B. TECH. ELECTRCAL & ELECTRONICS ENGINEERING

Total Contact Hours = 33 **Total Marks = 1000** **Total Credits = 27**

SEMESTER 3rd		Contact Hrs			Marks			Credits
Subject Code	**Subject Name**	**L**	**T**	**P**	**Int.**	**Ext.**	**Total**	
BMAT0- 301	Mathematics-III	3	2	0	40	60	100	5
BEEE1-301	Network Analysis and Synthesis	3	1	0	40	60	100	4
BEEE1-302	Electrical Measurement & Instrumentation	3	1	0	40	60	100	4
BEEE1-303	Electrical Machines –I	3	1	0	40	60	100	4
BEEE1-304	Electronic Devices & Circuits	3	1	0	40	60	100	4
BEEE1-305	Measurement & Instrumentation Lab.	0	0	2	60	40	100	1
BEEE1-306	Electrical Machines –I Lab.	0	0	2	60	40	100	1
BEEE1-307	Electronic Devices & Circuit Lab.	0	0	2	60	40	100	1
BEEE1-308	Training#	0	0	4	60	40	100	2
BSOS0-F91	Soft Skills- I	0	0	2	60	40	100	1
Total		**15**	**6**	**12**	**500**	**500**	**1000**	**27**

#Workshop training will be imparted in the institution at the end of 2nd semester for four-week duration (Minimum 36 hr per week) industrial tour will also from the part of this training.

Total Contact Hours = 26 **Total Marks = 800** **Total Credits = 23**

SEMESTER 4th		Contact Hrs			Marks			Credits
Subject Code	**Subject Name**	**L**	**T**	**P**	**Int.**	**Ext.**	**Total**	
BEEE1- 409	Electrical Machines-II	3	1	0	40	60	100	4
BEEE1- 410	Linear Control System	3	1	0	40	60	100	4
BEEE1- 411	Digital Electronics	3	1	0	40	60	100	4
BEEE1- 412	Power System-I	3	1	0	40	60	100	4
BEEE1- 413	Electromagnetic Field Theory	3	1	0	40	60	100	4
BEEE1- 414	Control System Lab.	0	0	2	60	40	100	1
BEEE1-415	Digital Electronics Lab.	0	0	2	60	40	100	1
BSOS0- F92	Soft Skills-II	0	0	2	60	40	100	1
Total		**15**	**5**	**6**	**380**	**420**	**800**	**23**

Total Contact Hours = 26 **Total Marks = 800** **Total Credits = 22**

SEMESTER 5th		Contact Hrs			Marks			Credits
Subject Code	**Subject Name**	**L**	**T**	**P**	**Int.**	**Ext.**	**Total**	
BEEE1- 516	Signals & Systems	3	1	0	40	60	100	4
BEEE1- 517	Power Electronics & Utilization	3	1	0	40	60	100	4
BEEE1- 518	Microprocessors and interfacing	3	1	0	40	60	100	4
BEEE1- 519	Microprocessors Lab	0	0	2	60	40	100	1
BEEE1-520	Training#	0	0	4	60	40	100	2
BSOS0-F93	Soft Skills-III	0	0	2	60	40	100	1
Department Elective – I (Select any one)		3	0	0	40	60	100	3
BEEE1-556	Sensors & Transducers							
BEEE1-557	Electrical Engineering Materials							
BEEE1-558	Generation and Economics of Electrical Power							
BEEE1-559	Modern Optimization Techniques							
Open Elective – I		3	0	0	40	60	100	3
Total		**15**	**3**	**8**	**380**	**420**	**800**	**22**

#Industrial training to be imparted at the end of 4th semester for six weeks

Total Contact Hours = 23 **Total Marks = 800** **Total Credits = 20**

SEMESTER 6th		Contact Hrs			Marks			Credits
Subject Code	**Subject Name**	**L**	**T**	**P**	**Int.**	**Ext.**	**Total**	
BEEE1- 621	Non Linear & Digital Control Systems	3	1	0	40	60	100	4
BEEE1- 622	Power System-II	3	1	0	40	60	100	4
BEEE1- 623	Power System Lab	0	0	2	60	40	100	1
BEEE1- 624	Power Electronics Lab	0	0	2	60	40	100	1
BSOS0-F94	Soft Skills-IV	0	0	2	60	40	100	1
Department Elective – II		3	0	0	40	60	100	3
BEEE1-660	Fuzzy Logic Systems							
BEEE1-661	VLSI Design							
BEEE1-662	Energy auditing & Management							
BEEE1-663	Micro-controller and Embedded Systems							
Department Elective – III		3	0	0	40	60	100	3
BEEE1-664	Digital Signal Processing							
BEEE1-665	Remote control & Telemetry							
BEEE1-666	Non-Conventional Energy Resources							
BEEE1-667	Neural Networks							
Open Elective – II		3	0	0	40	60	100	3
Total		**15**	**2**	**6**	**380**	**420**	**800**	**20**

Students will undergo 8-week industrial training after end semester examinations after 6th semester and present a seminar along with submission of report in 7th semester

Total Contact Hours = 32 **Total Marks = 800** **Total Credits = 24**

SEMESTER 7th		Contact Hrs			Marks			Credits
Subject Code	**Subject Name**	**L**	**T**	**P**	**Int.**	**Ext.**	**Total**	
BEEE1- 725	Computer Applications in Power System Analysis	3	1	0	40	60	100	4
BEEE1- 726	Communication System	3	1	0	40	60	100	4
BEEE1- 727	Computer Applications in Power System Analysis Lab.	0	0	2	60	40	100	1
BEEE1- 728	Communication System Lab.	0	0	2	60	40	100	1
BEEE1-729	Minor Project*	0	0	8	60	40	100	4
BEEE1-730	Industrial Training	0	0	8	60	40	100	4
Department Elective – IV		3	0	0	40	60	100	3
BEEE1-768	Industrial Automation							
BEEE1-769	Image Processing							
BEEE1-770	High Voltage Engineering							
BEEE1-771	HVDC & EHVAC Systems							
Open Elective – III		3	0	0	40	60	100	3
Total		**12**	**2**	**20**	**400**	**400**	**800**	**24**

***** *In this semester, the candidate shall submit a Minor Project (Hardware/ Software) based on area of interest in consultation with his/her supervisor. Student has to deliver the seminar associated with the same work. The same work of minor project can be extended to Major Project in the next semester.*

Total Contact Hours = 21 **Total Marks = 400** **Total Credits = 14**

SEMESTER 8th		Contact Hrs			Marks			Credits
Subject Code	**Subject Name**	**L**	**T**	**P**	**Int.**	**Ext.**	**Total**	
BEEE1- 831	Pulse Wave shaping & Switching	3	1	0	40	60	100	4
BEEE1- 832	Software Lab.	0	0	2	60	40	100	1
BEEE1- 833	Major Project	0	0	12	60	40	100	6
Department Elective – V		3	0	0	40	60	100	3
BEEE1-872	Electrical Machine Design							
BEEE1-873	Biomedical Instrumentation							
BEEE1-874	Flexible AC Transmission Systems							
BEEE1-875	Substation Equipment & Design							
BEEE1-876	Linear Integrated Circuits							
Total		**6**	**1**	**14**	**200**	**200**	**400**	**14**

Total Credits

Semester	Credits
I	25
II	25
III	27
IV	23
V	22
VI	20
VII	24
VIII	14
Total	**180**

MATHEMATICS-III

Subject Code: BMAT0-F91 **L T P C** **Duration: 55 Hrs.**
3 2 0 5

UNIT-I (13 Hrs.)

Fourier Series: Periodic function, Fourier Seies, Dirichlet's conditions, Fourier series for even and odd functions, Change of interval, Half range Fourier series, Other forms of Fourier series.

Fourier Transforms: Dirichlet's conditions, Fourier integral formula (without proof), Fourier transform, Inverse Theorem for Fourier transform, Fourier sine and cosine transforms and their inversion formulae. Properties of Fourier transform, Convolution theorem of Fourier transforms, Parseval's identity.

UNIT-II (10 Hrs.)

Laplace Transforms: Laplace transforms of various standard functions (Exponential, Algebraic, Sine, Cosine), Properties of Laplace transforms, inverse Laplace transforms, transform of derivatives and integrals, Laplace transform of unit step function, impulse function,

Application of Laplace Transforms: Solution of ordinary linear differential equations with constant coefficients, and simultaneous differential equations.

UNIT-III (12 Hrs.)

Partial Differential Equations: Formation of partial differential equations, Linear partial differential equations, homogeneous partial differential equations with constant coefficients. Classification of partial differential equation.

Applications of PDEs: Wave equation and Heat conduction equation in one dimension. Two dimensional Laplace equation in Cartesian Coordinates, solution by the method of separation of variables.

UNIT-IV (10 Hrs.)

Functions of Complex Variable: Limits, continuity and derivative of the function of complex variable, Analytic function, Cauchy-Riemann equations, conjugate functions, harmonic

functions; Conformal Mapping: Definition, standard transformations, translation, rotation, inversion, bilinear. Complex Integration: Line integrals in the complex plane, Cauchy's theorem, Cauchy's integral formula and derivatives of analytic function. Taylor's and Laurent's expansions (without proofs), singular points, poles, residue, Integration of function of complex variables using the method of residues(Integration Of type

$\int_0^{2\pi} F(Cos\theta, Sin\theta)d\theta, \quad \int_{-\infty}^{\infty} \frac{f(x)}{F(X)} dx)$

Recommended Books:

1. E. Kreyszing, 'Advanced Engineering Mathematics', 8th Edn., John Wiley, New Delhi.
2. B.S. Grewal, 'Higher Engineering Mathematics', Khanna Publishers, New Delhi.
3. Ian N. Sneedon, 'Elements of Partial Differential Equations', McGraw- Hill, Singapore, **1957**.
4. Peter. V. O'Nil, 'Advanced Engineering Mathematics', Wadsworth Publishing Company.
5. H.C. Taneja, 'Engineering Mathematics', Volume-I & II, I.K. Publisher.

NETWORK ANALYSIS AND SYNTHESIS

Subject Code: BEEE1-301 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

Course Objectives

1. To aware the students about the basics of networks.
2. To provide them basic concepts of different types of network theorems and their applications.
3. To impart knowledge about different circuits, analysing and synthesizing the circuits.

Course Outcomes

1. Students will be having skills to design, analyse and synthesize the circuits.
2. Knowledge of mathematical forms such as Laplace transforms and designing of filters circuits.

UNIT-I (10 Hrs.)

Circuits Concepts: Independent and dependent sources, Standard test signals: Step, ramp, impulse, and doublet. Mesh and nodal analysis. Network Theorems: Superposition, Thevenin's, Norton's, Maximum Power Transfer, Millman's, Tellegen's and Reciprocity.

UNIT-II (12 Hrs.)

Time and Frequency Domain Analysis: Representation of basic circuits in terms of generalized frequency and their response, Laplace transform, transient and steady response, transfer function, poles and zeros, pole zero diagram, time domain behaviors from poles and zeros, Convolution Theorem.

UNIT-III (12 Hrs.)

Network Synthesis: Network functions, Impedance and admittance function, Transfer functions. Network function for two port network, Sinusoidal network in terms of poles and zeros, Real liability condition for impedance synthesis of RL, LCand RC circuits, network synthesis techniques for 2-terminal network, foster and cauer forms.

UNIT-IV (11 Hrs.)

Filters Synthesis: Classification of filters, characteristics impedance and propagation constant of pure reactive network, Ladder network, T-section, π-section, terminating half section, pass bands and stop bands, Design of Constant-K, m-derived filters, Composite filters.

Recommended Books

1. Bird John, 'Electrical Circuit Theory and Technology'.
2. Abhijit Chakraborty, 'Circuit Theory', Dhanpat Rai, **2001.**
3. D. Roy Chaudhury, 'Networks and Synthesis', New Age International.
4. T.S.K.V. Iyer, 'Circuit Theory', Tata McGraw Hill, **2006.**
5. Mohan, Sudhakar Sham, 'Circuits and Networks Analysis and Synthesis TMH, **2005.**
6. Van Valkenberg, 'Network Analysis and Synthesis', PHI Course, **2009.**

ELECTRICAL MEASUREMENTS & INSTRUMENTATION

Subject Code: BEEE1-302 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

Course Objectives

1. To aware the students about the basics of measurements and instrumentation systems.
2. To impart knowledge about different instruments for electrical measurements.
3. To provide them basic concepts of different types of sensors and transducers.

Course Outcomes

1. The students will be having skills to design, analyse and instruments.
2. To gain the skill knowledge of bridges and CRO operations.

UNIT-I (12 Hrs.)

Measuring Instruments: Introduction to measuring techniques, necessity of measurements, block diagram of measurement system, types of instruments, classification of standards, fundamental and derived units. Instrument characteristics; accuracy, precision, repeatability and sensitivity. Different types of errors in measurement. Principle of operation and constructional features; D'Arsonval galvanometer, Moving Coil PMMC and Moving Iron instrument (Repulsion and Attraction type), Electrodynamics instruments.

UNIT-II (11 Hrs.)

Measurement of Resistance: Low, Medium and High resistance measurement using Kelvin Double Bridge, Ammeter-Voltmeter method, Wheat Stone Bridge, Loss of Charge and Megger.

Measurement of Inductance and Capacitance: Maxwell Inductance, Hay's, Anderson and Schering Bridges, Measurement of frequency by Wein bridge method.

UNIT-III (11 Hrs.)

Oscilloscope: Basic principle and construction of Analog CRO, sweep modes, applications in measurement of voltage, frequency (Lissajous pattern), Introduction to Dual Trace Oscilloscope, Digital Storage Oscilloscope, sampling oscilloscope. Comparison between analog and digital oscilloscope.

UNIT-IV (11 Hrs.)

Transducers: Transducer and its classifications, basic requirements of Transducer/Sensors. Displacement Transducers: LVDT, RVDT and Piezo Electric. Resistance Thermometer, Thermistors, Thermocouples and Strain Gauge Transducer: Basic principle of operation of Resistance strain gauge.

Recommended Books

1. H. Cooper, 'Modern electronic instrumentation and measurement techniques', PHI
2. A.K. Sawhney, 'Electronic Instrumentation and Measurement', Dhanpat Rai & Sons, **2011.**
3. Jones and Chin, 'Electronic Instruments and Measurement'.
4. J. Toppin, 'Theory of Errors', Wessely Publishing., **2000.**

ELECTRICAL MACHINES-I

Subject Code: BEEE1-303 **L T P C** **3 1 0 4** **Duration: 45 Hrs.**

Course Objectives

1. To aware the students about the basics of electromechanical energy conversion.
2. To impart knowledge about different construction operation of Transformers.
3. To study characteristics speed control methods and testing of different types of DC Generators and motors.

Course Outcomes

1. After the completion of course, students will be having skills to analyse the transformer.
2. Gain the skill knowledge of experimental performance and testing of Electrical DC Machines.

UNIT-I (11 Hrs.)

Single Phase Transformer: Construction, Theory and operation, E.M.F. equation, phasor diagram, rating of transformers, equivalent circuit, open and short circuit tests, back to back test,

parallel operation of single phase transformer, Scott connection, voltage regulation and efficiency, Ideal Transformer.

Auto-Transformers: Construction, Theory and operation, phasor diagram, equivalent circuit.

Three Phase Transformer: Three winding transformer, parallel operation of three phase transformers, three phase transformer connections, phasor groups, three phase to two phase and six phase conversion, Harmonics and excitation phenomenon, inrush current phenomenon.

UNIT-II (12 Hrs.)

Basics of DC Machines: Review of construction, types of armature winding, physical concepts of winding pitches, derivation of EMF equation & types of excitation, Armature reaction and its effect on the performance, methods adopted for compensation of armature reaction.

UNIT-III (11 Hrs.)

Excitation and Commutation of DC Generator: Characteristics of separately excited, shunt, series and compound generators, Compensating winding, Commutation and function of commutators, Improvement of commutation: Brush shift and interpoles.

UNIT-IV (12 Hrs.)

Control of DC Machines: Types of DC motors. Torque equation, speed torque characteristics: shunt, series and compound motors. Starting & speed control of DC motors. 3- point starter & its step calculation. Speed control by controlling armature resistance, field excitation and armature voltage, Ward- Leonard method of speed control, Losses & efficiency of DC machines, Hopkinson's & Swinburne's test.

Recommended Books

1. P.S. Bhimra, 'Electrical Machinery', Khanna Publisher.
2. I.J. Nagrath& D.P. Kothari, 'Electric Machines', TMH.
3. P.K. Mukherjee & S Chakrabarty, 'Electrical Machines', Dhanpat Rai.
4. S.K. Sen, 'Electrical Machinery', Khanna Publishers.

ELECTRONIC DEVICES & CIRCUITS

Subject Code: BEEE1-304 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

Course Objectives

1. To aware the students about basic electronic components.
2. To update the knowledge about amplification circuits to amplify the signal.
3. Various types of circuits to generate signals.
4. How electronic components are specified and selected for industrial applications.

Course Outcomes

1. The students could have skills about the basic electronic circuits, their operational characteristics and their applications.
2. Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

UNIT-I (10 Hrs.)

Introduction: Introduction to semiconductors theory, P type and N-Type semiconductors, different types of diodes, Drift current, diffusion current. Rectifiers.

UNIT-II (11 Hrs.)

Bipolar Junction Transistor: Working action of NPN and PNP. CE, CB and CC configurations, Current components, Concept of D.C. and A.C. load line and operating point, Q point selection, bias stability, various biasing circuits- fixed bias, collector to base bias, emitter bias, voltage divider, Stability factors.

UNIT-III (12 Hrs.)

Power Amplifiers: Classifications according to mode of operation and driving output, Class A direct coupled with resistive load, operation of class- B power amplifier, Push-Pull Amplifiers, Concept of feedback in amplifiers: Positive and negative feedback, effect of negative feedback.

Oscillators: Principle of operation of different oscillator circuits-RC Phase shift, Wien Bridge, Hartley Bridge, Colpits and Crystal oscillators.

UNIT-IV (12 Hrs.)

Field Effect Transistors: FET construction and working, P-channel and N-channel JFETs. Comparison with BJT, Characteristics of JFET, JFET parameters- AC drain resistance, trans-conductance, amplification factor, dc drain resistance. Construction, working and characteristics of MOSFET. Comparison of BJT, JFET and MOSFET.

Recommended Books

1. Boylstad and Nashelsky, 'Electronic Devices and Circuits', Prentice Hall.
2. Millman and Halkias, 'Integrated Electronics', McGraw Hill, **2001.**
3. Malvino, 'Electronic Principles', McGraw Hill, **2007**.
4. V.K. Mehta, 'Principles of Electronics', S. Chand, **2006.**
5. Donald L. Shilling and Charles Belowl, 'Electronic Circuits', TMH, **2009.**

MEASUREMENT & INSTRUMENTATION LAB.

Subject Code: BEEE1-305 **L T P C**
0 0 2 1

Course Objectives

1. To understand the working principal and construction of the measuring instruments and recorders.
2. To measure various electrical parameters using meters and transducers.
3. To calibrate the measuring devices such as meters and transducers.

Course Outcomes

1. The students could have skills about the basic measurement circuits.
2. Ability to use the techniques and skills to operate CRO.

EXPERIMENTS

1. Study of principle of operation of various types of electromechanical measuring instruments.
2. To measure high value of DC current and voltage using shunt and multiplier.
3. To measure low resistance using wheat stone bridge.
4. To measure active and reactive power in 3-phase balanced load by one wattmeter method.
5. To measure the active power in 3-phase balanced and unbalanced load by two wattmeter method and observe the effect of power factor variation on wattmeter readings.
6. To study and calibrate single phase energy meter.
7. Measurement of resistance using Kelvin's Bridge.
8. Measurement of self-inductance using Anderson's Bridge.
9. Measurement of capacitance using Schering Bridge.
10. Plotting of Hysteresis loop for a magnetic material using flux meter.
11. Measurement of frequency using Wein's Bridge.
12. To study the connections and use of Current and Potential transformers and to find out ratio error.
13. Determination of frequency and phase angle using CRO.
14. Measurement of unknown voltage using potentiometer.

15. To find 'Q' of an inductance coil and verify its value using Q-meter.

Note: At least ten experiments should be performed in semester.

ELECTRICAL MACHINES-I LAB.

Subject Code: BEEE1-306 **L T P C**
0 0 2 1

Course Objectives

1. To understand the working principal and construction of the Transformer.
2. To carry out laboratory experiments on electrical DC machines to find out parameters.
3. To perform the experiments to draw the characteristics of DC machines.

Course Outcomes

1. After the completion of the course, the students could have skills about the basics of testing of Transformer and DC machines.
2. An ability to analyse possible causes of discrepancy in comparison to theory.

EXPERIMENTS

1. To study cut section model and sketches of DC machine
2. To study cut section model and sketches of Transformer.
3. To perform load test on a single phase transformer.
4. To perform Open circuit and short circuit tests on a single phase transformer to determine equivalent circuit, voltage regulation and efficiency.
5. To find the efficiency and voltage regulation of single phase transformer under different loading conditions.
6. To perform parallel operation of two single phase transformers.
7. To study the various connections of three phase transformer.
8. To perform Scott connections on three phase transformer.
9. To measure armature and field resistance of DC shunt machine to obtain its open circuit characteristics.
10. To obtain load characteristics of DC shunt/series/compound generator.
11. To draw speed-torque characteristics of DCshunt/series/compound generator.
12. To study different types of DC motor starters.
13. To perform Swinburne's test on DC shunts motor.
14. To perform no load and blocked rotor test on DC shunt motor.

Note: At least ten experiments should be performed in semester

ELECTRONIC DEVICES AND CIRCUITS LAB.

Subject Code: BEEE1-307 **L T P C**
0 0 2 1

Course Objectives

1. To understand the characteristics of various semiconductor devices.
2. To understand identification and selection of various electronic components.

Course Outcomes

1. Ability to understand all types of electronics devices and circuits.
2. Ability to analyse and interpret data.

EXPERIMENTS

1. To analyze the response of Zener diode as regulator
2. To analyze the response of half wave, full wave and Bridge rectifiers.
3. To plot the input and output characteristics of CE configuration.
4. To plot the input and output characteristics of CB configuration.
5. To examine the characteristics of a Class-A amplifier.
6. To examine the characteristics of Class-B amplifier.
7. To analyze the characteristics of Class-B push-pull amplifier.
8. To analyze the characteristics of complementary symmetry amplifier.
9. To discuss the response of RC phase shift oscillator and determine frequency of oscillation.
10. To discuss the response of Hartley oscillator and determine frequency of oscillation.
11. To analyze the response of Colpitt's oscillator and determine frequency of oscillation.
12. To analyze the response of Wien Bridge oscillator and determine frequency of oscillation.
13. To study the characteristics and response of crystal oscillator.
14. To plot the characteristics of FET.
15. To plot the characteristics of MOSFET.

Note: At least ten experiments should be performed in semester

ELECTRICAL MACHINES-II

Subject Code: BEEE1-409 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

Course Objectives

1. To aware the students about basics of working principles of machines.
2. To update the knowledge about illustrate starting and control of induction motors.
3. To analyse the performance of induction motors

Course Outcomes

1. The students will gain teaching skills in this domain.
2. An ability to use the speed control schemes of machines.

UNIT-I (10 Hrs.)

Basic Concept of Electrical Machines: winding factors, generated E.M.F. and M.M.F, distributed winding, production of rotating magnetic field.

UNIT-II (12 Hrs.)

Induction Machines: Constructional features, production of torque, equivalent circuit, phasor diagram, torque slip characteristics, Testing running light and blocked rotor test, load test, Effect of rotor resistance, double cage induction motor, Generator operation, starting methods of squirrel cage and wound rotor induction motor, Effect of space harmonics.

UNIT-III (11 Hrs.)

Signal Phase Induction Motors: Constructional features, double revolving field theory, Equivalent circuit, determination of parameters, different types of single phase induction motor and their starting methods & applications.

UNIT-IV (12 Hrs.)

Synchronous Machines: Constructional features, salient and non-salient rotor.

Synchronous Generator: Generated emf, circuit model and phasor diagram, armature reaction, synchronous impedance, determination of voltage regulation by different methods, Parallel operation of alternators: Synchronisation and load sharing.

Synchronous Motor: Operating principle, circuit model, phasor diagram, effect of load, operating characteristics of synchronous motor, V-curves and inverted V-curves, starting methods of synchronous motors, Two reaction theory, analysis of phasor diagram, power angle characteristics, determination of X_d and X_q.

Recommended Books

1. P.S. Bhimbra, 'Electric Machinery', Khanna Publishers, **2011.**
2. Nagrath & Kothari, 'Electric Machines', TMH, **2010.**
3. Fitzerald & Kingsley, 'Electric Machinery', MGH, **2007.**

LINEAR CONTROL SYSTEM

Subject Code: BEEE1-410 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

Course Objectives

1. To obtained transfer functions for electrical circuits, translational/rotational mechanical systems and electromechanical systems.
2. To learn basic goals of control systems in terms of transient/steady state time response behaviour.
3. To update the knowledge about control components.

Course Outcomes

1. The students will have skills to model the control systems.
2. Ability to analyse the stability of designed systems.

UNIT-I (10 Hrs.)

Introductory Concepts: Plant, Systems, Servomechanism, regulating systems, Open loop control system, closed loop control systems, linear and non-linear systems, time variant and invariant, Block diagrams, some illustrative examples.

UNIT-II (12 Hrs.)

Modelling: Force voltage analogy, force current analogy, Transfer function, Block diagram reduction technique, signal flow graphs and Mason's gain formula, characteristics equation.

Time Domain Analysis: Transient response of the first and second order systems, Time domain specifications, Steady state error and coefficients, Absolute and relative stability, Routh-Hurwitz Criterion.

UNIT-III (12 Hrs.)

Stability Analysis: Root locus technique, sketch of the root locus plot, Frequency domain analysis: Closed loop frequency response, bode plots, relative stability using bode plot. Frequency response specifications, relation between time and frequency response for second order systems. Nyquist criterion for stability.

UNIT-IV (11 Hrs.)

State Space Analysis: State space representations, transfer function from state model, state transition matrix, controllability, observability. Control components: Error detectors-potentiometers and synchros, servo motors, A.C. and D.C. techno generators, Magnetic amplifiers.

Recommended Books

1. Dorf Richard and Bishop Robert, 'Modern Control System', Addison-Wesley, Pearson, **2009.**
2. K. Ogata, 'Modern Control Engineering', Prentice Hall, **2011.**

3. B.C. Kuo, 'Automatic Control System', Prentice Hall, **1999.**
4. I.J. Nagrath and M. Gopal, 'Control System Engineering', Wiley Eastern Ltd., **1997.**
5. B.S. Manke, 'Linear Control Systems', **2002.**

DIGITAL ELECTRONICS

Subject Code: BEEE1-411 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

Course Objectives

1. To provide knowledge about basics of digital electronics.
2. To impart knowledge about designing of digital circuits.
3. Students will use schematics and symbolic algebra to represent digital gates inthe creation of solutions to design problems.

Course Outcomes

1. An ability to understand all types of combinational and sequential digital circuits and their designing.
2. Students will have skills to simplify a digital design problem as part of the systematic approach to solving a problem.

UNIT-I (12 Hrs.)

Number System and Binary Code: Introduction, Binary, decimal, Octal, hexadecimal, BCD number system, Signed and unsigned numbers, binary operations: Addition, Subtraction. Multiplication and division. Subtractions using 1's and 2's compliment. ASCII code. Excess 3 codes and Gray code. Logic gates: OR, AND, NOT, NOR, NAND, Ex-OR gates, Basic theorems of Boolean algebra, sum of products and product of sums. Minimisation using theorems, minimisation using K-map up to 4 variables.

UNIT-II (10 Hrs.)

Combinational Logic Circuits: Combinational circuit design, multiplexer, demultiplexer, encoders, decoders, adders, subtractors, code converters, parity checkers, BCD display drive, magnitude comparators.

UNIT-III (12 Hrs.)

Sequential circuits: Flip Flop fundamentals, different flip flop configurations: SR, JK, D, T. Edge triggered and clocked flip flops, Registers: Types of Registers, series and parallel shift: circuit diagram, timing wave form and operations. Counters: synchronous and asynchronous, Johnson counter.

UNIT-IV (11 Hrs.)

D/A and A/D Converters: Introduction, Weighted register D/A converter, binary ladder D/A converter, D/A accuracy and resolution, parallel A/D converter, Counter type A/D converter, Successive approximation A/D converter, Single and dual slope A/D converter, A/D accuracy and resolution.

Recommended Books

1. D.P. Kothari and J.S. Dhillon, 'Digital Circuits and Design', Pearson, **2015**.
2. R.P. Jain, 'Modern Digital Electronics', TMH, **2011.**
3. Malvino and Leach, 'Digital Principles and Applications', TMH, **1991.**
4. Fletcher, 'An Engg. Approach to Digital Design', PHI, Indian Edn., **2011**.
5. Sanjay Sharma, 'Digital Electronics', Kataria Sons, 1st Edn., **2011**.

POWER SYSTEM-I

Subject Code: BEEE1-412 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

Course Objectives

1. To provide knowledge about basics of transmission systems.
2. To impart knowledge about representation of different power system components and loading capability of a generator.
3. Students will learn the basic concepts of mechanical and electrical design of transmission lines HVDC/EHVAC systems.

Course Outcomes

1. An ability to understand all types of different power system components
2. Students will have skills to differentiate transmission and distribution systems

UNIT-I (10 Hrs.)

Generation of Electric Power: Brief description of Thermal, hydro nuclear and gas power plants & other non- conventional power plants. Legal aspects of electricity supply- Electricity acts, rules and codes, Standards followed in power supply, environmental and safety measures.

UNIT-II (11 Hrs.)

Transmission and Distribution Systems: DC 2–wire and 3–wire systems, AC single phase, three phase and 4-wire systems, and comparison of copper efficiency.

Distribution Systems: primary and secondary distribution systems, concentrated & uniformly distributed loads on distributors fed one and both ends, ring distribution, sub mains and tapered mains, voltage drop and power loss calculations, voltage regulation.

UNIT-III (12 Hrs.)

Overhead Transmission Lines and Cables: Types of Conductors, Line parameters; calculation of inductance and capacitance of single and double circuit transmission lines, three phase lines with stranded and bundle conductors, Generalized ABCD constants and equivalent circuits of short, medium & long lines, Ferranti and proximity effect.

Line Performance: regulation and efficiency of short, medium and long lines, Series and shunt compensation, Calculations of capacity of cables, charging current, stress, grading, heating of cables, Construction and characteristics of HV & EHV cable.

UNIT-IV (12 Hrs.)

Overhead Line Insulators and Mechanical Design of Transmission Lines: Type, string efficiency, voltage distribution in string of suspended insulators, grading ring, preventive maintenance, Different types of tower, sag-tension calculations, sag-template, stringing charts, Corona-losses, Brief description of EHV/HVDC transmission.

Recommended Books

1. Grainger John, J. and Stevenson, Jr. W.D, 'Power System Analysis', McGraw Hill, **1994.** Harder Edwin, 'Fundamentals of Energy Production' John Wiley and Sons, **1982.**
2. C.L. Wadhwa, 'Electric Power Systems', Wiley Eastern Limited, **1985.**
3. I.J. Nagrath and D.P. Kothari, 'Power System Engineering', Tata McGraw Hill, **1995.**

ELECTROMAGNETIC FIELD THEORY

Subject Code: BEEE1-413 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

Course Objectives

1. To provide the knowledge about the time varying fields and Maxwell's equations.
2. To provide knowledge about the propagation of electromagnetic wave along different mediums.
3. Study of physical concept and all the important fundamental parameters of waveguides.

Course Outcomes

1. The students will learn the concepts of electromagnetic field theory and fundamental field equations.
2. The students will have skills to identify, formulate and solve engineering problems related to electromagnetic fields.

UNIT-I (10 Hrs.)

Review of Electrostatic and Magnetostatic fields: Review of vector algebra, Review of Cartesian, Cylindrical and spherical coordinate systems, Introduction to del operator, Use of del operator as gradient, divergence, curl. Introduction to coulomb's law, Gaussian law. Laplace's and Poission's equation in various coordinate systems. Introduction to Ampere's law, Magnetic vector potential.

UNIT-II (12 Hrs.)

Time Varying Fields and Maxwell's Equations: Equation of continuity, Inconsistency of Ampere's law for time varying fields, Concept of displacement current, Maxwell's equation in integral and differential form (for static fields, time varying fields, free space, good conductors, harmonically varying fields), Poynting theorem.

UNIT-III (11 Hrs.)

Uniform Plane Waves: Introduction, Uniform plane wave propagation, Wave equations: Wave equations for free space, Wave equations for conductors. Transverse nature of uniform plane waves, Reflection of electromagnetic waves by perfect conductor and perfect dielectric, wave impedance and propagation constant, depth of penetration, surface impedance.

UNIT-IV (12 Hrs.)

Wave Guides: Introduction, simple waveguides between two infinite and parallel conducting plates, Transverse Electric (TE) Waves or H-Waves, Transverse magnetic (TM) Waves or E-Waves, Characteristics of TE and TM waves, Transverse Electromagnetic (TEM) waves and its characteristics.

Recommended Book

1. Jordan and Balmain, Electromagnetic Wave', PHI and Radiation System, **2010.**
2. Kraus, 'Electromagnetics', TMH, **2003.**
3. W.H. Hayt and J.A. Buck, 'Problem and solutions in Electromagnetics', TMH, **1999.**
4. W.H. Hayt, 'Engineering Electromagnetic', TMH, **2012.**

CONTROL SYSTEM LAB.

Subject Code: BEEE1-414 **L T P C**
0 0 2 1

Course Objectives

1. To understand the basics concepts of MATLAB software.
2. To introduce variety of control system strategies.

3. To comment about the stability of designed systems.

Course Outcomes

1. To acquire skills to understand all types of control components.
2. Ability to analyse the stability of control systems.

EXPERIMENTS

1. Familiarization with MATLAB control system toolbox, MATLAB Simulink toolbox and PSPICE.
2. Determination of step response for first order and second order system with unity feedback and their display on CRO. Calculation and verification of time constant, peak overshoot, setting time etc. from the response.
3. Simulation of step response and impulseresponsefortype-0, type-1and type-2 systems with unity feedback using MATLAB and PSPICE.
4. Determination of RootLocus, Bode-Plot, Nyquist Plot using MATLAB-Control system toolbox for 2nd order system. Determination of different control system performance indices from the plots.
5. Experimental determination of approximate transfer function from Bode plot.
6. Evaluation of steady state error, settling time, percentage peak overshoot, gain margin, phase margin, with addition of lead compensator and by compensator in forward path transfer function for unity feedback control system using PSPICE.
7. Design of a second order linear time invariant control system and study of system response with unit step input.
8. To study the characteristics of potentiometers and to use 2-potentiometers as an error detector in a control system.
9. To study the synchro Transmitter-Receiver set and to use it as an error detector.
10. To study the Speed-Torque characteristics of an AC Servo Motor and to explore its applications.
11. To study the Speed-Torque characteristics of a DC Servo Motor and explore its applications.
12. To study various electro-mechanical transducers i.e. resistive, capacitive and inductive transducers.
13. To study the speed control of an A.C. Servo Motor using a closed loop and an open loop system.
14. To study the operation of a position sensor and study the conversion of position in to corresponding voltage

Note: At least ten experiments should be performed in semester.

DIGITAL ELECTRONICS LAB.

Subject Code: BEEE1-415 **L T P C**
0 0 2 1

Course Objectives:

1. To give students a practical knowledge about all types of digital circuits.
2. To give students a working knowledge to connect digital circuits and verify their truth tables.
3. To give students knowledge of different combinational and sequential circuits.

Course Outcomes

1. An ability to test and verify working and truth tables of combinational and sequential circuits.

2. To give knowledge of various logic families.

EXPERIMENTS

1. To Study Logic Gates: Truth-table verification of OR, AND, NOT, XOR, NAND and NOR
2. gates and realization of OR, AND, NOT and XOR functions using universal gates.
3. To design Half Adder using Logic gates on bread board.
4. To design Full Adder using Logic gates on bread board.
5. To design Half Subtractor using Logic gates on bread board.
6. To design Full Subtractor using Logic gates on bread board.
7. To design 4-Bit Binary-to-Gray Code Converter on bread board.
8. To design 4-Bit Gray-to-Binary Code Converter on bread board.
9. To study and design 4-Bit magnitude comparator using logic gates on bread board.
10. Design and verification of Truth-table of multiplexer.
11. Realization of Half adder and Full adder using MUX.
12. Design and verification of Truth-table of Demultiplexer.
13. Realization of half subtractor and full subtractor using DEMUX.
14. To study and verify Truth-table of RS, JK, D, JK Master Slave Flip Flops.
15. To design MOD-7 Synchronous up-counter using JK/RS/D Flip Flops.
16. To Study different shift registers: SIPO, SISO, PIPO, and PISO.
17. To Study digital logic families.

Note: At least ten experiments should be performed in semester

SIGNALS & SYSTEMS

Subject Code: BEEE1-516 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

Course Objectives

1. To introduce the students about the theoretical concepts associated with processing continuous & discrete time signals & systems.
2. To be able to think critically & to apply problem solving & reasoning strategies to the analysis of various types of signals & systems.
3. To impart them knowledge of various types of noises.

Course Outcomes

1. An ability to analyze various types of signals in communication system.
2. Developing skills to understand random signals.
3. To understand various types of noises.
4. Understand signal transmission through linear networks.

UNIT-I (12 Hrs.)

Systems and Signal Analysis: Detailed Classification of Signals and Systems, Fourier Series and its properties, Fourier transform and its properties along with applications, Discrete Time Fourier Series (DTFS) and Discrete Time Fourier Transform (DTFT).

Correlation and Spectral Density: Definition of Correlation and Spectral Density, Analogy between correlation, covariance and convolution, conceptual basis, auto-correlation, cross correlation, energy/power spectral density, properties of correlation and spectral density, inter relation between correlation and spectral density.

UNIT-II (12 Hrs.)

Random Signal Theory: Introduction to Probability Theory, Definition of Probability of Random Events. Joint and Conditional Probability, Probability Mass Function, Statistical

Averages. Probability Density Functions (PDF) and Statistical Averages, mean, moments and expectations, standard deviation and variance. Probability models: Uniform, Gaussian, Binomial. Examples of PDF, Transformation of Random Variables. Random Processes, Stationary and Ergodicity.

UNIT-III (12 Hrs.)

Introduction to Noise: Thermal Noise, Shot noise, Partition noise, Flicker noise, Gaussian Noise, Noise in Bipolar Junction Transistors (BJTs), FET noise. Equivalent input noise, Signal to Noise Ratio (SNR), Noise Temperature, Noise equivalent Bandwidth, Noise Figure. Experimental determination of Noise Figure, Pulse Response and Digital Noise and its elimination.

UNIT-IV (12 Hrs.)

Signal Transmission Through Linear Networks: Convolution Theorem and its graphical interpretation. The Sampling Theorem, Low Pass and Band Pass Networks, Matched Filter, Enveloped detector.

Recommended Books

1. B.P. Lathi, 'Digital and Analog Communication Systems', Oxford University Press.
2. Ravi Kumar, 'Signals and Systems', PHI Course.
3. Simon Haykin, 'Signals and Systems' Wiley.
4. D. Ganesh Rao and Satish Tunga, 'Signals and Systems', Pearson.

POWER ELECTRONICS AND UTILIZATION

Subject Code: BEEE1-517 **L T P C** **Duration: 45 Hrs**
3 1 0 4

Course Objectives

1. To introduce the students to Power Electronics and thyristor family of devices.
2. To make them to understand their switching characteristics and turn-on and turn-off methods
3. To develop the understanding about operational concepts of various types of convertors
4. To make them aware about use of thyristors in diverse applications.

Course Outcomes

1. Understand the Power Electronic devices and infer their usage as switches
2. Knowledge of various types of converters
3. Understand the use of converters in conversion and control of electrical power
4. Apply power electronics technology in efficient utilization of electrical power.

UNIT-I (11 Hrs.)

Thyristor Fundamentals: Construction of SCR, operating modes, Two Transistor Analogy, Static and Dynamic characteristics, Gate characteristics, Turn-on and Turn - off methods, Firing/Triggering circuits: R and RC type, UJT based triggering, Isolation of gate and base drive circuits using pulse transformer and optocouplers, Commutation circuits for thyristors.
Series and Parallel operation of SCRs: Need, string efficiency, Static and Dynamic equalizing circuits.
Ratings, di/dt and dv/dt rating, Snubber circuit and its design, Introduction to other members of Thyristor family such as SCR, DIAC, TRIAC, LASCR, GTO.

UNIT-II (11 Hrs.)

Phase Controlled (AC to DC) Converters: Principle of phase control, Single phase half wave circuit with different types of loads, Single phase and three phase full converter circuits with line commutation, Continuous and discontinuous load current, effect of Source impedance on single phase and three phase full converters, Single phase and three phase dual converters and their operation with circulating and non circulating currents.

Chopper Circuits (DC to DC Converters): Types of chopper: step up, step down. Different classes of chopper circuits: Class A, B, C, D, E for R, R-L and RLE load. Voltage commutated Chopper.

UNIT-III (11 Hrs.)

Inverters (DC to AC Converters): 1-Ø voltage source bridge inverters and their steady state analysis, Fourier analysis of output voltage, Modified McMurray Half bridge inverter, 3-Ø bridge inverters with 180^o and 120^o modes, Voltage Control in single Phase Inverters: PWM techniques, Methods of Harmonic Reduction, Space Vector Modulation (SVM), Relationship between PWM and SVM, Introduction to Current Source Inverter and Series Inverter.

UNIT-IV (12 Hrs.)

(AC to AC Converters)

AC Voltage Controller: Types of single-phase voltage controllers, Single-phase voltage controller with R and RL type of loads.

Cycloconverters: Principles of operation, Single phase to single phase step up and step down Cyclo-converters. Three phase to single phase and three-phase to three-phase cyclo-converters, Output voltage equation for a cyclo-converter.

Utilization: Introduction to Speed control of AC and DC motor drives, Control of Electric heating, Welding, Illumination, Application in HVDC transmission, Reactive power control in power systems.

Recommended Books

1. P.S. Bimbhra,'Power Electronics', Khanna Publishers, New Delhi, **2012.**
2. Muhammad H. Rashid, 'Power Electronics – Circuits, Devices and Applications', Prentice Hall of India Private Limited, **2006.**
3. M.D. Singh and K.B. Khan, 'Power Electronics', TMH, New Delhi, **2007.**
4. G.K. Dubey, S.R. Doradla, A. Joshi and R.N.K. Sinha, 'Thyristorised Power Controllers', New Age International (P) Limited, **2004.**

MICROPROCESSOR AND INTERFACING

Subject Code: BEEE1-518 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

Course Objectives

1. To understand the basic architecture of 8 and 16-bit microprocessor.
2. To understand interfacing of microprocessor with memory and peripheral chips involving system design.
3. To understand the techniques for faster execution of instructions and improve the performance of microprocessor.
4. To understand the concepts of multi core processor.

Course Outcomes

1. The students will able to write program to run on 8085 microprocessor based systems.
2. Design system using memory chips and peripheral chips.
3. Understand and devise techniques for faster execution of instructions, improve speed of operations and enhance performance of microprocessors.

UNIT-I (11 Hrs.)

Introduction: Introduction to microprocessor, Intel 8085 microprocessor architecture and pin diagram, Data flow to/from memory, from/to microprocessor unit, multiplexing and de-multiplexing of address data bus. Bus timings, T state, machine cycle, timing diagram, Memories- RAM, DDR/SDR, ROM, EROM, EPROM, EEPROM, Flash Memory, Cache Memory.

UNIT-II (12 Hrs.)

Programming with 8085: Addressing modes, Detail study of 8085 instruction set. I/O and Memory mapping, Interfacing I/O Devices, Interrupts, stack and subroutines, Counter and Time Delays, Code conversion, BCD Arithmetic and 16-bit data operations, Programming techniques with additional instructions, Program Debugging.

UNIT-III (12 Hrs.)

Interfacing with 8085: Architecture, interfacing and programming of 8155/8156 (programmable I/O port timer), 8251(universal synchronous, asynchronous receiver transmitter), 8253/ 8254 (programmable interval timer), 8255 (programmable peripheral interface), 8279 (keyboard display controller), and 8257 (direct memory access controller).

UNIT-IV (10 Hrs.)

Other Microprocessor and interfacing: 8086 -Block diagram, Architecture, pipelining, flag register, register bank operation, memory segmentation, addressing modes. Introduction to 80186, 80286, 80386, 80486 and Pentium and their comparison, Comparative study of 8-bit microprocessors: Intel 8085, Motorola 6800, Zilog Z-80.

Recommended Books

1. R.S. Gaonkar, Microprocessor Architecture Programming and Applications with the 8085' Penram International.
2. D.V. Hall, 'Microprocessor and Interfacing Programming and Hardware' McGraw Hill Co.
3. Barry B. Brey, 'The Intel Microprocessors, Architecture Programming and Interfacing', PHI.
4. B. Ram, 'Fundamentals of Microprocessor and Microcontrollers', Dhanpat Rai and Sons, New Delhi.

MICROPROCESSOR LAB.

Subject Code: BEEE1-519 **L T P C**
0 0 2 1

Course Objectives

The student should be made to:

1. Introduce assembling language Programming concepts and features
2. Write assembling language Programming for arithmetic and logical operations in 8085
3. Differentiate Serial and Parallel Interface
4. Interface different I/Os with Microprocessors

Course Outcomes

At the end of the course, the student should be able to:

1. Write assembling language Programmes for fixed and Floating Point and Arithmetic
2. Interface different I/Os with processor
3. Generate waveforms using Microprocessors
4. Execute Programs in 8085

EXPERIMENTS

1. Study of 8085 and 8086 Microprocessor Kits.
2. Write a program to add two 8-bit number using 8085.
3. Write a program to add two 16-bit number using 8085.
4. Write a program to subtract two 8-bit number using 8085.
5. Write a program to subtract two 16-bit number using 8085.
6. Write a program to multiply two 8 bit numbers by repetitive addition method using 8085.
7. Write a program to sort series using bubble sort algorithm using 8085.

8. Write a program to copy 12 bytes of data from source to destination using 8086.
9. Write a program to find maximum and minimum from series using 8086.
10. Write a program to control the operation of stepper motor using 8085/8086
11. microprocessors and 8255 PPI.
12. Write a program to control speed of DC motor using 8085/8086 microprocessors and
13. 8255 PPI.

Note: At least 08 experiments are required to be performed.

NON LINEAR & DIGITAL CONTROL SYSTEMS

Subject Code: BEEE1-621 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

Course Objectives

1. To explain the concepts of basic and modern control system for the real time analysis and design of control systems.
2. To explain the concepts of state variables analysis.
3. To study and analyze non linear systems.
4. To analyse the concept of stability for nonlinear systems and their categorization

Course Outcomes

1. To understand various terms of basic and modern control system for the real time analysis and design of control systems.
2. To perform state variables analysis for any real time system.
3. Apply the concept of optimal control to any system.
4. Able to examine a system for its stability, controllability and observability.
5. Implement basic principles and techniques in designing linear control systems.

UNIT-I (11 Hrs.)

Sampled Data Systems: Sampling process, mathematical analysis of sampling process, application of Laplace transform, zero order, first order hold. Z- transform definition, evaluation of Z-transform, limitations of Z-transform, inverse Z-transform, Reconstruction of sampled signal, pulse transfer function, Stability analysis of sampled data control system.

UNIT-II (12 Hrs.)

State Variable Techniques: State space representation, Concept of state, transfer function decomposition, solution of state equations, transfer matrix, State variable formulation of discrete time systems, solution of discrete time state equations. Stability definition, Jury's test of stability, extension of Routh-Hurwitz criterion to discrete time systems, State variable representation of systems by various methods, solution of state variable model, Controllability and observability.

UNIT-III (11 Hrs.)

Phase Plane Analysis: Singular points, Method of isoclines, delta method, phase trajectory, phase portrait of second order nonlinear systems, limit cycle.

Lyapunov's Stability Method: Lyapunov's direct method, generation of Lyapunov's function by Krasovskii's and Variable Gradient methods.

UNIT-IV (11 Hrs.)

Describing Function Analysis: characteristics of nonlinear system and its properties, Definition, limitations, use of describing function for stability analysis, describing function of ideal relay, relay with hystersis, dead zone, saturation, coulomb friction and backlash.

Recommended Books

1. Ogata K., 'Modern Control Engineering', Prentice Hall (India).

2. I.J. Nagrath and M. Gopal, 'Control System Engineering', New Age Publications.
3. M. Gopal, 'Digital Control and State Variable Methods', Tata McGraw Hill.
4. B.C. Kuo and Golnaraghi F, 'Automatic Control System', Wiley.
5. R.V. Dorf and R.H. Bishop, 'Modern Control Systems', Adison Wesle.
6. K.K. Aggarwal, 'Control Systems Analysis and Design', Khanna Publisher.
7. S. Hasan Saeed, 'Automatic Control Systems (With Matlab Programs)', S.K. Kataria & Sons.

POWER SYSTEM – II

Subject Code: BEEE1-622 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

Course Objectives

1. To know about substation equipment and need for protection
2. To study and operation of circuit isolation devices
3. To understand the application operation of protective relays
4. To know about grounding practices and protection against over voltages

Course Outcomes

1. Skill to understand basic need for protection schemes
2. Skill to understand functioning of isolators , fuses and circuit breakers
3. An ability to understand protection of feeders, transmission lines, Generators and Transformers.
4. Students will be able to understand protection against over voltages

UNIT- I (12 Hrs.)

Introduction: Principles and need for protective schemes, Types of Faults, Causes and Effects, Primary and Backup Protection, Basic Connection of Trip Circuit.

Sub-Station: Layout of Substation, Types, Main equipment in Substation, Busbar-arrangements.

UNIT- II (12 Hrs.)

Isolators and Fuses: Isolating switches functions, Types, Rating and operation. Fuse-types, Rating, Selection, theory and characteristics, applications.

Circuit Breakers: Need for Circuit Breakers, Arc phenomenon, Theory of Arc Interruption, Recovery Voltage and Restriking Voltage, Various Types of Circuit Breakers, Principles and Constructional Details of Air Blast, Minimum Oil, SF6, Vacuum Circuit Breakers etc.

UNIT- III (12 Hrs.)

Protective Relays: Introduction, classification, constructional features; and Characteristics of Electromagnetic, Induction, Thermal, Overcurrent relays, Directional relays, Distance relays, Differential, Translay Scheme, introduction to static and microprocessor-based relays.

Protection of Feeders: Time graded protection, Differential and Distance protection of feeders, choice between Impedance, Reactance and Mho relays, Elementary idea about carrier current protection of lines.

UNIT IV (12 Hrs.)

Protection of Generators and Transformers: Types of faults on alternator, Stator and rotor protection, Negative sequence protection, Loss of excitation and overload protection. Types of fault on transformers, percentage differential protection, Gas relays.

Protection against Over Voltages: Ground wires, Rod gap, Impulse gap, Valve type and Metal Oxide Arresters, Line Arrester/Surge Absorber. Ungrounded neutral system, Grounded neutral system and Selection of Neutral Grounding. Solid, resistance and reactance Earthing

Recommended Books

1. C.L Wadhwa, 'Electrical Power System', New Age International (P) Limited.
2. Sunil S. Rao, 'Switchgear Protection and Power Systems', Khanna Publishers.
3. S.L. Uppal, 'Electrical Power', Khanna Publishers.
4. Badri Ram, 'Power System Protection and Switchgear', Tata McGraw Hill.
5. N. Veerappan & S.R. Krishnamurthy, 'Power System Switchgear & Protection', S. Chand.
6. Ravinderpal Singh, 'Switchgear & Power System Protection', PHI.
7. Sunil S. Rao, 'Switchgear Protection & Power System', Khanna Publishers.

POWER SYSTEM LAB.

Subject Code: BEEE1-623 **L T P C**
0 0 2 1

Course Objectives

1. To provide practical knowledge about transmission systems.
2. To impart knowledge about performance of different types of Relays.
3. To develop understanding about operation of Circuit Breakers.
4. To provide knowledge about insulators, conductors and cables used in transmission and distribution.

Course Outcomes

1. Skill to understand practical transmission system
2. Skill to understand performance and operation of different types of Relays and Circuit Breaker
3. Skill to understand about construction of insulators, conductors and cables used in power system

EXPERIMENTS

1. Visit Local substation and draw layout of local substation
2. To find the earth resistance using three spikes
3. To study the performance of medium transmission line as π model and compute its ABCD parameters.
4. To study the performance of medium transmission line as T model and compute its ABCD parameters.
5. Verification of Ferranti Effect of a Long transmission line
6. To study various types of Insulators used in transmission and distribution.
7. To study various types of conductors used in transmission and distribution
8. To study the different types of faults on transmission line demonstration panel/model.
9. To study the radial feeder performance when
   a) Fed at one end
   b) Fed at both ends
10. To study the performance of Distance Relay
11. To study the performance of Differential Relays
12. To study operation of Bucholz Relay
13. To study operation of IDMT relay
14. To study the operation of Vacuum Circuit Breaker
15. To study the operation of SF_6 Circuit Breaker

Note: At least ten experiments should be performed in a semester

POWER ELECTRONICS LAB.

Subject Code: BEEE1-624 **L T P C**
0 0 2 1

Course Objectives

1. To develop the understanding of students about the behaviour of various type of
2. Thyristors by obtaining V-I characteristics.
3. To familiarize the performance of firing circuits and commutation circuits.
4. To check the output waveforms of converter circuits.
5. To introduce the students to some practical applications of Thyristors.

Course Outcomes

1. Ability to simulate characteristics of SCR.
2. Ability to understand speed control of induction motors using thyristor.

EXPERIMENTS

1. To obtain V-I characteristics of SCR and measure latching and holding currents.
2. To Draw V-I Characteristics of UJT.
3. To obtain the characteristics of TRIA
4. To obtain triggering wave forms of SCR for different types of firing circuits such as R, RC, UJT etc.
5. To obtain output voltage waveforms of single phase half wave controlled rectified for R-L load.
6. To obtain output voltage waveforms of single phase Full wave controlled rectified for R-L load.
7. To obtain output voltage waveforms of single phase ac voltage regulator with R-L load.
8. To study different types of chopper circuit and obtain output voltage waveforms.
9. To Study and obtain the output voltage waveform of single phase cycloconverter
10. Speed control of electric motor using thyristor.
11. To simulate single phase full wave ac voltage controller and draw load voltage and load current waveforms for inductive load.
12. To simulate single phase inverter using different modulation techniques and obtain load voltage and load current waveform for different types of loads.
13. Illumination control using SCR

SENSORS AND TRANSDUCERS

Subject Code: BEEE1-556 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

Course Objectives

1. Understanding the structural and functional principles of sensors and transducers used for various physical and nonelectric quantities and how to use them to measure these quantities.
2. Explain the principles of operation of the sensor parameters and generators
3. Interpretation of the measurement results by using transducers.
4. Development of measurement schemes for different non electrical quantities
5. Assimilating knowledge about the implementation of sensors and transducers into a control system structure.

Course Outcomes

1. To explain the structure of the Transducers and sensors.

2. To design applications using the sensors and transducers.
3. To enhance knowledge on various types of thermoelectric effects and devices.
4. To study the effects of various sensors and their applications.

UNIT-I (11 Hrs.)

Introduction to Sensors and Transducers, Basic elements of instrumentation system, Static and Dynamic characteristics of transducers, selection criterion, Mechanical and Electromechanical sensors. Resistive (potentiometric) type: resolution, accuracy, sensitivity. Strain Gauges: theory, types, sensitivity, gauge factor, variation with temperature. Inductive sensors: common types- reluctance change type, mutual inductance change type, transformer action type, magnetostrictive type. LVDT: Construction, output-input relationship, I/O curve, Proximity and Range sensors.

UNIT-II (11 Hrs.)

Capacitive Sensors: Variable distance- parallel plate type, Variable area- parallel plate, serrated plate/teeth type and cylindrical type. Variable Dielectric Constant Type: calculation of sensitivities Stretched Diaphragm type: microphones, response characteristics. Piezoelectric Elements: piezoelectric effects, charge and voltage coefficients, crystal model, materials, natural and synthetic types – their comparison, force and stress sensing, ultrasonic sensors

UNIT-III (11 Hrs.)

Thermal sensors: Material expansion type: solid, liquid, gas and vapour Resistance change type: RTD, materials, construction, tip sensitive and stem sensitive type, Thermistor materials, shapes, ranges, accuracy specifications. Thermoemf sensors: types, thermoelectric powers, general consideration Junction semiconductor type IC and PTAT type Radiation sensors: types, characteristics and comparisons, Pyroelectric type.

UNIT-IV (12 Hrs.)

Magnetic sensors: Sensors 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 cells- types, materials, construction, response Geiger counters, Scintillation detectors Introduction to Smart sensors, Humidity, pH, conductivity, Velocity, Acceleration: Electromagnetic velocity sensor; spring-mass-system, measurement of deflection principle of accelometers, sensitivity, Noise Flow: Pressure gradient technique; (orifice, venture, pitot,) rotameter thermal transport technique; electromagnetic sensor, laser Doppler anemometry; ultrasonic sensors.

Recommended Books

1. A.K. Sawhney, 'Electrical and Electronics Measurements and Instrumentation' Dhanpat Rai and Sons.
2. C.S. Rangan, G.R. Sarma, V.S.V. Mani, 'Instrumentation Devices and Systems', Tata McGraw Hill Publication.
3. B.C. Nakra, K.K. Chaudhary, 'Instrumentation Measurement and Analysis', McGraw Hill Publication Ltd.
4. D. Patranabis, 'Sensors and Transducers', Prentice Hall India Course Private Limited.
5. E.A. Doebelin, 'Measurement Systems: Application and Design', McGraw Hill, New York.
6. H.K.P. Neubert, 'Instrument Transducers', Oxford University Press, London and Calcutta.

ELECTRICAL ENGINEERING MATERIALS

Subject Code: BEEE1-557 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

Course Objectives

1. To provide knowledge about basics of electrical engineering materials.
2. Students will obtain skills of application of materials in daily life.

Course Outcomes

1. An ability to understand all types of magnetic and conducting materials.
2. To understand the various properties of electrical engineering materials.

UNIT-I (9 Hrs.)

Elementary Materials Science Concepts: Bonding and types of solids and its defects, resistivity, factors affecting resistivity, temperature dependence of resistivity, Skin Effect, Hall Effect.

UNIT-II (12 Hrs.)

Dielectric Properties of Insulators in Static and Alternating Field: Dielectric constant of gases, molecules and solids, internal field in solids and liquids, Properties of ferro-electric materials, polarization, types of polarizations, polarizability: atomic and molecular, frequency dependence of electronic and ionic polarizability, piezoelectricity and dielectric losses.

UNIT-III (13 Hrs.)

Magnetic Properties and Superconductivity: Magnetization of matter, magnetic material classification, ferromagnetic origin, Curie-Weiss law, soft and hard magnetic materials, Superconductivity and its origin, critical temperature, critical magnetic field, zero resistance and Meissner Effect, Type-I and Type-II superconductors, applications of superconductors.

UNIT-IV (11 Hrs.)

Conductivity of Metals: Drift velocity, relaxation time of electrons, collision time and mean free path, electron scattering and resistivity of metals.

Semiconductor Materials: Classification of semiconductors, semiconductor conductivity, temperature dependence, Carrier density and energy gap, fermi level, applications of semiconductors in electrical engineering.

Recommended Books

1. S.P. Seth, 'A Course in Electrical Engineering Materials', Dhanpat Rai and Sons, **2001.**
2. Electrical Engineering Materials, T.T.T.I., Madras, **1998.**
3. K.B. Raina and S.K. Bhattacharya, 'Electrical Engineering Materials, S.K. Kataria and Sons, **2004.**
4. P.K. Palanisamy, 'Material Science for Electrical Engineering, Scitech Pub. (India) Pvt. Ltd., Chennai, **2011.**

GENERATION & ECONOMICS OF ELECTRICAL POWER

Subject Code: BEEE1-558 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

Course Objectives

1. Define the performance characteristics and components of such power plants.
2. Estimate different efficiencies associated with such systems
3. Calculate present worth depreciation and cost of different types of power plants.
4. Estimate the cost of producing power per kW.

Course Outcomes

1. Discuss the environmental impact of electric power production on air quality, climate change, water, and land
2. Discuss power generation from renewable/alternate fuels and heat sources: bio fuels, synthetic fuels, geothermal, ocean thermal, solar thermal power plants.
3. Discuss the principles and potential of direct-electric power conversion systems, such as fuel-cell and solar photovoltaic units.
4. Explain the major types of hydro-power and wind-power turbines and estimate power generation potential.

UNIT-I (10 Hrs.)

Introduction: Energy sources and their availability, Principle types of power plants, Their special features and applications, Present status and future trends.

UNIT-II (13 Hrs.)

a) Conventional Power Generation:
Hydro Electric Power Plants: Essentials, Classifications, Hydroelectric survey, Rainfall run off, Hydrograph, Flow duration curve, Mass curve, Storage capacity, Site selection, Plant layout, various components, Types of turbines, Governor and speed regulation, Pumped storage, Small scale hydro–electric plants (mini and micro),

b) Steam Power Plant: General developing trends, Essentials, Plant layout, Coal–its storage, Preparation, Handling, Feeding and burning, Ash handling, Dust collection, High pressure boilers and steam turbines, Their main components like super heaters, Economizers, Pre–heaters etc., Fuel efficiency/heat balance, Layout of Gas turbine power plant and comparison with steam power plants.

c) Nuclear Power Plant: Nuclear fuels, Nuclear energy, Main components of nuclear power plant, Nuclear reactors types and applications, Radiation shielding, Radioactive and waste disposal safety aspect.

UNIT-III (10 Hrs.)

Non-Conventional Power Generation: Geothermal power plants, Electricity from biomass, direct energy conversion systems, Thermo-electric conversion system, Fuel cells, Magneto Hydro Dynamic system.

UNIT-IV (12 Hrs.)

Power Plant Economics: Cost of electrical energy, Selection of type of generation and generation equipment, Performance and operating characteristics of power plants, Economic scheduling principle, Load curves, Effect of load on power plant design, Methods to meet variable load, Load forecasting, Electric tariffs. Theory of peak load pricing, Theory and issues of real time pricing comparison of public supply and private generating units, Definition of Cogeneration and its scope, Cogeneration technologies, Sale of electricity and impact on cogeneration.

Recommended Books

1. S.C. Arora and S. Domkundawar, 'A course in Power Plant Engineering', Dhanpat Rai.
2. M.V. Deshpandey, 'Power Plant Engineering', Tata McGraw Hill, **2004.**
3. B.R. Gupta, 'Generation of Electrical Energy', S. Chand.
4. M.V. Deshpandey, 'Electrical Power System Design', McGraw Hill, **2004.**
5. A.J Wood and B.F. Wollenberg, 'Power Generation and Control', John Wiley, **2004.**
6. S.N. Singh, 'Electric Power Generation: Transmission and Distribution', PHI Course.

MODERN OPTIMIZATION TECHNIQUES

Subject Code: BEEE1-559 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

Course Objectives

The general objectives of the course are:

1. To introduce the fundamental concepts of Optimization Techniques
2. To make the learners aware of the importance of optimizations in real scenarios
3. To provide the concepts of various classical and modern methods of for constrained and unconstrained problems in both single and multivariable

Course Outcomes

Upon completion of this course, the students would be able to:

1. Formulate optimization problems for determining optimum state of the system.
2. Understand and apply the concept of optimality criteria for various type of optimization problems
3. Solve various constrained and unconstrained problems in single variable as well as multivariable
4. Apply the methods of optimization in real life situation.

UNIT-I (12 Hrs.)

Introduction to Optimization: Classification of Optimization, Design vector and constraints, Constraint surface, Objective function, Classification of Optimization Problems, problem formulation.

Classical Optimization Techniques: Introduction to Classical Methods, Single variable optimization, Multi-variable: Direct substitution method, Lagrange's method of multipliers, Karush-Kuhn-Tucker Conditions Calculus method, Method of Multipliers.

UNIT-II (10 Hrs.)

Linear Programming: Introduction to linear programming formulation of different models, Geometry of linear programming, Graphical method, Linear programming (LP) in standard form, Solution of LP by simplex method, Exceptional cases in LP, Duality theory, Dual simplex method, Sensitivity analysis.

UNIT-III (12 Hrs.)

Single Variable Optimization: Problems Optimality Criterion, Bracketing Methods, Region Elimination Methods, Interval Halving Method, Fibonacci method, Golden section method. Gradient Based Methods: Newton-Raphson Method, Bisection Method, Secant Method, application to Root finding.

Multivariable Optimization: Algorithms Optimality Criteria, Unidirectional Search. Direct Search Methods: Hooke-Jeeves pattern search method, Random search methods, Grid search method, Powell's Conjugate Direction Method. Gradient Based Methods: Cauchy's Steepest Descent Method, Newton's method, Marquardt's Method.

UNIT-IV (11 Hrs.)

Transportation and Assignment Problem: Initial basic feasible solutions of balanced and unbalanced transportation/assignment problems, Optimal solutions.

Project Management: Construction of networks, Network computations, Floats (free floats and total floats), Critical path method (CPM), Crashing.

Recommended Books

1. S. Chandra, Jayadeva, Mehra, A., 'Numerical Optimization and Applications' Narosa Publishing House.
2. H.A. Taha, 'Operations Research-An Introduction', PHI.

3. S.S. Rao, 'Engineering Optimization', New Age International.
4. E.J. Haug and J.S. Arora, 'Applied Optimal Design', Wiley, New York.
5. Kalyanmoy Deb, 'Optimization for Engineering Design', Prentice Hall of India.

FUZZY LOGIC SYSTEMS

Subject Code: BEEE1-660 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

Course Objectives

1. Provide an understanding of the basic mathematical elements of the theory of fuzzy sets
2. Provide an emphasis on the differences and similarities between fuzzy sets and classical sets theories.
3. Cover fuzzy logic inference with emphasis on their use in the design of intelligent or humanistic systems.
4. Provide a brief introduction to fuzzy arithmetic concepts.
5. Provide an insight into fuzzy inference applications in the area of control and robotics.

Course Outcomes

1. To learn crips and fuzzy set theory and decide the difference between crips set and fuzzy set theory.
2. To make calculation on fuzzy set theory.
3. To recognize fuzzy logic membership function.
4. To make applications on Fuzzy logic membership function and fuzzy inference systems.

UNIT-I (11 Hrs.)

Theory of Fuzzy Sets and Fuzzy Relations: Fuzzy Reasoning-Fuzzy Rules-Fuzziness compared to randomness- Introduction - Classical sets and fuzzy sets-operations on both-properties of fuzzy sets-classical relations and fuzzy relations- cardinality of fuzzy relations-Fuzzy Cartesian product and composition–fuzzy tolerance and equivalence relations- value assignments - cosine amplitude-max-min method.

UNIT-II (12 Hrs.)

Fuzzification and De-fuzzification: Formation of Fuzzy Rule Base-Membership functions - features –standard forms–fuzzification - membership value assignments - intuition – inference-rank ordering - angular fuzzy sets - inductive reasoning -fuzzy to crisp conversion – lambda/alpha cuts for fuzzy sets and fuzzy relations - defuzzification methods.

UNIT-III (12 Hrs.)

Fuzzy Logic: Classical logic and fuzzy logic –fuzzy rule based systems - approximate reasoning – canonical rule forms - decomposition of compound rules - likelihood and truth classification - aggregation of fuzzy rules – fuzzy inference systems- Mamdani and Takagi-Sugeno fuzzy models- fuzzy control Models-P-1-D like fuzzy control rules – implementation. Computer based Simulation-Language based programming in C/C++-Use of Simulation Tools.

UNIT-IV (10 Hrs.)

Fuzzy nonlinear simulation- fuzzy classification - clustering – fuzzy pattern recognition - fuzzy control systems- fuzzy optimization - case studies – Fuzzy Logic combined with Neural Networks and Genetic Algorithms-Soft Computing Techniques- Fuzzy measures (brief introduction only).

Recommended Books

1. Timothy J. Ross, 'Fuzzy Logic with Engineering Applications', McGraw Hill, **2007.**
2. Guanrong Chen & Trung Tat Pham, 'Introduction to Fuzzy Systems', Chapman & Hall CRC, **2006.**

3. D. Driankov, H. Hellendoorn, M. Reinfrank, 'An Introduction to Fuzzy Control', Narosa Publications.
4. Robert Babuska, 'Fuzzy Modeling for Control', International Series in Intelligent Technologies, Kluwer Academic Publications'.
5. Ronald R. Yager and Dimitar P. Filev, 'Essentials of Fuzzy Modelling & Control', John Wiley & Sons, Inc, **2002.**
6. B. Kosko, 'Fuzzy Engineering', Prentice Hall, **1997.**

VLSI DESIGN

Subject Code: BEEE1-661 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

Course Objectives

1. In this course, the MOS circuit realization of the various building blocks that is common to any digital VLSI circuit is studied.
2. Architectural choices and performance trade-offs involved in designing and realizing the circuits in CMOS technology are discussed.

Course Outcomes

Upon completion of the course, students should

1. Explain the basic CMOS circuits and the CMOS process technology.
2. Discuss the techniques of chip design using programmable devices.
3. Model the digital system using Hardware Description Language.

UNIT-I (11 Hrs)

Introduction: Introduction to Computer-aided design tools for digital systems. Hardware description languages, Introduction to VHDL, Data objects, Classes and data types, Operators, Overloading, and Logical operators. Types of delays, Entity and Architecture Declaration Introduction to behavioural, dataflow and structural models

VHDL Statements: Assignment statements, Sequential Statements and Process, Conditional Statements, Case Statements, Array and Loops, Resolution Functions, Packages & Libraries, Concurrent Statements.

UNIT-II (10 Hrs.)

Applications of VHDL: Combinational Circuit Design such as such as Multiplexers, Encoders, Decoders, Code Converters, Comparators, and Implementation of Boolean functions etc., Sequential Circuit Design such as Shift registers, Counters etc.

UNIT-III (12 Hrs.)

Review of MOS Devices: MOS Structure, Enhancement & Depletion Transistor, Threshold Voltage, MOS device design equations MOS Transistor Models. NMOS, PMOS, CMOS.

Basic Electrical Properties and Circuit Concepts: The NMOS Inverter and Transfer Characteristics pull up and pull down ratios of NMOS, alternative forms of pull up the CMOS Inverter and transfer characteristics. CMOS Inverter Delays. Driving large Capacitive loads, Propagation delays and effect of wiring capacitance.

UNIT-IV (12 Hrs.)

Circuit Characterization and Performance Estimation: Estimation of R, C, L, Switching Characteristics-delay models. Power dissipation. Scaling of MOS circuits. Effect of device scaling on circuit performance.

Recommended Books

1. Bhasker, 'A VHDL Primmer', Prentice Hall.
2. Weste and Eshrighian, 'Principle of CMOS VLSI Design', Pearson Education.
3. D.A. Pucknell and K. Eshraghian, 'Basic VLSI Design', Prentice Hall India, New Delhi.

4. Brown and Vranesic, 'Fundamentals of Digital Logic with VHDL Design', TMH.
5. S.M. Kang, Y. Lebiebici, 'CMOS Digital Integrated Circuits Analysis & Design', TMH.

ENERGY AUDITING AND MANAGEMENT

Subject Code: BEEE1-662 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

Course Objectives

1. To understand and appreciate the energy crisis and environmental concerns associated with the energy management, and the importance of energy conservation.
2. To know the techniques of energy analysis and the associated energy efficient technologies for the routinely used thermal and electrical energy systems.
3. To understand the energy management systems and their essential elements.
4. To acquire the knowledge and the basic skills for energy monitoring, energy bench marking, energy action planning and energy auditing.

Course Outcomes

1. Becoming aware of the energy crisis, and of environmental and sustainability concerns associated with the energy management.
2. Becoming aware of the Energy Conservation Act, 2001, and of the legal energy requirements applicable to the routinely used thermal and electrical energy systems Aware
3. Exposure to the most used energy planning and management softwares.
4. Able to carry out development, implementation and maintenance of ISO 50001 based Energy Management System.
5. Able to utilize the techniques and skills of Energy Management System Auditing.
6. Able to utilize the techniques and skills of energy analysis of organizations and development of energy baseline of organizations.

UNIT-I (12 Hrs.)

Energy Scenario: Energy needs of growing economy, Long term energy scenario, Energy pricing, Energy sector reforms, Energy and environment: Air pollution, Climate change, Energy security, Energy conservation and its importance, Energy strategy for the future, Energy conservation Act-2001 and its features.

Energy Management and Audit: Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution, Energy audit instruments.

UNIT-II (10 Hrs.)

Material and Energy Balance: Facility as an energy system, Methods for preparing process flow, Material and energy balance diagrams.

Financial Management: Investment-need, Appraisal and criteria, Financial analysis techniques- Simple payback period, Return on investment, Net present value, Internal rate of return, Cash flows, Risk and sensitivity analysis, Financing options, Energy performance contracts and role of ESCOs.

UNIT-III (11 Hrs.)

Electrical System: Electricity tariff, Load management and maximum demand control, Power factor improvement, Distribution and transformer losses. Losses in induction motors, Motor efficiency, Factors affecting motor performance, Rewinding and motor replacement issues, energy efficient motors. Light source, Choice of lighting, Luminance requirements, and Energy conservation avenues.

UNIT-IV (12 Hrs.)

Compressed Air System: Types of air compressors, Compressor efficiency, Efficient compressor operation, Compressed air system components, Capacity assessment, Leakage test Factors affecting the performance and efficiency

HVAC and Refrigeration System**:** Vapor compression refrigeration cycle, Refrigerants, Coefficient of performance, Capacity, Factors affecting refrigeration and air conditioning system performance and savings opportunities, Vapor absorption refrigeration system: Working principle, Types and comparison with vapor compression system, Saving potential, Fans, Blowers and pumps- Types, Performance evaluation, Efficient system operation, Flow control strategies and energy conservation opportunities.

Recommended Books

1. Y.P. Abbi and S. Jain, 'Handbook on Energy Audit and Environment Management', Teri Bookstore, **2006.**
2. P. Diwan, 'Energy Conservation', Pentagon Press, **2008.**
3. Thumann and W.J. Younger, 'Handbook of Energy Audits', Fairmont Press, Georgia, USA.

MICROCONTROLLER AND EMBEDDED SYSTEMS

Subject Code: BEEE1-663 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

Course Objectives

The student should be made to:

1. Study the Architecture of 8051 microcontroller.
2. Learn the design aspects of I/O and Memory Interfacing circuits.
3. Study about communication and bus interfacing.

Course Outcomes

At the end of the course, the student should be able to:

1. Design and implement 8051 microcontroller based systems.
2. Serial communication 0f 8051.
3. Interfacing with 8051.

UNIT-I (10 Hrs.)

Introduction: 8051 microcontroller, comparison of microcontroller and microprocessors, Embedded Systems, 8051 Microcontroller: Architecture and Pin Diagram, Program Counter and RAM Spaces, Data types and Directives, Flag Bits and PSW Register, Register Banks and Stack, interrupt.

UNIT-II (12 Hrs.)

Programming: Basic assembly language programming concepts Addressing Modes, Arithmetic, Logical instructions and Programming, I/O Port Programming, BCD and ASCII application programs, Single-bit instruction programming, Timers and Counter Programming, Jump and loop Instructions, Introduction of 8051 Programming in C.

UNIT-III (11 Hrs.)

Serial Communication of 8051: Basics of Communication, Overview of RS-232, UART, USB, 8051 connections to RS-232, serial communication programming, Programming of timer interrupts, Programming of External hardware interrupts, Interrupt priority.

UNIT-IV (12 Hrs.)

Interfacing with 8051: LCD and Keyboard Interfacing, interfacing with external memory and 8051 data memory space, interfacing with 8255, Sensors Interfacing and Signal

Conditioning, interfacing with Stepper Motor and Servo motors, DS12887 RTC Interfacing and its programming.

Recommended Books

1. Mazidi Muhammad Ali, 'The 8051 Microcontroller and Embedded Systems', Pearson Publications.
2. Joseph Yiu, 'The Definitive Guide to ARM Cortex-M3 processors' Newnes Publication.
3. Jonathan W. Valvano, 'Introduction to ARM Cortex-M Microcontrollers', Vol. 1.
4. Jonathan W. Valvano. 'Real-Time Interfacing to ARM Cortex-M Microcontrollers'.

DIGITAL SIGNAL PROCESSING

Subject Code: BEEE1-664 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

Course Objectives

1. To learn discrete Fourier transform and its properties
2. To know the characteristics of IIR and FIR filters learn the design of infinite and finite impulse response filters for filtering undesired signals
3. To understand Finite word length effects
4. To study the concept of Multirate and adaptive filters

Course Outcomes

Upon completion of the course, students will be able to

1. Apply DFT for the analysis of digital signals & systems
2. Design IIR and FIR filters
3. Characterize finite Word length effect on filters.

UNIT-I (11 Hrs.)

Introduction: Signals, Systems and Signal Processing, Classification of Signals, Concept of Frequency in Continuous Time and Discrete Time Signals, Analog-to-Digital and Digital-to-Analog Conversion, Applications of Signal Processing.

Discrete Time Signals and Systems: Discrete Time Signals, Discrete Time Systems, Analysis of Discrete Time Linear Time-Invariant Systems, Discrete Time Systems Described by Difference Equations, Implementation of Discrete Time systems, Correlation of Discrete Time Signals.

UNIT-II (12 Hrs.)

The Z-transform and its Application to the Analysis of LTI Systems: The z-Transform, Properties of z-Transforms, Inversion of z-Transform, One-sided z-Transform, Analysis of Linear Time-Invariant Systems in the z-Domain.

Frequency Analysis of Signals and Systems: Frequency Analysis of Continuous –Time Signals, Frequency Analysis of Discrete Time Signals, Properties of Fourier Transform for Discrete Time Signals. Frequency Domain Characteristics of Linear Time-Invariant Systems, Linear Time-Invariant Systems as Frequency-Selective Filters, Inverse Systems and Deconvolution.

UNIT-III (10 Hrs.)

The Discrete Fourier Transform- its Properties and Applications: Frequency Domain Sampling: The discrete Fourier Transform, Properties of the DFT, Linear Filtering Methods based on the DFT. Frequency Analysis of Signals Using the DFT.

Efficient Computation of DFT- Fast Fourier Transforms: Efficient Computation of DFT: FFT Algorithms, Application of FFT Algorithms, A Linear Filtering Approach to Computation of DFT. Quantization Effect in the Computation of DFT.

UNIT-IV (12 Hrs.)

Implementation of Discrete Time Systems: Structures for the realization of Discrete Time Systems, Structures for FIR Systems, Structures for IIR Systems, Representation of Numbers, Quantization of Filter Coefficients, Round off Effect in Digital Filters.

Design of Digital Filters: General Considerations like causality etc., Design of FIR Filters, Design of IIR Filters from Analog Filters, Frequency Transformations, Design of Digital Filters Based on Linear Squares Method.

Sampling and Reconstruction of Signals: Sampling of Bandpass Signals, Analog-to-Digital Conversion, Digital-to-Analog Conversion.

Recommended Books

1. J.G. Proakis and D.G. Manolakis, 'Digital Signal Processing: Principles, Algorithms and Applications', Prentice Hall.
2. S.K. Mitra, 'Digital Signal Processing: A Computer Based Approach', TMH.
3. A.V. Oppenheim, R.W. Schafer and J.R. Buck, 'Discrete-time Signal Processing', PHI.
4. A. Widrow and S.D. Stearns, 'Adaptive Signal Processing', Prentice Hall.

REMOTE CONTROL AND TELEMETRY

Subject Code: BEEE1-665 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

Course Objectives

1. To learn various types of telemetry required in instrumentation system
2. To study data acquisition
3. To understand the data analysis methods
4. To lean about the basics of Photo-grammetry

Course Outcomes

After study of this subject students will have skill

1. About the setup of telemetry system
2. To analyse the data from remote location
3. To acquire the data in real time system
4. To design Photo-grammetry system

UNIT-I (12 Hrs.)

Introduction: classification of telemetry systems - voltage, current, position, frequency and time. Components of tele-metering and remote control systems, Quantization theory - sampling theorem, sample and hold, data conversion-coding.

Remote Sensing: Introduction of Remote Sensing, Electro Magnetic Spectrum -Effects of Atmosphere-Scattering –Absorption-Atmospheric Window-Energy interaction with surface features – Spectral reflectance of earth objects and land covers Resolution concepts –types – Satellites, orbits and missions.

UNIT-II (10 Hrs.)

Data Acquisition and Distribution System: Fundamentals of audio-telemetry system - R.F. links. Telemetry design system, Standard for telemetry e.g. JRIG, Microwave links, Pulse code modulation (PCM) techniques, Practical telemetry system - pipe line telemetry, power system telemetry, supervisory tele-control systems, Introduction to ISDN.

UNIT-III (11 Hrs.)

Data Analysis: Sources of Errors –scene, sensor and atmospheric causes -correction: geometric and Radiometric –visual and digital interpretation-elements of interpretation – interpretation keys -digital analysis and classification –image formation, visualization: Image

enhancement, filters–Baye‟s theorem Image classification: unsupervised and supervised – thematic mapping -
accuracy assessment.

UNIT-IV (12 Hrs.)

Photo-grammetry: Principles –aerial photo-aerial camera -Scale –overlaps –stereoscopy – concepts –viewing and measuring systems –image and object co-ordinates–transformation - floating mark –parallax equation –height information -Flight planning –computation for flight plan –photo control

Recommended Books

1. Robert A. Schowen Gerdt, 'Remote Sensing: Models and Methods for Image Processing', Academic Press, **2007.**
2. Gottfried Konecny, 'RS, Photogrammetry and Geographic Information Systems', CRC, **2009.**
3. M. Schwartz, 'Information Transmission - Modulation & Noise', McGraw Hill, **1970.**
4. D. Patranabis, 'Telemetry Principles', Tata McGraw Hill.
5. A.K. Sawhney, 'A course in Electrical and Electronic Measurements and Instrumentation' Dhanpat Rai, New Delhi.

NON CONVENTIONAL ENERGY RESOURCES

Subject Code : BEEE1-666 **L T P C** **Duration: 48 Hrs.**
3 1 0 4

Course Objectives

1. To understand conventional and nonconventional sources of energy.
2. To evaluate different sources of energy
3. To persuade community to use renewable energy sources

Course Outcomes

1. Students would become aware about Non conventional Energy sources and Solar energy, different types of collectors, their uses, wind energy, tidal energy, geothermal energy, Thermo Nuclear Fusion, Cold Fusion.
2. Students will develop the use of wind energy and Biomass energy
3. Students would become aware about potential of energy present under earth surface and about energy of oceanic water tides.
4. Students would develop the understanding about Nuclear energy, Hydrogen energy etc.

UNIT-I (12 Hrs.)

Introduction: Energy sources and availability, new energy techniques, Renewable energy sources, Solar Energy; Solar constant, Radiation geometry, Solar energy collectors, Concentrated and flat plate, Energy balance and collector efficiency, Solar energy storage, Application to space heating, distillation, cooking and green house effect,

UNIT-II (10 Hrs.)

Wind Energy: Basic principle, site selection, Aerodynamic analysis of blades,
Bio-energy; Biomass conversion technology, photosynthesis, Biogas plant, thermal gasification.

UNIT-III (11 Hrs.)

Geothermal Energy: Sources, hydrothermal sources, hot dry rock resources, geothermal fossil system, prime movers for geothermal energy
Energy from ocean; Ocean thermal electric conversion, energy from tides, small scale hydroelectric development.

UNIT-IV (12 Hrs.)

Hydrogen energy sources; Production, storage, utilization, magneto hydrodynamic power, thermo ionic generation, Nuclear fusion energy, Energy storage. Energy conservation.

Recommended Books

1. G.D. Rai, 'Non-Conventional Energy Sources', Khanna Publishers, Delhi.
2. S. Rao, B.B. Parulekar, 'Energy Technology: Non-Conventional Renewable and Conventional', Khanna Publishers, Delhi.
3. H.P. Garg & Jai Prakash, 'Solar Energy: Fundamentals and Applications', Tata McGraw Hill, N. Delhi.
4. Sutton, 'Direct Energy Conversion', McGraw Hill Inc., **1966.**
5. Duffie and Beckman, 'Solar Energy Thermal Processes', John Wiley, **1974**.
6. R.K. Rajput, 'Non-Conventional Energy Sources and Utilization (Energy Engineering)', S. Chand Publishers.

NEURAL NETWORKS

Subject Code : BEEE1-667 **L T P C** **Duration: 45 Hrs.**
3 1 0 4

Course Objectives

1. Basic neuron models: McCulloch-Pitts model and the generalized one, distance or similarity based neuron model, radial basis function model, etc.
2. Basic neural network models: multilayer perceptron, distance or similarity based neural networks, associative memory and self-organizing feature map, radial basis function based multilayer perceptron, neural network decision trees, etc.
3. Basic Course algorithms: the delta Course rule, the back propagation algorithm, self-organization Course, the r4-rule, etc.
4. Applications: pattern recognition, function approximation, information visualization, etc.

Course Outcomes

1. To learn basic neural network architecture
2. To learn basic Course algorithms
3. To understand data pre and post processing
4. To learn training, verification and validation of neural network models
5. To design Engineering applications that can learn using neural networks

UNIT-I (12 Hrs.)

Introduction to Neural Networks: Human brain and Biological Neuron, Artificial Neural Network, ANN Terminology, McCulloch- Pitts Neural Model, Activation functions, Topology, Feedforward Neural Networks, ANN Course: Supervised, Un-supervised, Competitive Course, Reinforcement Course, Knowledge representation.

UNIT-II (11 Hrs.)

Course Laws: Hebb's rule, Delta rule, Widrow & Hoff LMS Course rule, Correlation Course rule, Instar and Outstar Course rules, Back-propagation Neural Networks, K-means clustering algorithm, Kohenen's feature maps, Associative Memories

UNIT-III (10 Hrs.)

Radial Basis Neural Networks: Function Neural Networks, Basic Course laws in RBF Nets, Recurrent Networks, Recurrent Backpropagation, Counter-Propagation Networks, CMAC Networks, ART Networks.

UNIT-IV (12 Hrs.)

Associative-Memories: Paradigms of Associative Memory, Pattern Mathematics, Hebbian Course, General Concepts of Associative Memory, Bidirectional Associative Memory

(BAM) Architecture, BAM Training Algorithms: Storage and Recall Algorithm, BAM Energy Function. Architecture of Hopfield Network: Discrete and Continuous versions, Storage and Recall Algorithm, Stability Analysis. Neural network applications: Process identification, control, fault diagnosis

Recommended Books

1. Laurene Fausett, 'Fundamentals of Neural Networks', Pearson Education, **2004.**
2. Simon Haykin, 'Neural Networks- A comprehensive foundation,'Pearson Education, **2003**.
3. S. Rajasekharan and G.A. Vijayalakshmi Pai, 'Neural Networks, Fuzzy logic, Genetic Algorithms: Synthesis and Applications', PHI Publication, **2004.**
4. Timothy J. Ross, 'Fuzzy Logic with Engineering Applications', Tata McGraw Hill Inc., **2000.**