of power system operation and control, reserve margin, load-frequency control, voltage control	
Unit II: Real Power - Frequency Control	**8Hours**
Speed governing mechanism and modelling, speed-load characteristics, load sharing, control area concept, LFC control of a single-area system, static and dynamic analysis, integration of economic dispatch control with LFC, two-area system – modelling – static analysis of uncontrolled case, tie line with frequency bias control of two-area system	
Unit III: Reactive Power – Voltage Control	**8 Hours**

Reactive power control, excitation systems – modelling, static and dynamic analysis, stability compensation, generation and absorption of reactive power, relation between voltage, power and reactive power at a node, method of voltage control, tap changing transformers, tap setting of OLTC transformer and MVAR injection of switched capacitors
Unit IV: Economic Load Dispatch **7 Hours**
Economic dispatch problem – cost of generation, incremental cost curve, co-ordination equations, solution by direct method and λ- iteration method, unit Commitment problem – constraints, solution methods – Priority-list methods – forward dynamic programming approach (Numerical problems only in priority-list method using full-load average production cost)..
Unit V: Computer control of power systems **7 Hours**
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, network topology, state estimation, security analysis and control, operating states (Normal, alert, emergency, in-extremis and restorative).

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Electric Drives				
Course Code	BEEE4001				
Prerequisite	Power Electronics				
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives:

1. To introduce the electric drives fundamentals including speed torque curves of motor and load, types of load.
2. To determine stability of drive system and select motor rating for any particular duty of application.

Course Outcomes

CO1	Demonstrate the basic of drive system and different types of loads.
CO2	Understand the motor dynamics and the rating of motor for different condition of load.
CO3	Analyse the types of breaking and select appropriate breaking to the working environment.
CO4	Analyse power circuit topology and control mechanism to control the speed of DC motor.
CO5	Apply various types of control mechanism to employ for variable speed drives.

Text Book (s)

1. G.K. Dubey, "Fundamentals of Electric Drives", Narosa publishing House
2. S.K.Pillai, "A First Course on Electric Drives", New Age International.

Reference Book (s)

1. M.Chilkin, "Electric Drives", Mir Publishers, Moscow.
2. N.K. De and Prashant K. Sen, "Electric Drives", Prentice Hall of India Ltd

Course Content:

Unit-1Fundamentals of Electric Drive **8 hours**
Electric Drives and its parts, advantages of electric drives, Classification of electric drives, Speed-torque conventions and multi-quadrant operations, Constant torque and constant power operation, Types of load, Load torque: components, nature and classification.
Unit-2Dynamics of Electric Drive **8 hours**
Dynamics of motor-load combination, Steady state stability of Electric Drive, Transient stability of electric Drive, Selection of Motor Power rating, Thermal model of motor for heating and cooling, classes of motor duty, determination of motor power rating for continuous duty, short time duty and intermittent duty, Load equalization
Unit-3Electric Braking **8 hours**
Purpose and types of electric braking, braking of dc, three phase induction and synchronous motors Dynamics During Starting and Braking: Calculation of acceleration time and energy loss during starting of dc shunt and three phase induction motors, methods of reducing energy loss during starting, Energy relations during braking, dynamics during braking.
Unit-4Power Electronic Control of DC Drives **8 hours**
Single phase and three phase controlled converter fed separately excited dc motor drives (continuous conduction only), dual converter fed separately excited dc motor drive, rectifier control

of dc series motor. Supply harmonics, power factor and ripples in motor current, Chopper control of separately excited dc motor and dc series motor.
Unit-5Power Electronic Control of AC Drives **8 hours**
Three Phase induction Motor Drive: Static Voltage control scheme, static frequency control scheme (VSI, CSI, and cycloconverter based) static rotor resistance and slip power recovery control schemes. Three Phase Synchronous motor: Self controlled schemes. Special Drives: Switched Reluctance motor, Brushless dc motor

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Exam (MTE)**	**End Term Exam (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	POWER SYSTEM PROTECTION & SWITCHGEAR			
Course Code	BTEE4003			
Prerequisite	Fundamental of power system			
Corequisite				
Antirequisite				
L	**T**	**P**	**C**	
3	0	0	3	

Course Objectives:

1. To introduce the students the principles of different protection schemes.
2. To develop students with an understanding of the characteristics, advantages and defects of different protection methods.
3. To prepare the students to design/coordinate protection schemes for given requirements.

Course Outcomes

CO1	Understand the principle of switchgear and protection schemes.
CO2	To develop students with an understanding of the characteristics, advantages and defects of different protection methods.
CO3	Apply their knowledge relays and circuit breakers for protection of electrical apparatus viz. transformers, motors and generators.
CO4	Explain the relay and circuit breaker theories and verify them through experiments
CO5	To design/coordinate protection schemes for given requirements.

Text Book (s)

1. S. S. Rao, "Switchgear and Protection", Khanna Publishers
2. B. Ravindranath and M. Chander, Power system Protection and Switchgear, Wiley Eastern Ltd.

Reference Book (s)

1. B. Ram and D. N. Vishwakarma, "Power System Protection and Switchgear", Tata Mcgraw Hill.
2. Y. G. Paithankar and S R Bhide, "Fundamentals of Power System Protection", Prentice Hall of India.
3. T.S.M Rao,"Power System Protection: Static Relays with Microprocessor Applications", Tata Macgraw Hill.

Course Content:

Unit I: Introduction to Protection System **8 Hours**

Introduction to protection system and its elements, functions of protective relaying, protective zones, primary and backup protection, desirable qualities of protective relaying, basic terminology. Relays: Electromagnetic, attracted and induction type relays, thermal relay, gas actuated relay, design considerations of electromagnetic relay.

Unit II: Relay Application and Characteristics **7 Hours** Amplitude and phase comparators, over current relays, directional relays, distance relays, differential relay. Static Relays: Comparison with electromagnetic relay, classification and their description, over current relays, directional relay, distance relays, differential relay.
Unit III: Protection of Transmission Line **8 Hours** Over current protection, distance protection, pilot wire protection, carrier current protection, protection of bus, auto re-closing.
Unit IV:Circuit Breaking **7 Hours** Properties of arc, arc extinction theories, re-striking voltage transient, current chopping, resistance switching, capacitive current interruption, short line interruption, circuit breaker ratings. Testing Of Circuit Breaker: Classification, testing station and equipments, testing procedure, direct and indirect testing.
Unit V: Apparatus Protection **10 Hours** Circuit Breaker: Operating modes, selection of circuit breakers, constructional features and operation of Bulk Oil, Minimum Oil, Air Blast, SF6, Vacuum and d. c. circuit breakers. Types of faults on alternator, stator and rotor protection, Types of fault on transformers and motors.

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Exam (MTE)**	**End Term Exam (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	Analog and Digital Communication				
Course Code	BEEE4003				
Prerequisite	signal and systems				
Corequisite					
Antirequisite	None				
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives:

1. to familiarize students with various techniques for amplitude modulation and demodulation of analog signals
2. to make students understand the techniques for generating and demodulating narrow-band and wide-band frequency and phase modulated signals
3. Analysis of noise behavior in modulation schemes.

Course Outcomes

CO1	Understand analog and digital Communication methods.
CO2	Discuss on various analog modulation techniques.
CO3	Analyze noise in modulation schemes.
CO4	Apply the principles of amplitude and angle modulation and demodulation to various problems of communication and understand waveform encoding techniques.
CO5	Understand communication system receivers and digital modulation techniques.

Text Books

1. Simon Haykin, "Communication Systems", 4th edition, John Wiley & Sons, 2001.
2. J. Proakis& M. Salehi, "Communication system engineering", 2nd edition Pearson Education Asia, 2002.

Reference Books

1. R. E. Ziemer, W. H. Tranter: "Principles of Communications: Systems, Modulation, and Noise", 5th Edition, John Wiley & Sons, 2001.

Course Content:

Unit-1Basics of Communication Theory	**6 hours**
Need and Importance of Communication, Elements of Communication System, Generalized block diagram of communication system, Types of communication systems- Simplex and Duplex systems, Analog and digital systems, Applications of Electronic Communications, Electromagnetic Spectrum used in communication and various frequency bands, Concept of bandwidth. Noise in communication and types of noise (External and Internal), Noise voltage, Signal-to-noise ratio, Noise Figure, Noise temperature	
Unit-2Amplitude Modulation	**9 hours**
Concept of modulation and demodulation, baseband and pass band signals. Amplitude Modulation (AM)- generation & demodulation, Modified forms of AM- Double sideband suppressed carrier (DSBSC), single sideband suppressed carrier (SSBSC) and Vestigial sideband (VSB) modulation.	
Unit-3Angle Modulation	**8hours**
Phase modulation (PM) and Frequency modulation (FM), narrow and wideband FM, Generation & demodulation, Pulse Modulation – PAM, PPM, PWM.	

Unit-4Baseband Modulation	**7hours**
Digital communication system- block diagram-Base – band transmission – binary Signalling schemes- PCM, DPCM, DM, ADM – Modulation and demodulation.	
Unit-5Digital Modulation Strategies	**8hours**
Digital modulation techniques-–Coherent and non-coherent receiver- Error performance of Binary Systems – ASK, FSK, MSK, PSK, QPSK- AWGN Noise.	

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Exam (MTE)**	**End Term Exam (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	Power Electronics				
Course Code	BEEE4011				
Prerequisite	Network analysis				
Corequisite					
Antirequisite	None				
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives:

1. To know the power electronics devices, basic structure, symbol and characteristics.
2. To understand the topologies and analyze ac to dc, dc to dc and dc to ac converters.

Course Outcomes

CO1	Differentiate between power semiconductor devices and small signal
CO2	semiconductor devices.
CO3	Understand the operation of switching power devices e.g Thyristors and Transistors
CO4	and TRIAC.
CO5	Implement different configurations of thyristor based choppers, controlled

Text Books

1. M.H. Rashid,"Power Electronics: Circuits, Devices & Applications", Prentice Hall of India, Ltd. 3rd Edition,2004
2. V.R. Moorthy, " Power Electronics : Devices, Circuits and Industrial Applications" Oxford, University Press,2007.
3. M.D.Singh&K.B.Khanchandani, "Power Electronics", Tata McGraw Hill publishing company, 1989

Reference Books

1. M.S. JamilAsghar, "Power Electronics" Prentice Hall of India Ltd., 2004.
2. Chakrabarti&Rai, "Fundamentals of Power Electronics &Drives"DhanpatRai& Sons.

Course Content:

Unit I: Power semiconductor Devices	**9 Hours**
*Power semiconductor devices their symbols and static characteristics:*haracteristics and specifications of switches, operation, steady state and switch characteristics, switching limits of Power Transistor Operation and steady state characteristics of Power MOSFET and IGBT. Snubber circuit, Series and parallel operation of thyristors, Commutation techniques of thyristor, methods of turn-on of thyristor, operation of GTO, MCT and TRIAC	
Unit II: DC-DC Converters	**8 Hours**
Principles of step-down chopper, step down chopper with R-L load Principle of step-up chopper, and operation with RL load, classification of choppers. Buck and boost converter.	
Unit III: Phase Controlled Converters	**7 Hours**
Single phase line commutated converters: single phase half controlled converter with resistive and inductive loads, Single phase fully controlled converter, midpoint and bridge connections with resistive and inductive loads, effect of freewheeling diode, performance parameters, effect of source inductance, single phase dual converter. Three phase line commutated converters: Three phase half wave converter, three phase fully controlled and half controlled converters with resistive and inductive loads, effect of freewheeling diode, performance parameters, effect of source inductance, three phase dual converter. Single phase half wave controlled rectifier with resistive and inductive loads, effect of freewheeling diode.	

Unit IV:AC Voltage Controllers **8 Hours**
Principle of On-Off and phase control, Single phase two SCRs in anti parallel with R and Rl load, Triac with R and RL load, Three phase ac voltage controllers (various configurations and comparison only),
Unit V: Inverters **7 Hours**
Single phase series resonant inverter, single phase bridge inverter, Three phase bridge inverters, Voltage control of inverters, Harmonics reduction techniques, Single phase and three phase current source inverters.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Smart Grid and Energy Management				
Course Code	BEEE4012				
Prerequisite	Power system				
Corequisite					
Antirequisite	None				
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives:

To know the Concept of Smart Grid, Definitions, Need of Smart Grid, Functions of Smart Grid.

Course Outcomes

CO1	Understand the background for Smart Grid and have knowledge about important terminology(K1,K2)
CO2	Know about challenges and possibilities related to smart metersK3
CO3	Analyze the types of Wide Area Measurement System(WAMS).K4
CO4	Understand the Site surveys and Energy systems surveyK3
CO5	Estimate Demand Side Management Concept and Scope of Demand Side Management.K4

Text Books

1.Ali Keyhani, Mohammad N. Marwali, Min Dai "Integration of Green and Renewable Energy in Electric Power Systems", Wiley.

2. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response", CRC Press.

Reference Books

1. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", Wiley

2. G.Sreenivasan, "Power Theft", PHI Learning Private Limited company, 1989

Course Content:

Unit I **7 Hours**
Introduction to Smart Grid: Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Functions of Smart Grid, Opportunities & Barriers of Smart Grid, Difference between conventional & smart grid, Concept of Resilient & Self Healing Grid, Present development & International policies in Smart Grid. Case study of Smart Grid. CDM opportunities in Smart Grid.
Unit II
Smart Grid and Smart Meters: Introduction to Smart Meters, Real Time Prizing, Smart Appliances, Automatic Meter Reading(AMR), Outage Management System(OMS), Plug in Hybrid Electric Vehicles(PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation, Phase Shifting Transformers.
Unit III
Wide Area Measurement System(WAMS): Smart Substations, Substation Automation, Feeder Automation. Geographic Information System(GIS), Intelligent Electronic Devices(IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System(WAMS), Phase Measurement Unit(PMU).
Unit IV
Principles of Energy Management and Energy Audit: General principles, Planning and program, Introduction to energy audit, General methodology, Site surveys, Energy systems survey, Energy audit, Instrumentation, Analysis of data and results.
Unit V

Electrical Load and Lighting Management: General principles, Illumination and human comfort, Lighting systems, Equipment's, Electrical systems, Electrical load analysis, Peak load controls. Demand Side Management: Concept and Scope of Demand Side Management, Evolution of Demand Side Management, DSM Strategy ,Planning, Implementation and its application. Customer Acceptance & its implementation issues. National and International Experiences with DSM

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Capstone Design - 1			
Course Code	BEEE9998			
Pre-requisite				
Co-requisite				
Anti-requisite				
	L	**T**	**P**	**C**
	0	0	6	5

Course Objectives:

1. Apply the knowledge of mathematics, science, engineeringfundamentals, and an engineering specialization to the solution of complex engineering problems
2. Work in team to formulate solution for Electronic System using hardware or software tools.
3. Analyze& research about the work to be implemented with resources available from internet & other sources.
4. "Work collaboratively to plan and execute project work or research to advance the scientific basis, technologies or practices within the Electronic Engineering discipline."

Course Outcomes

CO1	Identify project goals and constraints
CO2	Acquire knowledge about the project through previous works in the current field.
CO3	Formulate the methodologies to obtain experimental results.
CO4	Plan for the resource requirements.
CO5	Obtain the experimental results based on the methodologies formulated.

Reference Book (s)

1. Research papers from reputed journals.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Neural Networks and Fuzzy Control				
Course Code	BECE3202				
Pre-requisite	Control Systems				
Co-requisite					
Anti-requisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives:

1. Get the exposure to Artificial Neural Networks & Fuzzy Logic.
2. Understand the importance of tolerance of imprecision and uncertainty for design of robust &low-cost intelligent machines
3. Explore the functional components of neural network classifiers or controllers, and the functional components of fuzzy logic classifiers or controllers
4. Develop and implement a basic trainable neural network or a fuzzy logic system for a typical control, computing application or biomedical application

Course Outcomes:

CO1	Identify and describe Fuzzy Logic and Artificial Neural Network techniques in building intelligent machines.
CO2	Apply Artificial Neural Network & Fuzzy Logic models to handle uncertainty and solve engineering problems.
CO3	Understanding of fuzzy relation rule and aggregations
CO4	Understand concept of classical and fuzzy sets, fuzzification and defuzzification
CO5	Recognize the feasibility of applying a Neuro-Fuzzy model for a particular problem

Text Book (s)

1. Ross, Timothy J. Fuzzy logic with engineering applications. John Wiley & Sons, 2009
2. Yegnanarayana, B. Artificial neural networks. PHI Learning Pvt. Ltd., 2004
3. Stamatios V. Kartalopoulos, Understanding Neural Networks and Fuzzy Logic: Basic Concepts and Applications 1st Edition “
4. S. Rajasekaran, Neural Networks, Fuzzy Systems and Evolutionary Algorithms: Synthesis and Applications "

Reference Book (s)

1. "Aaron M. Tenenbaum, YedidyahLangsam and Moshe J. Augenstein “Data Structures Using C and C++” , PHI, 1996."
2. Jean Paul Trembley and Paul G. Sorenson, “An Introduction to Data Structures with applications”, McGraw Hill, 2007.
3. "Kosko, B, “Neural Networks and Fuzzy Systems: A Dynamical Approach to Machine Intelligence”, PrenticeHall, NewDelhi, 2004"
4. "Timothy J Ross, “Fuzzy Logic with Engineering Applications”,John Willey and Sons, West Sussex, England, 2005."

Course Content:

Unit-1Introduction to Artificial Neural Network	**9 hours**
Artificial neural networks and their biological motivation – Terminology – Models of neuron – Topology – characteristics of artificial neural networks – types of activation functions – learning methods – error correction learning – Hebbian learning – Perceptron – XOR Problem –Perceptron learning rule convergence theorem – Adaline.	

Unit-2Feed-forward and Recurrent Neural Networks	**12 Hours**
"Architecture: perceptron model, solution, single layer artificial neural network, multilayer perceptron model; back propogation learning methods, effect of learning rule co-efficient ;back propagation algorithm, factors affecting backpropagation training, applications; Recurrent neural networks: Linear auto associator – Bi-directional associative memory – Hopfield neural network."	
Unit-3Fuzzy Logic & Fuzzy Sets	**9 Hours**
Introduction to Fuzzy Logic, Classical and Fuzzy Sets, Membership Function ,Membership Grade, Universe of Discourse, Linguistic Variables, Operations on Fuzzy Sets: Intersections, Unions, Negation, Product, Difference, Properties of Classical set and Fuzzy sets, Fuzzy vs Probability, Fuzzy Arithmetic, Fuzzy Numbers.	
Unit-4Fuzzy Relations & Aggregations	**9 Hours**
Essential Elements of Fuzzy Systems, Classical Inference Rule, Classical Implications and Fuzzy Implications, Crisp Relation and Fuzzy Relations, Composition of fuzzy relations, Cylindrical Extension and Projection. Fuzzy IF-THEN rules, Inference: Scaling and Clipping Method, Aggregation, Fuzzy rule based Model: Mamdani Model, TSK model, Fuzzy Propositions, De-fuzzification: MOM, COA	
Unit-5Fuzzy Optimization and Neuro Fuzzy Systems	**6 Hours**
Fuzzy optimization –one-dimensional optimization. Introduction of Neuro-Fuzzy Systems, Architecture of Neuro Fuzzy Networks.	

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Exam (MTE)**	**End Term Exam (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	VLSI Design				
Course Code	BECE3013				
Pre-requisite	Semiconductor Devices, Integrated Circuits, Digital Design				
Co-requisite					
Anti-requisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives:

1. To bring both Circuits and System views on design together.
2. Study the fundamental concepts and structures of designing digital VLSI systems include CMOS devices and circuits.
3. Understand standard CMOS fabrication processes, CMOS design rules, static and dynamic logic structures, interconnect analysis.
4. It offers a profound understanding of the design of complex digital VLSI circuits, computer aided simulation and synthesis tool for hardware design.

Course Outcomes

CO1	Utilize the subject knowledge in specifying the technological problems for evolving cellular technology.
CO2	Be able to use mathematical methods and circuit analysis models in analysis of CMOS digital electronics circuits, including logic components and their interconnect.
CO3	Have an understanding of the characteristics of CMOS circuit construction and the comparison between different state-of-the-art CMOS technologies and processes.
CO4	Be able to design and solve complex problems.
CO5	Be able to complete a significant VLSI design project having a set of objective criteria and design constraints.

Text Book (s)

1. S.M.Sze, “VLSI technology”, 2nd Edition, Tata McGraw Hill Education, 2003, ISBN 9780070582910
2. Sung-Mo Kang & Yusuf Leblebici, “CMOS Digital Integrated Circuits – Analysis and Design”, 3rd Edition, Tata McGraw-Hill, New Delhi, 2003.
3. N. Weste and K. Eshranghian, "Principles of CMOS VLSI Design", Addison Wesley, 1998.

Reference Book (s)

1. Jacob Backer, Harry W. Li and David E. Boyce, " CMOS Circuit Design, Layout and Simulation ", Prentice Hall of India, 1998.
2. L.Glaser and D. Dobberpuhl, "The Design and Analysis of VLSI, Circuits”, Addison Wesley 1993.
3. Randel& Geiger, “ VLSI Analog and Digital Circuit Design Techniques” McGraw-Hill,1990.
4. John P. Uyemura, "Introduction to VLSI Circuits and Systems," John Wiley & Sons, ,Inc, 2002.

Course Content:

Unit-1 Integrated Circuit: Fabrication And Characteristics **7 hours**
Integrated circuit technology, basic monolithic integrated circuits, epitaxial growth, Masking and etching, diffusion of impurities, transistors for monolithic circuits, monolithic diodes, Integrated resistors, Integrated capacitors and inductors, monolithic circuit layout, additional isolation

methods, LSI and MSI, the metal semiconductor contacts.
Unit-2 Introduction to MOS Transistor **8 Hours**
The Metal Oxide Semiconductor (MOS) Structure, The MOS System under External Bias, Structure and Operation of MOS, Transistor (MOSFET), MOSFET Current-Voltage Characteristics, MOSFET Scaling and Small-Geometry Effects, MOSFET Capacitances, Numerical and spice simulations.
Unit-3MOS Inverters: Static and Switching Characteristic, Interconnect Effects **10 Hours**
Introduction, Resistive-Load Inverter, Inverters with n-Type MOSFET Load, CMOS Inverter, Delay-Time Definitions, Calculation of Delay Times, Inverter Design with Delay Constraints, Estimation of Interconnect Parasitics, Calculation of Interconnect Delay, Switching Power Dissipation of CMOS Inverters, Numerical and spice simulations
Unit-4 Combinational and Sequential MOS Logic Circuits **7 Hours**
Introduction, Basic Principles of Pass Transistor Circuits, Voltage Bootstrapping, Synchronous Dynamic Circuit Techniques, High-Performance Dynamic CMOS Circuits, Introduction, MOS Logic Circuits with Depletion nMOS Loads, CMOS Logic Circuits, Complex Logic Circuits, CMOS Transmission Gates (Pass Gates), Introduction, Behavior of Bistable Elements, The SR Latch Circuit, Clocked Latch and Flip-Flop Circuits, CMOS D-Latch and Edge-Triggered Flip-Flop
Unit-5 Memories and VLSI Design Methodologies **7 Hours**
Introduction, Read-Only Memory (ROM) Circuits, Static Read-Write Memory (SRAM) Circuits, Dynamic Read-Write Memory (DRAM) Circuits Introduction, VLSI Design Flow, Design Hierarchy, Concepts of Regularity, Modularity and Locality, VLSI Design Styles, Design Quality, Packaging Technology, Computer-Aided Design Technology

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	Database Concepts				
Course Code	BECE3101				
Pre-requisite	Data Structures				
Co-requisite					
Anti-requisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives:

This course is an introduction to principles, use and applications of databasesystems. On completion of the course you will be able to understand the purposes for which databases are used, design and create databases, query/extract information from databases and understand in broad terms how database systems work.

Course Outcomes

CO1	Understand the relational database theory, application of database system in real life.
CO2	Describe DBMS architecture, physical and logical database designs, database modeling, relational, hierarchical and network models.
CO3	Learn and apply Structured query language (SQL) for database definition and database manipulation.
CO4	Illustrate relational database theory, and be able to write relational algebra expressions for queries.
CO5	Demonstrate an understanding of normalization theory and apply such knowledge to the normalization of a database.

Text Book (s)

1. Korth, Silbertz, Sudarshan," Database Concepts", McGraw Hill
2. Date C J, " An Introduction to Database Systems", Addision Wesley
3. Elmasri, Navathe, " Fudamentals of Database Systems", Addision Wesley

Reference Book (s)

1. O'Neil, Databases, Elsevier Pub.
2. Leon &Leon,"Database Management Systems", Vikas Publishing House
3. J.Gowar, "Optical Communication System", 2nd edition, Prentice Hall of India, 2001
4. "Majumdar& Bhattacharya, "Database Management System", TMH (14) "

Unit-1 Introduction **10 hours**
Introduction: An overview of database management system, database system Vs file system, Database system concept and architecture, data model schema and instances, data independence and database language and interfaces, data definitions language, DML, Overall Database Structure. Data Modelling using the Entity Relationship Model: ER model concepts, notation for ER diagram, mapping constraints, keys, Concepts of Super Key, candidate key, primary key, Generalization, aggregation, reduction of an ER diagrams to tables, extended ER model.
Unit-2 Relational data Model and Language **8 Hours**
Relational data model concepts, integrity constraints, entity integrity, referential integrity, Keys constraints, Domain constraints, relational algebra, relational calculus, tuple and domain calculus. Introduction on SQL: Characteristics of SQL, advantage of SQL. SQl data type and literals. Types of SQL commands. SQL operators and their procedure. Tables, views and indexes. Queries and sub queries. Aggregate functions. Insert, update and delete operations, Joins, Unions, Intersection, Minus.
Unit-3 Data Base Design & Normalization **7 Hours**
Functional dependencies, normal forms, first, second, third normal forms, BCNF, inclusion dependence, loss less join decompositions, normalization using FD, MVD.

Unit-4 Data Base Design	**7 Hours**
Transaction system, Testing of serializability, serializability of schedules, conflict & view serializable schedule, recoverability, Recovery from transaction failures, log based recovery, checkpoints, deadlock handling.	
Unit-5 Concurrency Control Techniques	**8 Hours**
Concurrency control, Locking Techniques for concurrency control, Time stamping protocols for concurrency control.	

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	Computer Networks				
Course Code	BECE3105				
Pre-requisite	Digital Electronics				
Co-requisite					
Anti-requisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives:

1. Build an understanding of the fundamental concepts of computer networking.
2. Familiarize the student with the basic taxonomy and terminology of the computer networking area.
3. Introduce the student to advanced networking concepts, preparing the student for entry Advanced courses in computer networking.
4. Allow the student to gain expertise in some specific areas of networking such as the design and maintenance of individual networks.

Course Outcomes

CO1	Have a good understanding of the OSI Reference Model and in particular have a good knowledge of Layers 1-3.
CO2	Analyze the requirements for a given organizational structure and select the most appropriate networking architecture and technologies;
CO3	have a basic knowledge of the use of cryptography and network security;
CO4	Specify and identify deficiencies in existing protocols, and then go onto formulate new and better protocols;
CO5	familiar with the basic protocols of computer networks, and how they can be used to assist in network design and implementation.

TEXT BOOKS

1. A. Leon –Garcia, IndraWidjaja, “Communication Networks”, Tata McGraw Hill.
2. W. Stallings, “Data and Computer Communication”, 7th edition, PHI, New Delhi

REFERENCEBOOKS

3. M.SteenStrub, “Routing in Communication networks”, PH, New York.
4. William Stallings, High speed Networks TCP/IP & ATM Design Principles, PH, NY
5. Alder.M..Scheideler.Ch.Annual ACM Symposium on Parallel Algorithms and Architectures, ACM, NewYork.
6. Sivarammurthy, Manoj, “Ad Hoc Wireless Networks: Architectures and Protocols”, Pearson Education, 2004.
7. Charles E. Perkins, “Ad Hoc Networking”, Addison Wesley, 2008.

Course Content:

Unit-1 Network and Services **8 hours**
Approaches to Network design, Network topologies and design constraints, Transmission media - copper and optical fiber, OSI Reference Model; Overview of TCP/ IP, Application Layer Protocols and TCP/IP, Application Layer Protocols and TCP/IP Utilities. Peer-to-peer protocols: Service Models, ARQ Protocols and reliable data transfer service, sliding Window Flow Control.
Unit-2Medium Access Control Protocol **8 hours**
Multiple access communication, Random access scheduling approaches to medium access control, Delay performance of MAC and channelization schemes, LAN Access methods, Introduction to

LAN Standards, IEEE 802.5, FDDI, WLAN, Hubs, Bridges and Switches Ethernet networking.
Unit-3 Packet Switching Networks 8 hours
Network Services and Internal Network Operation, Packet Network Topology, Routing in packet Networks, shortest path Algorithms, and Introduction to traffic management &QoS.
Unit-4 TCP/IP Architecture 8 hours
The Internet Protocol, IP addressing and subnetting, Limitations of IPv4 and Introduction to IPv6, User Datagram protocol, Transmission Control Protocol, Introduction to Internet Routing Protocols.
Unit-5 Wireless Routing Protocols 8 hours
Routing in cellular radio mobile communication networks, Packet radio Routing Internet based mobile ad-hoc networking, communication strategies, routing algorithms Destination sequenced Distance Vector(DSDV),Dynamic source Routing (DSR),Ad-hoc On demand Distance Vector(AODV) &Temporarily Ordered Routing algorithm (TORA),Quality of service.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	Soft Computing Techniques				
Course Code	BECE4401				
Pre-requisite	C++/Java/ Matlab programming				
Co-requisite					
Anti-requisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives:

1. Introduce the fundamentals of Soft Computing.
2. Apply Computing models to solve problems.
3. Get the exposure of soft computing, especially evolutionary computation, fuzzy logic, GA and neural networks
4. Become expert in calculating and comparing complexities of various searching and sorting algorithms.

Course Outcomes

CO1	Identify and describe Soft-Computing techniques and their roles in building intelligent machines
CO2	Apply Soft – Computing models & reasoning to handle uncertainty and solve engineering problems.
CO3	Recognize the feasibility of applying a soft computing methodology for a particular problem
CO4	Apply genetic algorithms to optimization problems
CO5	Identify the importance of tolerance of imprecision and uncertainty for design of robust & low cost intelligent machines.

Text Book (s)

1. Ross, Timothy J. Fuzzy logic with engineering applications. John Wiley & Sons, 2009.
2. Yegnanarayana, B. Artificial neural networks. PHI Learning Pvt. Ltd., 2004.

Reference Book (s)

1. Zurada, Jacek M. Introduction to artificial neural systems, West St. Paul, 1992.
2. Hagan, Martin T., Howard B. Demuth, and Mark H. Beale. Neural network design. Boston: Pws Pub., 1996.
3. Haykin, Simon. Neural networks: a comprehensive foundation. Prentice Hall PTR, 1994.

Course Content:

Unit-1Artificial Neural Networks 9 hours
Introduction, model of neuron, activation functions, important terminologies of ANN, Hebb's learning, Supervised learning, Unsupervised learning, reinforcement learning, Adaline, Perceptron, Back propagation networks, Adaptive Resonance Theory, Associative Memories, Applications.
Unit-2Fuzzy Logic & Fuzzy Sets 9 Hours
Introduction to Fuzzy Logic, Classical and Fuzzy Sets, Membership Function ,Membership Grade, Universe of Discourse, Linguistic Variables, Operations on Fuzzy Sets: Intersections, Unions, Negation, Product, Difference, Properties of Classical set and Fuzzy sets, Fuzzy vs Probability, Fuzzy Arithmetic, Fuzzy Numbers
Unit-3Fuzzy Relations & Aggregations 9 Hours

Essential Elements of Fuzzy Systems, Classical Inference Rule, Classical Implications and Fuzzy Implications, Crisp Relation and Fuzzy Relations, Composition of fuzzy relations, Cylindrical Extension and Projection. Fuzzy IF-THEN rules, Inference: Scaling and Clipping Method, Aggregation, Fuzzy rule based Model: Mamdani Model, TSK model, Fuzzy Propositions, De-fuzzification: MOM, COA
Unit-4Neuro-Fuzzy Systems 6 Hours
Introduction of Neuro-Fuzzy Systems, Architecture of Neuro Fuzzy Networks. Application of Fuzzy Logic: Medicine, Economics, Industry etc.
Unit-5Genetic algorithm 8 Hours
Genetic Algorithm: An Overview, GA in problem solving, Implementation of GA fundamentals, basic concepts, working principle, encoding, fitness function, reproduction, Genetic modelling: Inheritance operator, crossover, inversion & deletion, mutation operator, Bitwise operator, Generational Cycle, Convergence of GA, Applications & advances in GA, Differences & similarities between GA & other traditional method

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Embedded System Design				
Course Code	BECE3019				
Pre-requisite	VLSI Design				
Co-requisite					
Anti-requisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives:

To learn the basic concepts of Embedded Systems

1. To learn the concept of designing computer organization and architecture
2. To gain an understanding of applications of embedded systems involving real-time programming of microcontrollers.

Course Outcomes

CO1	To learn the basic concepts of Embedded Systems
CO2	Explain and work on Real time operating systems.
CO3	Apply the concepts of embedded system.
CO4	Design and program for Embedded Systems.
CO5	Demonstrate applications of RTOS with case studies

Text Book (s)

1. Raj Kamal , Embedded Systems Architecture, Programming and Design, Tata McGraw-Hill, New Delhi, 2003. ISBN 0-07-049470-3
2. Wayne Wolf, Computers as Components: Principles of Embedded Computing System Design, Morgan Kaufman Publishers, 2001. ISBN=012388436

Reference Book (s)

1. Frank Vahid and Tony Givargi Embedded System Design: A Unified Hardware/Software Introduction's, John Wiley & Sons, 2000. ISBN: 978-0-471-38678-0
2. John B Peatman, Design with PIC Microcontrollers, Prentice Hall of India, 2007 ISBN=0130462136

Course Content:

Unit-1 PIC Microcontroller **7 hours**
Architecture - Features – Resets –Memory Organizations: Program Memory, Data Memory – Instruction Set – simple programs. Interrupts –I/O Ports –Timers- CCP Modules- Master Synchronous serial Port (MSSP)- USART –ADC- I2C
Unit-2 Embedded Processors **9 Hours**
ARM processor- processor and memory organization, Data operations, Flow of Control, CPU Bus configuration, ARM Bus, Memory devices, Input/output devices, Component interfacing, designing with microprocessor development and debugging, Design Example : Alarm Clock.
Unit-3 Embedded Programming **10 Hours**
Programming in Assembly Language (ALP) Vs. High level language – C program elements, Macros and Functions – Use of pointers – NULL pointers – use of function calls – multiple function calls in a cyclic order in the main function pointers – Function queues and interrupt service Routines queues pointers – Concepts of Embedded programming in C++ - Object oriented programming – Embedded programming in C++, C program compilers – Cross compiler – optimization of memory codes
Unit-4 Embedded System design **6 Hours**
Embedded System project management – Embedded system design and Co-Design Issues in System Development process – Design cycle in the development phase for an embedded system – Uses of Target system or its emulator and In-Circuit Emulator – Use of software Tools for Development of an embedded system – Use of scopes and logic analyzers for system hardware tests – Issues in Embedded System Design.

Unit-5 Real Time Operating Systems	**8 Hours**
Operating system services –I/O subsystems – Network operating systems –Interrupt Routines in RTOS Environment – RTOS Task scheduling models, Interrupt – Performance Metric in Scheduling Models – IEEE standard POSIX functions for standardization of RTOS and inter-task communication functions – List of Basic functions in a Preemptive scheduler – Fifteen point strategy for synchronization between processors, ISRs, OS Functions and Tasks – OS security issues- Mobile OS.	

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	**Electrical Engineering Materials**			
Course Code	**BTEE2010**			
Prerequisite	Basic Electrical			
Corequisite				
Antirequisite				
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives:

1. The course is aimed to impart a sound knowledge in engineering materials emphasizing onmodern technological aspects in different fields of electrical engineering and technology.

2. It also teaches the basics of engineering material standards and convention.

Course Outcomes

CO1	Evaluate insulating, conducting and magnetic materials used in electrical machines
CO2	Know the application of materials and select the appropriate material in the field of electrical machines, devices, instruments, appliances etc.
CO3	Understand the properties of liquid, gaseous and solid insulating materials
CO4	Understand the Properties of magnetic material
CO5	Understand the Dielectric Materials and Insulation

Text Book (s)

1. A.J. Dekker,"Electrical Engineering Materials" Prentice Hall of India
2. R.K. Rajput," Electrical Engg. Materials," Laxmi Publications.
3. C.S. Indulkar&S.Triruvagdan "An Introduction to Electrical Engg. Materials, S.Chand& Co.
4. S.O.Kasap, 'Principles of Electronic Material & Devices', McGraw Hill Publications

Reference Book (s)

1. Solymar, "Electrical Properties of Materials" Oxford University Press.
2. Ian P. Hones, "Material Science for Electrical and Electronic Engineering," Oxford University Press
3. G.P. Chhalotra& B.K. Bhat, "Electrical Engineering Materials" Khanna Publishers

Course Content:

Unit I: Crystal Structure of Materials **9 Hours**

Bonds in solids, crystal structure, co-ordination number, atomic packing factor, Miller Indices, Bragg's law and x-ray diffraction, structural Imperfections, crystal growth, energy bands in solids, classification of materials using energy band.

Unit II: Conductivity of Metals **9 Hours**

Electron theory of metals, factors affecting electrical resistance of materials, thermal conductivity of metals, heat developed in current carrying conductors, thermoelectric effect, superconductivity and super conducting materials, Properties and applications of

electrical conducting and insulating materials, mechanical properties of metals.

Unit III: Semiconductor materials **7 Hours**

Properties of semiconductors, Silicon wafers, integration techniques, Large and very large scale integration techniques (VLSI).

Unit IV: Properties of magnetic material **9 Hours**

Classification of magnetic materials, spontaneous magnetization in ferromagnetic materials, magnetic Anisotropy, magnetostriction, diamagnetism, magnetically soft and hard materials, special purpose materials, feebly magnetic materials, Ferrites, factors effecting permeability and hysteresis.

Unit V: Dielectric Materials and Insulation **11 Hours**

Dielectric as electric field Medium, leakage currents, dielectric loss, dielectric strength, breakdown voltage, breakdown in solid dielectrics, flashover, liquid dielectrics, electric conductivity in solid, liquid and gaseous dielectrics, Ferromagnetic materials, properties of ferromagnetic materials in static fields, spontaneous, polarization, curie point, anti-ferromagnetic materials, piezoelectric materials, pyro electric materials.

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Exam (MTE)**	**End Term Exam (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	Satellite Communication				
Course Code	BECE3103				
Pre-requisite	Analog and Digital Communication				
Co-requisite					
Anti-requisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives:

Course Outcomes

CO1	Explain the fundamentals of satellite communication systems
CO2	Design a satellite communication link under specified characteristics.
CO3	Explain the modulation and multiplexing techniques in satellite communication.
CO4	Describe propagation effects and their impact on satellite-earth links
CO5	Demonstrate the working of satellite based systems.

Text Book (s)

1. Satellite Communications / Dennis Roddy / McGraw-Hill
2. Satellite Communications / Pratt, Bostian, Allnutt / John Wiley & Sons.

Reference Book (s)

1. Digital Satellite Communications/ Tri T. Ha./ McGraw-Hill.

Course Content:

Unit-1 Basic Knowledge **6 hours**
Elements of Satellite Communication Orbital mechanics look angle and orbit determination, launches & launch vehicle, orbital effects, Geostationary Orbit.
Unit-2 Sub Systems **10 Hours**
Satellite subsystems, attitude and orbit control systems, TTC&M, communication subsystem, satellite antenna satellite link design: basic transmission theory, system noise temperature and G/T ratio, downlink design, uplink design, satellite systems using small earth station, design for specified C/N.
Unit-3 Different modulation schemes **8 Hours**
Modulation and multiplexing techniques for satellite links: FM, pre-emphasis and de-emphasis, S/N ratios for FM video transmission, digital transmission, digital modulation and demodulation, TDM. Multiple access techniques.
Unit-4 Amplifiers & Switches **8 Hours**
Error control for digital satellite links: error detection and correction, channel capacity, error control coding schemes. Propagation effects and their impact on satellite-earth links: attenuation and depolarization, atmospheric absorption, rain, cloud and ice effects etc.
Unit-5 Power Supply **8 Hours**
Introduction of various satellite systems: VSAT, low earth orbit and non-geostationary, direct broadcast satellite television and radio, satellite navigation and the global positioning systems.

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
20	30	50	100

Name of The Course	Digital Image Processing				
Course Code	BECE3301				
Pre-requisite	Digital Signal Processing				
Co-requisite					
Anti-requisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives:

1. To impart the basic concepts of image segmentation and shaping
2. To apply different types signal processing techniques in image processing

Course Outcomes

CO1	Students will be able to describe and Interpret basic elements of Digital Image Processing, Analyze the need and suitability of transforms in image processing applications
CO2	Design and implement filters for image enhancement in spatial domain and frequency domain for real time applications and apply image restoration algorithms
CO3	Segment and Extract features from images for analysis and recognition
CO4	Perform Wavelet analysis on images
CO5	Interpret Still and Video compression algorithms

Text Book (s)

1. Gonzalez and Wood, "Digital Image Processing", Addison Wesley, 1993
2. Anil K.Jain, "Fundamental of Image Processing", Prentice Hall of India

Reference Book (s)

1. Rosenfeld and Kak, "Digital Picture Processing" vol.I&vol.II, Academic,1982
2. Ballard and Brown, "Computer Vision", Prentice Hall, 1982.
3. Wayne Niblack, "An Introduction to Digital Image Processing", Prentice Hall, 1986
4. Milan Sonka, Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis and Machine Vision", Vikas Publications

Course Content:

Unit-1 Introduction to Image Processing **5 hours**
Image formation, image geometry perspective and other transformation, sterio imaging elements of visual perception. Digital Image-sampling and quantization serial & parallel Image processing.
Unit-2 Signal Processing **9 Hours**
Signal Processing - Fourier, Walsh-Hadmard discrete cosine and Hotelling transforms and their properties, filters, correlators and convolvers. Image enhancement-Contrast modification. Histogram specification, smoothing, sharpening, frequency domain enhancement, pseudo-colour Enhancement
Unit-3 Image Restoration **8 Hours**
Constrained and unconstrained restoration Wiener filter , motion blur remover, geometric and radiometric correction Image data compression-Huffman and other codes transform compression, predictive compression two tone Image compression, block coding, run length coding, and contour coding.
Unit-4 Segmentation Techniques **7 Hours**
Segmentation Techniques-thresholding approaches, region growing, relaxation, line and edge detection approaches, edge linking, supervised and unsupervised classification techniques, remotely sensed image analysis and applications.
Unit-5 Shape Analysis **8 Hours**
Shape Analysis – Gestalt principles, shape number, moment Fourier and other shape descriptors,

skelton detection, Hough transform, topological and texture analysis, shape matching. Practical Applications – Finger print classification, signature verification, text recognition, map understanding, bio-logical cell classification.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Name of The Course	Non Conventional Energy Resources				
Course Code	BEEE2018				
Pre-requisite	Power system				
Co-requisite					
Anti-requisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives:

1. To have an overview of non-conventional energy sources.
2. To understand the need of alternate sources of energy.

Course Outcomes

CO1	Understand the different types of renewable energy sources and their utilities
CO2	Design models for generating energy through alternate energy sources (with the help of additional learning)
CO3	To understand the practical limitation and hence steps for continuous improvement through research.
CO4	Apply genetic algorithms to optimization problems
CO5	Design models for generating energy through alternate energy sources (with the help of additional learning)

Text Book (s)

5. 1. Renewable energy technologies - R. Ramesh, Narosa Publication
6. Non-conventional Energy Systems – Mittal, Wheelers Publication.

Reference Book (s)

7. John F Walker &Jekins. N, Wind Energy Technology., John Wiley and Sons, chichester, UK, 1997.
8. Van Overstra ,Mertens, R.P, Physics, Technology and use of Photovoltaics, Adam Hilger, Bristol, 1996.

Course Content:

Unit I:Energy Scenario
6 Hours
Classification of Energy Sources, Energy resources (Conventional and nonconventional), Energy needs of India, and energy consumption patterns. Worldwide Potentials of these sources. Energy efficiency and energy security. Energy and its environmental impacts. Global environmental concern, Kyoto Protocol, Concept of Clean Development Mechanism (CDM) and Prototype Carbon Funds(PCF). Factors favoring and against renewable energy sources, IRP.
Unit II: Solar Energy **9 Hours**
Solar thermal Systems: Types of collectors, Collection systems, efficiency calculations, applications. Photo voltaic (PV) technology: Present status, - solar cells , cell technologies,characteristics of PV systems, equivalent circuit, array design , building integrated PV system, its components , sizing and economics. Peak power operation. Standalone and grid interactive systems.
Unit III: Wind Energy **10 Hours**

wind speed and power relation, power extracted from wind, wind distribution and wind speed predictions. Wind power systems: system components, Types of Turbine, Turbine rating, Choice of generators, turbine rating, electrical load matching, Variable speed operation, maximum power operation, control systems, system design features, stand alone and grid connected operation.
Unit IV :Other energy sources 8 Hours
Biomass – various resources, energy contents, technological advancements, conversion of biomass in other form of energy – solid, liquid and gases. Gasifiers, Biomass fired boilers, Cofiring, Generation from municipal solid waste, Issues in harnessing these sources. Hydro energy – feasibility of small, mini and micro hydel plants scheme layout economics. Tidal and wave energy ,Geothermal and Ocean-thermal energy conversion. (OTEC) systems – schemes, feasibility and viability.
Unit V: Energy storage and hybrid system configurations 7 Hours
Energy storage: Battery – types, equivalent circuit, performance characteristics, battery design, charging and charge regulators. Battery management. Fly wheel-energy relations, components, benefits over battery. Fuel Cell energy storage systems. Ultra Capacitors.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	High Voltage Engineering				
Course Code	BEEE2020				
Pre-requisite	Power system				
Co-requisite					
Anti-requisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives:

1. The course imparts knowledge about voltage break down of solid, liquid and gaseous materials used in electrical engineering field.
2. Students will learn generation of high voltages and currents.
3. Students will learn the measurement and testing of high voltages and currents.

Course Outcomes

CO1	Understand the significance high voltage engineering and its implementation in power system.
CO2	Overcome upon the challenges associated with generation and measurement of high voltages and currents
CO3	To understand the practical limitation and hence steps for continuous improvement through research.
CO4	Measurement of dielectric constant and loss.
CO5	High voltage testing

Text Book (s)

1. M. S. Naidu and V. Kamaraju, "High Voltage Engineering, Tata Mc-Graw Hill

Reference Book (s)

1. Subir Ray,' An Introduction to High Voltage Engineering' Prentice Hall of India.
2. E. Kuffel and W. S. Zacngal, High Voltage Engineering", Pergamon Press.
3. M. P. Chaurasia , "High Voltage Engineering", Khanna Publishers.
4. R. S. Jha, "High Voltage Engineering", DhanpatRai& sons.

Course Content:

Unit I:Break Down In Gases
Ionization processes, Townsend's criterion, breakdown in electronegative gases, time lags for breakdown, streamer theory, Paschen's law, break down in non-uniform field, breakdown in vacuum.
Unit II: Generation of High Voltages and Currents
Generation of high direct current voltages, generation of high alternating voltages, generation of impulse voltages, generation of impulse currents, tripping and control of impulse generators
Unit III: Measurement of High Voltages and Currents

Measurement of high direct current voltages, measurement of high alternating and impulse voltages, measurement of high direct, alternating and impulse currents, Cathode Ray Oscillographs for impulse voltage and current measurements. factor, partial discharge measurements.
Unit IV : Non-Destructive Testing
Measurement of direct current resistively, measurement of dielectric constant and loss.
Unit V: High Voltage Testing
Testing of insulators and bushings, testing of isolators and circuit breakers, testing of cables, testing of transformers, testing of surge arresters, radio interference measurements.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Power Electronics Applications in Power Systems			
Course Code	BEEE2020			
Pre-requisite	Power system			
Co-requisite				
Anti-requisite				
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives:

1. The course aims to impart in-depth knowledge of power electronics controllers (FACTS devices),
2. Application of FACTS controllers in the area of power system to enhance system capability.
3. Power electronics applications in HVDC transients.

Course Outcomes

CO1	Understand the principles and characteristics of power electronic circuits and systems and apply the concept ofload compensation and reactive power control to AC power system.
CO2	Design and implement various FACTS controllers.
CO3	analyze and predict the capabilities and performance of standard power electronic controllers.
CO4	To compute, analyze, and reflect on the performance of a power system under steady state and transient conditions.
CO5	To analyse of load flow equations and representation of power system components

Text Book (s)

1. NarainHingorani&LazzloGyugi -Understanding FACTS. Concepts & Technology of FACTS. (Standard publishers & distributors, Delhi-110 006)
2. Yong Hua Song and Allan T Johns - Flexible AC Transmission Systems (FACTS) (IEE Press, London, UK)

Reference Book (s)

1. T.J.E Miller -Reactive Power Control in Electric system (John Wiley & Sons, NY)
2. Edward Wilson Kimbark, 'Direct Current Transmission (volume I)', John Wiley & Sons
3. K.R.Padiyar,"HVDC Power Transmission Systems – Technology & System Interaction", 2005.
4. Arindam Ghosh, "Enchancing Power Quality using custom power devices"
4. Prabha Kundur, "Power system stability and control" McGraw Hill.

Course Content:

Unit I:Introduction	**7 Hours**
Steady state and dynamic problems in AC systems- Theory of Load compensation- Power factor correction- Voltage regulation and Phase balancing. Theory of Reactive Power Control in Transmission systems.	
Unit II: Facts Devices	**9 Hours**
Introduction to Flexible AC transmission systems (FACTS):Principles of series and shunt compensation. Description of static var compensators (SVC), Thyristor Controlled series compensators (TCSC), Static phase shifters (SPS), Static condenser (STATCON), Static synchronous series compensator (SSSC) and Unified power flow controller (UPFC). Modeling and Analysis of FACTS controllers: Control strategies to improve system stability. Active & Passive Filters.	

Unit III: Power Quality improvement using custom power devices **8 Hours**
Modeling of harmonics creating loads, harmonic propagation, harmonic power flow, Mitigation of harmonics through filters. Mitigation of power quality problems using power electronic conditioners. IEEE standards.
Unit IV:HVDC Transmission **8 Hours**
Comparison AC and DC Transmission, Introduction to HVDC Transmission systems, HVDC Systems Control, HVDC systems in India
Unit V: Static Excitation Systems8 Hours
Different types of Solid State excitation systems, their effects on Power System stability.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100