



(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: 2019 – 2023

## 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
		<b>Total</b>	<b>11</b>	<b>1</b>	<b>14</b>	<b>19</b>			
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
		<b>Total</b>	<b>11</b>	<b>0</b>	<b>24</b>	<b>23</b>			

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
		<b>Total</b>	<b>18</b>	<b>0</b>	<b>8</b>	<b>22</b>			
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.	BTEE9009	Disruptive Technologies	0	0	2	1	50	-	50
6.	BECE2012	Electromagnetic Field Theory	3	0	0	3	20	30	50
7.	BEEE6003	Renewable Energy	3	0	0	3	20	30	50
8.	SLBT2002	English Proficiency and Aptitude Building – 3	0	0	4	2	50	-	50
9	BEEE3011	Fundamental of power system	3	0	0	3	20	30	50
10	BECE9005	Machine Learning by Python Programming	0	0	2	1	50	-	50
		<b>Total</b>	<b>15</b>	<b>0</b>	<b>12</b>	<b>21</b>			
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	0	0	4	2	50	-	50

		Aptitude Building – 4							
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.	BEEE2019	Electrical Engineering Materials	3	0	0	3	20	30	50
		<b>Total</b>	<b>15</b>	<b>0</b>	<b>14</b>	<b>22</b>			

### 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
		<b>Total</b>	<b>15</b>	<b>0</b>	<b>10</b>	<b>20</b>			

### 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
		<b>Total</b>	<b>18</b>	<b>0</b>	<b>12</b>	<b>24</b>			

### Semester VIII

Sl No	Course	Name of the Course					Assessment Pattern		
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	<b>Code</b>		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>	<b>IA</b>	<b>MTE</b>	<b>ETE</b>
1	BEEE9999	Capstone Design – 2	0	0	18	9	50	-	50
		<b>Total</b>	<b>0</b>	<b>0</b>	<b>18</b>	<b>9</b>			

### List of Electives

#### Basket-1

<b>Sl No</b>	<b>Course Code</b>	<b>Name of the Electives</b>					<b>Assessment Pattern</b>		
			<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>	<b>IA</b>	<b>MTE</b>	<b>ETE</b>
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

<b>Sl No</b>	<b>Course Code</b>	<b>Name of the Elective</b>					<b>Assessment Pattern</b>		
			<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>	<b>IA</b>	<b>MTE</b>	<b>ETE</b>
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**

<b>Name of The Course</b>	<b>Basic Electrical and Electronics Engineering</b>			
<b>Course Code</b>	<b>BEEE1002</b>			
<b>Prerequisite</b>	Physics			
<b>Corequisite</b>				
<b>Antirequisite</b>				
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	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:

<b>CO1</b>	Solve complex electrical network by using basic theorems.
<b>CO2</b>	Sketch phasor diagram of different AC circuits.
<b>CO3</b>	Understand transient DC analysis of different networks.
<b>CO4</b>	Reduce complexity of digital circuit by using Boolean algebra.
<b>CO5</b>	Understand construction, working, operating principle of different electrical machines Understand 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”, 3<sup>rd</sup> Edition, Tata McGraw Hill, 2008.
4. Morris Mano, “Digital Computer Design”, PHI, 2003

### Course Content:

<b>UNIT I Elementary Circuit Analysis</b>	<b>9 Hours</b>
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.	
<b>UNIT II Analysis of DC and AC Circuits</b>	<b>9 Hours</b>
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.	

<b>UNIT III Digital Systems</b>	<b>9 Hours</b>
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	
<b>UNIT IV Semiconductor Devices</b>	<b>8 Hours</b>
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.	
<b>UNIT V Electro mechanics</b>	<b>10 Hours</b>
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



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

### Course Outcomes

<b>CO1</b>	Understand the knowledge of elements and Identification of electric tools for the physical operation.
<b>CO2</b>	To apply the knowledge of Magnetic circuits Concepts and Basic laws and rules.
<b>CO3</b>	To develop the knowledge for utilize of the instrument measuring the ac/dc voltage, current and power.
<b>CO4</b>	To construct the connection of the electrical wiring and domestic equipments
<b>CO5</b>	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:

<b>Unit-1</b>	<b>5 hours</b>
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	
<b>Unit-2</b>	<b>9 Hours</b>
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.	
<b>Unit-3</b>	<b>8 Hours</b>
Types of instruments, Construction and working principles of PMMC and moving iron type voltmeters & ammeters, Single phase dynamometer wattmeter, Different methods of power measurement.	
<b>Unit-4</b>	<b>7 Hours</b>
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.	
<b>Unit-5</b>	<b>8 Hours</b>
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**

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

<b>Name of The Course</b>	Electrical Measurements and Instrumentation			
<b>Course Code</b>	BECE2001			
<b>Prerequisite</b>	Basic Electrical and Electronics Engineering			
<b>Corequisite</b>	EMFT			
<b>Antirequisite</b>				
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	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

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

### 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:

<b>Unit-1Philosophy of Measurement &amp; Analog Measurement of Electrical Quantities</b> <b>9 hours</b>	
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, Electrodynamical Wattmeter, errors and remedies, Three Phase Wattmeter, Power in three phase system, Energy meter.	
<b>Unit-2Measurement: Instrument Transformer</b> <b>hours</b>	<b>6</b>
Instrument Transformer and their applications in the extension of instrument range, Introduction to	

measurement of speed, frequency and power factor.
<b>Unit-3 Measurement of Parameters</b> <span style="float: right;"><b>10 hours</b></span>
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.
<b>Unit-4 AC Potentiometer &amp; Magnetic Measurement</b> <span style="float: right;"><b>8 hours</b></span>
Polar type & Co-ordinate type AC potentiometers, application of AC Potentiometers in electrical measurement. Ballistic Galvanometer, Flux meter.
<b>Unit-5 Digital Measurement of Electrical Quantities &amp; Cathode Ray Oscilloscope</b> <span style="float: right;"><b>7 hours</b></span>
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

<b>Name of The Course</b>	Network Analysis and Synthesis			
<b>Course Code</b>	BECE2002			
<b>Prerequisite</b>	Basic Electrical and Electronics Engineering			
<b>Corequisite</b>	Signals and systems			
<b>Antirequisite</b>				
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	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

<b>CO1</b>	Apply the knowledge of graph theory with basic circuital laws and simplify the network using reduction techniques
<b>CO2</b>	Analyze the circuit using Kirchoff's law and Network simplification theorems
<b>CO3</b>	Infer and evaluate transient response, Steady state response, network functions
<b>CO4</b>	Evaluate two-port network parameters and explain the inter-relationship among parameters for network analysis.
<b>CO5</b>	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).

### Course Content:

<b>Unit-1Graph Theory</b>	<b>6 hours</b>
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.	
<b>Unit-2Network Theorems (Applications to ac networks)</b>	<b>9 hours</b>
Super-position theorem, Thevenin's theorem, Norton's theorem, maximum power transfer theorem, Reciprocity theorem. Millman's theorem, compensation theorem, Tellegen's theorem.	
<b>Unit-3Network Functions and Transient analysis</b>	<b>11 hours</b>
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.	
<b>Unit-4Two Port Networks</b>	<b>10 hours</b>

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 &  $\Pi$  Representation.

**Unit-5 Network 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**

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

<b>Name of The Course</b>	Network Analysis and Synthesis Lab			
<b>Course Code</b>	BECE2003			
<b>Prerequisite</b>	Basic Electrical Engineering lab			
<b>Corequisite</b>				
<b>Antirequisite</b>				
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	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

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

### Network Analysis and Synthesis Lab

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

### Continuous Assessment Pattern

<b>Internal Assessment (IA)</b>	<b>Mid Term Exam (MTE)</b>	<b>End Term Exam (ETE)</b>	<b>Total Marks</b>
<b>50</b>	<b>-</b>	<b>50</b>	<b>100</b>

<b>Name of The Course</b>	Signals and Systems			
<b>Course Code</b>	BECE2016			
<b>Pre-requisite</b>	Engineering Mathematics			
<b>Co-requisite</b>				
<b>Anti-requisite</b>				
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	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:

<b>CO1</b>	Understand about various types of signals, classify them, analyze them, and perform various operations on them.
<b>CO2</b>	Understand about various types of systems, classify them, analyze them and understand their response behaviour
<b>CO3</b>	Appreciate use of transforms in analysis of signals and system.
<b>CO4</b>	Carry simulation on signals and systems for observing effects of applying various properties and operations.
<b>CO5</b>	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

### Course Content:

<b>Unit I: Introduction to Signals</b>	<b>9 Hours</b>
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)	
<b>Unit II :Introduction to Systems</b>	<b>8 Hours</b>
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.	
<b>Unit III: Fourier Transforms (FT)</b>	<b>10 Hours</b>
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.	
<b>Unit IV: Laplace-Transform (LT) and Z-transform (ZT)</b>	<b>10 Hours</b>
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**

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

<b>Name of The Course</b>	Digital Electronics			
<b>Course Code</b>	BECE2010			
<b>Prerequisite</b>	BEEE			
<b>Corequisite</b>				
<b>Antirequisite</b>				
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	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

<b>CO1</b>	Verify and analyze the input/output data of each logic gate and circuits such as adders, counters, coders, etc.,.
<b>CO2</b>	Analyze the basic operation of memory cell and its limitations in circuit designing.
<b>CO3</b>	Apply the digital circuit design concept in developing basic component of computer organization, projects or experiments.
<b>CO4</b>	Verifying and analyzing the practical digital circuits.
<b>CO5</b>	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.

<b>Unit I: Number System and Boolean Algebra</b>	<b>9 Hours</b>
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.	
<b>Unit II: Combinational Circuits</b>	<b>8 Hours</b>
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.	

<b>Unit III: Synchronous Sequential Circuits</b>	<b>9 Hours</b>
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.	
<b>Unit IV: Asynchronous Sequential Circuits</b>	<b>7 Hours</b>
Analysis of asynchronous sequential machines, state assignment, asynchronous design problem.	
<b>Unit V: PLD, Memories and Logic Families</b>	<b>7 Hours</b>
Memories: ROM, RAM, PROM, EPROM, Cache Memories, PLA, PLD, FPGA, digital logic families: TTL, ECL, CMOS.	

#### Continuous Assessment Pattern

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

<b>Name of The Course</b>	Electromagnetic Field Theory			
<b>Course Code</b>	BECE2012			
<b>Pre-requisite</b>	Engineering Mathematics			
<b>Co-requisite</b>				
<b>Anti-requisite</b>				
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	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:**

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

**Course Content:**

<b>UNIT I STATIC ELECTRIC FIELDS</b>	<b>9 Hours</b>
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	
<b>UNIT II: STATIC MAGNETIC FIELDS</b>	<b>8 Hours</b>
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.	
<b>UNIT III: ELECTRIC AND MAGNETIC FIELDS IN MATERIALS</b>	<b>9 Hours</b>

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

**UNIT 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**

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

<b>Name of The Course</b>	Electrical Machine-I			
<b>Course Code</b>	BTEE2006			
<b>Prerequisite</b>	Basic Electrical Engineering			
<b>Corequisite</b>				
<b>Antirequisite</b>				
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	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

<b>CO1</b>	Apply the knowledge of circuit analysis and electromagnetic principles of electric machines
<b>CO2</b>	Analyse the electrical machines performance.
<b>CO3</b>	Test and estimate the parameter of the electrical machine.
<b>CO4</b>	Analysis the numerical problems associated with transformer and DC machines.
<b>CO5</b>	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.

### Course Content:

<b>Unit-1 Introduction</b>	<b>8 hours</b>
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.	
<b>Unit-2 Single Phase Transformer</b>	
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.	
<b>Unit-3 Three Phase Transformers</b>	

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**

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

<b>Name of The Course</b>	Electrical Machine-I lab			
<b>Course Code</b>	BTEE2007			
<b>Prerequisite</b>	Basic Electrical Engineering lab			
<b>Corequisite</b>				
<b>Antirequisite</b>				
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	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

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

### List of Experiments of Electrical Machine –I

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

### Continuous Assessment Pattern

<b>Internal Assessment (IA)</b>	<b>Mid Term Exam (MTE)</b>	<b>End Term Exam (ETE)</b>	<b>Total Marks</b>
<b>50</b>	<b>-</b>	<b>50</b>	<b>100</b>



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

**Course Objectives:**

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

**Course Outcomes**

<b>CO1</b>	<b>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.</b> (Understanding-KL-2)
<b>CO2</b>	<b>Outline the principle of operation and analyse the model's solar energy and Wind energy conversion systems.</b> (Understanding-KL-2)
<b>CO3</b>	<b>Model the solar and wind energy system for standalone and grid integration system.</b> (Apply-KL-3)
<b>CO4</b>	<b>Demonstrate the principle of operation of other renewable energy sources(ocean thermal, geo-thermal and micro hydro power) also importance of its role.</b> (Understanding-KL-2)
<b>CO5</b>	<b>Understand the importance of energy storage and develop the model for energy storage configurations.</b> (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:**

<b>Unit-1Energy Scenario</b>	<b>6 hours</b>
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.	
<b>Unit-2Solar Energy</b>	<b>9 hours</b>
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.	

<b>Unit-3 Wind Energy</b>	<b>10 hours</b>
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.	
<b>Unit-4 Other energy sources</b>	<b>8 hours</b>
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.	
<b>Unit-5 Energy storage and hybrid system configurations</b>	<b>7 hours</b>
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

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

<b>Name of The Course</b>	<b>Fundamental of Power systems</b>			
<b>Course Code</b>	BEEE3011			
<b>Prerequisite</b>	Basic Electrical			
<b>Corequisite</b>				
<b>Antirequisite</b>				
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	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

<b>CO1</b>	Exposure to the modeling of individual power system components like transmission lines and generators
<b>CO2</b>	To analyze the overhead transmission line
<b>CO3</b>	To analyze the corona and interference
<b>CO4</b>	To analyze the mechanical design
<b>CO5</b>	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:

<b>Unit-1 Power System Components</b>	<b>6 hours</b>
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	
<b>Unit-2: Over Head Transmission Lines</b>	<b>6 hours</b>
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	
<b>Unit 3 Corona and Interference</b>	<b>9 hours</b>

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-4 Mechanical 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 triangle

**Unit-5 Neutral 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

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

### Course Objectives:

1. To understand and develop the Mathematical Modeling of 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

<b>CO1</b>	Understand mathematics modeling of control systems and solve it using transfer function, block diagram and signal flow diagram reduction techniques.
<b>CO2</b>	Design and analyze control system engineering problems in time response of first and second order systems.
<b>CO3</b>	Analyze the concept and stability of servo systems using algebraic stability criteria with necessary conditions.
<b>CO4</b>	Understand and analyze the stability analysis using the polar, inverse polar, Bode, and Nyquist stability criterion of control systems
<b>CO5</b>	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 India Ltd, 2008.
2. D.Roy Choudhary, "Modern Control Engineering", Prentice Hall of India.

### Course Content:

<b>Unit-1 Introduction</b>	<b>8 hours</b>
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.	
<b>Unit-2</b>	
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.	
<b>Unit-3</b>	

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**

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

<b>Name of The Course</b>	<b>Electrical Machine-2</b>			
<b>Course Code</b>	<b>BTEE3004</b>			
<b>Prerequisite</b>	<b>Electrical Machine-1</b>			
<b>Co requisite</b>				
<b>Antirequisite</b>				
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	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

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

<b>Unit-1 Three phase Induction Machine – I</b>	<b>7 Hours</b>
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.	
<b>Unit-2 Three phase Induction Machine- II</b>	<b>8 Hours</b>
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.	
<b>Unit-3 Single phase Induction Motor</b>	<b>7 Hours</b>

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**

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



<b>Name of The Course</b>	Electrical Machine-II lab			
<b>Course Code</b>	BTEE3005			
<b>Prerequisite</b>	Electrical Machine-I and BEEE Lab			
<b>Corequisite</b>				
<b>Antirequisite</b>				
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	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

<b>CO1</b>	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.
<b>CO2</b>	Analysis the AC machines performance through experiments
<b>CO3</b>	Estimate the parameter of the Induction machines and Synchronous machines
<b>CO4</b>	Test Induction and Synchronous machines with various loads
<b>CO5</b>	Make use of application of the subject topic with industries and day to day life

### List of Experiments of Electrical Machine –II

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

### Continuous Assessment Pattern

<b>Internal Assessment (IA)</b>	<b>Mid Term Exam (MTE)</b>	<b>End Term Exam (ETE)</b>	<b>Total Marks</b>
<b>50</b>	<b>-</b>	<b>50</b>	<b>100</b>

<b>Name of The Course</b>	Analog Electronics Circuit			
<b>Course Code</b>	BEEE3021			
<b>Prerequisite</b>	Basic Electronics			
<b>Co requisite</b>				
<b>Antirequisite</b>				
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	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

<b>CO1</b>	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
<b>CO2</b>	Observe the amplitude and frequency responses of common amplification circuits and utilize the data for designing.	K2 & K4
<b>CO3</b>	Design, construct, and take measurement of various analog circuits to compare	K2 & K3
<b>CO4</b>	Design, construct, and take measurement of various analog circuits to compare	K4
<b>CO5</b>	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, 3<sup>rd</sup> 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, 10<sup>th</sup> Edition Prentice Hall, 2009, ISBN 0135026490, 9780135026496

**Course Content:**

<b>Unit I: BJT at low and high frequencies</b>	<b>12 Hours</b>
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 – $\pi$ common emitter transistor model – hybrid $\pi$ conductance and capacitance – CE short circuit current gain – current gain with resistive load – gain bandwidth product – Study of the effect of un bypassed emitter resistor on amplifier performance, cascode amplifier. HF & LF compensation of RC coupled amplifier.	
<b>Unit II: FET amplifiers and Power Amplifiers</b>	<b>8 Hours</b>
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.	
<b>Unit III: Feedback Amplifiers</b>	<b>6 Hours</b>
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.	
<b>Unit IV: Oscillators</b>	<b>8 Hours</b>
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.	
<b>Unit V: Tuned Amplifiers</b>	<b>6 Hours</b>
Characteristics of Tuned amplifiers – Analysis of Single tuned, Doubled tuned and stagger tuned amplifiers, Gain – bandwidth product – High frequency effect – neutralization.	

**Continuous Assessment Pattern**

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

<b>Name of The Course</b>	Analog Electronics Circuit Lab			
<b>Course Code</b>	BEEE3022			
<b>Prerequisite</b>	Semiconductor Devices and Circuits			
<b>Corequisite</b>				
<b>Antirequisite</b>				
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	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

<b>CO1</b>	Design, construct, and take measurement of various analog circuits to compare
<b>CO2</b>	Experimental results in the laboratory with theoretical analysis.
<b>CO3</b>	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..
<b>CO4</b>	Observe the amplitude and frequency responses of common amplification circuits and utilize the data for designing.
<b>CO5</b>	Design, construct, and take measurement of various analog circuits to compare

### List of Experiments of Analog Electronics Circuit Lab

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

### Continuous Assessment Pattern

<b>Internal Assessment (IA)</b>	<b>Mid Term Exam (MTE)</b>	<b>End Term Exam (ETE)</b>	<b>Total Marks</b>
<b>50</b>	<b>-</b>	<b>50</b>	<b>100</b>

<b>Name of The Course</b>	<b>Electronics Devices and Circuits</b>			
<b>Course Code</b>	BECE2015			
<b>Prerequisite</b>				
<b>Corequisite</b>				
<b>Antirequisite</b>				
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	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

<b>CO1</b>	Identify different electronic devices, apply subject knowledge and solve electronic device problems.
<b>CO2</b>	Design a device/equipment such as amplifier, power supply and SMPS for the given parameters.
<b>CO3</b>	Apply BJT and FET fundamentals for transistors related analysis.
<b>CO4</b>	Apply fundamentals of semiconductor devices in electronics projects in circuit design, evaluation and analysis.
<b>CO5</b>	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', 2<sup>nd</sup> 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.Theodore F. Boghert, 'Electronic Devices & Circuits',6th Edition, Pearson Education 2004 ISBN 8177588877, 9788177588873.
2. Ben G. Streetman and Sanjay Banerjee, 'Solid State Electronic Devices', 6<sup>th</sup> Edition, PHI 2009, ISBN 0132454793, 9780132454797

### Course Content:

<b>Unit I:PN Diodes and Rectifiers</b>	<b>11 Hours</b>
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, $\pi$ &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.	
<b>Unit II: Bipolar Junction Transistors</b>	<b>9 Hours</b>
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**

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

<b>Name of The Course</b>	<b>Power System Analysis</b>			
<b>Course Code</b>	BTEE3009			
<b>Prerequisite</b>	Fundamental of power system			
<b>Corequisite</b>				
<b>Antirequisite</b>				
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	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

<b>CO1</b>	Exposure to the modeling of individual power system components like transmission lines and generators
<b>CO2</b>	To analyze the unsymmetrical faults
<b>CO3</b>	Enable the students to do load flow and short circuit calculations
<b>CO4</b>	To analyze the power system stability
<b>CO5</b>	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:

<p><b>Unit-1 Representation of Power System Components</b> <span style="float: right;"><b>9 hours</b></span></p> <p>Synchronous machines, Transformers, Transmission lines, One line diagram, Impedance and reactance diagram, per unit System. <i>Symmetrical components</i>: Symmetrical Components of unbalanced phasors, power in terms of symmetrical components, sequence impedances and sequence networks.</p> <p><i>Symmetrical fault analysis</i>, 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.</p>
<p><b>Unit-2: Unsymmetrical faults</b> <span style="float: right;"><b>6 hours</b></span></p> <p>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.</p>
<p><b>Unit-3Load Flow Analysis</b> <span style="float: right;"><b>9 hours</b></span></p> <p>Introduction, bus classifications, nodal admittance matrix ( <i>bus y</i> ), development of load flow</p>

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-4 Power 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-5 Traveling 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**

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



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

### Course Objectives:

### Course Outcomes

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

### Course Content:

<b>Unit I:Operational Amplifiers</b>	<b>9 Hours</b>
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.	
<b>Unit II: Applications of Operational Amplifiers</b>	<b>8 Hours</b>
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, Componder 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**

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

<b>Name of The Course</b>	Operation and Control in Power System			
<b>Course Code</b>	BEEE5005			
<b>Pre-requisite</b>	Power system			
<b>Co-requisite</b>				
<b>Anti-requisite</b>				
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	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**

<b>CO1</b>	construct mathematical models for computing the steady state performance, and basic unbalanced performance of power systems
<b>CO2</b>	Overcome upon the challenges associated with generation and measurement of high voltages and currents apply different methods,
<b>CO3</b>	Use the concepts of load flows for power system network solutions Understand the significance high voltage engineering and its implementation in power system.
<b>CO4</b>	To compute, analyze, and reflect on the performance of a power system under steady state and transient conditions.
<b>CO5</b>	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.
2. L.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:**

<b>Unit I: Introduction</b>	<b>7 Hours</b>
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	
<b>Unit II: Real Power - Frequency Control</b>	<b>8 Hours</b>
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	
<b>Unit III: Reactive Power – Voltage Control</b>	<b>8 Hours</b>
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	

<b>Unit IV: Economic Load Dispatch</b>	<b>7 Hours</b>
Economic dispatch problem – cost of generation, incremental cost curve, co-ordination equations, solution by direct method and $\lambda$ - 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)..	
<b>Unit V: Computer control of power systems</b>	<b>7 Hours</b>
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**

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

<b>Name of The Course</b>	<b>Electric Drives</b>			
<b>Course Code</b>	BEEE4001			
<b>Prerequisite</b>	Power Electronics			
<b>Corequisite</b>				
<b>Antirequisite</b>				
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	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

<b>CO1</b>	Demonstrate the basic of drive system and different types of loads.
<b>CO2</b>	Understand the motor dynamics and the rating of motor for different condition of load.
<b>CO3</b>	Analyse the types of braking and select appropriate braking to the working environment.
<b>CO4</b>	Analyse power circuit topology and control mechanism to control the speed of DC motor.
<b>CO5</b>	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:

<b>Unit-1 Fundamentals of Electric Drive</b>	<b>8 hours</b>
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.	
<b>Unit-2 Dynamics of Electric Drive</b>	<b>8 hours</b>
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	
<b>Unit-3 Electric Braking</b>	<b>8 hours</b>
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.	
<b>Unit-4 Power Electronic Control of DC Drives</b>	<b>8 hours</b>
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-5 Power 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**

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

<b>Name of The Course</b>	<b>POWER SYSTEM PROTECTION &amp; SWITCHGEAR</b>			
<b>Course Code</b>	BTEE4003			
<b>Prerequisite</b>	Fundamental of power system			
<b>Corequisite</b>				
<b>Antirequisite</b>				
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	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

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

<b>Unit I: Introduction to Protection System</b>	<b>8 Hours</b>
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.	

<p><b>Unit II: Relay Application and Characteristics</b> <span style="float: right;"><b>7 Hours</b></span>  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.</p>
<p><b>Unit III: Protection of Transmission Line</b> <span style="float: right;"><b>8 Hours</b></span>  Over current protection, distance protection, pilot wire protection, carrier current protection, protection of bus, auto re-closing.</p>
<p><b>Unit IV: Circuit Breaking</b> <span style="float: right;"><b>7 Hours</b></span>  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.</p>
<p><b>Unit V: Apparatus Protection</b> <span style="float: right;"><b>10 Hours</b></span>  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.</p>

**Continuous Assessment Pattern**

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



<b>Name of The Course</b>	Analog and Digital Communication			
<b>Course Code</b>	BEEE4003			
<b>Prerequisite</b>	signal and systems			
<b>Corequisite</b>				
<b>Antirequisite</b>	None			
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	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

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

<b>Unit-1 Basics of Communication Theory</b>	<b>6 hours</b>
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	
<b>Unit-2 Amplitude Modulation</b>	<b>9 hours</b>
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.	
<b>Unit-3 Angle Modulation</b>	<b>8 hours</b>
Phase modulation (PM) and Frequency modulation (FM), narrow and wideband FM, Generation & demodulation, Pulse Modulation – PAM, PPM, PWM.	

<b>Unit-4 Baseband Modulation</b>	<b>7 hours</b>
Digital communication system- block diagram-Base – band transmission – binary Signalling schemes- PCM, DPCM, DM, ADM – Modulation and demodulation.	
<b>Unit-5 Digital Modulation Strategies</b>	<b>8 hours</b>
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

<b>Name of The Course</b>	Power Electronics			
<b>Course Code</b>	BEEE4011			
<b>Prerequisite</b>	Network analysis			
<b>Corequisite</b>				
<b>Antirequisite</b>	None			
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	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

<b>CO1</b>	Differentiate between power semiconductor devices and small signal
<b>CO2</b>	semiconductor devices.
<b>CO3</b>	Understand the operation of switching power devices e.g Thyristors and Transistors
<b>CO4</b>	and TRIAC.
<b>CO5</b>	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. Jamil Asghar, "Power Electronics" Prentice Hall of India Ltd., 2004.
2. Chakrabarti & Rai, "Fundamentals of Power Electronics & Drives" Dhanpat Rai & Sons.

### Course Content:

<b>Unit I: Power semiconductor Devices</b>	<b>9 Hours</b>
<i>Power semiconductor devices their symbols and static characteristics:</i> characteristics 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	
<b>Unit II: DC-DC Converters</b>	<b>8 Hours</b>
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.	
<b>Unit III: Phase Controlled Converters</b>	<b>7 Hours</b>
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.	

<b>Unit IV:AC Voltage Controllers</b>	<b>8 Hours</b>
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),	
<b>Unit V: Inverters</b>	<b>7</b>
<b>Hours</b>	
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

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

**Course Objectives:**

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

**Course Outcomes**

<b>CO1</b>	Understand the background for Smart Grid and have knowledge about important terminology(K1,K2)
<b>CO2</b>	Know about challenges and possibilities related to smart metersK3
<b>CO3</b>	Analyze the types of Wide Area Measurement System(WAMS).K4
<b>CO4</b>	Understand the Site surveys and Energy systems surveyK3
<b>CO5</b>	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:**

<b>Unit I</b>	<b>7 Hours</b>
<b>Introduction to Smart Grid:</b> 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.	
<b>Unit II</b>	
<b>Smart Grid and Smart Meters:</b> Introduction to Smart Meters, Real Time Pricing, Smart Appliances, Automatic Meter Reading(AMR), Outage Management System(OMS), Plug in Hybrid Electric Vehicles(PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation, Phase Shifting Transformers.	
<b>Unit III</b>	
<b>Wide Area Measurement System(WAMS):</b> 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).	
<b>Unit IV</b>	
<b>Principles of Energy Management and Energy Audit:</b> General principles, Planning and program, Introduction to energy audit, General methodology, Site surveys, Energy systems survey, Energy audit, Instrumentation, Analysis of data and results.	
<b>Unit V</b>	

**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**

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

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

### Course Objectives:

1. Apply the knowledge of mathematics, science, engineering fundamentals, 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

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

### Reference Book (s)

1. Research papers from reputed journals.

### Continuous Assessment Pattern

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

<b>Name of The Course</b>	Neural Networks and Fuzzy Control			
<b>Course Code</b>	BECE3202			
<b>Pre-requisite</b>	Control Systems			
<b>Co-requisite</b>				
<b>Anti-requisite</b>				
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	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:

<b>CO1</b>	Identify and describe Fuzzy Logic and Artificial Neural Network techniques in building intelligent machines.
<b>CO2</b>	Apply Artificial Neural Network & Fuzzy Logic models to handle uncertainty and solve engineering problems.
<b>CO3</b>	Understanding of fuzzy relation rule and aggregations
<b>CO4</b>	Understand concept of classical and fuzzy sets, fuzzification and defuzzification
<b>CO5</b>	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, YediyahLangsam 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:

<b>Unit-1 Introduction to Artificial Neural Network</b>	<b>9 hours</b>
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.	



<b>Unit-2 Feed-forward and Recurrent Neural Networks</b>	<b>12 Hours</b>
"Architecture: perceptron model, solution, single layer artificial neural network, multilayer perceptron model; back propagation 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."	
<b>Unit-3 Fuzzy Logic &amp; Fuzzy Sets</b>	<b>9 Hours</b>
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.	
<b>Unit-4 Fuzzy Relations &amp; Aggregations</b>	<b>9 Hours</b>
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	
<b>Unit-5 Fuzzy Optimization and Neuro Fuzzy Systems</b>	<b>6 Hours</b>
Fuzzy optimization –one-dimensional optimization. Introduction of Neuro-Fuzzy Systems, Architecture of Neuro Fuzzy Networks.	

#### Continuous Assessment Pattern

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

<b>Name of The Course</b>	VLSI Design			
<b>Course Code</b>	BECE3013			
<b>Pre-requisite</b>	Semiconductor Devices, Integrated Circuits, Digital Design			
<b>Co-requisite</b>				
<b>Anti-requisite</b>				
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	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

<b>CO1</b>	Utilize the subject knowledge in specifying the technological problems for evolving cellular technology.
<b>CO2</b>	Be able to use mathematical methods and circuit analysis models in analysis of CMOS digital electronics circuits, including logic components and their interconnect.
<b>CO3</b>	Have an understanding of the characteristics of CMOS circuit construction and the comparison between different state-of-the-art CMOS technologies and processes.
<b>CO4</b>	Be able to design and solve complex problems.
<b>CO5</b>	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. Eshraghian, "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:

<b>Unit-1</b> Integrated Circuit: Fabrication And Characteristics	<b>7 hours</b>
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.	
<b>Unit-2</b> Introduction to MOS Transistor	<b>8 Hours</b>

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-3** MOS 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

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

### Course Objectives:

This course is an introduction to principles, use and applications of database systems. 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

<b>CO1</b>	Understand the relational database theory, application of database system in real life.
<b>CO2</b>	Describe DBMS architecture, physical and logical database designs, database modeling, relational, hierarchical and network models.
<b>CO3</b>	Learn and apply Structured query language (SQL) for database definition and database manipulation.
<b>CO4</b>	Illustrate relational database theory, and be able to write relational algebra expressions for queries.
<b>CO5</b>	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", Addison Wesley
3. Elmasri, Navathe, "Fundamentals of Database Systems", Addison 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) "

### Course Content:

<b>Unit-1 Introduction</b>	<b>10 hours</b>
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.	
<b>Unit-2 Relational data Model and Language</b>	<b>8 Hours</b>
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.	
<b>Unit-3 Data Base Design &amp; Normalization</b>	<b>7 Hours</b>

Functional dependencies, normal forms, first, second, third normal forms, BCNF, inclusion dependence, loss less join decompositions, normalization using FD, MVD.
<b>Unit-4 Data Base Design</b> <span style="float: right;"><b>7 Hours</b></span>
Transaction system, Testing of serializability, serializability of schedules, conflict & view serializable schedule, recoverability, Recovery from transaction failures, log based recovery, checkpoints, deadlock handling.
<b>Unit-5 Concurrency Control Techniques</b> <span style="float: right;"><b>8 Hours</b></span>
Concurrency control, Locking Techniques for concurrency control, Time stamping protocols for concurrency control.

**Continuous Assessment Pattern**

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

<b>Name of The Course</b>	Computer Networks			
<b>Course Code</b>	BECE3105			
<b>Pre-requisite</b>	Digital Electronics			
<b>Co-requisite</b>				
<b>Anti-requisite</b>				
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	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

<b>CO1</b>	Have a good understanding of the OSI Reference Model and in particular have a good knowledge of Layers 1-3.
<b>CO2</b>	Analyze the requirements for a given organizational structure and select the most appropriate networking architecture and technologies;
<b>CO3</b>	have a basic knowledge of the use of cryptography and network security;
<b>CO4</b>	Specify and identify deficiencies in existing protocols, and then go onto formulate new and better protocols;
<b>CO5</b>	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”, 7<sup>th</sup> 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:

<b>Unit-1 Network and Services</b>	<b>8 hours</b>
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.	
<b>Unit-2Medium Access Control Protocol</b>	<b>8 hours</b>
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.	

<b>Unit-3 Packet Switching Networks</b>	<b>8 hours</b>
Network Services and Internal Network Operation, Packet Network Topology, Routing in packet Networks, shortest path Algorithms, and Introduction to traffic management &QoS.	
<b>Unit-4 TCP/IP Architecture</b>	<b>8 hours</b>
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.	
<b>Unit-5 Wireless Routing Protocols</b>	<b>8 hours</b>
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

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

<b>Name of The Course</b>	Soft Computing Techniques			
<b>Course Code</b>	BECE4401			
<b>Pre-requisite</b>	C++/Java/ Matlab programming			
<b>Co-requisite</b>				
<b>Anti-requisite</b>				
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	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

<b>CO1</b>	Identify and describe Soft-Computing techniques and their roles in building intelligent machines
<b>CO2</b>	Apply Soft – Computing models & reasoning to handle uncertainty and solve engineering problems.
<b>CO3</b>	Recognize the feasibility of applying a soft computing methodology for a particular problem
<b>CO4</b>	Apply genetic algorithms to optimization problems
<b>CO5</b>	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:

<b>Unit-1 Artificial Neural Networks</b>	<b>9 hours</b>
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.	
<b>Unit-2 Fuzzy Logic &amp; Fuzzy Sets</b>	<b>9 Hours</b>
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	
<b>Unit-3 Fuzzy Relations &amp; Aggregations</b>	<b>9 Hours</b>



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-4 Neuro-Fuzzy Systems**

**6 Hours**

Introduction of Neuro-Fuzzy Systems, Architecture of Neuro Fuzzy Networks. Application of Fuzzy Logic: Medicine, Economics, Industry etc.

**Unit-5 Genetic 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**

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

<b>Name of The Course</b>	Embedded System Design			
<b>Course Code</b>	BECE3019			
<b>Pre-requisite</b>	VLSI Design			
<b>Co-requisite</b>				
<b>Anti-requisite</b>				
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	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

<b>CO1</b>	To learn the basic concepts of Embedded Systems
<b>CO2</b>	Explain and work on Real time operating systems.
<b>CO3</b>	Apply the concepts of embedded system.
<b>CO4</b>	Design and program for Embedded Systems.
<b>CO5</b>	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:

<b>Unit-1</b> PIC Microcontroller	<b>7 hours</b>
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	
<b>Unit-2</b> Embedded Processors	<b>9 Hours</b>
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.	
<b>Unit-3</b> Embedded Programming	<b>10 Hours</b>
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	
<b>Unit-4</b> Embedded System design	<b>6 Hours</b>

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

<b>Name of The Course</b>	<b>Electrical Engineering Materials</b>			
<b>Course Code</b>	<b>BTEE2010</b>			
<b>Prerequisite</b>	Basic Electrical			
<b>Corequisite</b>				
<b>Antirequisite</b>				
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	3	0	0	3

### Course Objectives:

1. The course is aimed to impart a sound knowledge in engineering materials emphasizing on modern technological aspects in different fields of electrical engineering and technology.
2. It also teaches the basics of engineering material standards and convention.

### Course Outcomes

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

<b>Unit I: Crystal Structure of Materials</b>	<b>9 Hours</b>
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.	
<b>Unit II: Conductivity of Metals</b>	<b>9 Hours</b>
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.	
<b>Unit III: Semiconductor materials</b>	<b>7 Hours</b>
Properties of semiconductors, Silicon wafers, integration techniques, Large and very large scale integration techniques (VLSI).	
<b>Unit IV: Properties of magnetic material</b>	<b>9 Hours</b>
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.	
<b>Unit V: Dielectric Materials and Insulation</b>	<b>11 Hours</b>
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

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

### Course Objectives:

#### Course Outcomes

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

#### Text Book (s)

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

#### Reference Book (s)

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

#### Course Content:

<b>Unit-1</b> Basic Knowledge	<b>6 hours</b>
Elements of Satellite Communication Orbital mechanics look angle and orbit determination, launches & launch vehicle, orbital effects, Geostationary Orbit.	
<b>Unit-2</b> Sub Systems	<b>10 Hours</b>
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.	
<b>Unit-3</b> Different modulation schemes	<b>8 Hours</b>
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.	
<b>Unit-4</b> Amplifiers & Switches	<b>8 Hours</b>
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.	
<b>Unit-5</b> Power Supply	<b>8 Hours</b>
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

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

<b>Name of The Course</b>	Digital Image Processing			
<b>Course Code</b>	BECE3301			
<b>Pre-requisite</b>	Digital Signal Processing			
<b>Co-requisite</b>				
<b>Anti-requisite</b>				
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	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

<b>CO1</b>	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
<b>CO2</b>	Design and implement filters for image enhancement in spatial domain and frequency domain for real time applications and apply image restoration algorithms
<b>CO3</b>	Segment and Extract features from images for analysis and recognition
<b>CO4</b>	Perform Wavelet analysis on images
<b>CO5</b>	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

<b>Unit-1</b> Introduction to Image Processing	<b>5 hours</b>
Image formation, image geometry perspective and other transformation, stereo imaging elements of visual perception. Digital Image-sampling and quantization serial & parallel Image processing.	
<b>Unit-2</b> Signal Processing	<b>9 Hours</b>
Signal Processing - Fourier, Walsh-Hadamard 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	
<b>Unit- 3</b> Image Restoration	<b>8 Hours</b>
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.	
<b>Unit-4</b> Segmentation Techniques	<b>7 Hours</b>
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.	
<b>Unit-5</b> Shape Analysis	<b>8 Hours</b>
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**

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



<b>Name of The Course</b>	Non Conventional Energy Resources			
<b>Course Code</b>	BEEE2018			
<b>Pre-requisite</b>	Power system			
<b>Co-requisite</b>				
<b>Anti-requisite</b>				
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	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**

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

<b>Unit I:Energy Scenario</b>	<b>6 Hours</b>
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.	
<b>Unit II: Solar Energy</b>	<b>9 Hours</b>
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.	
<b>Unit III: Wind Energy</b>	<b>10 Hours</b>

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**

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

<b>Name of The Course</b>	High Voltage Engineering			
<b>Course Code</b>	BEEE2020			
<b>Pre-requisite</b>	Power system			
<b>Co-requisite</b>				
<b>Anti-requisite</b>				
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	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**

<b>CO1</b>	Understand the significance high voltage engineering and its implementation in power system.
<b>CO2</b>	Overcome upon the challenges associated with generation and measurement of high voltages and currents
<b>CO3</b>	To understand the practical limitation and hence steps for continuous improvement through research.
<b>CO4</b>	Measurement of dielectric constant and loss.
<b>CO5</b>	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. Zaengal, "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:**

<b>Unit I: Break Down In Gases</b>
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.
<b>Unit II: Generation of High Voltages and Currents</b>
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
<b>Unit III: Measurement of High Voltages and Currents</b>
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**

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

<b>Name of The Course</b>	Power Electronics Applications in Power Systems			
<b>Course Code</b>	BEEE2020			
<b>Pre-requisite</b>	Power system			
<b>Co-requisite</b>				
<b>Anti-requisite</b>				
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	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**

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

**Text Book (s)**

1. Narain Hingorani & László Gyugyi - 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, "Enhancing Power Quality using custom power devices"
4. Prabha Kundur, "Power system stability and control" McGraw Hill.

**Course Content:**

<b>Unit I: Introduction</b>	<b>7 Hours</b>
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.	
<b>Unit II: Facts Devices</b>	<b>9 Hours</b>

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**

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