COURSE STRUCTURE & SYLLABI

B. TECH. Lateral Entry

ELECTRICAL ENGINEERING (EE)

&

ELECTRICAL & ELECTRONICS ENGINEERING

(EN)

Under Choice Based Credit System (CBCS)

Program Structure (Lateral Entry EE & EN)

Sr. No.	Categorization	Credits
1.	Humanities & Social Sciences	19
2.	Basic Sciences	6
3.	Engineering Sciences	0
4.	Project Work / Seminars	17
5.	Program Core	48
6.	Program Electives	26
7.	Open Electives	16
8.	Non Graded Mandatory Courses	8(2 credits in each sem.)
	Total Credits	**134/142(Including MNC)**

Project Work / Seminars	Mini Project	4 = (1+3)
	Industrial Training	2
	Minor Project	3
	Major Project	8

Program Core (EE)

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR /WK	PRE/Co-REQUISITES
			L	T	P	J			
THEORY									
1.	BEEC0003	Engineering Circuit Analysis & Synthesis	3	0	0	0	3	3	-
2.	BEEC0004	Electrical Measurement & Measuring Instruments	3	0	0	0	3	3	-
3.	BEEC0005	Field Theory & Applications	3	0	0	0	3	3	-
4.	BEEC0006	Basic System Analysis	3	0	0	0	3	3	-
5.	BEEC0007	Analog Integrated Circuit	3	0	0	0	3	3	-
6.	BEEC0008	Digital Electronics & Circuits	3	0	0	0	3	3	-
7.	BEEC0009	Electrical Machines – I	3	0	0	0	3	3	
8.	BEEC0010	Electrical Machines – II	3	0	0	0	3	3	
9.	BEEC0011	Control System	3	0	0	0	3	3	
10.	BEEC0012	Elements Of Power System	3	0	0	0	3	3	
11.	BEEC0013	Power System Analysis	3	0	0	0	3	3	
12.	BEEC0014	Power Electronics	3	0	0	0	3	3	
13.	BEEC0015	Microprocessor & Its Applications	3	0	0	0	3	3	
PRACTICAL									
14.	BEEC0803	Network Lab	0	0	2	0	1	2	BEEC0003
15.	BEEC0804	Electrical Measurement Lab	0	0	2	0	1	2	BEEC0004
16.	BEEC0805	Analog & Digital Electronics Lab	0	0	2	0	1	2	BEEC0008
17.	BEEC0806	Electrical Machines Lab – I	0	0	2	0	1	2	BEEC0009
18.	BEEC0807	Electrical Machines Lab – II	0	0	2	0	1	2	BEEC0010
19.	BEEC0808	Control System Lab	0	0	2	0	1	2	BEEC0011
20.	BEEC0809	Power System Lab	0	0	2	0	1	2	BEEC0013
21.	BEEC0810	Power Electronics Lab	0	0	2	0	1	2	BEEC0014
22.	BEEC0811	Microprocessor Lab	0	0	2	0	1	2	BEEC0015
		Total	**39**	**0**	**18**	**0**	**48**	**57**	

Program Core (EN)

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR /WK	PRE/Co-REQUISITES
			L	T	P	J			
THEORY									
1.	BEEC0003	Engineering Circuit Analysis & Synthesis	3	0	0	0	3	3	-
2.	BEEC0004	Electrical Measurement & Measuring Instruments	3	0	0	0	3	3	-
3.	BEEC0005	Field Theory & Applications	3	0	0	0	3	3	-
4.		**Signals & Systems**	3	0	0	0	3	3	-
5.	BEEC0007	Analog Integrated Circuit	3	0	0	0	3	3	-
6.	BEEC0008	Digital Electronics & Circuits	3	0	0	0	3	3	-
7.	BEEC0009	Electrical Machines – I	3	0	0	0	3	3	
8.	BEEC0010	Electrical Machines – II	3	0	0	0	3	3	
9.	BEEC0011	Control System	3	0	0	0	3	3	
10.		**Power System Transmission & Distribution**	3	0	0	0	3	3	
11.		**Power System Analysis & Protection**	3	0	0	0	3	3	
12.	BEEC0014	Power Electronics	3	0	0	0	3	3	
13.	BEEC0015	Microprocessor & Its Applications	3	0	0	0	3	3	
PRACTICAL									
14.	BEEC0803	Network Lab	0	0	2	0	1	2	BEEC0003
15.	BEEC0804	Electrical Measurement Lab	0	0	2	0	1	2	BEEC0004
16.	BEEC0805	Analog & Digital Electronics Lab	0	0	2	0	1	2	BEEC0008
17.	BEEC0806	Electrical Machines Lab – I	0	0	2	0	1	2	BEEC0009
18.	BEEC0807	Electrical Machines Lab – II	0	0	2	0	1	2	BEEC0010
19.	BEEC0808	Control System Lab	0	0	2	0	1	2	BEEC0011
20.		**Power Systems & Protection Lab**	0	0	2	0	1	2	BEEC0013
21.	BEEC0810	Power Electronics Lab	0	0	2	0	1	2	BEEC0014
22.	BEEC0811	Microprocessor Lab	0	0	2	0	1	2	BEEC0015
		Total	**39**	**0**	**18**	**0**	**48**	**57**	

Program Elective

S. NO.		CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR /WK	PRE/CO-REQUISITES
				L	T	P	J			
Bouquet - Power System										
Theory										
1.	5th, 6th	BEEE0030	Electrical Power Generation	3	0	0	0	3	3	-
2.		BEEE0033	Power Station Practice	3	0	0	0	3	3	-
3.	7th	BEEE0035	Switch Gear & Protection	3	0	0	0	3	3	-
4.		BEEE0036	Intelligent Techniques In Electrical Engineering	3	0	0	0	3	3	-
5.		BEEE0037	Computer Methods in Power Systems	3	1	0	0	4	4	
6.		BEEE0039	Distributed Generation & Micro Grid	3	1	0	0	4	4	
7.	8th	BEEE0031	High Voltage Engineering	3	0	0	0	3	3	
8.		BEEE0032	Smart Grid	3	0	0	0	3	3	
9.		BEEE0038	Optimization Techniques In Power System	3	1	0	0	4	4	
10.		BEEE0034	Power System Operation & Control	3	1	0	0	4	4	
11.		BEEE0040	FACTS & HVDC	3	0	0	0	3	3	
Practical										
12.		BEEE0850	Switch Gear & Protection Lab	0	0	2	0	1	2	BEEE0035
13.		BEEE0851	Intelligent Techniques In Electrical Engineering Lab	0	0	2	0	1	2	BEEE 0036
14.		BEEE0852	Computer Methods in Power Systems Lab	0	0	2	0	1	2	BEEE0037
15.		BEEE0853	Optimization Techniques In Power System Lab	0	0	2	0	1	2	BEEE0039
16.		BEEE0854	FACTS & HVDC Lab	0	0	2	0	1	2	
Projects										
17.		BEEJ0956	FACTS& HVDC Project	0	0	0	8	2	8	BEEE0035
18.		BEEJ057	Distributed Generation & Micro Grid Project	0	0	0	8	2	8	BEEE0037

Program Elective

S. NO.		CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR /WK	PRE/CO-REQUISITES
				L	T	P	J			
Bouquet – Instrumentation & Control										
Theory										
1.		BEEE0050	Sensors& Transducers	3	0	0	0	3	3	
2.		BEEE0056	PLC & SCADA	3	0	0	0	3	3	
3.	7th	BEEE0052	Advance Control System	3	0	0	0	3	3	CS
4.		BEEE0053	Biomedical Instrumentation	3	0	0	0	3	3	
5.	8th	BEEE0054	Process Control & Advanced Instrumentation	3	0	0	0	4	5	EMMI & CS
6.		BEEE0055	Digital Control System	3	1	0	0	4	4	
7.		BEEE0051	Optimal Control System	3	0	0	0	3	3	CS
8.		BEEE0057	Neural Network & Fuzzy Control	3	0	0	0	3	3	
Practical										
9.		BEEE0860	Process Control & Advanced Instrumentation Lab	0	0	2	0	1	2	BEEE0054
10.		BEEE0861	PLC& SCADA Lab	0	0	2	0	1	2	BEEE0056
11.		BEEE0862	Neural Network & Fuzzy Control Lab	0	0	2	0	1	2	BEEE0057
Project										
12.		BEEJ0961	PLC & SCADA Project	0	0	0	4	1	4	BEEE0056
13.		BEEJ0962	Neural Network & Fuzzy Control Projects	0	0	0	8	2	8	BEEE0862

Program Elective

S. NO.		CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR /WK	PRE/CO-REQUISITES
				L	T	P	J			
Bouquet – Machine & Drives										
Theory										
1.		BEEE0070	Electrical Engineering Materials	3	0	0	0	3	3	
2.		BEEE0072	Electric Drives	3	0	0	0	3	3	
3.	7th	BEEE0071	Special electric Machines	3	0	0	0	3	3	
4.		BEEE0074	Computer Aided Electric Machine Design	3	0	0	0	3	3	
5.		BEEE0077	Power Electronics Circuit Modeling & Simulation	3	0	0	0	3	3	
6.	8th	BEEE0076	Electric Vehicles	3	1	0	0	4	4	
7.		BEEE0073	Advanced Power Electronics	3	1	0	0	4	4	
8.		BEEE0075	Industrial Drives & Automation	3	0	0	4	4	7	
Practical										
9.		BEEE0870	Electric Drives Lab	0	0	2	0	1	2	BEEE0072
10.		BEEE0871	Computer Aided Electric Machine Design Lab	0	0	2	0	1	2	BEEE0074
11.		BEEE0872	Power Electronics Circuit Modeling & Simulation Lab	0	0	2	0	1	2	BEEE0077
Projects										
12.		BEEJ0966	Electric Vehicles Project	0	0	0	8	2	8	
13.		BEEJ0967	Power Electronics Circuit Modeling & Simulation Project	0	0	0	8	2	8	

Program Elective

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE/CO-REQUISITES
			L	T	P	J			
Bouquet – Energy Systems									
Theory									
1.	BEEE0090	Introduction to Renewable Energy Technologies	3	0	0	0	3	3	
2.	BEEE0099	Design & Installation of Solar PV System	3	1	0	0	4	4	
3.	BEEE0095	Solar Energy Systems	3	0	0	0	3	3	
4.	BEEE0094	Wind Energy Conversion System	3	0	0	0	3	3	
5.	BEEE0091	Power Generation & Systems Planning	3	0	0	0	3	3	
6.	BEEE0092	Fluid Mechanics	3	0	0	0	3	3	
7.	BEEE0093	Batteries & Fuel Cells	3	0	0	0	3	3	
8.	BEEE0096	Energy Management	3	1	0	0	4	4	
9.	BEEE0097	Energy Audit & Energy Regulation	3	1	0	0	4	4	
10.	BEEE0098	Energy Systems Modeling & Analysis	3	1	0	4	5	8	
11.	BEEE0099	Design & Installation of Solar Photo-voltaic System	3	0	0	0	3	3	
Practical									
12.	BEEE0880	Wind Energy Conversion System Lab	0	0	2	0	1	2	BEEE0094
13.	BEEE0881	Solar Energy Systems Lab	0	0	2	0	1	2	BEEE0095
14.	BEEE 0882	Design & Installation of Solar PV System Lab	0	0	2	0	1	2	BEEE 0099
Projects									
15.	BEEJ0971	Energy System Modeling & Analysis Project	0	0	0	8	2	8	BEEE0098
16.	BEEJ0972	Design & Installation of Solar PV System Project	0	0	0	8	2	8	BEEE0099

Program Elective

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE/CO-REQUISITES
			L	T	P	J			
Bouquet – Electronics & Embedded System									
Theory									
1.	BEEE0112	Digital Signal Processing	3	1	0	0	4	4	
2.	BEEE0113	Micro Electro Mechanical System (MEMS Technology)	3	0	0	0	3	3	
3.	BEEE0114	VLSI Design	3	1	0	0	4	4	
4.	BEEE0110	Biomedical Signal Processing	3	0	0	0	3	3	
5.	BEEE0111	Analog & Digital Communication	3	0	0	0	3	3	
6.	BEEE0115	Medical Image Processing	4	0	0	0	4	4	
Practical									
7.	BEEE0890	Medical Image Processing Lab	0	0	2	0	1	2	
Projects									
8.	BEEJ0976	MEMS Project	0	0	0	4	1	4	

Projects

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE/CO-REQUISITES
			L	T	P	J			
Projects									
1.	BEEJ0950	Mini Projects - I	0	0	0	0	1	0	
2.	BEEJ0951	Mini Project - II	0	0	0	0	3	0	
3.	BEEJ0953	Minor Project	0	0	0	0	3	0	
4.	BEEJ0955	Major Project	0	0	0	0	8	0	
5.	BEEJ0991	Industrial Training	0	0	2	0	2	0	
6.		Total	0	0	0	0	17	0	

Mandatory Non Graded Course

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE/CO-REQUISITES
			L	T	P	J			
Theory									
1.	BCSM0001	Introduction to Cyber Security	2	0	0	0	0	2	
2.	BCHM0101	Disaster Management	2	0	0	0	0	2	
3.	MBAM0001	Basic Course in Entrepreneurship	2	0	0	0	0	2	
4.	MBAM0002	Leadership And Organizational Behavior	2	0	0	0	0	2	
		Total	**8**	**0**	**0**	**0**	**0**	**8**	

Humanities and Social Sciences (H)

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE/CO-REQUISITES
			L	T	P	J			
Theory									
1.	BELH0001	English Language Skills for Communication – I	2	0	0	0	2	2	
2.	BELH0002	English Language Skills for Communication – II	2	0	0	0	2	2	
3.	BELH0003	English for Professional Purpose – I	2	0	0	0	2	2	
4.	BELH 0004	English for Professional Purpose – II	2	0	0	0	2	2	
5.	BELH0006	Ethics & Values	2	0	0	0	2	2	
6.	MBAC0005	Industrial Management	3	0	0	0	3	3	
Practical									
7.	BELH0801	English Language Lab – I	0	0	2	0	1	2	
8.	BELH0802	English Language Lab – II	0	0	2	0	1	2	
9.	BTDH0301	Soft Skills – I	0	0	2	0	1	2	
10.	BTDH 0302	Soft Skills – II	0	0	2	0	1	2	
11.	BTDH0303	Soft Skills – III	0	0	8	0	4	4	
12.	BTDH0304	Soft Skills – IV	0	0	8	0	4	4	
		Total	**13**	**0**	**24**	**0**	**25**	**37**	

Basic Sciences (S)

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE/CO-REQUISITES
			L	T	P	J			
Theory									
1.	BMAS0101	Engineering Mathematics I	3	1	0	0	4	4	
2.	BMAS0102	Engineering Mathematics II	3	1	0	0	4	4	
3.	BMAS0103	Engineering Mathematics III	3	1	0	0	4	4	
4.	BCHS0101	Engineering Chemistry	3	1	0	0	4	4	
5.	BPHS0001	Engineering Physics	3	1	0	0	4	4	
6.	BCHS0201	Environmental Studies	2	0	0	0	2	2	
Practical									
7.	BCHS0801	Engineering Chemistry Lab	0	0	2	0	1	2	
8.	BPHS0801	Engineering Physics Lab	0	0	2	0	1	2	
		Total	**17**	**5**	**4**	**0**	**24**	**26**	

Engineering Sciences (G)

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE/CO-REQUISITES
			L	T	P	J			
Theory									
1.	BEEG1001	Basic Electrical Engineering	3	1	0	0	4	4	
2.	BECG0001	Electronics Engineering	3	1	0	0	4	4	
3.	BMEG0001	Basic Mechanical Engineering	3	1	0	0	4	4	
4.	BEEG0002	Electrical Technology	3	0	0	0	3	3	
5.	BCSC0001	Computer Programming	4	1	0	0	5	5	
Practical									
6.	BEEG0800	Electrical Engineering Lab	0	0	2	0	1	2	
7.	BEEG0801	Electrical Simulation Lab	0	0	4	0	2	4	
8.	BEEG0802	Electrical technology Lab	0	0	2	0	1	2	
9.	BECG0800	Electronics Lab I	0	0	2	0	1	2	
10.	BMEG0800	Engineering Workshop Practice Lab	0	0	2	0	1	2	
11.	BMEG0801	Engineering Drawing Lab	0	0	2	0	1	2	
12.	BCSC0800	Computer Programming Lab	0	0	2	0	1	2	
		Total	16	4	14	0	**28**	16	

Open Elective (O) (Offer to other Departments By EE Dept.)

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE/CO-REQUISITES
			L	T	P	J			
Theory									
1.	BEEO0090	Electrical Machine & Automatic Control	3	0	0	0	3	3	
2.	BEEO0091	Special Electrical Machines	4	0	0	0	4	4	
3.	BEEO0092	Non-Conventional Energy Resources	4	0	0	0	4	4	
4.	BEEO0094	INSTRUMENTATION	4	0	0	0	4	4	
Practical									
5.	BEEO0900	Electrical Machines & Automatic Control Lab	0	0	2	0	1	2	BEEO0090

BEEG 1001: BASIC ELECTRICAL ENGINEERING

Credits: 04 **L-T-P-J:3-1-0-0**

Module No.	Content	Teaching Hours
I	DC circuit analysis & Network theorems: Fundamentals of electric circuits, Kirchhoff's laws, mesh analysis, nodal analysis, Thevenin's theorem, maximum power transfer theorem, superposition theorem. Steady state AC analysis: AC fundamentals, average & rms values of different AC waveforms, phasor algebra, analysis of series AC circuits, power triangle, concept of power factor. Three phase AC circuits: Generation & advantages of three phase system, star & delta connection, line & phase voltage/current relations.	20
II	Magnetic circuits: Faraday's law, circuit analysis, analogy between magnetic and electric circuit, magnetic hysteresis. Single phase Transformers: : Constructional feature, Working Principle, EMF equation, Ideal transformer, Equivalent Circuit, Phasor diagram, parameter evaluation using O.C & S.C test, efficiency, voltage regulation. Rotating Electrical Machines: DC Machine: Construction, Operating principle, Need of Starter, EMF Equation, Types of DC Motor, Torque Equation, Torque-speed Characteristics and applications. Induction motor: 3-phase: Construction & Principle, Need of Starter, Torque Equation, Torque-slip Characteristics. Single Phase Induction motor: Principle and Starting methods.	22

Text Book:

- D.C. Kulshrestha, "Basic Electrical Engineering", Tata McGraw Hill.

Reference Books:

- T.K. Nagsarkar&M.S.Sukhija, "Basic Electrical Engineering", Edition 2008, Oxford University Press.
- H. Cotton, "Advanced Electrical Technology", 2nd Edition 2009, Wheeler Publishing.
- I. J. Nagarath, "Basic Electrical Engineering", 2nd Edition, Tata McGraw Hill.
- D. E. Fitzgerald & A. Grabel Higginbotham, "Basic Electrical Engineering", 5th Edition, McGraw Hill.
- Edward Hughes, "Electrical Technology", 3rd Edition, Pearson Education.

Outcome: *After completion of course, students will be able to:*

1. *Define the basic concept of Active and Passive elements, Linear & non-linear elements, Unilateral and Bilateral Elements. Sources-Ideal & Practical voltage and current sources.*
2. *Explain the concept of KVL/KCL and can calculate the current, voltage and power by using nodal method, mesh method, Thevenin's theorem, Super position Theorem and Maximum power transfer theorem.*
3. *To evaluate the steady state behavior of single phase and three phase AC electrical circuits.*
4. *Analyze the Magnetic circuit, principle of operation and efficiency of transformer.*
5. *Analyze the components of low voltage electrical installation.*
6. *Explain the various machines like DC Machine, Induction motor and synchronous motor in terms of working principle and applications.*

BEEC0003: ENGINEERING CIRCUIT ANALYSIS & SYNTHESIS

Credits: 3 **L-T-P-J: 3-0-0-0**

Module No.	Content	Teaching Hours
I	**Network Theorems for AC circuits:** Mesh Analysis with Super Mesh, Nodal Analysis With Super Node(Dependent Source), Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem, Super Position Theorem, Tellegen's Theorem, Reciprocity Theorem **AC power & Resonance** Resonance in Series and Parallel Circuits: Quality Factor, Voltage/Current Magnification, Bandwidth of Resonant Circuit Active power, Reactive power & Apparent power, power triangle, concept of power factor and its improvement	14
II	**Transient Analysis** Transient AC Circuit Analysis: zero input & zero state Response of RL, RC Networks to Different Inputs with differential equation approach **Magnetic coupling** Magnetically Coupled Circuits: Mutual Inductance, Coefficient of Mutual Inductance, Dot Convention, Combined mutual & self-Inductance Voltage, Energy Considerations, Upper Limit of M, Coupling Coefficient **Network Topology** Concept of Network Graphs, Tree, Link, Cut Set Matrix, Node Incidence Matrix, loop Matrix.	14
III	**Two -Port Network** Open Circuit, Short Circuit, Hybrid, Transmission, Relationship between Two Port Parameters, Series, Parallel & Cascade Connections **Complex frequency:** Complex Frequency, Network Function: Driving Point Admittance Function & Transfer Functions of the Network & their Properties. **Positive Real function:** Hurwitz polynomial and its properties, properties of PRF, Testing driving point function	14

Text Book:

1. Charles K Alexender, M. Sadiku, "Fundamental of Electrical Circuit" 5th Edition Mcgraw hill

Reference Books:

1. "Basic Circuit Theory" by Charles A. Desoer&Ernest S. Kuh
2. William H. Hayt& Jack E. Kemmerly Engineering Circuit Analysis" McGraw-Hill Book Company Inc. 1971
3. M.E. Van Valkenburg, "Network Analysis", Wiley Eastern Ltd.
4. Sudhakar, "Circuits & Networks: Analysis and Synthesis", TMH Education Pvt. Ltd.
5. D.RoyChoudhary, "Networks and Systems" 2nd Ed., New Age International (P) Ltd. Publishers.
6. C.L Wadhwa, "Network Analysis and Synthesis (Including Linear System Analysis)" 3rd Ed., New Age International Publishers.
7. A.Chakrabarti, "Network Analysis & Synthesis", DhanpatRai& Co

Course Outcomes: Upon completion of this course, students shall be able to

CO1: Analyze the AC and DC circuits using Kirchhoff's law and Network simplification theorems.
CO2: Understand the concept of resonance and analyze the resonant circuits. Also evaluate AC power and Power Factor.
CO3: Analyse the transient response of AC and DC circuits using classical method and also analyze magnetically coupled circuits.
CO4: Simplify the network using Graph theory approach.
CO5: Demonstrate the concept of complex frequency and analyze the structure and function of two port network. Also evaluate and analyze two-port network parameters.

CO6: Evaluate network function for network synthesis.

BEEC0004: ELECTRICAL MEASUREMENT & MEASURING INSTRUMENTS

Credits: 3 **L-T-P-J:3-0-0-0**

Module	Content	Teaching Hour
I	**Philosophy of Measurement**: Methods of Measurement, Classification & Characteristics of Instrument & Measurement System, Errors in Measurement & Its Analysis, Standards. **Measurement of Current and voltage:** Classification of Analog instruments. Principle of operation, construction, sources of error and compensations in PMMC – Moving iron – Dynamometer and induction type instruments. Extension of ranges and calibration of ammeters & voltmeters. **Measurement of power** Power measurement – Voltmeter ammeter method, Electrodynamics wattmeter – Theory, errors and compensation.	14
II	**Instrument Transformers**: Instrument Transformers and Applications in the Extension of Instrument Range, methods of minimizing errors; testing and applications. **Measurement of Circuit Parameters**: Different Methods of Measuring Low, Medium and High Resistances, Measurement of Inductance, Capacitance& Frequency With The Help of AC Bridges. Potentiometer. **Sensors and Transducers:** Classification of Sensors &Transducers, Resistive Transducers, Inductive Transducers.	14
III	**Digital Measurement:** Concept of Digital Measurement, Block Diagram Study of Digital Voltmeter, Frequency Meter Power Analyzer and Harmonics Analyzer; Digital Multi meter **Cathode Ray Oscilloscope:** Basic CRO Circuit (Block Diagram), Cathode Ray Tube (CRT) & Its Components, Application of CRO in Measurement, Lissajous Pattern; Digital storage oscilloscope (Block Diagram, theory and applications only)	13

Text Books:

1. G.K. Banerjee, Electrical Measurement & Measuring Instruments, New Age International.
2. A.K. Sawhney, "*A Course in Electrical & Electronic Measurements & Instrumentation*", DhanpatRai&Sons India.

References:

1. Forest K. Harris, "*Electrical Measurement*", Willey Eastern Pvt. Ltd. India.
2. M.B. Stout, "*Basic Electrical Measurement*" Prentice hall of India, India.
3. Helfrick and Cooper, "*Modern Electronic Instrumentation & Measurement Techniques*", PHI
4. Learning.
5. RajendraPrashad, "*Electrical Measurement &Measuring Instrument*", Khanna Publisher.
6. J.B. Gupta, "*Electrical Measurements and Measuring Instruments*", S.K. Kataria& Sons.
7. MMS Anand, "*Electronic Instruments and Instrumentation Technology*", PHI Learning.

Course outcomes: *After completing the course the student will able -*

1. *Define measurement parameters and methods, standards, characteristics, errors.*
2. *Graduates will be able to study the working of different ac and dc bridges, Transformers. Oscilloscopes and recorders.*
3. *Gain knowledge on data acquisition and conversion.*

4. *Gain Knowledge on Utilization & interpretation of various Transducers along with practical implementation.*

BEEC0007: ANALOG INTEGRATED CIRCUIT

Credits: 3 **L-T-P-J: 3-0-0-0**

Module No.	Content	Teaching Hour
I	**Review of transistors**: Configurations of BJTs and FETs with their characteristics. **Feedback:** General Feedback Structure; Properties of Negative Feedback Amplifiers and types of feedback amplifier. **Oscillators**:-Conditions for oscillations Basic Principle of Sinusoidal Oscillator, R-C , LC Oscillators. **Current Mirror Circuits:** Current Mirrors using BJT and MOSFETs.	14
II	**Operational Amplifier, Characteristics and Applications:** Basic Information of Op-Amp, Operational Amplifier Internal Circuit. DC and AC Characteristics, Instrumentation Amplifier, Applications of Op-Amp **Active Filters :** First and Second order LP, HP, BP, BS and All pass active Filters **Comparators and Waveform Generators: Comparator**, Regenerative Comparator (Schmitt Trigger), Square Wave Generator (Astable Multi vibrator), Mono stable Multi vibrator, Triangular Wave Generator.	14
III	**Voltage Regulator:** Series Op-Amp Regulator, IC Voltage Regulators **555 Timer:**Functional Diagram, Mono stable and Astable Operation, Schmitt Trigger. **Phase-Locked Loop** : Basic Principles, Phase Detector/Comparator, Voltage Controlled Oscillator (VCO), , Monolithic Phase-Locked Loop, PLL Applications **A/D and D/A Converters-** Weighted Resistors & R-2R D-A Converter, Flash Type, Single Ramp & Dual Ramp A-D Converters**.**	13

Text Books:

1. A.S. Sedra and K.C. Smith "*Microelectronics Circuits*"4th Edition, Oxford University Press (India).
2. Roy Choudhury, Shail B. Jain "*Linear Integrated Circuits*", 4th Edition, New Age International Publishers

References:

1. R.A. Gayakwad, "*OP-AMP and Linear Integrated Circuits*" Third edition, Prentice Hall of India.
2. Robert L. Boylestad and Louis nashel sky, "*Electronic devices and circuit theory*", Pearson Education/PHI,

Outcomes: *After completing the course the student will able -*

1. *Understand feedback structure, properties of Negative Feedback Amplifiers and different types of feedback amplifier circuit*
2. *design R-C , LC Oscillators after understanding Basic Principle of Sinusoidal Oscillator and Current Mirror circuit.*
3. *understand the characteristics and different applications of Op-amps.*
4. *Calculate the cut-off frequency of different types of active filters after understanding their operation.*
5. *Understand the operation of voltage Regulators, 555 timer under different mode of operation and signal frequency tracking using PLL.*
6. *Convert A-D and D-A using Flash Type, Single Ramp & Dual Ramp A-D and Weighted Resistors & R-2R D-A Converter respectively.*

BEEC0005: FIELD THEORY & APPLICATIONS

Credits: 3 **L-T-P-J: 3-0-0-0**

Module	Contents	Teaching Hours
I	Coordinate Systems and Transformation: Basics of Vectors: Addition, subtraction and multiplications; Cartesian, Cylindrical, Spherical transformation. Vector calculus: Differential length, area and volume, line surface and volume integrals, Del operator, Gradient, Divergence of a vector, Divergence theorem, Curl of a vector, Stokes's theorem, Laplacian of a scalar . Electrostatic fields: Coulombs law and field intensity, Electric field due to charge distribution, Electric flux density, Gausses' Law - Maxwell's equation, Electric dipole and flux line, Energy density in electrostatic fields, Electric field in material space: Properties of materials, convection and conduction currents, conductors, polarization in dielectrics, Dielectric –constants.	14
II	Electrostatic fields: Continuity equation and relaxation time, boundary conditions, Electrostatic boundary value problems: Poisson's and Laplace's equations., Methods of Images. Magneto statics : Magneto -static fields, Biot - Savart's Law, Ampere's circuit law, Maxwell's equation, Application of ampere's law, Magnetic flux density - Maxwell's equation, Maxwell's equation for static fields, magnetic scalar and vector potential. Magnetic forces: Materials and devices, Forces due to magnetic field, Magnetic torque and moment, a magnetic dipole. Magnetization in materials, Magnetic boundary conditions, Inductors and inductances, Magnetic energy.	14
III	Waves and Applications: Maxwell's equation, Faraday's Law, transformer and motional electromotive forces, Displacement current, Maxwell's equation in final form Electromagnetic wave propagation: Wave propagation in loss dielectrics, Plane waves in lossless dielectrics Plane wave in free space. Plain waves in good conductors, Power and the pointing vector, Reflection of a plain wave in a normal incidence. Transmission Lines and Smith Chart.	14

Text Book:

7. M. N. O. Sadiku , "Elements of Electromagnetics", 4 th , Ed, Oxford University Press

Reference Books:

1. W. H. Hayt and J. A. Buck, "Electromagnetic field theory", 7 th Ed., TMH. Pramanik - Electromagnetism: Vol.1 - Theory, PHI Learning Pvt. Ltd

Outcomes: *After completion of course student will be able to-*

1. *Solve the problems in different EM fields.*
2. *Design a programming to generate EM waves subjected to the conditions.*
3. *Apply EM Waves in different domains and to find the time average power density*
4. *Formulate Electromagnetic Relation using Maxwell Formulae*
5. *Solve Electro Static and Magnetic to Static circuits using Basic relations*
6. *Analyze moving charges on Magnetic fields*

BEEC0010: ELECTRICAL MACHINES-II

Objective: *To expose the students to the concepts of Synchronous/Induction machines and to analyze their performance.*

Credits: 3 L-T-P-J:3-0-0-0

Module	Content	Teaching Hour
I	**Synchronous Machine-I:** constructional features, emf equation, winding coefficients, rotating magnetic field, armature reaction and Two Reaction Theory, phasor diagram based on Two Reaction Theory, expression for power developed in terms of load angle, open and short circuit tests, voltage regulation by Synchronous Impedance Method, MMF Method, ASA Method, Operation on infinite bus bar, parallel operation of synchronous generators, active and reactive power control of alternators operating on infinite bus bar.	14
II	**Synchronous Machine-II:** starting of synchronous motors, effect of variation of field current at constant load and V-Curves, synchronous condenser, synchronizing power and torque, hunting. **Three phase Induction Machine-I:** constructional features, principle of operation, phasor diagram, equivalent circuit, power flow and efficiency, relation between rotor power input, mechanical power developed and rotor copper loss, expression for torque and torque-slip characteristics.	14
III	**Three Phase Induction Machine-II:** determination of parameters of equivalent circuit by no load and blocked rotor tests, methods of starting of three phase induction motors. Deep bar and double cage rotors, harmonics and its effects: cogging and crawling, induction generator and its applications. **Single Phase Induction Motor:** Double Revolving Field Theory, equivalent circuit, no load and blocked rotor tests. Different types of single phase induction motors: starting methods, characteristics and applications.	14

Text Books:

1. J. Nagrath and D.P. Kothari, "*Electric Machines*" Tata McGraw Hill.
2. J.B.Gupta," Theory and Performance of Electrical Machines", S.K. Kataria and Sons.
3. AshfaqHussain, "*Electric Machines*", Dhanpatrai and Sons.

Reference Books:

1. M.G. Say, *"The Performance and Design of AC machines",* Pit man & Sons.
2. A.E. Fitzgerald, C.KingsleyandUmans, "*Electric Machinery*" 6th Edition, Tata McGraw Hill.
3. Alexander S. Langsdorf, "Theory of Alternating Current Machinery", McGraw Hill Book Company.
4. F.Puchstein, T.C. Lloyd, A.G. Conard, "*Alternating CurrentMachines*", Asia Publishing House.

Course Outcome: *After completion of course student will be able to learn*

1. *To familiarize with the constructional details of different type of Synchronous/Induction Machine, working principle and their performance.*
2. *To understand the voltages Regulation of synchronous generator by using different methods.*
3. *To understand the concept of parallel operation/ Constant KW operation/ effect of steam input to generator.*
4. *To understand the concept of starting of synchronous motor & V Curve.*
5. *To understand the concept speed control of IM.*

BEEC0012: ELEMENTS OF POWER SYSTEM

Objective: *The objective of the subject is to identify major components of power transmission and distribution systems. Describe the principle of operation of transmission and distribution equipment & to know and appreciate the key factors in equipment specification and design.*

Credits: 03 **L-T-P-J: 3-0-0-0**

Module No.	Content	No. of Lectures
I	**Introduction:** Structure of Power Systems, Overview & growth of Power Systems; Indian-Scenario, Interconnections and their advantages **Transmission Lines:** Choice of voltage and frequency, Types of conductors, Bundled conductors. Calculation of Electrical parameters of Overhead Transmission Lines; Resistance, Inductance and Capacitance using the concept of GMR and GMD for 1-Phase , 3- Phase, Single Circuit & Double Circuit Lines, Skin effect, Proximity effect. **Transmission Line Performance-I:** Characteristics and Performance of Transmission Lines; Short and Medium - Generalized Constants, Power flow, and Voltage regulation.	14
II	**Transmission Line Performance-II:** Characteristics and Performance of Long Transmission Lines, Ferranti Effect, Surge Impedance & Surge Impedance Loading. Indian Electricity Rules. **Mechanical Design of Overhead Transmission Lines:** Tension and Sag Calculations, Effect of weather conditions, Stringing Charts, Vibration & Damper. **Insulators:** Insulator Types, String Efficiency & Methods to improve String efficiency; Capacitance grading, Guard ring. **Corona and Interference With Communication Lines:** Corona; Visual and Disruptive, Critical Voltage, Corona Loss, Factors affecting Corona. Methods of reducing Corona, Interference with Communication Lines.	15
III	**Insulated Cables:** Constructional Features, Parameters. Electric stress in single-core cable, grading of cable. Cable laying procedures, Fault location methods. High Voltage Cables. Thermal Characteristics of cables. **Distribution Systems:** Primary and Secondary Distribution, Ring Main and Radial Systems, Systematic design of Distribution Systems. **HVDC Transmission and EHV-AC Transmission:** Introduction to HVDC and EHV-AC transmission systems and their comparison.	13

Text Books:

1. D.P. Kothari and I.J. Nagrath, "*Power System Engineering*", Tata McGraw Hill.
2. B. R. Gupta, "*Power System Analysis and Design*", S. Chand & Co.

References:

1. Ashfaq Husain, "Electrical *Power System",* CBS Publishers and Distributors.
2. C. L. Wadhwa, "*Electrical Power Systems*", New Age International Ltd.
3. S. N. Singh, "Electric Power Generation, Transmission& distribution." PHI Learning

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

CO1. Understand the structure of an interconnected power system including generation, transmission and distribution; their function and growth.

CO2. Calculate the electrical parameters of overhead transmission lines using the concept of geometrical mean distances.

CO3. Model and analyze overhead transmission line to obtain their performance – voltage regulation, efficiency and power transfer capability.

CO4. Design overhead transmission lines considering mechanical, insulation and Corona aspects.

CO5. Understand the constructional features of single and multi-core cables including parameter calculations, grading and thermal rating of cables.

CO6. Understand and design distribution systems; radial & ring-mains systems for urban and rural requirements.

BEEC0014: POWER ELECTRONICS

Credits: 3 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hours
I	**Thyristor:** Construction, V-I and Switching characteristics (Turn-On And Turn-Off), Two Transistor Model, Methods of Turn-On, Operation of GTO, DIAC, TRIAC, Firing Circuits for SCR (R, RC Half Wave and RC Full Wave and UJT Triggering Circuits), Protection of Devices, Series and Parallel Operation of Thyristors. **Commutation:** Commutation Techniques of Thyristor.	14
II	**Phase Controlled Converters:** Single Phase Half Wave Controlled Rectifier With Resistive and Induction Loads, Effects of Freewheeling Diode, Single Phase Fully Controlled and Half Controlled Bridge Converters, Performance Parameters, Three Phase Half Wave Converters, Three Phase Fully Controlled and Half Controlled Bridge Converters, Effect of Source Impedance, Single Phase and Three Phase Dual Converters. **Inverters:** Introduction (VSI), VSI-Single Phase Half and Full Bridge Inverters for R, RL And RLC Loads, Three Phase Bridge Inverters 180° and 120° Mode Operations.	13
III	**Inverters:** CSI-Single Phase Series Resonant and Parallel Inverters,Voltage Control of Inverters, Harmonic Reduction Techniques. **DC-DC Converters:** Principle of Step-Down Chopper, Step Down Chopper With R-L Load, Principle of Step-Up Chopper and Operation With RL Loads, control strategies for varying duty cycle, Classification of Choppers and Multiphase Choppers. **Cyclo converters:** Basic Principle of Operation, Single Phase to Single Phase, Three Phase to Single Phase and Three Phase to Three Phase Cyclo converters, Output Voltage Equation. **AC Voltage Controllers:** Introduction, Single Phase Ac Voltage Controller With Resistive and Inductive Loads, Three Phase Ac Voltage Controllers (Various Configurations And Comparison Only).	15

Text Books:

- M. H. Rashid, *Power, "Electronics: Circuits, Devices & Applications"*, Prentice Hall of India Ltd.
- P.S. Bhimbra, "*Power Electronics"*, Khanna Publishers.

References:

- M.S. JamilAsghar, "*Power Electronics*", Prentice Hall of India Ltd.
- Chakrabarti&Rai, "*Fundamentals of Power Electronics & Drives*", DhanpatRai& Sons.
- Ned Mohan, T. M. Undeland and W. P. Robbins, "*Power Electronics: Converters, Applications and Design*",Wiley India Ltd.
- S. N. Singh, "*A Text Book of Power Electronics*", DhanpatRai&Sons.M.D.Singh&K. B. Khanchandani"*Power Electronics*", TMH.
- V.R. Moorthy, "*Power Electronics: Devices, Circuits, Industrial Applications*", Oxford Univ. Press

Outcomes: After learning the course the students should be able to:

1. explain the construction, operation and characteristics of Thyristors, methods of Turn-On, Switching characteristics, and its firing circuits.
2. design of over voltage, over current, dv/dt, di/dt and thermal protection circuits of SCR after understanding the

operation of natural and forced Commutation techniques of thyristors.
3. understand the operation of single and three-phase controlled rectifier with different loads.
4. explain of VSI-Single-phase and three-phase Inverters for different Loads and CSI-Single phase series resonant and parallel inverters, and their harmonic reduction techniques.
5. design the step-down, step-up chopper with r-l loads and control strategies for different duty cycle after understanding the principle of step-down, step-up chopper and classification of choppers.
6. understand the operation of single-phase and three-phase ac voltage controller with resistive and inductive loads and the operation of single-phase to single-phase, three-phase to single-phases and three-phase to three - phase cyclo-converters.

BEEC0015: MICROPROCESSOR & IT'S APPLICATIONS

Credits: 3 **L-T-P-J: 3-0-2-0**

Module	Content	Teaching Hours
I	Introduction to Microprocessor, Components of a Microprocessor: Registers, ALU and control & timing, System bus (data address and control bus), Microprocessor systems with bus organization. Microprocessor Architecture and Operations, Memory, I/O devices, Memory and I/O operations. 8085 Microprocessor Architecture, Address, Data And Control Buses, 8085 Pin Functions, Demultiplexing of Buses, Generation Of Control Signals, Instruction Cycle, Machine Cycles, T-States,	14
II	Assembly Language Programming Basics, Classification of Instructions, Addressing Modes, 8085 Instruction Set, Instruction And Data Formats, Writing, Assembling & Executing A Program, Debugging The Programs. Writing 8085 assembly language programs with decision, making and looping using data transfer, arithmetic, logical and branch instructions. Stack & Subroutines, Developing Counters and Time Delay Routines, Code Conversion, BCD Arithmetic and 16-Bit Data operations, Interrupts In 8085	14
III	Interfacing Concepts, Memory Interfacing ,Ports, Interfacing Of I/O Devices, , Programmable Peripheral Interface 8255A, TIMER IC 8253,Programmable Interrupt Controller 8259A, **Advanced Microprocessors**: 8086 logical block diagram and segments, Addressing Modes, 80286: Architecture, Register organization and real or protected addressing. **Introduction to Microcontrollers and Embedded Processors**	13

Text Book:

1. B Ram "Fundamental of Microprocessor & Microcontrollers", DhanpatRai publication.

Reference Books:

1. Ramesh S. Gaonkar , "Microprocessor Architecture, Programming, and Applications" with the 8085, Pub: Penram International.
2. N. Senthil Kumar, M. Saravanan, S. Jeevanathan, S. K. Shah "Microprocessors and Interfacing", Oxford
3. Daniel Tabak "Advanced Microprocessors", McGrawHill.
4. Douglas Hall "Microprocessor & Interfacing" , TMH.
5. Savaliya M. T. "8086 Programming and Advance Processor Architecture", WileyIndia.
6. Triebel& Singh "The 8088 and 8086 Microprocessors", Pearson Education.
7. Kenneth Ayala "The 8051 Micro controller" 3rd Edition.

Outcomes:*After learning the course the students should be able to:*

1. *List and specify the various features of microprocessor, memory and I/O devices including concepts of system bus.*
2. *Identify the various elements of 8085 microprocessor architecture, its bus organization including control signals.*
3. *List the pin functions of the 8085 microprocessor.*
4. *Describe the 8085 processor addressing modes, instruction classification and function of each instruction and write the Assembly language programs using 8085 instructions.*
5. *Explain the concepts of memory and I/O interfacing with 8085 processor with Programmable devices. List and describe the features of advance microprocessors.*

BEEE0050: SENSORS AND TRANSDUCERS

Credits: 03 **L-T-P-J:3-0-0-0**

Module	Content	Teaching hours
I	**Mechanical and Electromechanical sensor**: Definition, principle of sensing & transduction, classification. Resistive (potentiometric type): Forms, material, resolution, accuracy, sensitivity. Strain gauge: Theory, type, materials, design consideration, sensitivity, gauge factor, variation with temperature, adhesive, rosettes. **Inductive sensor**: common types- Reluctance change type, Mutual inductance change type, transformer action type, Magnetostrictive type, brief discussion with respect to material, construction and input output variable, Ferromagnetic plunger type, short analysis. LVDT: Construction, material, output input relationship, I/O curve, discussion. Proximity sensor. **Capacitive sensors**: Variable distance-parallel plate type, variable area- parallel plate, serrated plate/teeth type and cylindrical type, variable dielectric constant type, calculation of sensitivity. Stretched diaphragm type: microphone, response characteristics.	14
II	**Piezoelectric element**: piezoelectric effect, charge and voltage co-efficient, crystal model, materials, natural & synthetic type, their comparison, force & stress sensing, ultrasonic sensors. **Thermal sensors**: Material expansion type: solid, liquid, gas & vapor Resistance change type: RTD materials, tip sensitive & stem sensitive type, Thermister material, shape, ranges and accuracy specification.	14
III	**Thermo emf sensor**: types, thermoelectric power, general consideration, Junction semiconductor type IC and PTAT type. Radiation sensors: types, characteristics and comparison. Pyroelectric type. **Magnetic sensors**: Sensor based on Villari effect for assessment of force, torque, proximity, Wiedemann effect for yoke coil sensors, Thomson effect, Hall effect, and Hall drive, performance characteristics. Radiation sensors: LDR, Photovoltaic cells, photodiodes, photo emissive cell types, materials, construction, response. Geiger counters, Scintillation detectors, Introduction to smart sensors.	14

Text Books:

1. Sensor & transducers, D. Patranabis, 2nd edition, PHI
2. Instrument transducers, H.K.P. Neubert, Oxford University press.
3. Measurement systems: application & design, E.A.Doebelin, McGraw Hill

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

1. Use concepts in common methods for converting a physical parameter into an electrical quantity
2. Classify and explain with examples of transducers, including those for measurement of temperature, strain, motion, position and light

3. Choose proper sensor comparing different standards and guidelines to make sensitive measurements of physical parameters like pressure, flow, acceleration, etc
4. Predict correctly the expected performance of various sensors
5. Locate different type of sensors used in real life applications and paraphrase their importance
6. Set up testing strategies to evaluate performance characteristics of different types of sensors and transducers and develop professional skills in acquiring and applying the knowledge outside the classroom through design of a real-life instrumentation system.

BEEE0090: Introduction to Renewable Energy Technologies

Credits: 03 **L-T-P-J:3-0-0-0**

Module	Content	Teaching hours
I	Introduction to world energy scenario, Renewable energy resources, Radiation, Solar Geometry, radiation models; Solar Thermal, Optical efficiency, thermal efficiency, concentrators, testing procedures.	12
II	Introduction to thermal systems (flat plate collector), solar architecture, solar still, air heater, panel systems; Photovoltaic ; Introduction to semiconductor physics, doping, P_N junction, Sola r cell and its I_V characteristics, PV systems components, design of a solar PV systems.	13
III	Biomass, Biomass resources, wood composition, pyrolysis, gasifies, biogas, biodiesel, ethanol; Wind, Introduction, types of wind machines, Cp- λ curve &betz limits, wind recourse analysis; Systems, stand alone, grid connected, hybrid, system design; Hydro systems , Hydro resources, types of hydro turbine, small hydro systems; Other systems, Geothermal, wave energy, ocean energy.	13

TEXTBOOKS

1. S. P. Sukhatme, Solar Energy - Principles of thermal collection and storage, second edition, Tata McGraw-Hill, New Delhi, 1996
2. J. A. Duffie and W. A. Beckman, Solar Engineering of Thermal Processes, second edition, John Wiley, New York, 1991

REFERENCES

1. D. Y. Goswami, F. Kreith and J. F. Kreider, Principles of Solar Engineering, Taylor and Francis, Philadelphia, 2000
2. D. D. Hall and R. P. Grover, Biomass Regenerable Energy, John Wiley, New York, 1987.
3. J. Twidell and T. Weir, Renewable En ergy Resources, E & F N Spon Ltd, London, 1986.
4. M. A. Green, Solar Cells, Prentice-Hall, Englewood Cliffs, 1982.

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

CO1: Able to recognize the need of renewable energy technologies and their role in India and world energy demand.
CO2: Understand solar geometry principles and also the concept of solar thermal system and its components.
CO3:Describe the use of solar energy and the various components used in the energy production with respect to various applications.
CO4: Understand the solar cell – construction, working principle and characteristics and also understand solar PV system and its components.
CO5: Appreciate the need of Wind Energy and the various components used in energy generation and know the classifications. Also understand the concept of Biomass energy resources and their classification, types of biogas Plants & applications
CO6: Understand the concept of Geothermal and Hydro systems, their resources and applications.

BEEG100: ILLUMINATION SCIENCE & ENGINEERING

Credits: 04 **L-T-P-J:3-1-0-0**

Module No.	Content	Teaching Hours
I	**Importance of Lighting in Human Life:** Optical systems of human eye ,Dependence of human activities on light, performance characteristics of human visual system, Radiant energy and visible spectrum, energy conversion to light ,External factors of vision-visual acuity, contrast, sensitivity, time illuminance, colour, visual perception, optical radiation hazards, Good and bad effects of lighting & perfect level of illumination. **Lighting Systems:** Daylight, incandescent, electric discharge, fluorescent, arc lamps and lasers; Energy efficient lamps; Artificial lighting as substitute to natural light.	13
II	**Light sources and their assets:** Laws of illumination, polar, curves, photometry, photocells. Environment and glare.General illumination design, Illumination levels, loss factors, lamp selection and maintenance, types of lamps, lamp fittings, Light control, design aspects of indoor and outdoor lighting **Electrical Control of Light Sources:** Ballast, ignitors and dimmers for different types of lamps. Ability to control natural light, Production of light, physics of generation of light, Properties of light, Quantification & Measurement of Light, Luminaries, wiring, switching and control circuits.	13
III	**Interior lighting Design**: Industrial, residential, office departmental stores, indoor stadium, theater and hospitals. **Exterior lighting Design:** Flood, street, aviation and transport lighting, lighting fordisplays and signalling - neon signs, LED-LCD displays beacons and lighting for surveillance. Energy Conservation codes for lighting; lighting controls-daylight sensors and occupancy sensors; controller design. Special Features of Aesthetic Lighting	14

Text Book:

- H. S. Mamak, "Book on Lighting", Publisher International lighting Academy
- Joseph B. Murdoch, "Illumination Engineering from Edison's Lamp to Lasers" Publisher -York, PA: Visions Communications
- M. A. Cayless, A. M. Marsden, "Lamps and Lighting", Publisher-Butterworth-Heinemann(ISBN978-0-415-50308-2)
- Designing with light: Lighting Handbook., Anil Valia; Lighting System 2002
- John Matthews Introduction to the Design and Analysis of Building Electrical Systems, Springer, 1993

Reference Books:

- "BIS, IEC Standards for Lamps, Lighting Fixtures and Lighting", ManakBhavan, New Delhi
- D. C. Pritchard, "Lighting", 4th Edition, Longman Scientific and Technical, ISBN 0-582-23422-0
- "IES Lighting Handbook", (Reference Volume 1984), Illuminating Engineering Society ofNorth America.
- "IES Lighting Handbook", (Application Volume 1987), Illuminating Engineering Society ofNorth America
- IESNA lighting Handbook., Illuminating Engineering Society of North America 9th edition2000
- Applied Illumination Engineering, Jack L. Lindsey FIES (Author), Scott C. Dunning PHD PECEM (Author) ,ISBN-13: 978-0824748098 ISBN-10: 0824748093, 3rd Edition.IS 3646: Part I: 1992, Code of practice for interior illumination.

- Organic Light Emitting Diodes (OLEDs): Materials, Devices and Applications, Alastair Buckley,University of Sheffieid, UK, ISBN: 978-0-85709-425-4.

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

1. Understand the concept of illumination and can recognized the importance of raising awareness of light, as well as its fundamental role in the development of human society, health, communication, energy, education, agriculture, design and much more.
2. Calculated and compared variable lighting systems inherent properties and a narrow group of wavelengths between about 380 nm and 730 nm is to enable vision and performance interior and exterior illumination of visual tasks through the eyes.
3. Rendering and analyzing the impact of physical design of lighting and laws of illumination for categorize various parameters for perform calculations on photometric performance of light sources and luminaires, polar curve for lighting design.
4. Design modern lighting sources and controls for energy efficient lighting and a smart control drive circuit.
5. Augments the aesthetic appeal and creates the mood and ambiance of a living space of interior Lighting fixtures.
6. Understand about the different types of exterior security lighting planning, designing, implementing and maintaining elements for protect valuable assets.

BEEE0056: PLC & SCADA

Credits: 3 **L-T-P-J: 3-0-0-0**

Module No.	Content	Teaching Hours
I	**PLC Introduction:** Technical Definition, advantages, characteristics, Chronological Evolution, Types of PLC: Unitary, Modular, Small, Medium and Large. Block Diagram of PLC: Input/output (I/O) section, Processor Section, Power supply, Memory central Processing Unit: Processor Software / Executive Software, Multi-tasking, Languages, Ladder Language. **Bit Logic Instructions:** I/O Symbols, Numbering system of inputs and outputs, Program format, introduction to logic: Equivalent Ladder diagram of various logic gates, De Morgan theorem validation.	14
II	**Timers and Counters:** Timer-on Delay, Timer off delay, Retentive and non-retentive timers. Format of a timer instruction. Operation of PLC Counter, Counter Parameters, Counters Instructions Overview Count up (CTU) Count down (CTD). **Advanced instructions:** Introduction: Comparison instructions, discussions on comparison instructions, "EQUAL" or "EQU" instruction, "NOT EQUAL" or "NEQ" instruction, "LESS THAN" or "LESS" instruction, "LESS THANOR EQUAL' or "LEQ" instruction, GREATER THAN" OR "GRT" instruction, "GREATER THAN OR EQUAL TO" or "GRO" instruction, "MASKED COMPARISON FOR EQUAL" or "MEQ" instruction, "LIMIT TEST" or "LIM" instruction.	14
III	**PLC input output (I/O) modules and power supply:** Classification of I/O, I/O system overview, practical I/O system and its mapping addressing local and expansion I/O, input-output systems, direct I/O, parallel I/O systems serial I/O systems. Sinking and sourcing. Discrete input module. Rectifier with filter, threshold detection, Isolation, logic section, specifications of discrete input module, types of analog input module, special input modules, analog output module, **SCADA: D**efinition and history of Supervisory Control and Data Acquisition, typical Architecture, Communication Requirements, Desirable properties of SCADA system, Features, advantages, disadvantages and applications of SCADA. SCADA Architecture(First generation-Monolithic, Second Generation-Distributed, Third generation Networked Architecture), SCADA systems in operation and control of interconnected power system,	14

Text Book:

- "PLC and Industrial application", MadhuchhandaMitraand SamarjitSengupta, Pernram international pub. (Indian) Pvt. Ltd., 2011.
- Ronald L Krutz, "Securing SCADA System", Wiley Publication

Reference Books:

- Gary Dunning, "Introduction to Programmable Logic Controllers", Thomson, 3rd Edition.
- John W Webb, Ronald A Reis, "Programmable Logic Controllers: Principles and Application", PHI Learning,New Delhi, 5th Edition.
- Stuart A Boyer, "SCADA Supervisory Control and Data Acquisition", ISA, 4th Revised edition

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

CO 1: Understand the structure of a PLC system and its components such as power supply, memory and Input/output section.
CO 2: Understand numbering system of I/Os and develop the ladder diagrams for various Boolean expressions.
CO 3: Design ladder programs for the problems related to timers and counters.
CO 4: Understand and apply the comparison instructions including equality and non-equalities.

CO 5: Understand the PLC Input/output modules interfacing.
CO 6: Understand the definition and history of Supervisory Control and Data Acquisition, typical Architecture

BEEE0030: ELECTRICAL POWER GENERATION

(With effective from session 2019 - 20)

Credits: 03 **L-T-P-J: 3-0-0-0**

Module No.	Content	Teaching Hours
I	**Introduction:** Importance of Electrical Energy, Comparison with other forms of energy. Electrical energy sources. **Power Plant Economics and Tariffs:** Load Curve, Load Duration Curve, Different Factors related to plants and consumers, Cost of electrical energy. Depreciation, Tariffs, Causes and effects of low power factor. Different methods for power factor improvement and advantages of pf improvement. **Power Plant Auxiliaries:** Excitation system, Turbine and Governors, Storage Batteries. EHV Substation – classification & its equipment's.	13
II	**Thermal Power Plant:** Location and site selection, general layout and working of plant. Brief description of Boilers, Economizers, Super heaters, Draft system. Fuel and Ash handling plant. **Gas Turbine Power Plant:** Layout & operationalprinciple of Gas Turbine Plant & its efficiency, Fuels, Open and Closed-cycle plants, Regeneration, Inter-cooling and reheating. **Nuclear Power Plant:** Location, Site selection, General layout and operation of plant, Brief description of different types of Reactors, Moderator material, Fissile materials. Control of nuclear reactors, Disposal of nuclear waste, Shielding. **Hydro Electric Plants:** Classifications, Location and site selection, Detailed description of various components, General layout and operation of plants, Brief description of Impulse, Reaction, Kaplan and Francis turbines. Advantages &disadvantages.	14
III	**Wind Energy:** Basic principles of Wind energy conversion, Wind energy power calculation, Analysis of aerodynamic forces acting on the Blades, Site selection considerations, Types of wind energy Collectors, applications of wind energy. **Solar Energy:** Solar radiation at the Earth's surface, Solar radiation measurement, Solar energy Collectors, Solar Thermal Power Plant, Solar PV Cells. Applications of Solar Energy. **Neutral Earthing:** Introduction, isolated neutral, earth neural systems-solid, resistance & reactance. Arc suppression coil, voltage transformer earthing transformer. Substation Automation: Requirement & Cost Justification.	14

Text Books:

1. B. H. Khan, "*Non-conventional Energy Resources*", Tata Mcgraw-Hill Education.
2. B. R. Gupta, "*Generation of Electrical Energy*", S. Chand Publication.

References:

1. S.L. Uppal, "*Electrical Power*", Khanna Publishers.
2. Soni, Gupta &Bhatnagar, "*A Text Book on Power System Engg.",*DhanpatRai& Co.
3. Brand K, Lohmann V and Wimmer, W, "*Substation Automation Handbook*", Utility Automation Consulting Lohman.

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

1. Understand the concept of various economic factors, load curve and load duration curves.
2. Estimate the cost of energy generated, type of tariffs used & selection of most economic power factor.
3. Explain the function of excitation system, turbine & governor and stations storages batteries.
4. Draw the layout of thermal, hydro, nuclear and gas power plants and explain their operating principle.
5. Describe the solar and wind plants, power output, fill factor & factors affecting the operation of plant.

6. Classify the neutral earthing and explain requirement of substation automation and cost justifications.

EEE-7002: SWITCHGEAR AND PROTECTION

(With effective from session 2017-18)

Course Objective: *To introduce the basic concepts of different protection schemes, Relays, Circuit breakers together with the basics of Arc Interruption Theory. Protection against over-voltages.*

Credits: 04 **Semester VII** **L-T-P: 3-1-0**

Module No.	Content	Teaching Hours
I	**Introduction to Protection System:** Philosophy of protection, nature, causes and consequences of faults, requirements of a protective scheme, Basic terminology and components of protection scheme. Fuse, Isolators. Theory of arc formation, properties of arc. Theories of arc Interruption, RRRV, Current chopping, Duties of switch-gear, Resistance switching. **Circuit Breakers-I**: Construction and operation of Air CBs, Oil CBs, Single and Multi-break construction, Vacuum circuit breaker, SF_6 circuit breaker, D.C. circuit breaker.	14
II	**Circuit Breakers-II**: Comparative merits and demerits of CBs, Application of CBs, Circuit breaker rating, Recent development in circuit breakers. **Relays:** Need for protectiverelaying,Protective Zones, Primary and back up protection, Properties of protective relaying, Relay classification, Principle and operation of electromagnetic and Induction type relay, Relay settings, Types of Relays; Directional, Distance, Differential, Over Current and earth fault relays, Bucholz relay,Harmonic resistant relay,Static relays(amplitude and phase comparator), Numerical relay/IEDs(Intelligent Electronic Devices).	13
III	**Protection Schemes:** Protection of Feeders, Generator, Transformer and Transmission line.Bus Zone and Pilot protection. **Over Voltage Protection**: Spark gaps, Arresters, Surge absorbers. BIL, Insulation coordination, Grounding of Power System.	14

Text Books:

1. Y. G. Paithankar and S R Bhide, "Fundamentals of Power System Protection", PHI.
2. S. S. Rao, "Switchgear and Protection", KhannaPublishers

References:

1. B. Ram and D. N. Vishwakarma, "Power System Protection and Switchgear", TMH.
2. C.R. Mason, "The Art and Science of Protective Relaying", New Age International, New Delhi.
3. BhaveshBhalja , R.P.Maheshwari&NileshChothani, " Protection & Switchgear", Oxford university press
4. Nirmal-Kumar C Nair, Bhuvanesh A Oza, Vijay H Makwana, Rashesh P Mehta, "Power system protection &switchgear",McGraw Hill

Course Outcomes: *At the end of the course the students will be able to:*

1. *Apply the fundamental concept of different types of protective relays.*
2. *Apply fundamental concepts of various protection schemes.*
3. *Use different types of circuit breakers according to their principle of operation, characteristics, ratings and their duties.*
4. *Explain the familiar with arc properties, their formation and extinction.*
5. *Understand with Power System Transients, Lightning arrestors, BIL and insulation coordination.*
6. *Differentiate between unit and non unit protection system*

EEE-7001: ELECTRIC DRIVES

(With effective from session 2017-18)

Objective:*This course enables to develop the basics of electric drives and maintain different types of DC in industries. Today's industrial and domestic loads demands precise and smooth variable speed control. The development of compact thyristor power converters has made this possible by smooth speed control of both AC and DC motors which are employed for several applications such as DC/AC drives, Vehicles and renewable energy.*

Credits: 04 **Semester VII** **L–T–P: 3–1–0**

Module	Content	Teaching Hour
I	**Types of Drives and Loads**: Classification of electric drives, comparison with other types of drives. Characteristics of different types of mechanical loads, stability of motor-load systems. **Selection of Motor Power Rating:** Thermal loading of motors, estimation of motor ratings for continuous, intermittent and short time duty loads. Fluctuating loads and load equalization. **Classical Methods of speed control:** Speed control of d.c. motors: rheostatic, field and armature control methods.Speed control of induction motors: stator voltage control, frequency control, pole changing and rotor resistance control methods.	14
II	**StaticControl of D.C.Drives**:Phase control of fully controlled dc drives: continuous and discontinuous conduction modes of operation. Chopper controlled drives: TRC and CLC controls, continuous, discontinuous and critical conduction modes of operation. Closed loop control of d.c. drives: phase and chopper controlled drives.Electric braking of d.c. drives.	14
III	**StaticControl of A.C. Drives**: Static stator voltage control, variable frequency Constant volts/Hertz control, slip power recovery schemes. Method ofvoltage injection in rotor circuit. Introduction to vector control. Closed loop control of induction motor drives: VSI control, static rotor resistance control, StaticScherbius drives. Electric braking of induction motor drives.	14

Text Book:

1. G.K.Dubey, "Fundamentals of Electrical Drives", Narosa Publishing House,New Delhi.
2. S.K.Pillai, "A First Course on Electric Drives", New Age Publication.

Reference Books:

1. G.K.Dubey," Power Semiconductor Controlled Drives", Prentice Hall.
2. VedamSubrahmanyam, "Electric Drives: Concepts and Applications", Tata McGraw Hill.
3. Bimal K. Bose, "Modern Power Electronics and A.C. Drives", Pearson Education, India.
4. Joseph Vithayathil, " Power Electronics, Principles and Applications", McGraw Hill, Inc.
5. R.Krishnan," Electric Motor Drives",Prentice Hall, India.

Course Outcome: *After learning the course the students should be able to:*

1. *Select a drive for a particular application based on power rating.*
2. *Select a drive based on mechanical characteristics for a particular drive application.*
3. *Operate and maintain solid state drives for speed control of DC and AC machines.*

EEE 7013: SPECIAL ELECTRICAL MACHINES

(With effective from session 2017-18)

Objective:*The objective of this course is to have brief introduction to electrical machines which have special application like Camera Auto Focus, Robotics, Solar Tracking System. It includes machines whose stator coils are energized by electronically switched currents.*

Credits: 04 **Semester VII** **L–T–P: 3–1–0**

Module No.	Content	Teaching Hour
I	**Single Phase Synchronous Motor**: Construction, principle of operation and characteristics of: reluctance motors, hysteresis motors, switched reluctance motors. **Stepper Motors:** Construction and principle of operation of: variable reluctance, permanent magnet and hybrid stepper motors.	14
II	**Permanent Magnet Machines:** Permanent magnet ac and dc motors: brushless dc motors and their important features and applications, PCB motors, introduction to permanent magnet generators. **Two-Phase AC Servomotors:** Construction, torque-speed characteristic, performance and applications.	14
III	**Single-Phase Commutator Motors**: Construction, principle of operation and applications of: universal motor, single phase a.c. series motor, repulsion motors. **Principle of voltage injection:** Principle of voltage injection in rotor circuit of slip ring induction motor: Schrage Motor. **Linear motors**: Construction and principle of operation of Linear induction motors.	14

Text Books:

1. J. Nagrath and D.P. Kothari, "*Electric Machines*" Tata McGraw Hill.
2. J.B.Gupta," Theory and Performance of Electrical Machines", S.K. Kataria and Sons.
3. AshfaqHussain, "*Electric Machines*", Dhanpatrai and Sons.

Reference Books:

1. Penshaw Taylor, "The Performanceand Design of A.C. Commutator Motors", A.H.Wheeler& Co.
2. Cyril G. Veinott , "Fractional and Sub-fractional horse power electric motors", McGraw Hill.
3. M.G. Say, "*The Performance and Design of AC machines*", Pit man & Sons.
4. A.E. Fitzgerald, C.Kingsley andUmans, "*Electric Machinery*" 6th Edition, Tata McGraw Hill.
5. F.Puchstein, T.C. Lloyd, A.G. Conard, "*Alternating CurrentMachines*", Asia Publishing House.

Outcome: *After completion of course, student will be able to:*

CO1. Understand the constructional features and operating working principle of single phase reluctance motor and stepper motor.
CO2. Understand the concept of high stating torque of double cage induction motor.
CO3. Understand the concept of speed control of PMDC motor and characteristic of BLDC motor.
CO4. Calculate the fundamentals of systematical components of 2-phase AC servo motor leading the design of its equivalent circuit and evaluation of its performance.
CO5. Acquire the knowledge of fundamentals, construction details and operating working principle of universal motors.
CO6. Understand the constructional features and operating working principle of linear induction motor including its application

BEEG0002: ELECTRICAL TECHNOLOGY

Credits: 03 **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**Introduction to Power Generation** Power generation scenario in India**,** conventional generation and plant layout: Hydroelectric power generation, thermal power generation, Nuclear power generation, comparison. Renewable generation and system layout: photovoltaic generation, wind power, tidal power, geothermal power, fuel cell. Load curves, Important terms and factors: connected load, maximum demand, average load, load factor, diversity factor.	14
II	**Economics of power generation:** fixed cost, semi fixed cost, running cost, Tariff: objective, desirable characteristics, types. **Transmission and distribution:** Electric supply system layout, introduction to ac and dc transmission system, comparison, elements of transmission: power transformer, towers, insulators, conductors, cables, distribution transformer; requirements of satisfactory electric supply, overview of distribution system, challenges in power system.	14
III	**Power factor improvement:** Power triangle, disadvantages of low power factor, causes of low power factor, power factor improvement method, calculation for power factor correction **Electrical loads:** Modelling of load, Electric lighting: Basic parameter used in lighting, various types of lighting sources: Fluorescent lamps, electrical circuitry, CFLs, LED lighting, Lighting design process, Electric Motor: load characteristics, gearing, various applications such as elevator, hybrid electric vehicle (HEV). Introduction to transducers and sensors.	14

Text Books:

1. Mehta V.K. & Mehta Rohit. Principles of Power System (Multicolor Edition).S. Chand, 2005 (illustrated, revised edition).
2. Gross, Charles A., and Thaddeus A. Roppel. Fundamentals of electrical engineering. CRC press, 2012.

Reference Books:

1. Bird, John. Electrical circuit theory and technology. Routledge, 2017
2. Hughes, Edward, et al. Hughes electrical and electronic technology. Pearson education, 2008.

Course Outcome: at the end of course student will able to,
CO1: Elaborate and compare conventional and renewable energy power generation.
CO2: Understand the terms as used in load curves.
CO3: Estimatecost of power generation and tariffs.
CO4: Identify role of various components involved in transmission and distribution of electrical power.
CO5: Understand the importance of power factor improvement.
CO6: Explain circuitry components role in various electrical loads.

BEEC0006: BASIC SYSTEM ANALYSIS

Credits:3 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hour
I	**Introduction to signals and systems**: Classification of Signals, Transformations of Independent Variables(Time), Singularity Functions: Unit Step, Unit Ramp and Unit Impulse Function, Even And Odd Signals ,Periodic and Aperiodic Signals, Real Exponential Signals, Complex Exponential Signals, Energy and Power Signals, **Basic systems**: Causal and Non Causal, Linear & Nonlinear, Time Varying and Time Invariant, System With & Without Memory, Convolution Integral	**14**
II	**Fourier and Laplace Transform Analysis**: Review of Fourier & Laplace Transforms, Transform of Basic Signals and Periodic and Complex Waveforms, Initial and Final Value Theorems, Inverse Laplace Transform , Application of Fourier and Laplace Transform To Analysis of Networks, **Z-Transform Analysis**: Concept of Z-Transform, ROC, Properties of Z-Transform, Inverse Z Transform, Initial and Final Value Theorems, Applications To Solution of Difference Equations.	**14**
III	**Analogous System:** Linear Mechanical Elements, Force-Voltage and Force-Current Analogy, Modeling of Mechanical and Electro-Mechanical Systems. **State – Variable analysis**: Introduction, State Space Representation of Linear Systems, Transfer Function and State Variables, State Transition Matrix, Solution of State Equations For Homogeneous and Non-Homogeneous Systems, Applications of State-Variable Technique To The Analysis of Linear Systems.	**14**

Text Books:

- ChoudharyD.Roy, "*Networks & Systems*", 2nd Ed., New Age International Publishers.
- I.J. Nagrath, S.N. Saran, R. Ranjan and S.Kumar, "*Singnals and Systems*", Tata Mc. Graw Hill.

References:

- C.L.Wadhwa, "*Network Analysis and Synthesis*", 3rd Ed., New Age International Publishers.
- SmarjitGhosh, "*Network Theory: Analysis and Synthesis*" PHI Learning Pvt. Ltd.
- ME Van-Valkenburg, "*Network Analysis*", 3rd Ed., PHI Learning Pvt. Ltd.
- B.P. Lathi, "*Linear Systems & Signals*" Oxford University Press.DavidK.Cheng; "*Analysis of Linear System*", Narosa Publishing Co.
- Taan S. Elali&Mohd. A. Karim, "*Continuous Signals and Systems with MATLAB*" 2nd Edition, CRCPress.

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

1. ***Understand the difference among various types of signals and their practical applications.***
2. ***Evaluate the response of a system for different types of signals.***
3. ***Apply the concept of Laplace and Fourier transform for engineering problems.***
4. ***Analyze the stability and instability of system with the help of Laplace and Z transform.***
5. ***Model a physical system in to corresponding electrical system***
6. ***Create the model of physical system based on input and output behavior.***

BEEC0009: ELECTRICAL MACHINES-I

Credits:3 **L-T-P-J:3-0-0-0**

Module No.	Content	Teaching Hour
I	**Single Phase Transformers:** Review: Classification; principle of operation, e.m.f. equation, equivalent circuit, losses and efficiency: maximum and all-day; voltage regulation.Testing : open circuit and short circuit tests, load test, Sumpner's test. **Autotransformers:** Principle of operation, equivalent circuit, comparison with two winding transformers.	14
II	**Three phase Transformers:** Construction of three phase transformers and their phase groupings; Phase transformation: three-phase to two-phase. Parallel operation of single and three phase transformers. Harmonics in transformers. **D. C. Generators:**Construction, lap and wave type windings, function of commutator, emf equation, types of d.c. machines, characteristics.	14
III	**D.C.Motors:** Armature reaction and its effects. Commutation: method of improving commutation, interpoles. Torque developed, losses and efficiency, Characteristics of different types of d.c. motors, d.c. motor starters. Testing of dc machines.	14

Text Books:

1. J. Nagrath and D.P. Kothari, "*Electric Machines*" Tata McGraw Hill.
2. J.B.Gupta," Theory and Performance of Electrical Machines", S.K. Kataria and Sons.
3. AshfaqHussain, "*Electric Machines*", Dhanpatrai and Sons.

Reference Books:

1. M.G. Say, "*The Performance and Design of AC machines*", Pit man & Sons.
2. A.E. Fitzgerald, C.KingsleyandUmans, "*Electric Machinery*" 6th Edition, Tata McGraw Hill.
3. Alexander S. Langsdorf, "Theory of Alternating Current Machinery", McGraw Hill Book Company.
4. F. Puchstein, T.C. Lloyd, A.G. Conard, "*Alternating CurrentMachines*", Asia Publishing House.
5. Alexander S. Langsdorf, " Principles of Direct-current Machines", McGraw Hill Book Company.
6. Albert E.Clayton,"The Performance and Design of Direct Current Machines",The English Language Book Society.

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

1. Understand the construction and principle of operation of operation of single and three phase transformers.
2. Evaluate the performance in terms of efficiency, voltage regulation of transformers, and the methods of testing of transformers like open and short circuit tests and the Sumpner's test.
3. Understand the construction and principle of operation of operation of auto transformers.
4. Understand the construction and principle of operation of d.c. generators including action of commutator.
5. Understand armature reaction and commutation in d.c. machines.
6. Understand the principle of operation of d.c. motors, their characteristics, and methods of starting

BEEC0011: CONTROL SYSTEM

Credits: 3 **L-T-P: 3-0-0**

Module No.	Content	Teaching Hours
I	**The Control System:** Open loop & closed control, Servomechanism, Control System Physical examples. Transfer functions, Block diagram algebra, Signal flow graph, Mason's gain formula **Control System Components:** Constructional and working concept of ac servomotor, synchros, Standard test signals.	12
II	**Time Response analysis:** Time response of first and second order systems, time response specifications, steady state errors and error constants PID compensations, performance indices, Introduction to fuzzy logic **Stability in Time Domain:** Concept of stability and necessary conditions, Routh-Hurwitz criteria and limitations. **Root Locus Technique:** The root locus concepts, construction of Root Loci **Frequency Response Analysis:** Frequency response, correlation between time and frequency responses.	14
III	**Frequency Response Analysis:** Polar plots, Bode plots **Stability in Frequency Domain**:Nyquist stability criterion, assessment of relative stability, gain margin and phase margin **Introduction to Design:** The design problem and preliminary considerations lead, lag and lead-lag networks, design of closed loop systems using compensation techniques in frequency domain**.** **Overview of State Variable Technique:** Overview of state variable technique, conversion of state variable model to transfer function model and vice-versa, diagonalization, Controllability and observability.	14

Text Books:

1. Nagrath&Gopal, Control System Engineering, New age International.

References:

1. Norman S. Nise, Control System Engineering, Wiley Publishing Co.
2. Ajit K Mandal, "Introduction to Control Engineering" New Age International.
3. R.T. Stefani, B.Shahian, C.J.Savant and G.H. Hostetter, Design of Feedback Control Systems, Oxford University Press.
4. N.C. Jagan, Control Systems, B.S. Publications.

5. K. Ogata, Modern Control Engineering, Prentice Hall of India.
6. B.C. Kuo&FaridGolnaraghi, Automatic Control System, Wiley India Ltd.
7. D.RoyChoudhary, Modern Control Engineering, Prentice Hall of India.

Outcome: *After completion of course, students will be able to:*

CO1. Explain the meaning of control system, its types as well as treatment of special control system.
CO2. Solve the transfer functions of physical systems using block diagram reduction method or signal flow graph approach.
CO3. Understand time response and frequency response analysis and stability aspects of a system.
CO4. Implement different numerical and graphical stability technique to analyze the stability of control system.
CO5. Understand the overview and importance of time domain approach such as state variable technique in control system analysis.
CO6. Design compensators for closed loop systems in frequency domain.

BEEC 0008: DIGITAL ELECTRONICS & CIRCUITS

Credits: 3 **L-T-P-J: 3-0-2-0**

Module No.	Content	Teaching Hours
I	**Number Systems &Codes:** Decimal, binary, octal, hexadecimal number system and conversion, Floating point representation, 1's &2's complement, Signed binary numbers, signed binary numbers, weighted binary codes, Excess 3 code, Error Detecting and Correcting Codes. **Boolean Algebra & Minimization:** Boolean logic operation, Boolean laws, Digital Logic Gates, Demorgan's Theorems, Gate-level minimization: K-Map, POS simplification, QuineMc-Clusky method.	14
II	**Combinational Logic:** Combinational circuits, analysis procedure, design procedure, Binary Adder-Sub tractor, Decimal Adder, Binary Multiplier, Multiplexers, De-multiplexer, Decoders, Encoders. **Synchronous sequential logic:** Sequential Circuits, Storage Elements: Latches, Flip Flops (S-R, J-K, D, T, MASTER SLAVE), Analysis of Clocked Sequential Circuits.	14
III	**Registers and Counters:** Shift Registers, Ring Counter, Ripple Counter, Synchronous Counter, Other Counters. **Digital integrated circuits:** Logic levels, propagation delay time, power dissipation, fan-out and fan-in, noise margin, logic families and their characteristics TTL, CMOS and ECL integrated circuits and their performance comparison, open collector and tri-state gates and buffers. **Memory and programmable logic:**RAM , ROM, PROM, and EPROM.	14

Text Book:

1. M. Morris Mano and M. D. Ciletti, "*Digital Design*" 6th Edition, Pearson Education.
2. S. Salivahanan& S. Asivazhagan, "*Digital Circuit & Design*", IInd Edition

Reference Books:

1. John F.Wakerly, Digital Design, Fourth Edition, Pearson/PHI, 2006
2. John. M Yarbrough, Digital Logic Applications and Design, Thomson Learning, 2002.
3. Charles H.Roth. Fundamentals of Logic Design, Thomson Learning, 2003.
4. Donald P.Leach and Albert Paul Malvino, Digital Principles and Applications, 6thEdition, TMH, 2003.
5. William H. Gothmann, Digital Electronics, 2nd Edition, PHI, 1982.

Outcomes:

To be able to:

1. Convert between Decimal, binary, octal, hexadecimal numbers and formation of the code of a number.
2. Understand Boolean laws and simplification of given function using Boolean algebra, k map & Quine-McClauskey method.
3. Understand the function & implementation of binary adder, subtractor, multiplier, Multiplexers, De-multiplexer, Decoders, Encoders.
4. Understand the function of latch and flipflop S-R, J-K, D, T and master slave and derive the state equation, state table and state diagram of a clocked sequential circuit.
5. Explain the function& mode of operation of registers shift registers and design of synchronous counters.
6. Explain the characteristics of digital logic, performance of TTL, CMOS and ECL integrated circuits, classification & structure of memory RAM, ROM, PROM, and EPROM.

BEEO 0090: ELECTRICAL MACHINES AND AUTOMATIC CONTROL

Credits: 03 **L–T–P: 3–0–0**

Module	Contents	Teaching Hours
I	**Three -Phase Transformer**: Three-Phase Transformer connections and its applications. **DC Motors:** Torque equation, starting of DC motors, speed control. **Three-Phase Induction Motor:** Torque equation, torque-slip characteristics, speed control: v/f control, rotor resistance control.	13
II	**Synchronous Machines**: Construction, derivation of EMF equation, parallel operation of alternators, effects of excitation on synchronous motor. Stepper motor, permanent magnet DC motor and its applications. **Analogous System:** Linear mechanical elements, force-voltage and force-current analogy, electrical analogy of simple mechanical systems. **Control System: Introduction:** Concept of transfer function and its determination for simple systems, open loop and closed loop controls, servomechanisms, concept of various types of systems. **Servomotor:** DC and AC servomotors. **Signals:** Unit step, unit ramp, unit impulse and periodic signals with their mathematical representations and characteristics.	13
III	**Time Response Analysis:** Time response of first and second order systems for unit step input, response specifications, steady state error and error constants. **Process Control:** Introduction of P, PI, PID controllers, their representations, characteristics and applications. **Stability:** Concepts of stability, Routh-Hurwitz criterion and determination of stability. **Frequency Response Analysis**: Correlation between time and frequency response of a second order system, polar plots, gain margin & phase margin and their determination.	13

Text Books:

- Bhimbra, P.S, "Electric Machines", Khanna Publishers.
- AshfaqHussain, "Electric Machines", Dhanpatrai& Sons.
- Nagrath&Gopal, "Control System Engineering", New age International.
- *B.S. Manke*, Linear Control Systems, Khanna Publishers.

Reference Books:

- Nagrath I. J. & Kothari D.P., "Electrical Machines", Tata McGraw Hill.
- Fitggerald A.E., Kingsley C. Jr. and Umans, "Electric Machinery", 6th Edition McGraw Hill.
- K. Ogata, "Modern Control Engineering", Prentice Hall of India.

Course Outcome: *After completion of course student will be able to*

1. *Analyze the connections of 3-phase transformer and their applications*
2. *Acquire knowledge about constructional details , principle of operation, starting and applications of DC motor, 3-phase induction motor, synchronous motors, stepper motor and PMDC motor.*
3. *Analyze the mathematical model of DC motor, 3-phase induction motors and hence control their speed.*
4. *Illustrate parallel operation of alternators and the effect of excitation on alternators.*

5. *Formulate the mathematical models of electromechanical systems and also able to describe various types of control systems and signals used.*
6. *Understand the concept of servomechanism and acquire knowledge about constructional details, principle of operation and applications of AC and DC servomotors.*
7. *Analyze the time response and stability of second order systems with the help of Routh's and Nyquist stability criterion.*
8. *Sketch the root locus, bode plot and also able to demonstrate the P, PI and PID controllers and their applications..*

BEEE 0035: SWITCHGEAR AND PROTECTION

Credits: 03 **L-T-P: 3-0-0**

Module No.	Content	Teaching Hours
I	**Introduction to Protection System:** Philosophy of protection, nature, causes and consequences of faults, requirements of a protective scheme, Basic terminology and components of protection scheme. Fuse, Isolators. **Relays:** Need for protective relaying, Protective Zones, Primary and back up protection, Properties of protective relaying, Relay classification, Principle and operation of electromagnetic and Induction type relay, Relay settings, Types of Relays; Directional, Distance, Differential, Over Current and earth fault relays, Buchholz relay, Harmonic resistant relay,	14
II	**Static relays -** (amplitude and phase comparator), Numerical relay/IEDs (Intelligent Electronic Devices). **Protection Schemes:** Protection of Feeders, Generator, Transformer and Transmission line. Bus Zone and Pilot protection. **Over Voltage Protection**: Spark gaps, Arresters, Surge absorbers. BIL, Insulation coordination, Grounding of Power System.	13
III	**Circuit Breakers-I**: Theory of arc formation, properties of arc. Theories of arc Interruption, RRRV, Current chopping, Duties of switch-gear, Resistance switching. Construction and operation of Air CBs, Oil CBs, Single and Multi-break construction, Vacuum circuit breaker, SF_6 circuit breaker, D.C. circuit breaker. **Circuit Breakers-II**: Comparative merits and demerits of CBs, Application of CBs, Circuit breaker rating, Recent development in circuit breakers.	14

Text Books:

3. Y. G. Paithankar and S R Bhide, "Fundamentals of Power System Protection", PHI.
4. S. S. Rao, "Switchgear and Protection", KhannaPublishers

References:

5. B. Ram and D. N. Vishwakarma, "Power System Protection and Switchgear", TMH.
6. C.R. Mason, "The Art and Science of Protective Relaying", New Age International, New Delhi.
7. BhaveshBhalja , R.P.Maheshwari&NileshChothani, " Protection & Switchgear", Oxford university press
8. Nirmal-Kumar C Nair, Bhuvanesh A Oza, Vijay H Makwana, Rashesh P Mehta, "Power system protection &switchgear",McGraw Hill

Course Outcomes: *At the end of the course the students will be able to:*

7. *Learn the fundamental concept of different types of protective relays.*
8. *Apply fundamental concepts of various protection schemes.*
1. *Use different types of circuit breakers according to their principle of operation, characteristics, ratings and their duties.*
9. *Become familiar with arc properties, their formation and extinction.*
10. *Become familiar with Power System Transients, Lightning arrestors, BIL and insulation coordination.*

BEEE 0036: INTELLIGENT TECHNIQUES IN ELECTRICAL ENGINEERING

Objective: *To develop a basic understanding of Artificial intelligence techniques, and their applications to Electrical Engineering and to provide motivation to design intelligent systems and control.*

Credits: 3-0-1-2 **L–T–P-J: 3–0–2-4`**

Module No.	Content	Teaching Hours
I	**Introduction:** Motivation, Rationale for using Artificial Intelligence (Neural Network, Fuzzy, Evolutionary Computation) in Engineering. **Artificial Neural Network:** Concept of Artificial Neural Networks (ANN), Adaline, Linear Separable Patterns, Single Layer Perceptron, Multilayer Perceptron, Neural Network (NN) architecture, NN Classifications, Back Propagation Algorithm, Radial Basis Function Network (RBFNN), Applications of ANN.	14
II	**Fuzzy logic**: Introduction, Classical Sets, Classical Sets Operations, Properties of Classical Sets, Fuzzy Sets, Fuzzy Membership Functions, Fuzzy Set Operations, Properties of Fuzzy Sets, Alpha-Cut Fuzzy Sets, Extension Principle, Fuzzy Measures, Measures of Fuzziness, Classical Relations vs. Fuzzy Relations, Predicate Logic, Fuzzy Logic, Approximate Reasoning, Fuzzy Rule Based System, Fuzzy Logic Controller, Applications of Fuzzy Logic.	13
III	**Evolutionary Computation:** Introduction to Evolutionary algorithms, Genetic Algorithm (GA), solution, initial population, genetic operators, fitness function, stopping condition, fitness scaling, rank scaling, proportional scaling, top scaling, selection, Roulette Wheel selection, stochastic universal sampling, rank selection, tournament selection, other selection methods, mutation, uniform mutation, Gaussian mutation, variable mutation rate, crossover techniques, other genetic operators, Generation Gap, Elitism, Duplicates, Genetic Search, Genetic Programming, Applications of GA.	13

Text Book:

- Ali Zilouchian, Mo Jamshidi, "Intelligent control systems using soft computing methodologies", CRC Press, 2001.
- James M. Keller, Derong Liu, David B. Fogel, "Fundamentals of Computational Intelligence. Neural Networks, Fuzzy Systems, and Evolutionary Computation", Wiley, 2016.
- Chennakesava R. Alavala, "Fuzzy Logic and Neural Networks-Basic Concepts and Applications" New Age Publications (Academic), 2008.

Reference Book:

- Timothy J. Ross, "Fuzzy Logic with Engineering Applications", Wiley India.
- Anupam Shukla, Ritu Tiwari, Rahul Kala, "Real Life Applications of Soft Computing", CRC Press, T & F Group.
- Kevin M. Passino and Stephen Yurkovich, "Fuzzy Control", Addison Wesley Longman, Menlo Park, CA, 1998.
- Kevin Warwick, Arthur Ekwue and Raj Agarwal, "Artificial Intelligence Techniques in Power Systems", Institution of Engineering and Technology, London, United Kingdom.

Outcome: *On successful completion of the program, the student will be able to:*

1. *Examine the fuzzy system and implement fuzzy controllers for control and classification.*
2. *Explain neural networks behavior and use them for classification, control system and optimization problem.*
3. *Obtain the optimum solution of well formulated optimization problem using GA.*

BEEE 0071: SPECIAL ELECTRICAL MACHINES

Credits: 03 **Semester VII** **L–T–P: 3–0–0**

Module No.	Content	Teaching Hour
I	**Single Phase Synchronous Motor**: Construction, principle of operation and characteristics of: reluctance motors, hysteresis motors, switched reluctance motors. **Stepper Motors:** Construction and principle of operation of: variable reluctance, permanent magnet and hybrid stepper motors.	14
II	**Permanent Magnet Machines:** Permanent magnet ac and dc motors: brushless dc motors and their important features and applications, PCB motors, introduction to permanent magnet generators. **Two-Phase AC Servomotors:** Construction, torque-speed characteristic, performance and applications.	14
III	**Single-Phase Commutator Motors**: Construction, principle of operation and applications of: universal motor, single phase a.c. series motor, repulsion motors. **Principle of voltage injection:** Principle of voltage injection in rotor circuit of slip ring induction motor: Schrage Motor. **Linear motors**: Construction and principle of operation of Linear induction motors.	14

Text Books:

4. J. Nagrath and D.P. Kothari, "*Electric Machines*" Tata McGraw Hill.
5. J.B.Gupta," Theory and Performance of Electrical Machines", S.K. Kataria and Sons.
6. AshfaqHussain, "*Electric Machines*", Dhanpatrai and Sons.

Reference Books:

6. Penshaw Taylor, "The Performanceand Design of A.C. Commutator Motors", A.H.Wheeler& Co.
7. Cyril G. Veinott , "Fractional and Sub-fractional horse power electric motors", McGraw Hill.
8. M.G. Say, "*The Performance and Design of AC machines*", Pit man & Sons.
9. A.E. Fitzgerald, C.Kingsley andUmans, "*Electric Machinery*" 6th Edition, Tata McGraw Hill.
10. F.Puchstein, T.C. Lloyd, A.G. Conard, "*Alternating CurrentMachines*", Asia Publishing House.

Outcome: *After completion of course, student will be able to:*

1. *Understand the working principle of some new machines*
2. *Application in daily and specific purposes.*
3. *Implement them for their projects.*
4. *Application of machines in feedback control and position control systems*

ADVANCE CONTROL SYSTEM

Credits: 04 **L–T–P: 3–0–0**

Module	Content	Teaching Hour
I	**State Space Analysis of Continuous System:** Review of state variable representation of continuous system, design of state observer and controller. **Analysis of Discrete System:** Discrete system and discrete time signals, state variable model and transfer function model of discrete system, conversion of state variable model to transfer function model and vice-versa, modeling of sample hold circuit, solution of state difference equations, steady state accuracy, stability on the z-plane and Jury stability criterion, bilinear transformation, Routh-Hurwitz criterion on rth planes.	14
II	**Stability:** Lyapunov's stability theorems for continuous and discrete systems, methods for generating Lyapunov function for continuous and discrete system. **Non-linear control system:** Types of non linearities, phenomena related to non-linear systems, analysis of non-linear systems, linearization method, second order non-linear system on the phase plane, types of phase portraits, singular points, system analysis by phase-plane method and describing function method.	13
III	**Optimal Control:** Introduction, formation of optimal control problem, calculus of variations minimization of functions, constrained optimization, Pontryagin's minimum maximum principle. **Adaptive Control:** Introduction, modal reference adaptive control systems, controller structure, self-tuning regulators. Introduction to neural network, fuzzy logic and genetic algorithms.	15

Text Book:

1. M. Gopal, "Digital Control and State variable Methods", Tata McGraw Hill.
2. Ajit K. Madal, "Introduction to Control Engineering: Modelling, Analysis and Design", New Age International.
3. D. Landau, "Adaptive Control", Marcel Dekker Inc.
4. S. Rajasekaran& G. A. VjayalakshmiPai, "Neural Networks, Fuzzy Logic and Genetic Alogorithms: Synthesis and Applications", Prentice Hall of India.

References:

1. Donald E. Kiv, "Optimal Control Theory: An Introduction", Prentice Hall.
2. B.C. Kuo, "Digital Control Systems", Sounders College Publishing.
3. C.H. Houpis and G.B. Lamont, "Digital Control Systems: Theory, Hardware, Software", McGraw Hill.
4. Hassan K. Khalil, "Nonlinear systems", Prentice Hall.

Outcomes:

1. At the end of the course students will be able apply the modeling concepts.
2. Students will be equipped with stability analysis of linear and nonlinear system.
3. Understand the concept of adaptive and optimal control problems and there control.

BEEG0002: ELECTRICAL TECHNOLOGY

Credits: 03 **L–T–P-J: 3–0–0-0**

Module No.	Content	Teaching Hours
I	**Introduction to Power Generation** Power generation scenario in India**,** conventional generation and plant layout: Hydroelectric power generation, thermal power generation, Nuclear power generation, comparison. Renewable generation and system layout: photovoltaic generation, wind power, tidal power, geothermal power, fuel cell. Load curves, Important terms and factors: connected load, maximum demand, average load, load factor, diversity factor.	14
II	**Economics of power generation:** fixed cost, semi fixed cost, running cost, Tariff: objective, desirable characteristics, types. **Transmission and distribution:** Electric supply system layout, introduction to ac and dc transmission system, comparison, elements of transmission: power transformer, towers, insulators, conductors, cables, distribution transformer; requirements of satisfactory electric supply, overview of distribution system, challenges in power system.	14
III	**Power factor improvement:** Power triangle, disadvantages of low power factor, causes of low power factor, power factor improvement method, calculation for power factor correction **Electrical loads:**Modelling of load, Electric lighting: Basic parameter used in lighting, various types of lighting sources: Fluorescent lamps, electrical circuitry,CFLs, LED lighting, Lighting design process, Electric Motor: load characteristics, gearing, various applications such as elevator, hybrid electric vehicle (HEV). Introduction to transducers and sensors.	14

Text Books:

3. Mehta V.K. & Mehta Rohit. Principles of Power System (Multicolor Edition).S. Chand, 2005 (illustrated, revised edition).
4. Gross, Charles A., and Thaddeus A. Roppel. Fundamentals of electrical engineering. CRC press, 2012.

Reference Books:

3. Bird, John. Electrical circuit theory and technology. Routledge, 2017
4. Hughes, Edward, et al. Hughes electrical and electronic technology. Pearson education, 2008.

Course Outcome: at the end of course student will able to,
CO1: Elaborate and compare conventional and renewable energy power generation.
CO2: Understand the terms as used in load curves.
CO3: Estimate cost of power generation and tariffs.
CO4: Identify role of various components involved in transmission and distribution of electrical power.
CO5: Understand the importance of power factor improvement.
CO6: Explain circuitry components role in various electrical loads.

BEEG0800: ELECTRICAL ENGINEERING LAB

Objective: *To provide exposure to the students with hands on experience on basic Electrical & Electronics circuits.*

Credits: 01 **L–T–P-J: 0–0–2-0**

Module No.	Content	Teaching Hours
I, II & III	1. To Verify the Thevenin's Theorem (DC Circuits). 2. To Verify the Maximum Power Transfer Theorem (DC Circuits). Also Draw Graph between Power and Load Resistance. 3. To Verify the Superposition Theorem (DC Circuits). 4. To Study the Phenomenon of Resonance in R-L-C Series Circuit and to Draw Graph Between Frequency and Current. Also Show Half Power Points. 5. To Determine the V-I Characteristics of A Semiconductor Diode. Also Calculate Forward and Reverse Static and Dynamic Resistances. 6. To Study the Half Wave and Full Wave (Center Tapped) Rectifier With and Without Filter. Also to Calculate the Ripple Factor in Both Cases (Without Filter). 7. To Study Single Phase (Induction Type) Energy Meter. To Study Various Logic Gates Such As OR, AND, NOT, NAND, NOR. 8. Study of CRO and Measurement of Voltage and Frequency Using CRO. 9. V-I Characteristics of Zener Diode. 10. Identification of Active and Passive Components. 11. V-I Characteristics of Bipolar Junction Transistor in Common Base Mode.	24

Outcomes: *At the end of the course students will be able*

1. *To construct basic circuits.*
2. *To construct circuits on a breadboard.*
3. *To measure the various electrical quantities(like voltage, current, frequency and power)*
4. *To measure resistance using DMM*
5. *To measure energy using single-phase energy meter.*
6. *To understand working of 1-phase transformer.*
7. *To write satisfactory laboratory reports.*

BEEG 0802: ELECTRICAL TECHNOLOGY LAB

Objective: *Primary purpose of this laboratory course is to familiarize students with the various hardware simulations. Along withArduino is a prototype platform (open-source) based on an easy-to-use hardware and software. It consists of a circuit board, which can be programmed (referred to asa microcontroller) and a ready-made software called Arduino IDE (IntegratedDevelopment Environment), which is used to write and upload the computer code to thephysical board. In form of various experiments are to be given so as to explore the vast capabilities of these hardware in field of academics and industrial application.*

Credits: 1 **L-T-P-J:0-0-2-0**

Module No	List of Experiment	Teaching hours
I, II & III	1. To develop Matlab program to determine power factor and calculation of shunt capacitor for power factor improvement 2. Study of electricity bill for industry and residential consumers 3. To develop a Matlab program to design the lightning of an office space 4. To perform the electrical load, their rating calculation of a residential building. 5. To perform the study of Arduino – description and installation 6. To perform the experiment of LED blinking, fading LED, reading analog voltages, LED bar graph using arduino board 7. To perform an experiment on humidity sensor, temperature sensor, water detector/sensor, PIR sensor, ultra sonic sensor using arduino board. 8. To perform speed control, direction reversal of small rating DC motors. 9. To perform interfacing of electric motors with arduino board.	24

References:

1. *Exploring Arduino: Tools and Techniques for Engineering Wizardry*.
2. *Programming Arduino: Getting Started with Sketches (Tab) 2nd Edition, Kindle Edition.*
3. *Arduino: 101 Beginners Guide*

Outcomes:

1. *To be able to understand need of hardware simulation in academia as well as industry.*
2. *To be able to develop a comprehensive understanding of various hardware simulation.*
3. *To be able to solve theoretical problem by using hardware simulation.*
4. *Can make a workable model of his idea on real world hardware.*

BEEG 0801: ELECTRICAL SIMULATION LAB

Objective: *Primary purpose of this laboratory course is to familiarize students with the various simulation software's. Along with introduction, hands on practice in form of various experiments are to be given so as to explore the vast capabilities of these software's in field of academics and industrial application.*

Credit: 02 **L-T-P-J: 0-0-4-0**

Module No.	Content	Teaching Hours
I, II & III	**List of Experiments** 1. Introduction to MATLAB. 2. To perform basic arithmetic operations using MATLAB. 3. To perform basic operations with matrices using MATLAB. 4. Script files application and managing data using MATLAB. 5. To perform basic operation on a given polynomial such as addition, subtraction, multiplication & division. 6. To perform various plotting options using MATLAB. 7. Introduction to SIMULINK. 8. Basic circuit operations using MATLAB (SIMULINK). 9. Introduction to advanced tools such as PSIM. 10. Basic circuit operations using PSIM. 11. Impact of energy storing element on output waveforms for a given electrical circuit using PSIM. 12. Comparison of a common problem on MATLAB and PSIM.	24

Text Books:

1. Gilat, Amos. MATLAB: An introduction with Applications. John Wiley & Sons, 2004.
2. Palm, William J. Introduction to MATLAB for Engineers (BEST Series). McGraw-Hill Higher Education, 2005.
3. McMahon, David. MATLAB demystified. New York: McGraw-Hill, 2007.

Outcomes:

1. *To be able to understand need of simulation software's in academia as well as industry.*
2. *To be able to develop a comprehensive understanding of various software's.*
3. *To be able to solve theoretical problem by using software's.*
4. *Can make a workable model of his idea on simulation software before converting it to real world hardware.*

BEEC 0804: ELECTRICAL MEASURMENT LAB

Objectives: *The objective of the lab is that student will learn testing methods of energy meter and current transformer. To learn measurement of low and medium resistance, use of ac bridges for L and C measurement, measurement of power and power factor & to understand the basics of active and reactive power. The students will also able to understand the basics of current transformer and its applications*

Credits: 1 **L-T-P-J: 0-0-2-0**

Module No.	Content	Teaching Hours
I,II,III	1. Measurement of low resistance by using Kelvin double bridge. 2. Measurement of self-inductance using Anderson Bridge. 3. Study of the Schering Bridge and to find capacitance of the capacitor with the help of Schering Bridge. 4. Study of Hay's bridge and to find self-inductance of the given inductor with the help of hay's bridge. 5. Study of a De-Sauty bridge & to compare the capacitance of Two capacitors with the help of De-Sauty Bridge 6. To measure the form factor of rectified sine wave and calculation of error. 7. Measurement of weight by using Load cell. 8. Instrument Transformer (CT &PT). 9. To draw the characteristics of the given LVDT. 10. To study the operation of a LDR and draw its V-I characteristics. 11. Measurement of Level by using Capacitive Transducer. Measurement of phase difference and frequency using CRO (lissajous figure).	24

Outcomes: *After successful completion of the lab student will-*

1. *Identify the parts of measuring instruments and select a suitable measuring instrument for measurement of ac/dc electrical quantity.*
2. *Differentiate between MI, MC and electrostatic instruments.*
3. *Use of instrument transformers used during measurement of current and voltages.*
4. *Design and calculate the resistance, inductance and capacitance by using potentiometers, ac bridges.*

BEEC 0806: ELECTRICAL MACHINES LAB-I

Objective: *To expose the students to the operation of DC machines, Transformers and give them experimental skills.*

Credits: 1 **L-T-P-J:0-0-2-0**

Module No.	Content	Teaching Hours
I,II,III	1. To obtain magnetization characteristics of a D.C. shunt generator. 2. To obtain load characteristics of a compound generator (a) cumulatively compounded (b) differentially compounded. To obtain load characteristics of a D.C. shunt generator 3. To obtain efficiency of a dc shunt machine using Swinburn's test. 4. To perform Hopkinson's test and determine losses and efficiency of DC machine. 5. To obtain speed-torque characteristics of a dc shunt motor. 6. To obtain speed control of dc shunt motor using (a) armature resistance control (b) field control 7. To study Ward Leonard method of speed control of dc motor. 8. To perform polarity and ratio test of single phase transformer. 9. To perform open circuit and short circuit test in single phase transformer and find efficiency and voltage regulation. 10. To obtain efficiency and voltage regulation of a single phase transformer by Sumpner's test. 11. To perform polarity and ratio test on 3-phase transformer. To study various connections of 3-pahse transformers. 12. To study Scott connection of transformers.	24

Outcome: *After successful completion of the lab student will-*

1. *Analyze the characteristics of DC and Transformer.*
2. *Understand the concept of efficiency, winding resistance, short circuit test, and load test.*

3. *Experimentally obtain the load characteristics of various dc motors and generators.*

BEEC 0808: CONTROL SYSTEM LAB

Objective: *The objective of the lab course is to strengthen the knowledge of Feedback control systems. To introduce the concept of different controller and their time response comparison & to familiarize the student with computer software application such as MATLAB Software as a supplementary tool for solving control related problems.*

Credits: 1 **L-T-P-J:0-0-2-0**

Module NO.	Contents	Lab Hours
I, II & III	1. Open loop response of various systems. 2. Closed loop response of various systems. 3. Lead-Lag compensation of first order system under various system parameter changes. 4. Transfer function determination of thermal system and Temperature control using RTD (up to 100^0 C) with Analog and Digital PID. 5. Transfer function determination of light intensity system and Light intensity control using photo-diode (up to 2000 Lux) with Analog and Digital PID. 6. To study dc motor speed control in open & closed loop configuration with eddy current braking as a disturbance. **7. DC Motor Position/Speed Control:** I. DC motor position plant parameter measurement & transfer function determination. II. DC motor position plant transfer function determination by indirect method (frequency Response) III. Closed loop control of DC motor a) DC servo motor speed control or velocity control using PID control with step change in set point b) DC servo motor position control using PID control with step change in set point c) Cascade control of speed & position feedback using Analog & Digital PID. **8. AC Servo motor control:** I. Open loop response of AC servo motor and determination of transfer function II. Torque-speed characteristics of AC servo motor III. Position control of AC servomotor with step change in set point using Analog and Digital PID 9. To study the speed-torque characteristics of an AC servo motor. **10. Fuzzy Logic Control:** I. Temperature control using RTD (upto 100^0 C). II. Light intensity control using photo-diode (upto 2000 Lux). III. DC servo motor position control IV. DC motor speed/velocity control 11. To study two dc potentiometers as an error detector. 12. To study synchro-transmitter and receiver and obtain output v/s input characteristics. **Software based experiments:** **1.** To determine time domain response of a second order systems for step input and obtain transient response specifications. **2.** To plot root locus diagram of an open loop transfer function and determine range of gain 'k' for stability.	24

	3. To plot Bode diagram of an open loop transfer function and examine the stability of the closed loop system using gain margin & phase margin. **4.** To draw a Nyquist plot of an open loop transfer function and examine the stability of the closed loop system. To convert transfer function of a system into state space form and vice-versa.	

Outcomes: *After completion of course student will be able to learn*

1. *Student will have knowledge of feedback systems.*
2. *Student will have knowledge of different controller.*
3. *Implement different numerical control problem through MATLAB software and understand the MATLAB commands and can verify the results.*

BEEC0807: ELECTRICAL MACHINES LAB-II

Objective: *To prepare the students to have a basic knowledge of 1-phase Induction motor, 3-phase Induction motor and synchronous motor.*

Credits: 1 **L-T-P-J:0-0-2-0**

Module No.	Content	Teaching Hours
I	**Hardware based experiments** 1. To perform no load and blocked rotor tests on a three phase squirrel cage induction motor and determine equivalent circuit. 2. To perform load test on a three phase induction motor and draw: Torque -speed characteristics 3. To study speed control and reversal of direction of rotation of three phase induction motor by varying supply voltage. 4. To perform open circuit and short circuit tests on a three phase alternator and determine voltage regulation at full load and at unity, 0.8 lagging and leading power factors by (i) EMF method (ii) Z P F method 5. To determine V-curves and inverted V-curves of a three phase synchronous motor at no load 6. To determine Xd and Xq of a three phase salient pole synchronous machine using the slip test and draw the power-angle curve. 7. To study synchronization of an alternator with the infinite bus by using two bright and one dark lamp method. **Software based experiments** 8. To determine speed-torque characteristics of three phase slip ring induction motor and study the effect of including resistance, or capacitance in the rotor circuit. 9. To determine speed-torque characteristics of single phase induction motor and study the effect of voltage variation. 10. To determine speed-torque characteristics of a three phase induction by (i) keeping v/f ratio constant (ii) increasing frequency at the rated voltage.	24

Outcomes: *After performing experiments in this lab, students will have knowledge about the various parts of the machines. They will be able to obtain the speed-torque characteristics, perform No - load and block rotor test and control the speed*

using various methods for 1-phase and 3-phase Induction motor. They will also be able to obtain the V-curve of synchronous motor and parallel operation of two alternators.

BEEC0805: ANALOG & DIGITAL ELECTRONICS LAB

Credits: 01 **L-T-P-J: 0-0-2-0**

Module No.	List of Experiments:	Lab Hours
I,II & III	1. To Study V-I Characteristic of JFET and MOSFET. 2. Realization of Multistage Amplifier Using BJT and Calculation of Current Gain. 3. Realization of comparator and zero crossing detector using op- Amp. 4. Realization of adder and subtractor using op-Amp. 5. Realization of 2nd order active low pass and high pass filter. 6. Realization of triangular and sine wave generator using op-Amp. 7. Realization of Astable and Mono stable multi vibrator using IC 555. 8. Realization of full-adder & full subtractor using logic gates and using Boolean expression. 9. Realization of 4-bit even / odd parity checkers using Ex-OR gate. 10. Realization of 4-bit binary decoder/ demultiplexer. 11. Realization of 2-bit/ 4-bit multiplexer. 12. Realization of decimal to BCD encoder using IC 74147. 13. Realization and implementation of RS, JK, T and D flip-flop using logic gates. 14. Realization and implementation serial in parallel out and parallel in serial out shift register. 15. Realization and implementation 4-bit binary ripple counter using JK flip-flop. 16. Realization and implementation of 2-bit up/down synchronous counter.	24

- **Have to perform any 10 experiments out of these.**

Outcomes: *A student who successfully fulfills the course requirements will have demonstrated:*

1. *An ability to operate laboratory equipment.*
2. *An ability to design the digital circuits with basic resistors and semiconductor devices to meet a set of specifications.*
3. *An ability to simulate the designed digital circuits using Pspice software.*
4. *An ability to construct, analyze, and troubleshoot the analog & digital circuits.*
5. *Ability to measure and record the experimental data, analyze the results, and prepare a formal laboratory report.*

BEEC0810: POWER ELECTRONICS LAB

Objective:*The objective of this lab is that students will understand the fundamentals of power electronic devices and circuits and also their simulations using different simulation softwares.*

Credits: 1 **L-T-P-J:0-0-2-0**

Module No.	Content	Lab Hours
I,II & III	***LIST OF EXPERIMENTS*** 1. To study V-I characteristics of SCR and measure latching and holding Currents. 2. To study UJT trigger circuit for half wave and full wave control. 3. To study single-phase half wave controlled rectified with (i) resistive load (ii) inductive load with and without free-wheeling diode. 4. To study single phase (i) fully controlled (ii) half controlled bridge rectifiers with resistive and Inductive loads. 5. To study three-phase fully/half controlled bridge rectifier with resistive and inductive loads. 6. To study single-phase ac voltage regulator with resistive and inductive loads. 7. To study single phase cyclo-converter. 8. To study triggering of (i) IGBT (ii) MOSFET (iii) power transistor 9. To study operation of IGBT/MOSFET chopper circuit. 10. To study MOSFET/IGBT based single-phase bridge inverter. 11. To obtain illumines control using TRIAC. **SOFTWARE BASED EXPERIMENTS (PSPICE/MATLAB)** 12. To obtain simulation of SCR and GTO thyristor. 13. To obtain simulation of Power Transistor and IGBT. 14. To obtain simulation of single phase fully controlled bridge rectifier and draw load voltage load current waveform for inductive load. 15. To obtain simulation of single phase full wave ac voltage controller and draw load voltage and load current waveforms for inductive load. 16. To obtain simulation of step down dc chopper with L-C output filter for inductive load and determine steady-state values of output voltage ripples in output voltage and load current.	*24*

Outcomes: *Ability to design and conduct experiments for different converters.*

1. *Ability to simulate characteristics of SCR, MOSFET, IGBT, GTO, UGT.*

2. *Ability to simulate Rectifier, Chopper and AC Voltage Controller for different types of load.*

BEEC0809: POWER SYSTEM LAB

Objective: *To allow students to know various aspects of power systems: Transmission line, power cables, PV module characteristics measurement & load flow, system study & analysis of symmetrical and unsymmetrical faults.*

Credits: 1 **L-T-P-J:0-0-2-0**

Module	List of Experiments:	Lab Hours
I,II & III	**Hardware based** 1. To calculate the ABCD parameters of transmission lines for Nonimal-T &Noninal-π models & determine the efficiency & voltage regulation of transmission lines. Also To study the Ferrenti effect on transmission lines. 2. To study the VAR shunt compensation for long transmission line. 3. To determine the fault location in the cables using Murray loop test. 4. To study 3 phase short circuit fault. 5. To study the operation of over voltage relay and hence obtain the voltage characteristics. 6. To study the I-V characteristics of P-V cell. 7. To study the series and parallel operation of P-V module. 8. Efficiency of solar P-V module. 9. Observation of current waveform for linear and nonlinear loads and calculation. 10. To perform the power flow experiment on radial & ring main distribution network. **Simulation Based Experiments** 11. To obtain steady state, transient and sub-transient short circuit currents of 3 phase alternator. 12. To formulate Y-bus for a given power system network. 13. To perform symmetrical fault analysis in a given power system 14. To perform unsymmetrical fault analysis in a given power system for LG, LL, LLG faults. 15. To perform the load flow analysis for a given power system network using Gauss Seidal method. 16. Introduction of ETAP & performing a load flow, short circuit analysis using ETAP.	24

Outcomes: *After successful completion of the lab the student will-*

1. *Understand how to measure electrical parameters characteristics of a 3-phase transmission line.*
2. *Understand the effect of voltage level on power transmission and the effect that different types of loads (capacitive, inductive) have on power plant loading.*
3. *Understand the procedure and steps needed to implement a load flow system study and interpret the results provided by the software.*

4. *Understand the PV & IV characteristics of solar cell.*

BEEC 0811: MICROPROCESSOR LAB

Objective: *In the last twenty five years or so, microprocessors in general have brought about a revolution in computer science, manufacturing, telecommunications as well as in space and high-energy physics. In view of the impact of this new technology .In recent years the Laboratory has organized and provided support not only to courses strictly related to Microprocessors, but also to other activities.*

Credits: 1 **L-T-P-J:0-0-2-0**

Module No.	List of Experiments:	Lab Hours
I,II & III	**1.** To Study of 8085 Microprocessor Kit. **2.** To Study of 8086 Microprocessor Kit. **3.** Write a program to add two 8-bit numbers. **4.** Write a program to add two 16-bit numbers. **5.** Write a program to subtract two 8-bit numbers. **6.** Write a program to subtract two 16-bit numbers. **7.** Write a program to multiply two 8 bit numbers by repetitive addition method. **8.** Write a program to divide two 8 bit numbers. **9.** To develop and run a program for finding out the largest from a given set of numbers. **10.** To develop and run a program for finding out the smallest from a given set of numbers. **11.** To develop and run a program for arranging in ascending/descending order of a set of numbers. **12.** To perform computation of square of a given number. **13.** Write a program to transfer the block of data from one memory location to other memory location. **14.** Interfacing with 8255 in I/O mode/BSR mode to 8085/8086 based system. **15.** Interfacing with 8253 to 8085/8086 based system	24

Course outcomes: *At the end of the course student will have ability to*

1. *To familiarize with the assembly level programming.*
2. *Design circuits for various applications using Microcontrollers.*
3. *An in-depth knowledge of applying the concepts in real time applications.*
4. *To provide students with solid foundation on interfacing the external devices to the processor according to the user requirements to create novel products and solutions for the real life problems*