Syllabus

B. Tech (Electrical Engineering)

BoS - 2020

Syllabus

Core Courses

B. Tech (Electrical Engineering)

BoS - 2020

<table>
<tr><td colspan="9">ELECTRICAL ENGINEERING DEPARTMENT</td></tr>
<tr><td colspan="9">Course:- Bachelor of Technology (Electrical Engineering)</td></tr>
<tr><td>Semester</td><td>Third</td><td colspan="2">Subject Title</td><td colspan="2">Electrical Circuit Analysis</td><td>Code</td><td colspan="2">TEE 301</td></tr>
<tr><td colspan="2">Course Components</td><td colspan="2">Credits</td><td rowspan="2">Contact Hours</td><td>L</td><td>T</td><td colspan="2">P</td></tr>
<tr><td colspan="2">Core Course (CC)</td><td colspan="2">04</td><td>03</td><td>01</td><td colspan="2">00</td></tr>
<tr><td colspan="2" rowspan="2">Examination Duration (Hrs)</td><td>Theory</td><td>Practical</td><td rowspan="2">WEIGHTAGE: EVALUATION</td><td>CWA</td><td>MSE</td><td colspan="2">ESE</td></tr>
<tr><td>03</td><td>00</td><td>25</td><td>25</td><td colspan="2">50</td></tr>
<tr><td colspan="9">Course Objectives</td></tr>
<tr><td>CO 1</td><td colspan="8">Apply network theorems for the analysis of electrical circuits.</td></tr>
<tr><td>CO2</td><td colspan="8">Explain the transient and steady-state response of electrical circuits.</td></tr>
<tr><td>CO3</td><td colspan="8">Analyze circuits in the sinusoidal steady-state (single-phase and three-phase).</td></tr>
<tr><td>CO4</td><td colspan="8">Familiarity with the solution of first and second order networks.</td></tr>
<tr><td>CO5</td><td colspan="8">Application of Laplace transform for circuit analysis</td></tr>
<tr><td>CO6</td><td colspan="8">Design of different kinds of two port networks</td></tr>
<tr><td>Unit No.</td><td colspan="7">Content</td><td>Hours</td></tr>
<tr><td>Unit -1</td><td colspan="7">Network Theorems
Superposition theorem, Thevenin’s theorem, Norton theorem, Maximum power transfer theorem. Analysis with dependent current and voltage sources. Node and Mesh Analysis. Graph Theory, Network Topology, formation of incidence matrix, Tie set and cutest matrix, equilibrium equations, solution of electric circuits. Concept of duality and dual networks.</td><td>10</td></tr>
<tr><td>Unit -2</td><td colspan="7">Sinusoidal steady state analysis
Representation of sine function as rotating phasor, phasor diagrams, impedances and admittances, AC circuit analysis, effective or RMS values, average power and complex power. Three-phase circuits. Mutual coupled circuits, Dot Convention in coupled circuits, Ideal Transformer.</td><td>7</td></tr>
<tr><td>Unit -3</td><td colspan="7">Electrical Circuit Analysis Using Laplace Transforms
Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform for standard inputs, convolution integral, inverse Laplace transform, transformed network with initial conditions. Transfer function representation. Poles and Zeros. Frequency response (magnitude and phase plots), series and parallel resonances</td><td>8</td></tr>
<tr><td>Unit -4</td><td colspan="7">Fourier Circuit analysis: Trignometric form of Fourier series. Concept of Symmetry. Circuit response to periodic forcing functions. Circuit analysis in the S-domain. Z(s) & Y(s) functions, Modelling of inductor, Capacitor. Nodal & Mesh analysis in the S-domain. Transfer functions.</td><td>10</td></tr>
<tr><td>Unit -5</td><td colspan="7">Two Port Network
Two Port Networks, terminal pairs, relationship of two port variables, impedance parameters, admittance parameters, transmission parameters and hybrid parameters, interconnections of two port networks.</td><td>7</td></tr>
<tr><td></td><td colspan="7">Total Hours</td><td>42</td></tr>
</table>

Test Books/ References:

1. M. E. Van Valkenburg, “Network Analysis”, Prentice Hall, 2006.
2. D. Roy Choudhury, “Networks and Systems”, New Age International Publications, 1998.
3. W. H. Hayt and J. E. Kemmerly, “Engineering Circuit Analysis”, McGraw Hill Education, 2013.
4. C. K. Alexander and M. N. O. Sadiku, “Electric Circuits”, McGraw Hill Education, 2004.
5. K. V. V. Murthy and M. S. Kamath, “Basic Circuit Analysis”, Jaico Publishers, 1999

ELECTRICAL ENGINEERING DEPARTMENT							
Course:- Bachelor of Technology (Electrical Engineering)							
Semester	Third	***Subject Title***		**Analog Electronics**		***Code***	TEE 305
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***
Core Course (CC)		03			03	00	00
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE:EVALUATION***	***CWA***	***MSE***	***ESE***
		03	00		25	25	50

Course Objectives	
CO 1	**Demonstrate** the characteristics of diode and BJT.
CO2	**Understand** the characteristics of MOSFET.
CO3	**Design** the various types of rectifier and amplifier circuits.
CO4	**Design** of sinusoidal and non-sinusoidal oscillators.
CO5	**Understand** the functioning of OP-AMP and design OP-AMP based circuits.
CO6	**Familiarize** with linear and nonlinear applications of OP-AMP.

Unit No.	***Content***	***Hours***
Unit -1	**Diode circuits** Junction diode, I-V characteristics of a diode; review of half-wave and full-wave rectifiers, Zener diodes, clamping and clipping circuits, Varactor diode. **BJT circuits** Structure and I-V characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal model, biasing circuits, common-emitter, common-base and common-collector amplifiers; Small signal equivalent circuits, high-frequency equivalent circuits	12
Unit -2	**MOSFET circuits** MOSFET structure and I-V characteristics. MOSFET as a switch. MOSFET as an amplifier: small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, trans-conductance, high frequency equivalent circuit.	8
Unit -3	**Introduction to operational amplifier** Basics of op-amp, Ideal Op-amp, Internal circuit of op-amp, Differential amplifier; DC characteristics of op-amp, AC characteristics of op-amp.	6
Unit -4	**Linear applications of op-amp** Inverting and non-inverting amplifier, differential amplifier, Adder, Subtractor, instrumentation amplifier, integrator, differentiator, Op-amp based active filter, oscillators (Wein bridge and phase shift).	6
Unit -5	**Nonlinear applications of op-amp** Hysteretic Comparator, Zero Crossing Detector, Square-wave and triangular-wave generators. Precision rectifier, peak detector.	4
	Total Hours	36

Test Books/ References:

1. A. S. Sedra and K. C. Smith, "Microelectronic Circuits", New York, Oxford University Press, 1998.
2. J. V. Wait, L. P. Huelsman and G. A. Korn, "Introduction to Operational Amplifier theory and applications", McGraw Hill U. S., 1992.
3. J. Millman and A. Grabel, "Microelectronics", McGraw Hill Education, 1988.
4. P.R. Gray, R.G. Meyer and S. Lewis, "Analysis and Design of Analog Integrated Circuits", John Wiley & Sons, 2001.
5. Milliman, J. and Halkias, C.C., Intergrated Electronics, Tata McGraw Hill (2007).

ELECTRICAL ENGINEERING DEPARTMENT								
Course:- Bachelor of Technology (Electrical Engineering)								
Semester	3RD	***Subject Title***		**Electrical Machines - I**		***Code***	TEE 302	
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***	
Core Course (CC)		03			03	00	00	
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE:EVALUATION***	***CWA***	***MSE***	***ESE***	
		03	00		25	25	50	

Course Objectives

CO 1	**Understand** the concepts of magnetic circuits.
CO2	**Application** of magnetic field in production of force and torque
CO3	**Analysis of** dc machine configurations and characteristics
CO4	**Examine** the various performance parameters of dc machine.
CO5	**Acquire** the concept of operation of various types of transformers.
CO6	**Assessment** of various performance parameters of single phase and three phase transformers circuits.

Unit No.	***Content***	***Hours***
Unit -1	**Magnetic fields and magnetic circuits** Review of magnetic circuits - MMF, flux, reluctance, inductance; review of Ampere Law and Biot Savart Law; Visualization of magnetic fields produced by a bar magnet and a current carrying coil - through air and through a combination of iron and air; influence of highly permeable materials on the magnetic flux lines.	8
Unit -2	**Electromagnetic force and torque** B-H curve of magnetic materials; flux-linkage vs current characteristic of magnetic circuits; linear and nonlinear magnetic circuits; energy stored in the magnetic circuit; - Force and Torque Calculation from Energy and Co-energy Model of Electromechanical Systems	6
Unit -3	**Transformers** Principle, construction and operation of single-phase transformers, equivalent circuit, phasor diagram, voltage regulation, losses and efficiency Testing - open circuit and short circuit tests, polarity test, back-to-back test, separation of hysteresis and eddy current losses Three-phase transformer - construction, types of connection and their comparative features, Parallel operation of single-phase and three-phase transformers, Autotransformers - construction, principle, applications and comparison with two winding transformer, Magnetizing current, effect of nonlinear B-H curve of magnetic core material, harmonics in magnetization current, Phase conversion - Scott connection, three-phase to six-phase conversion, Tap-changing transformers - No-load and on-load tap-changing of transformers, Three-winding transformers. Cooling of transformers.	8
Unit -4	**DC machines** Basic construction of a DC machine, magnetic structure - induced EMF in an armature coil. Armature winding and commutation - Elementary armature coil and commutator, lap and wave windings, construction of commutator, linear commutation armature MMF wave, derivation of torque equation, armature reaction, air gap flux density distribution with armature reaction.	6
Unit-5	**DC machine - motoring and generation** DC motor – principle of operation – back emf – classification – torque equation – losses and efficiency – power flow diagram – performance characteristics of shunt, series and compound motors – starting of dc motors – necessity and types of starters – speed control – methods of speed control – testing – Swinburne’s test – Hopkinson’s test – separation of losses – retardation test – applications of dc motors.	8
	Total Hours	36

Text / References

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery”, New York, McGraw Hill Education, 2013.
2. A. E. Clayton and N. N. Hancock, “Performance and design of DC machines”, CBS Publishers, 2004.
3. M. G. Say, “Performance and design of AC machines”, CBS Publishers, 2002.
4. P. S. Bimbhra, “Electrical Machinery”, Khanna Publishers, 2011.
5. I. J. Nagrath and D. P. Kothari, “Electric Machines”, McGraw Hill Education, 2010.

ELECTRICAL ENGINEERING DEPARTMENT								
Course:-Bachelor of Technology (Electrical Engineering)								
Semester	Third	***Subject Title***		Electrical and Electronics Measuring Instruments		***Code***	TEE 303	
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***	
Core Course (CC)		03			03	00	00	
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE:EVALUATION***	***CWA***	***MSE***	***ESE***	
		03	00		25	25	50	

Course Objectives

CO 1	**Understand** the concept of measurement and different measuring instruments.
CO2	**Realize** the working of various analog instruments to measure electrical quantities
CO3	**Estimation** of electrical quantities through measuring instruments.
CO4	**Application** of instrument transformer.
CO5	**Developing** the concept of digital measurement of electrical quantities.
CO6	**Analyze** various electrical signals through cathode ray oscilloscope and power analyzer

Unit No.	***Content***	***Hours***
Unit-1	**Introduction to Measurement:** Methods of Measurement, Classification of instrument system, Characteristic of instrument & measurement system**,** Errors in Measurement & its Analysis.	5
Unit-2	**Analog Measurement of Electrical Quantities:** Principle of operations and torque equations for different types of instruments, PMMC, Moving Iron, Electrodynamometer, Ammeters & Voltmeters, Multi-Range ammeter & voltmeter, Electrodynamometer type Wattmeter, Power in three Phase System. **Measurement of Electrical Quantities:** Different methods of measuring low, medium and high resistances**,** Measurement of Inductance & Capacitance with the help of AC Bridge, Measurement of Frequency and Power factor.	10
Unit-3	**Instrument Transformer:** Instrument Transformer and their application in the extension of instrument range. Difference between CT and PT, transformation ratio and phase angle error for CT and PT, causes of errors, reduction of errors, effect of secondary open circuit for CT.	7
Unit-4	**Digital Measurement of Electrical Quantities:** Concept of digital Measurement, Digital voltmeter, Digital frequency meter.	6
Unit-5	**Cathode Ray Oscilloscope:** Introduction, cathode ray tube, electron gun, electrostatic deflection plates, time base generator, Attenuator, synchronization, storage oscilloscope, observations of waveform on CRO, measurements using CRO – Voltage, Frequency, Period, Phase.	8
	Total Hours	36

Text Book:

1. E.W. Golding& F.C. Widdis, “Electrical Measurement &Measuring Instrument”, A.W. Wheeler& Co. Pvt. Ltd. India.
2. A.K. Sawhney: “Electrical & Electronic Measurement & Instrument “, Dhanpat Rai& Sons, India.

References:

1. Forest K. Harries, “Electrical Measurement “Willey Eastern Pvt. Ltd. India.
2. M.B. Stout, “Basic Electrical Measurement” Prentice hall of India, India.

<table>
<tr><td colspan="8">ELECTRICAL ENGINEERING DEPARTMENT</td></tr>
<tr><td colspan="8">Course:- Bachelor of Technology (Electrical Engineering)</td></tr>
<tr><td>Semester</td><td>Third</td><td colspan="2">Subject Title</td><td colspan="2">Electromagnetic Fields</td><td>Code</td><td>TEE 304</td></tr>
<tr><td colspan="2">Course Components</td><td colspan="2">Credits</td><td rowspan="2">Contact Hours</td><td>L</td><td>T</td><td>P</td></tr>
<tr><td colspan="2">Core Course (CC)</td><td colspan="2">04</td><td>03</td><td>01</td><td>00</td></tr>
<tr><td colspan="2" rowspan="2">Examination Duration (Hrs)</td><td>Theory</td><td>Practical</td><td rowspan="2">WEIGHTAGE:EVALUATION</td><td>CWA</td><td>MSE</td><td>ESE</td></tr>
<tr><td>03</td><td>00</td><td>25</td><td>25</td><td>50</td></tr>
<tr><td colspan="8">Course Objectives</td></tr>
<tr><td>CO 1</td><td colspan="7">Application of various forms of vectors</td></tr>
<tr><td>CO2</td><td colspan="7">Acquiring the knowledge of various laws associated with electrostatics and electromagnetics</td></tr>
<tr><td>CO3</td><td colspan="7">Application of Laplace's and Poisson's equations.</td></tr>
<tr><td>CO4</td><td colspan="7">Acquiring the knowledge of various characteristics of conductor, dielectric, capacitance.</td></tr>
<tr><td>CO5</td><td colspan="7">Demonstration of Maxwell's equation in different forms and different media.</td></tr>
<tr><td>CO6</td><td colspan="7">Utilization of EM waves.</td></tr>
<tr><td>Unit No.</td><td colspan="6">Content</td><td>Hours</td></tr>
<tr><td>Unit - 1</td><td colspan="6">Review of Vector Calculus
Vector algebra-addition, subtraction, components of vectors, scalar and vector multiplications, triple products, three orthogonal coordinate systems (rectangular, cylindrical and spherical). Vector calculus-differentiation, partial differentiation, integration, vector operator del, gradient, divergence and curl; integral theorems of vectors. Conversion of a vector from one coordinate system to another.</td><td>6</td></tr>
<tr><td>Unit - 2</td><td colspan="6">Static Electric Field
Coulomb's law, Electric field intensity, Electrical field due to point charges. Line, Surface and Volume charge distributions. Gauss law and its applications. Absolute Electric potential, Potential difference, Calculation of potential differences for different configurations. Electric dipole, Electrostatic Energy and Energy density.
Static Magnetic Fields. Biot-Savart Law, Ampere Law, Magnetic flux and magnetic flux density, Scalar and Vector Magnetic potentials. Steady magnetic fields produced by current carrying conductors.</td><td>12</td></tr>
<tr><td>Unit - 3</td><td colspan="6">Conductors, Dielectrics and Capacitance
Current and current density, Ohms Law in Point form, Continuity of current, Boundary conditions of perfect dielectric materials. Permittivity of dielectric materials, Capacitance, Capacitance of a two wire line, Poisson's equation, Laplace's equation, Solution of Laplace and Poisson's equation, Application of Laplace's and Poisson's equations.
Magnetic Forces, Materials and Inductance: Force on a moving charge, Force on a differential current element, Force between differential current elements, Nature of magnetic materials, Magnetization and permeability, Magnetic boundary conditions, Magnetic circuits, inductances and mutual inductances.</td><td>12</td></tr>
<tr><td>Unit - 4</td><td colspan="6">Time Varying Fields and Maxwell's Equations
Faraday's law for Electromagnetic induction, Displacement current, Point form of Maxwell's equation, Integral form of Maxwell's equations, Motional Electromotive forces. Boundary Conditions.</td><td>6</td></tr>
<tr><td>Unit - 5</td><td colspan="6">Electromagnetic Waves
Derivation of Wave Equation, Uniform Plane Waves, Maxwell's equation in Phasor form, Wave equation in Phasor form, Plane waves in free space and in a homogenous material. Wave equation for a conducting medium, Plane waves in lossy dielectrics, Propagation in good conductors, Skin effect. Poynting theorem</td><td>6</td></tr>
<tr><td></td><td colspan="6">Total Hours</td><td>42</td></tr>
</table>

Test Books/ References:

1. M. N. O. Sadiku, "Elements of Electromagnetics", Oxford University Publication, 2014.
2. G.W. Carter, "The electromagnetic field in its engineering aspects", Longmans, 1954.

3. W.J. Duffin, “Electricity and Magnetism”, McGraw Hill Publication, 1980.
4. E.G. Cullwick, “The Fundamentals of Electromagnetism”, Cambridge University Press, 1966.
5. B. D. Popovic, “Introductory Engineering Electromagnetics”, Addison-Wesley Educational Publishers, International Edition, 1971.
6. W. Hayt, “Engineering Electromagnetics”, McGraw Hill Education, 2012.

<table>
<tr><td colspan="8">ELECTRICAL ENGINEERING DEPARTMENT</td></tr>
<tr><td colspan="8">Course:- Bachelor of Technology (ELECTRICAL ENGINERING)</td></tr>
<tr><td>Semester</td><td>Third</td><td colspan="2">Subject Title</td><td colspan="2">Analog Electronics Lab</td><td>Code</td><td>PEE 351</td></tr>
<tr><td colspan="2">Course Components</td><td colspan="2">Credits</td><td rowspan="2">Contact Hours</td><td>L</td><td>T</td><td>P</td></tr>
<tr><td colspan="2">Core Course (CC)</td><td colspan="2">01</td><td>00</td><td>00</td><td>02</td></tr>
<tr><td colspan="2" rowspan="2">Examination Duration (Hrs)</td><td>Theory</td><td>Practical</td><td rowspan="2">WEIGHTAGE: EVALUATION</td><td>CWA</td><td>MSE</td><td>ESE</td></tr>
<tr><td>00</td><td>03</td><td>25</td><td>25</td><td>50</td></tr>
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Course Objectives	
CO1	Understand the use the CRO and Multimeter for different applications.
CO2	Understand and Verify the physical construction, working and operational characteristics of semiconductor diodes.
CO3	Design and Analyze the different applications of semiconductor diodes.
CO4	Verify and Analyze the output characteristics of Transistors (such as: BJTs, FETs)

Experiment No.	***Name of the Experiment***
1	Plot V-I characteristics of Junction diode under forward and reverse-biased condition. (Si & Ga)
2	Plot V-I characteristics of Zener diode under reverse-biased condition.
3	Plot the Input - Output characteristics for the common-base, Common Emitter and Common Collector configurations of a BJT
4	To plot output characteristics of MOFET & measure pinch-off voltage. Calculate MOFET parameters at a given operating point.
5	To study R-C coupled two-stage common-emitter amplifier and determine voltage gain, current gain, input impedance and output impedance.
6	To study single stage RC-coupled MOFET amplifier.
7	To study common-emitter / common source amplifier and determine voltage gain, current gain, input impedance and output impedance.
8	To study open loop response of inverting and non-inverting op-amp
9	To study closed loop response of inverting and non-inverting op-amp
10	To design and test op-amp based adder and Subtractor circuits
11	To design and test op-amp based integrator and differentiator circuit
12	To study op-amp based low pass and high pass active filters
13	To design and test op-amp based comparator circuit
14	To realize Op-amp based triangular wave generator

-- Two innovative experiments can be given by the faculty In-charge.

Note: Minimum of 10 experiments to be performed.

ELECTRICAL ENGINEERING DEPARTMENT							
Course:- Bachelor of Technology (ELECTRICAL ENGINERING)							
Semester	Third	***Subject Title***		Electrical Machines Lab - I		***Code***	PEE 352
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***
Core Course (CC)		01			00	00	02
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE: EVALUATION***	***CWA***	***MSE***	***ESE***
		00	03		25	25	50

Course Objectives	
CO 1	Understand the working of DC machines and its applications.
CO2	Understand and Verify the various operating curves on the DC machines.
CO3	Analyze the various tests on DC Machine
CO4	Verify and Analyze the test of 3-phase Transformer.

Experiment No.	***Name of the Experiment***
1	To estimate voltage ratio of 1-phase transformer.
2	To perform Polarity test of 1-phase transformer.
3	To determine efficiency and voltage regulation of 1-phase transformer through load test
4	To determine core losses of 1-phase transformer using open circuit tests
5	To find the copper losses of 1-phase transformer by short circuit test
6	To perform 3-phase to 2-phase conversion by Scott connection.
7	To find the efficiency and losses of dc shunt motor by Hopkinson’s test
8	To find the efficiency of a dc shunt motor by Swinburne’s test.
9	To perform Speed control of a dc shunt motor by field flux method.
10	To perform Speed control of dc shunt motor by armature terminal voltage method.
11	To perform load test on a dc shunt motor.
12	To find the magnetizing characteristics of a dc shunt generator.

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<tr><td colspan="9">ELECTRICAL ENGINEERING DEPARTMENT</td></tr>
<tr><td colspan="9">Course:- Bachelor of Technology (Electrical Engineering)</td></tr>
<tr><td>Semester</td><td>Third</td><td colspan="2">Subject Title</td><td colspan="2">Career Skills - I (Verbal+ Logical Reasoning)</td><td>Code</td><td colspan="2">XCS 301</td></tr>
<tr><td colspan="2">Course Components</td><td colspan="2">Credits</td><td rowspan="2">Contact Hours</td><td>L</td><td>T</td><td colspan="2">P</td></tr>
<tr><td colspan="2">Career Skills (CK)</td><td colspan="2">01</td><td>02</td><td>00</td><td colspan="2">00</td></tr>
<tr><td colspan="2" rowspan="2">Examination Duration (Hrs)</td><td>Theory</td><td>Practical</td><td rowspan="2">WEIGHTAGE: EVALUATION</td><td>CWA</td><td>MSE</td><td colspan="2">ESE</td></tr>
<tr><td>03</td><td>00</td><td>25</td><td>25</td><td colspan="2">50</td></tr>
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Course Objectives		
CO 1	To develop inter personal skills and be an effective goal oriented team player.	
CO2	To develop professionals with idealistic, practical and moral values.	
CO3	To develop communication and problem solving skills	
CO4	To re-engineer attitude and understand its influence on behavior	
Unit No.	***Content***	***Hours***
Unit1.	Meeting Etiquette – Introductions - the Handshake– Exchange of Visiting Cards Personal Etiquette – Hygiene, Grooming, and Good sense Travel Etiquette, Sharing Apartments Behavior at Work – Formal behavior with seniors and Colleagues – Etiquette with Women/men – Adherence to Office Rules – Discipline Table Manners and Small Talk (unit 1) **Group Discussions:** Group Discussion Techniques/ Do's and Dont's / body language/mock sessions.	8
Unit 2.	**Logical Reasoning:** Series completion, Coding decoding, direction sense test, logical Venn diagram,	6
Unit 3.	**Logical Reasoning:** mathematical operation, number ranking, time sequence test, arithmetical reasoning.	6
Unit 4.	**Job application:** Importance of Business Communication in today's world, Designing Business Letters, Types of Letters . Writing Effective Emails, Report Writing Essential parts - Cover Letter and the 'resume'. Types of 'resumes ' (*Curriculum Vitae*) Chronological 'resume', functional 'resume'	8
	Total	**28**

References

For Verbal Section:

Spoken English for India by R.K. Bansal and J.B. Harrison- Orient Longman
A practical English Grammar by Thomson and Martinet-Oxford University Press
Professional Communication by Malti Aggarwal
English grammar, composition and correspondence by M.A.Pink and A.E.Thomas –S.Chand and Sons. Word Power by Blum Rosen-Cambridge University Press
A Dictionary of Modern Usage-Oxford University Press

For Aptitude Section:

Quantitative aptitude by R.S Agarwal
Verbal and Non Verbal Reasoning by R.S Agarwal
All books of puzzles to puzzle to puzzle you by Shakuntala Devi.
Question Bank on the practice exercise (Created for internal use)

ELECTRICAL ENGINEERING DEPARTMENT							
Course:- Bachelor of Technology (Electrical Engineering)							
Semester	Fourth	***Subject Title***		**Digital Electronics**		***Code***	TEE 404
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***
Core Course (CC)		03			03	00	00
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE:EVALUATION***	***CWA***	***MSE***	***ESE***
		03	00		25	25	50

Course Outcomes: After successful completion of this course, students will be able to	
CO1	**Acquiring** the knowledge of digital codes and logic gates
CO2	**Realization** of Boolean algebra in digital circuits
CO3	**Implementation** of circuit elements as mathematical functions
CO4	**Formulation** of combinational circuits
CO5	**Formulation** & **implementation** of sequential logic
CO6	**Design** and **Analyse** counters.

Unit No.	***Content***	***Hours***
Unit -1	**Number System & Codes:** Binary, Octal, Hexadecimal number systems and their inter-conversion, Binary Arithmetic (Addition, Subtraction, Multiplication and Division), Diminished radix and radix compliments, BCD codes, Gray codes. **Logic Gates & Boolean Algebra:** Basic Theorems and properties of Boolean Algebra, Boolean Functions, Canonical and Standard forms, Digital Logic Gate.	10
Unit -2	**Simplification of Boolean functions using Map and Tabulation methods:** The map method, Two, Three, Four and Five variable maps, Sum of products and Product of Sums Simplification, NAND and NOR implementation, , Ex-OR functions, The tabulation method, Determination of Prime implicants, Selection of Essential Prime implicants.	8
Unit -3	**Combinational logic design :** Design procedure, adders, subtarctors, code converters, magnitude comparators, Multiplexer, Binary adder and subtractor, Multiplexers, Decoders / De-multiplexers, Read Only Memory, Programmable Logic Arrays.	8
Unit -4	**Introduction to Sequential Logic & counter design:** Introduction, S-R Flip-flops, JK flip-flop, D flip-flop, T flip-flop, master slave flip-flop. Flip-flop excitation table, Classification of sequential circuits.	5
Unit – 5	**Introduction to counter design:** design & analysis of Counters, mod-n synchronous counters, BCD counter, Johnson counter, Ring counter, design of synchronous counter for a random sequence, mod-n Asynchronous/ Ripple counter.	5
	Total Hours	36

Test Books/ References:

1. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education,2009.
2. M. M. Mano, "Digital logic and Computer design", Pearson Education India,2016.
3. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India,2016.

ELECTRICAL ENGINEERING DEPARTMENT							
Course:- Bachelor of Technology (Electrical Engineering)							
Semester	Fourth	***Subject Title***		**Electrical Machines – II**		***Code***	TEE 401
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***
Core Course (CC)		03			03	00	00
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE:EVALUATION***	***CWA***	***MSE***	***ESE***
		03	00		25	25	50

Course Objectives

CO1	**Understanding** of various windings of AC machine
CO2	**Utilization** of Pulsating and Revolving magnetic field.
CO3	**Evaluation** of various characteristics of 3-phase induction motor.
CO4	**Evaluation** of various characteristics of 1-phase induction motor.
CO5	**Analysis** of The various performance parameters of an alternator.
CO6	**Understanding** of construction, principle of operation, and performance of various AC motors and generator.

Unit No.	*Content*	*Hours*
Unit -1	**Fundamentals of AC machine windings** Physical arrangement of windings in stator and cylindrical rotor of electrical machine. Air-gap MMF distribution with fixed current through winding-concentrated and distributed, Sinusoidally distributed winding, winding distribution factor	6
Unit -2	**Pulsating and revolving magnetic fields** Constant magnetic field, pulsating magnetic field, Magnetic field produced by a single winding – fixed current and alternating current, Pulsating fields produced by spatially displaced windings, three windings spatially shifted by 120 degrees (carrying three-phase balanced currents), revolving magnetic field.	7
Unit-3	**Induction Machines** Construction, Types (squirrel cage and slip-ring), Torque Slip Characteristics, Starting and Maximum Torque. Equivalent circuit. Phasor Diagram, Losses and Efficiency. Effect of parameter variation on torque speed characteristics (variation of rotor and stator resistances, stator voltage, frequency). Methods of starting, braking and speed control for 3-phase induction motors.	8
Unit-4	**Single-phase induction motors** Double revolving field theory, equivalent circuit, determination of parameters. Split-phase starting methods and applications	5
Unit -5	**Synchronous machines** Constructional features, cylindrical rotor synchronous machine - generated EMF, equivalent circuit and phasor diagram, armature reaction, synchronous impedance, voltage regulation. Operating characteristics of synchronous machines, V-curves. Salient pole machine - two reaction theory, analysis of phasor diagram, power angle characteristics. Parallel operation of alternators - synchronization and load division.	10
	Total Hours	36

Text/References:

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", McGraw Hill Education, 2013.
2. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
3. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
4. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.
5. A. S. Langsdorf, "Alternating current machines", McGraw Hill Education, 1984.
6. P. C. Sen, "Principles of Electric Machines and Power Electronics", John Wiley & Sons, 2007.

<table>
<tr><td colspan="9">ELECTRICAL ENGINEERING DEPARTMENT</td></tr>
<tr><td colspan="9">Course:- Bachelor of Technology (Electrical Engineering)</td></tr>
<tr><td>Semester</td><td>Fourth</td><td colspan="2">Subject Title</td><td colspan="2">Introduction to Electrical Energy Sources</td><td>Code</td><td colspan="2">TEE 402</td></tr>
<tr><td colspan="2">Course Components</td><td colspan="2">Credits</td><td rowspan="2">Contact Hours</td><td>L</td><td>T</td><td colspan="2">P</td></tr>
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<tr><td colspan="2" rowspan="2">Examination Duration (Hrs)</td><td>Theory</td><td>Practical</td><td rowspan="2">WEIGHTAGE: EVALUATION</td><td>CWA</td><td>MSE</td><td colspan="2">ESE</td></tr>
<tr><td>03</td><td>00</td><td>25</td><td>25</td><td colspan="2">50</td></tr>
</table>

Course Objectives	
CO1	Apply knowledge of India's power scenario, power system structure and related agencies.
CO2	Acquire the knowledge of thermal power plant
CO3	Understanding the working of nuclear power plant
CO4	Understanding the working of gas turbine plant
CO5	Utilization of turbines and working of hydro power plant
CO6	Understand the economic aspects of power system operation

Unit No.	***Content***	***Hours***
Unit -1	**Introduction:** Electric energy demand and growth in India, electric energy sources. **Thermal Power Plant:** Site Selection, Coal Handling Plant, Pulverising Plant, Ash Handling Plant, General Layout and Operation of Plant, Detailed Description and Use of Different Parts.	8
Unit -2	**Nuclear Power Plant:** Site Selection, General Layout and Operation of Plant, Brief description of different types of reactors, Moderator material, fissile and fertile materials, control of nuclear reactors, Coolant, Disposal of nuclear waste material, shielding.	8
Unit -3	**Hydro Electric Plants:** Classifications, Location and site selection, Detailed description of various components, General Layout and Operation of Plants, Brief description of Impulse, Reaction, Kaplan and Francis turbines, Advantages & Disadvantages, Pumped Storage Plants, Hydro-Potential in India	8
Unit -4	**Diesel and Gas Turbine Plants:** Advantages and Disadvantages of Diesel Plants, Application, Diesel Plant Equipment, Layout, Changing Role of Diesel Plant. Operational principle of gas turbine plant & its efficiency, fuels, Open and closed-cycle plants, regeneration, inter-cooling and reheating, role and applications.	6
Unit -5	**Economics of Power Generation:** Energy Requirements, Maximum Demand, Types of Load, Load Curve, Load Duration Curve, Load Factor, Base Load and Peak Load Plants, Types of Tariff, Hydro Thermal Coordination, Incremental Fuel Cost, Economic Dispatch	6
	Total Hours	36

Text Books

1. Deshpande, M.V., Power Plant Engineering, Tata McGraw Hill (2004).
2. Soni, Gupta &Bhatnagar, A text book on Power System Engg., DhanpatRai& Co.
3. P.S.R. Murthy, Operation and control of Power System BS Publications, Hyderabad.
4. Electrical power Generation, Transmission and Distribution S.N. Singh PHI 2nd Edition, 2009

ELECTRICAL ENGINEERING DEPARTMENT								
Course:- Bachelor of Technology (Electrical Engineering)								
Semester	Fourth	***Subject Title***		Signals and Systems		***Code***	TEE 403	
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***	
Core Course (CC)		03			02	01	00	
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE:EVALUATION***	***CWA***	***MSE***	***ESE***	
		03	00		25	25	50	

Course Objectives	
CO1	**Understanding** of various types of signals and their characteristics
CO2	**Analysis** of LTI system based on their response for different input signals
CO3	**Implement** Laplace transformation for signals analysis
CO4	**Application** of continuous time Fourier Transform
CO5	**Understanding** of Discrete time Fourier Transform
CO6	**Estimation of sampling frequency of given signal.**

Unit No.	***Content***	***Hours***
Unit -1	**Introduction to signals and systems:** Signals, Transformation of the independent variable, basic continuous time and discrete time signals, Classification of signals, Properties of signals. **Elementary Signals:** unit step, unit impulse, sinusoidal, exponential, unit ramp, rectangular pulse, triangular pulse, trapezoidal, etc. **Systems:** Classification of systems, Properties of systems: Causality, Stability, linearity: additively and homogeneity, Time Invariance, time-shift, causality, stability.	8
Unit -2	**Linear Time Invariant (LTI) Systems:** Representation of signals in terms of impulses, Convolution integral of Continuous time, Properties of Convolution Integral, Convolution sum of Discrete time LTI systems, properties of LTI systems.	6
Unit -3	**The Laplace Transform for continuous time signals and systems:** Laplace Transform, Region of convergence for Laplace transforms, Inverse Laplace Transforms, Properties of Laplace transforms. Analysis and Characterization of LTI systems using Laplace transforms.	8
Unit -4	**Fourier Analysis of Continuous/Discrete time signals:** Exponential form and Trigonometric form of Fourier series, Fourier symmetry. Fourier integral and Fourier transform. Transform of common functions and periodic wave forms. Properties of Fourier Transform. Representation of a periodic signals using Fourier transform.	8
Unit-5	Sampling Theorem and its implications. Spectra of sampled signals. Sampling techniques, Aliasing and its effects, Reconstruction using interpolation.	6
	Total Hours	36

Text Books/ References:

1. A. V. Oppenheim, A. S. Willsky and S. H. Nawab, “Signals and systems”, Prentice Hall India, 1997.
2. B. P. Lathi, “Linear Systems and Signals”, Oxford University Press, 2009.
3. S. Haykin and B. V. Veen, “Signals and Systems”, John Wiley and Sons, 2007.
4. M. J. Robert “Fundamentals of Signals and Systems”, McGraw Hill Education, 2007.

ELECTRICAL ENGINEERING DEPARTMENT								
Course:- Bachelor of Technology (Electrical Engineering)								
Semester	Fourth	***Subject Title***		**Mathematics – III (Probability and Statistics)**		***Code***	TMA 401	
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***	
Basic Science Course (BSC)		04			03	01	00	
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE:EVALUATION***	***CWA***	***MSE***	***ESE***	
		03	00		25	25	50	

Course Objectives

CO 1	Understand basics of probability
	Understand basics of multinomial distribution
CO2	Understand probability distribution
CO3	Understand bivariate distribution
CO4	Understand basics of statistics
CO5	Understand basics of applied statistics

Unit No.	***Content***	***Hours***
Unit -1	**Basic Probability** Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality.	8
Unit -2	**Continuous Probability Distributions** Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities.	10
Unit -3	**Bivariate Distributions** Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.	8
Unit -4	**Basic Statistics** Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation.	8
Unit -5	**Applied Statistics** Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations.	8
	Total Hours	42

Test Books/ References:

1. E. Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 2006.
2. P. G. Hoel, S. C. Port and C. J. Stone, "Introduction to Probability Theory", Universal Book Stall, 2003.
3. S. Ross, "A First Course in Probability", Pearson Education India, 2002.
4. W. Feller, "An Introduction to Probability Theory and its Applications", Vol. 1, Wiley, 1968.
5. N.P. Bali and M. Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 2010.
6. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 2000.
7. T. Veerarajan, "Engineering Mathematics", Tata McGraw-Hill, New Delhi, 2010.

ELECTRICAL ENGINEERING DEPARTMENT								
Course:- Bachelor of Technology (ELECTRICAL ENGINERING)								
Semester	Fourth	***Subject Title***		Digital Electronics Lab		***Code***	PEE 453	
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***	
Core Course (CC)		01			00	00	02	
Examination Duration (Hrs)		***Theory***	***Practical***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***	
		00	03		25	25	50	

Course Objectives

CO 1	Able to explain the basic logic operations of NOT, AND, OR, NAND, NOR, and XOR.
CO2	Able to interpret logic functions, circuits, truth tables, and Boolean algebra expressions.
CO3	Able to understand the basic electronics of logic circuits and be able to use integrated circuit packages.
CO4	Able to model, analyze, and test a sequential digital circuit

Experiment No.	***Name of the Experiment***
1	To verify the truth table of basic logic gates
2	To realize basic gates from universal gates
3	To verify the Consensus Theorem (Boolean algebra functions) using universal digital IC Gates.
4	To design and test a half/full adder circuit using digital IC gates.
5	To design and test a half/full subtractor circuit using IC gates.
6	To design, implement and test the function F(A,B,C,D)=m(1,3,5,7,9,15)+d(4,6,12,13) using K-Map
7.	To design 2-bit comparator using logic gates
8	To design binary to Gray code converter
9	To design, implement and test half/full adder functions using a multiplexer.
10	To design, implement and test half/full subtractor functions using a multiplexer.
11	To design and test RS and D flip flops using logic gates.
12	To design and test JK and T flip flops using logic gates.
13	To design and test a mod-3 synchronous counter
14	To design and test an asynchronous/ripple counter

<table>
<tr><td colspan="8">ELECTRICAL ENGINEERING DEPARTMENT</td></tr>
<tr><td colspan="8">Course:- Bachelor of Technology (ELECTRICAL ENGINERING)</td></tr>
<tr><td>Semester</td><td>Fourth</td><td colspan="2">Subject Title</td><td colspan="2">Electrical Machines- II Lab</td><td>Code</td><td>PEE 451</td></tr>
<tr><td colspan="2">Course Components</td><td colspan="2">Credits</td><td rowspan="2">Contact Hours</td><td>L</td><td>T</td><td>P</td></tr>
<tr><td colspan="2">Core Course (CC)</td><td colspan="2">01</td><td>00</td><td>00</td><td>02</td></tr>
<tr><td colspan="2" rowspan="2">Examination Duration (Hrs)</td><td>Theory</td><td>Practical</td><td rowspan="2">WEIGHTAGE: EVALUATION</td><td>CWA</td><td>MSE</td><td>ESE</td></tr>
<tr><td>00</td><td>03</td><td>25</td><td>25</td><td>50</td></tr>
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Course Objectives

CO 1	Understand the working of 3-phase induction motor and its applications.
CO2	Understand the working of 1-phase induction motor and its applications
CO3	Understand and Verify the various operating curves on the induction machines.
CO4	Analyse the operating difference between the induction and synchronous machine
CO5	Verify and Analyse the output characteristics of 3-phase synchronous machine

Experiment No.	**Name of the Experiment**
1	To Perform no load test on a 3-phase induction motor
2	To perform block rotor test on 3 phase induction motor
3	To perform Load test on a 3-phase induction motor
4	To perform no load test on 1 phase induction motor
5	To perform block rotor test on 1 phase induction motor.
6	To perform load test on 1-phase induction motor
7	To perform the synchronization of an alternator with infinite bus or parallel operation of two alternator.
8	To study the starters of 3-phase induction motors
9	To perform the speed control of 3-phase induction motor by frequency variation method.
10	To perform open circuit test on 3 phase alternator
11	To perform short circuit test on 3 phase alternator.
12	To perform load test on 3-phase alternator
13	To draw V-curves of synchronous motor.

ELECTRICAL ENGINEERING DEPARTMENT								
Course:- Bachelor of Technology (ELECTRICAL ENGINERING)								
Semester	Fourth	***Subject Title***		Electrical Measurement Lab		***Code***	PEE 452	
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***	
Core Course (CC)		01			00	00	02	
Examination Duration (Hrs)		***Theory***	***Practical***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***	
		00	03		25	25	50	

Course Objectives

CO 1	Ability to perform experiments to determine various types of errors in measurements and perform error analysis
CO2	Familiarity with various measuring instruments used to detect electrical quantities
CO3	To use AC and DC bridges to measure unknown resistance, inductance and capacitance.
CO4	Develop an understanding of need of calibration and to calibrate various electrical instruments.

Experiment No.	***Name of the Experiment***
1	To calibrate AC voltmeter and AC ammeter using standard AC voltmeter and standard AC ammeter.
2	To measure the Quality factor and inductance of the coil using Maxwell’s bridge.
3	To measure the Quality factor and inductance of the coil using Hay’s bridge.
4	To measure high value of AC current by a low range AC ammeter and Current Transformer (CT).
5	To measure high value of AC voltage by a low range AC voltmeter and Potential Transformer (PT).
6	To measure power using Current Transformer (CT) and Potential Transformer (PT).
7	Calibration of digital energy meter using wattmeter method.
8	Calibration of digital Energy meter using Voltmeter/Ammeter method
9	To determine the unknown capacitance and dissipation factor of the unknown capacitor using Schering Bridge
10	To determine the unknown capacitance and dissipation factor of the unknown capacitor using De’sauty Bridge
11	To measure the power factor in a single phase AC circuit with the resistive and inductive (RL) load.
12	To analyze the improvement of power factor of RL network through capacitor.

ELECTRICAL ENGINEERING DEPARTMENT							
Course:- Bachelor of Technology (Electrical Engineering)							
Semester	Fourth	***Subject Title***		Career Skills - II (Verbal+ Logical Reasoning)		***Code***	XCS 401
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***
Career Skills (CK)		01			02	00	00
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE: EVALUATION***	***CWA***	***MSE***	***ESE***
		03	00		25	25	50

Course Objectives

CO 1	To develop inter personal skills and be an effective goal oriented team player.
CO2	To develop professionals with idealistic, practical and moral values.
CO3	To develop communication and problem solving skills
CO4	To re-engineer attitude and understand its influence on behavior

Unit No.	*Content*	*Hours*
Unit 1.	**Functional Grammar**: Parts of speech, articles, parallel construction, subject verb agreement.	08
Unit 2.	**Logical Reasoning** : Blood relation, puzzle test, syllogism, classification, seating/placing arrangements,	06
Unit 3.	**Logical Reasoning:** ranking and comparison, sequential order and things, selection based on conditions, data interpretation	06
Unit 4.	**Building Vocabulary**: Analogy, Para jumbles, antonyms and synonyms.	08
	Total	**28**

References Readings

For Verbal Section:

Spoken English for India by R.K.Bansal and J.B. Harrison- Orient Longman
A practical English Grammar by Thomson and Martinet-Oxford University Press
Professional Communication by MaltiAggarwal
English grammar, composition and correspondence by M.A.Pink and A.E.Thomas –S.Chand and Sons.Word Power by Blum Rosen-Cambridge University Press
A Dictionary of Modern Usage-Oxford University Press

For Aptitude Section:

Quantitative aptitude by R.S Agarwal
Verbal and Non Verbal Reasoning by R.S Agarwal
All books of puzzles to puzzle to puzzle you by Shakuntala Devi.
Question Bank on the practice exercise (Created for internal use)

ELECTRICAL ENGINEERING DEPARTMENT							
Course:- Bachelor of Technology (Electrical Engineering)							
Semester	Fifth	***Subject Title***		**Power Systems - I**		***Code***	TEE 501
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***
Core Course (CC)		03			03	00	00
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE:EVALUATION***	***CWA***	***MSE***	***ESE***
		03	00		25	25	50

Course Objectives	
CO 1	**Analysis** of various types of supply systems
CO2	**Estimation** of various parameters of transmission line
CO3	**Understanding** of corona phenomenon and its effects
CO4	Mechanical **designing** of overhead transmission lines
CO5	**Estimation** of the performance of overhead line insulator
CO6	**Assessment** of the various performance parameters of underground cable

Unit No.	***Contents***	***Hours***
Unit -1	**Supply System:** Single line Diagram of Power system, Different kinds of supply system and their comparison, choice of transmission voltage **Transmission Lines:** Configurations, types of conductors, resistance of line, skin effect, Kelvin's law, Proximity effect	6
Unit -2	**Over Head Transmission Lines:** Calculation of inductance and capacitance of single phase, three phase, single circuit and double circuit transmission lines, Representation and performance of short, medium and long transmission lines, Ferranti effect, Surge impedance loading.	8
Unit -3	**Corona and Interference:** Phenomenon of corona, corona formation, calculatio potential gradient, corona loss, factors affecting corona, methods of reducing corona interference. Electrostatic and electromagnetic interference with communication lines	8
Unit -4	**Mechanical Design of transmission line:** Catenary curve, calculation of sag & tension, effects of wind and ice loading, sag template, vibration dampers	6
Unit-5	**Overhead line Insulators:** Type of insulators and their applications, potential distribution over a string of insulators, methods of equalizing the potential, string efficiency **Insulated cables:** Type of cables and their construction, dielectric stress, grading of cables, insulation resistance, capacitance of single phase and three phase cables, dielectric loss, heating of cables	8
	Total Hours	36

Test Books/ References:

1. J. Grainger and W. D. Stevenson, "Power System Analysis", McGraw Hill Education, 1994.
2. O. I. Elgerd, "Electric Energy Systems Theory", McGraw Hill Education, 1995.
3. A. R. Bergen and V. Vittal, "Power System Analysis", Pearson Education Inc., 1999.
4. D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis", McGraw Hill Education, 2003.
5. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, "Electric Power Systems", Wiley, 2012.

ELECTRICAL ENGINEERING DEPARTMENT							
Course:- Bachelor of Technology (Electrical Engineering)							
Semester	Fifth	***Subject Title***		Control Systems		***Code***	TEE 502
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***
Core Course (CC)		03			03	00	00
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE:EVALUATION***	***CWA***	***MSE***	***ESE***
		03	00		25	25	50

Course Objectives: After successful completion of this course, students will be able to	
CO 1	**Understand** the fundamentals of control systems and to **Estimate** the transfer function model of physical systems
CO2	**Apply** block diagram and signal flow analysis for simplification of feedback control system represented in block diagrams.
CO3	**Determine** the time and frequency-domain responses of first and second-order systems to step and sinusoidal (and to some extent, ramp) inputs.
CO4	**Determine** the (absolute) stability of a closed-loop control system
CO5	**Apply** root-locus and frequency response techniques to analyze and design control systems
CO6	**Understand** and **Develop** state space model of physical systems

Unit No.	***Content***	***Hours***
Unit -1	**Control System Concepts:** Basic elements in control systems, Open and closed loop systems, mathematical modelling and representation of physical systems and analogous systems, Transfer Function, block diagram reduction techniques, signal flow graphs, and Meson's gain formula.	8
Unit -2	**Time Response Analysis** Standard test signals. Time response of first order systems, Characteristics equation of feedback control systems, Transient response of second order systems for standard test inputs, Time domain specifications, Initial and final value theorem. Steady state response, Steady state errors and error constants, Performance Indices, P, PI and PID control modes.	10
Unit -3	**Concept of Stability Analysis**. Introduction to stability, Necessary condition for stability (Bounded-Input Bounded-Output Stability, Zero Input Stability), Characteristics equation, Routh-Hurwitz Criteria, Relative Stability analysis, Root-Locus technique concept, construction of root loci.	6
Unit -4	**Frequency-response analysis** Introduction to frequency response, Correlation between frequency domain and time domain specifications, Polar plots, Bode plots, Nyquist stability criterion. Gain and Phase margin, Closed-loop frequency response of a second order system, Frequency Domain Performance Specifications. **Compensation techniques:** Lag, lead, and lag-lead compensator.	8
Unit -5	**State variable Analysis** Concept of state variables, State space representation of continuous linear time invariant systems, state transient matrix, solution of state equation, Concepts of controllability and observability.	4
	Total Hours	36

Test Books/ References:

1. M. Gopal, "Control Systems: Principles and Design", McGraw Hill Education, 1997.
2. B. C. Kuo, "Automatic Control System", Prentice Hall, 1995.
3. K. Ogata, "Modern Control Engineering", Prentice Hall, 1991.
4. I. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International, 2009

<table>
<tr><td colspan="9">ELECTRICAL ENGINEERING DEPARTMENT</td></tr>
<tr><td colspan="9">Course:- Bachelor of Technology (Electrical Engineering)</td></tr>
<tr><td>Semester</td><td>Fifth</td><td colspan="2">Subject Title</td><td colspan="2">Microprocessors</td><td>Code</td><td colspan="2">TEE 503</td></tr>
<tr><td colspan="2">Course Components</td><td colspan="2">Credits</td><td rowspan="2">Contact Hours</td><td>L</td><td>T</td><td colspan="2">P</td></tr>
<tr><td colspan="2">Core Course (CC)</td><td colspan="2">03</td><td>03</td><td>00</td><td colspan="2">00</td></tr>
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<tr><td>03</td><td>00</td><td>25</td><td>25</td><td colspan="2">50</td></tr>
<tr><td colspan="9">Course Objectives</td></tr>
<tr><td>CO 1</td><td colspan="8">Understanding of microprocessor 8085 and 8086 architecture and its operations.</td></tr>
<tr><td>CO2</td><td colspan="8">Acquiring the knowledge of various instruction sets of 8085 and 8086.</td></tr>
<tr><td>CO3</td><td colspan="8">Development of microprocessor programming.</td></tr>
<tr><td>CO4</td><td colspan="8">Acquiring the knowledge of interfacing with data transfer devices.</td></tr>
<tr><td>CO5</td><td colspan="8">Development of interfacing with timing devices.</td></tr>
<tr><td>CO6</td><td colspan="8">Develop the understanding to work on projects based on embedded system.</td></tr>
<tr><td>Unit No.</td><td colspan="7">Content</td><td>Hours</td></tr>
<tr><td>Unit -1</td><td colspan="7">Introduction to Microprocessor:
Evolution of microprocessors, Architectural advancements of microprocessors, single-chip microcomputers, large and small computers, microprocessor applications.
Pin diagram, hardware model and internal architecture of 8085 microprocessor, registers, Address/data bus Demultiplexing, Status Signals and the control signals, Interrupts & their types</td><td>8</td></tr>
<tr><td>Unit -2</td><td colspan="7">Instruction Set and Programming
Addressing modes, Assembly language programming using various instruction sets: Data transfer group, Arithmetic group, Logical group, Branch, Stack, I/O and Machine control group.
Timing diagram and various machine cycles.</td><td>9</td></tr>
<tr><td>Unit -3</td><td colspan="7">16-bit Microprocessors (8086):
Architecture, register organization, bus interface unit, execution unit, pin diagram, Physical address, memory segmentation, addressing modes, Instruction set.</td><td>7</td></tr>
<tr><td>Unit -4</td><td colspan="7">Interfacing (Data Transfer) with Microprocessor:
Data Transfer Schemes: Introduction, handshaking signals, Types of transmission, I/O interfacing- Peripheral mapped I/O and memory mapped I/O, 8255 (PPI), Serial Data transfer (USART 8251), memory interfacing, 8257 (DMA), programmable interrupt Controller (8259).</td><td>6</td></tr>
<tr><td>Unit -5</td><td colspan="7">Interfacing of Microprocessor with Timing Devices: Programmable Interval Timer/ Counter (8253/8254): Introduction, modes, Interfacing of 8253, applications. Introduction to DAC & ADC, ADC & DAC Interfacing (0808, 0809).</td><td>6</td></tr>
<tr><td></td><td colspan="7">Total Hours</td><td>36</td></tr>
</table>

Test Books/ References:

1. M. A.Mazidi, J. G. Mazidi and R. D. McKinlay, “The8051Microcontroller and Embedded Systems: Using Assembly and C”,Pearson Education, 2007.
2. K. J. Ayala, “8051 Microcontroller”, Delmar Cengage Learning,2004.
3. R. Kamal, “Embedded System”, McGraw Hill Education,2009.
4. R. S. Gaonkar, “, Microprocessor Architecture: Programming and Applications with the 8085”, Penram International Publishing, 1996
5. D. V. Hall, “Microprocessors & Interfacing”, McGraw Hill Higher Education, 1991.

ELECTRICAL ENGINEERING DEPARTMENT								
Course:- Bachelor of Technology								
Semester	**Fifth**	***Subject Title***		Disaster Management		***Code***	UCE 501	
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***	
Core Course (CC)		02			02	00	00	
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE: EVALUATION***	***CWA***	***MSE***	***ESE***	
		03	00		25	25	50	

Course Objectives

CO 1	**Demonstrate** a critical understanding of key concepts in disaster risk reduction and humanitarian response
CO2	**Recognize** issues and challenges arising from the nexus between paradigm of development and disasters
CO3	**Respond** to disaster risk reduction initiatives and disasters in an effective, humane and sustainable manner.
CO4	Critically **evaluate** disaster risk reduction and humanitarian response policy and practice from multiple perspectives
CO5	**Develop** an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations
CO6	Critically **understand** the strengths and weaknesses of disaster management approaches, planning and programming in their home country

Unit No.	***Content***	***Hours***
Unit -1	**Introduction, Definitions and Classification:** Concepts and definitions - Disaster, Hazard, Vulnerability, Resilience, Risks Natural disasters: Cloud bursts, earth quakes, Tsunami, snow, avalanches, landslides, forest fires, diversion of river routes (ex. Kosi river), Floods, Drought, Cyclones, volcanic hazards/ disasters (Mud volcanoes): causes and distribution, hazardous effects and environmental impacts of natural disasters, mitigation measures, natural disaster prone areas in India, major natural disasters in India with special reference to Uttarakhand. **Man-induced disasters:** water logging, subsidence, ground water depletion, soil Erosion, release of toxic gases and hazardous chemicals into environment, nuclear explosions	10
Unit -2	**Unit 2: Inter-relationship between Disasters and Development:** Factors affecting vulnerabilities, differential impacts, impacts of development projects such as dams, embankments, changes in land use etc., climate change adaption, relevance of indigenous knowledge, appropriate technology and local resources, sustainable development and its role in disaster mitigation, roles and responsibilities of community, panchayat raj institutions/urban local bodies, state, centre and other stake holders in disaster mitigation.	06
Unit -3	**Unit 3: Disaster Management (Pre-disaster stage, Emergency stage and Post disaster stage):** Pre-disaster stage (preparedness): Preparing hazard zonation maps, predictability/forecasting and "warning. Preparing disaster preparedness plans, land use zoning, and preparedness through information education and communication (IEC), disaster resistant house construction, population reduction in vulnerable areas, awareness. Emergency Stage: Rescue training for search & operation at national & regional level, immediate relief, assessment surveys Post Disaster stage-Rehabilitation and reconstruction of disaster affected areas; urban disaster mitigation: Political and administrative aspects, social aspects, economic aspects, environmental aspects.	10

Unit -4	**Disaster Management Laws and Policies in India:** Environmental legislations related to disaster management in India: Disaster Management Act. 2005; Environmental policies &programmes in India- Institutions & natural centers for disaster mitigation: National Disaster Management Authority (NDMA): structure and functional responsibilities, National Disaster Response Force (NDRF): Role and responsibilities, National Institute of Disaster Management (NIDM): Role and responsibilities.	10
Unit-5	**Case studies: Natural and Man-made disasters in India** **A. Natural disasters in India with special reference to Uttarakhand** 1. Earth *quakes*: Uttarkashi (1991), Kutch (2001), Sikkim (2011) 2. Cloud Bursts: Uttarkashi (2012) 3. Landslides along Himalayan and other regions: Malpa (Pithoragarh) (1998), Varunavrat Hill landslide at Uttarkashi (2003) 4. Floods: Orissa floods (2011) 5. Tsunami : Indian Ocean earth quake and Tsunami (2004) 6. Cyclones: Thane (2011) 7. Droughts: Karnataka (2011) 8. Snow Avalanche **B. Man-induced disasters in India:** 1. Forest fires: Forest fires in Uttarakhand, 2004, 2012 and deforestation 2. Industrial disasters: Bhopal gas tragedy, 1984 3. Mining: Chasnala(Bihar) mining disaster, 1975 4. Oil spills: Mumbai oil spill, 2010. 5. Nuclear disaster accidents: Narora atomic power station, Blandshahar (1993); Kalpakkam atomic power station (2002); Kota Atomic power station, Rajasthan (1995) **C. Disasters relevant to the area specific to the discipline of the students. Lectures)** **Mock shows:** Mock shows will be organized and conducted by expert agencies tor understanding the vulnerability of areas in and around campus along with adopting the preventive measures.	06

Text Books:

1. K.J. Anandha Kumar, AjinderWalia, Shekher Chaturvedi, India Disaster Report, 2011, National Institute of Disaster Management, June, 2012
2. R.B.Singh (Ed) Environmental Geography, Heritage Publishers New Delhi,1990
3. Savinder Singh Environmental Geography, PrayagPustakBhawan, 1997
4. Kates,B.I& White, G.F The Environment as Hazards, oxford, New York, 1978
5. R.B. Singh (Ed) Disaster Management, Rawat Publication, New Delhi, 2000
6. H.K. Gupta (Ed) Disaster Management, Universiters Press, India, 2003

Refrences:

1. R,B. Singh, Space Technology for Disaster Mitigation in India (INCED), University of Tokyo,1994
2. Dr. Satender , Disaster Management in Hills, Concept Publishing Co., New Delhi, 2000
3. A.S. Arya Action Plan For Earthquake, Disaster, Mitigation in V.K. Sharma (Ed) Disaster Management IIPA Publication New Delhi, 1994
4. R.K. Bhandani An overview on Natural & Man-made Disaster & their Reduction ,CSIR, New Delhi
5. M.C. Gupta. Manuals on Natural Disaster management in India, National Centre for Disaster Management, IIPA, New Delhi, 2001

ELECTRICAL ENGINEERING DEPARTMENT							
Course:- Bachelor of Technology (ELECTRICAL ENGINERING)							
Semester	Fifth	***Subject Title***		**Power System- I Lab**		***Code***	PEE 551
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***
Core Course (CC)		01			00	00	02
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE: EVALUATION***	***CWA***	***MSE***	***ESE***
		00	03		25	25	50

Course Objectives

CO 1	**Understanding** of mechanical and electrical design of a transmission line via industrial visit.
CO2	**Knowledge** of sources and load simulation.
CO3	**Evaluation** of parameters of a transmission line.
CO4	**Understanding** of performance of transmission line under fault condition.

Experiment No.	*Name of the Experiment*
1	Visit to a Local Substation or a Generating Plant.
2	To obtain the transient response of an RLC circuit with its damping frequency and damping ratio using MATLAB.
3	To determine the parameters of equivalent circuit of transformer from OC SC test data using MATLAB.
4	To simulate and analyze three phase source and load using SIMULINK.
5	Measurement of active and reactive powers using SIMULINK.
6	a) Optimal dispatch neglecting Losses b) Optimal dispatch including Losses
7	To calculate ABCD parameters for Medium line using MATLAB.
8	To calculate ABCD parameters for long line network MATLAB.
9	To determine voltage and power at the sending end and to regulate the voltage using medium line model.
10	To determine line performance when loaded at receiving end.
11	To obtain the effect of sudden short-circuit on a synchronous generator output.
12	Step response of rotor angle and generator frequency of a Synchronous Machine.

ELECTRICAL ENGINEERING DEPARTMENT							
Course:- Bachelor of Technology (ELECTRICAL ENGINERING)							
Semester	Fifth	***Subject Title***		**Control Systems Lab**		***Code***	PEE 552
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***
Core Course (CC)		01			00	00	02
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE: EVALUATION***	***CWA***	***MSE***	***ESE***
		00	03		25	25	50

Course Objectives	
CO 1	**Understand** the open and closed loop response of first and/or second order systems.
CO2	**Study** and **Analyse** speed control of various types of electric motors in open loop and/or closed loop.
CO3	**Study** and **Understand** the fundamentals of control systems and effect of standard test signals on unity feedback and to **study** the time response of physical systems using MATLAB
CO4	**Design** various compensators and **Analyse** the stability of given systems using conventional techniques (Bode Plot/Root Locus/Nyquist/Routh-Hurwitz) using MATLAB

Experiment No.	***Name of the Experiment***
Experiments on Hardware kits/panels	
1	To study time response of a first/second order system
2	To study a first/second order system using PID controller
3	To study the characteristics of digital Proportional + Integral + Derivative control action on the simulated second order process.
4	To carry out the open loop speed control of BLDC motor using IPM.
5	To carry out the closed loop speed PI control of BLDC motor using IPM
6	To examine the operation of conveyor control system using PLC.
7	To carry out the speed control of AC motor using PLC.
8	To study speed torque characteristic of AC servomotor
9	To study speed control of stepper motor using stepper motor controller
10	To study the speed control of various motors (AC/Stepper/DC) using microprocessor
Experiments using MATLAB/SIMULINK	
11	To obtain the following using MATLAB I. Pole, zero, gain values from a given transfer function II. Transfer function model from pole, zero, gain values III. Pole, zero plot of a transfer function
12	To reduce linear systems, block diagram using series, parallel and feedback configuration by using commands in MATLAB.
13	Determination of step & impulse response for a first and second order unity feedback system.
14	To Study the effects of P, PD, PI, PID controllers on the response of a given (first/second order) system and determine the time response specifications.
15	To draw the Bode plot and determine the frequency domain specifications of a given system.
16	To draw the Root locus and study the stability of a given system.
17	To draw the Nyquist plot of a given system and determine the Gain margin and phase margin.
18	To execute stability analysis using Routh- Hurwitz method.
19	To design a lag, lead and lead – lag compensator and obtain the characteristics.

-- Two innovative experiments can be given by the concerned faculty in-charge.
Note: minimum of any 10 experiments to be performed.

<table>
<tr><td colspan="10" align="center">ELECTRICAL ENGINEERING DEPARTMENT</td></tr>
<tr><td colspan="10">Course:- Bachelor of Technology (ELECTRICAL ENGINERING)</td></tr>
<tr><td colspan="2">Semester</td><td>Fifth</td><td colspan="2">Subject Title</td><td colspan="2">Microprocessor Lab</td><td>Code</td><td colspan="2">PEE 553</td></tr>
<tr><td colspan="3">Course Components</td><td colspan="2">Credits</td><td rowspan="2">Contact Hours</td><td>L</td><td>T</td><td colspan="2">P</td></tr>
<tr><td colspan="3">Core Course (CC)</td><td colspan="2">01</td><td>00</td><td>00</td><td colspan="2">02</td></tr>
<tr><td colspan="3" rowspan="2">Examination Duration (Hrs)</td><td>Theory</td><td>Practical</td><td rowspan="2">WEIGHTAGE: EVALUATION</td><td>CWA</td><td>MSE</td><td colspan="2">ESE</td></tr>
<tr><td>00</td><td>03</td><td>25</td><td>25</td><td colspan="2">50</td></tr>
<tr><td colspan="10">Course Objectives</td></tr>
<tr><td>CO 1</td><td colspan="9">Assessment of the 8085 based microprocessor system and 8086 and 8086A based microprocessor system</td></tr>
<tr><td>CO2</td><td colspan="9">Develop and run a program for finding out the largest/smallest number and for arranging in ascending order.</td></tr>
<tr><td>CO3</td><td colspan="9">Develop and run a program for multiplication/division and conversion of temperature from 0F to 0C and vice-versa</td></tr>
<tr><td>CO4</td><td colspan="9">Develop interfacing of 8085/ 8086 with various devices.</td></tr>
<tr><td colspan="10"></td></tr>
<tr><td colspan="2">Experiment No.</td><td colspan="8">Name of the Experiment</td></tr>
<tr><td colspan="2">1.</td><td colspan="8">A. Study Experiments
1. To study 8085 based microprocessor system
2. To study 8086 and 8086A based microprocessor system
3. To study Pentium Processor</td></tr>
<tr><td colspan="2">2.</td><td colspan="8">B. Programming based Experiments (any four)
1. To develop and run a program for finding out the largest/smallest number from a given set of numbers.
2. To develop and run a program for arranging in ascending/descending order of a set of numbers
3. To perform multiplication/division of given numbers
4. To perform conversion of temperature from 0F to 0C and vice-versa
5. To perform computation of square root of a given number
6. To perform floating point mathematical operations (addition, subtraction, multiplication and division)</td></tr>
<tr><td colspan="2">3.</td><td colspan="8">Interfacing based Experiments (any four)
1. To perform interfacing of RAM chip to 8085/8086 based system
2. To perform interfacing of keyboard controller
3. To perform interfacing of DMA controller
4. To perform interfacing of PPI
5. To perform interfacing of UART/USART
6. To perform microprocessor-based stepper motor operation through 8085 kit
7. To perform microprocessor-based traffic light control
8. To perform microprocessor-based temperature control of hot water.</td></tr>
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<table>
<tr><td colspan="7">ELECTRICAL ENGINEERING DEPARTMENT</td></tr>
<tr><td colspan="7">Course:- Bachelor of Technology (Electrical Engineering)</td></tr>
<tr><td>Semester</td><td>Fifth</td><td colspan="2">Subject Title</td><td colspan="2">Career Skills - III (Verbal+ Logical Reasoning)</td><td>Code</td><td>XCS 501</td></tr>
<tr><td colspan="2">Course Components</td><td colspan="2">Credits</td><td rowspan="2">Contact Hours</td><td>L</td><td>T</td><td>P</td></tr>
<tr><td colspan="2">Career Skills (CK)</td><td colspan="2">02</td><td>02</td><td>00</td><td>00</td></tr>
<tr><td colspan="2" rowspan="2">Examination Duration (Hrs)</td><td>Theory</td><td>Practical</td><td rowspan="2">WEIGHTAGE: EVALUATION</td><td>CWA</td><td>MSE</td><td>ESE</td></tr>
<tr><td>03</td><td>00</td><td>25</td><td>25</td><td>50</td></tr>
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Course Objectives

CO 1	To develop inter personal skills and be an effective goal oriented team player.
CO2	To develop professionals with idealistic, practical and moral values.
CO3	To develop communication and problem solving skills
CO4	To re-engineer attitude and understand its influence on behavior

Unit No.	*Content*	*Hours*
Unit 1.	**Effective Reading Skills:** Reading Comprehension Purpose of reading, skimming and scanning. Tips for improving comprehension skills. (For effective reading skills practice papers on Reading Comprehension will be provided to students)	6
Unit 2.	**Aptitude section**: Clocks, Calendar, Profit/loss, Percentage, Average.	4
Unit 3.	**Aptitude Section:** Ages, Trains & Boats, Simplification, Ratio & proportion, Partnership	12
Unit 4.	**Critical Reasoning**: Analyze logical arguments.	6
	Total	**28**

References

For Verbal Section:

Spoken English for India by R.K. Bansal and J.B. Harrison- Orient Longman
A practical English Grammar by Thomson and Martinet-Oxford University Press
Professional Communication by Malti Aggarwal
English grammar, composition and correspondence by M.A.Pink and A.E.Thomas –S.Chand and Sons. Word Power by Blum Rosen-Cambridge University Press
A Dictionary of Modern Usage-Oxford University Press

For Aptitude Section:

Quantitative aptitude by R.S Agarwal
Verbal and Non-Verbal Reasoning by R.S Agarwal
All books of puzzles to puzzle to puzzle you by Shakuntala Devi.
Question Bank on the practice exercise (Created for internal use)

ELECTRICAL ENGINEERING DEPARTMENT							
Course:- Bachelor of Technology (Electrical Engineering)							
Semester	Sixth	***Subject Title***		Power Electronics		***Code***	TEE 601
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***
Core Course (CC)		03			03	00	00
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE: EVALUATION***	***CWA***	***MSE***	***ESE***
		03	00		25	25	50

Course Objectives: After successful completion of this course, students will be able to:	
CO 1	**Understand** the basics of various power semiconductor devices and thyristor.
CO2	**Design** the line commutated converters and **Analyse** their performance.
CO3	**Design** the single and three-phase inverters and **Assess** their performance.
CO4	**Understand** and **Analyse** the working and behavior of various types of chopper.
CO5	**Understand** the working of Cyclo-converters.
CO6	**Develop** skills to build, and troubleshoot power electronics circuits.

Unit No.	***Content***	***Hours***
Unit -1	**Power Semi-Conductor Devices:** Review of power semiconductor devices (such as power diode, power BJT and power MOSFET), Review of TRIAC, GTO, IGBT. **Thyristor**: I-V characteristics, switching characteristics, turn-on methods, Protection and cooling of Thyristor, Gate circuit requirements, Series- parallel operation, Commutation Techniques.	8
Unit -2	**Line Commutated Converters:** **AC to DC Converters (Phase Controlled Rectifiers):** Phase Control, Half and full wave-controlled rectifier and their Analysis with different types of loads (R, RL, and RLE), Dual converters, Three phase converters. **AC to AC Converters (A.C Voltage Controllers)**: Phase control & integral cycle control, Single-phase voltage controllers (R & RL load).	8
Unit -3	**DC to AC Converters (Inverters):** Principle of inverters, Types of inverters, single phase half wave and full wave voltage source inverters, Three phase bridge inverters, voltage control in single-phase inverters, Current Source inverters, Series inverter, parallel inverter.	8
Unit -4	**DC to DC Converters (Choppers):** Principle of chopper operation, control strategies, Types of chopper circuits, steady state analysis of Type-A chopper, voltage commutated chopper, current commutated chopper. Introduction to Buck, Boost and Buck-Boost converters.	6
Unit -5	**Frequency Converters (Cyclo-converter):** Types, principle of operation: Single-phase to single phase step-up & step-down cyclo-converter, three phase to three phase and three phase to single-phase cyclo-converter.	6
	Total Hours	36

Text Books:

1. M.H. Rashid, "Power Electronics Circuits, Devices &Applications", PHI.
2. Dr. PS. Bimbhra, "Power Electronics" 4/e, Khanna Publishers.
3. Ned mohan, Tore. M. Undeland, Williams P. Robbins, "Power Electronics" 3/e Wiley India

Reference Readings:

1. Bimal K Bose "Power Electronic and variable frequency drives", Wiley India
2. M D Singh,K B Khanchandani," Power Electronics", 2nd edition, Tata McGraw hill publication

ELECTRICAL ENGINEERING DEPARTMENT							
Course:- Bachelor of Technology (Electrical Engineering)							
Semester	Sixth	***Subject Title***		**Power Systems - II**		***Code***	TEE 602
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***
Core Course (CC)		03			03	00	00
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE:EVALUATION***	***CWA***	***MSE***	***ESE***
		03	00		25	25	50

Course Objectives	
CO1	**Application** of per unit representation and reactance diagram in power system analysis
CO2	**Analysis** of unbalanced power systems through symmetrical component method
CO3	**Design** of power system model under symmetrical and unsymmetrical fault conditions
CO4	**Application** of power flow analysis in assessment node parameters.
CO5	**Examine** power system stability under various conditions.
CO6	**Analysis** of symmetrical faults.

Unit No.	***Content***	***Hours***
Unit -1	**Representation of Power System Components:** Per unit System, Impedance and reactance diagram. **Symmetrical components:** Symmetrical Components of unbalanced phasors, power in terms of symmetrical components, sequence impedances and sequence networks.	8
Unit -2	**Unsymmetrical faults:** Analysis of single line to ground fault, line-to-line fault and Double Line to ground fault on an unloaded generators and power system network with and without fault impedance.	8
Unit -3	**Load Flows:** Introduction, bus classifications, nodal admittance matrix (YBUS), development of load flow equations, load flow solution using Gauss Siedel and Newton-Raphson method, approximation to N-R method, line flow equations and fast decoupled method	8
Unit -4	**Power System Stability:** Stability and Stability limit, Steady state stability study, derivation of Swing equation, transient stability studies by equal area criterion and step-by-step method. Factors affecting steady state and transient stability and methods of improvement.	8
Unit-5	**Symmetrical fault analysis:** Transient in R-L series circuit, calculation of 3-phase short circuit current and reactance of synchronous machine, internal voltage of loaded machines under transient conditions	4
	Total Hours	36

Test Books/ References:

1. J. Grainger and W. D. Stevenson, “Power System Analysis”, McGraw Hill Education, 1994.
2. O. I. Elgerd, “Electric Energy Systems Theory”, McGraw Hill Education, 1995.
3. A. R. Bergen and V. Vittal, “Power System Analysis”, Pearson Education Inc., 1999.
4. D. P. Kothari and I. J. Nagrath, “Modern Power System Analysis”, McGraw Hill Education, 2003.
5. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, “Electric Power Systems”, Wiley, 2012.

<table>
<tr><td colspan="9" align="center">ELECTRICAL ENGINEERING DEPARTMENT</td></tr>
<tr><td colspan="9">Course: - Bachelor of Technology (Electrical Engineering)</td></tr>
<tr><td>Semester</td><td>Sixth</td><td colspan="2">Subject Title</td><td colspan="2">Power System Protection</td><td>Code</td><td colspan="2">TEE 603</td></tr>
<tr><td colspan="2">Course Components</td><td colspan="2">Credits</td><td rowspan="2">Contact Hours</td><td>L</td><td>T</td><td colspan="2">P</td></tr>
<tr><td colspan="2">Core Course (CC)</td><td colspan="2">03</td><td>03</td><td>00</td><td colspan="2">00</td></tr>
<tr><td colspan="2" rowspan="2">Examination Duration (Hrs)</td><td>Theory</td><td>Practical</td><td rowspan="2">WEIGHTAGE: EVALUATION</td><td>CWA</td><td>MSE</td><td colspan="2">ESE</td></tr>
<tr><td>03</td><td>00</td><td>25</td><td>25</td><td colspan="2">50</td></tr>
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Course Objectives	
CO 1	**Understanding** of the different components of a protection systems
CO2	**Developing** concepts of various types of relays
CO3	**Utilization** of various relays in protection of power system components.
CO4	**Understanding** of Static relays
CO5	**Acquiring** the knowledge of the various characteristics of circuit breaker
CO6	**Application** of various types of circuit breakers

Unit No.	***Content***	***Hours***
Unit -1	**Protection Schemes:** Principles and need for protective schemes – nature and causes of faults – types of faults – Fault Clearing Process – Zones of protection and essential qualities of protection – Protection scheme	4
Unit -2	**Electromagnetic Relays**: Operating principles of relays – Classification – the Universal relay – Torque equation – R-X diagram – Electromagnetic Relays – Over current, Directional, Distance, Differential, Negative sequence.	8
Unit -3	**Apparatus Protection:** Current transformers and Potential transformers and their applications in protection schemes - Protection of transformer, generator, motor, bus bars and transmission line.	8
Unit -4	**Static Relay:** Static relays – Phase, Amplitude Comparators – Classification – Block diagram of Static relays – Over current protection, transformer differential protection, distant protection of transmission lines.	6
Unit -5	**Circuit Breakers:** Physics of arcing phenomenon and arc interruption - DC and AC circuit breaking – re-striking voltage and recovery voltage - rate of rise of recovery voltage - resistance switching - current chopping - interruption of capacitive current - Types of circuit breakers – air blast, air break, oil, SF6, MCBs, MCCBs and vacuum circuit breakers – comparison of different circuit breakers – Rating and selection of Circuit breakers.	10
	Total Hours	36

TEXT BOOKS/ REFERENCES

1. Sunil S.Rao, 'Switchgear and Protection', Khanna Publishers, New Delhi, 2008.
2. B.Rabindranath and N.Chander, 'Power System Protection and Switchgear', New Age International (P) Ltd., First Edition 2011.
3. Arun Ingole, 'Switch Gear and Protection' Pearson Education, 2017.
4. BadriRam, B.H. Vishwakarma, 'Power System Protection and Switchgear', New Age International Pvt Ltd Publishers, Second Edition 2011.
5. Y.G.Paithankar and S.R.Bhide, 'Fundamentals of power system protection', Second Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2010.
6. C.L.Wadhwa, 'Electrical Power Systems', 6th Edition, New Age International (P) Ltd., 2010

ELECTRICAL ENGINEERING DEPARTMENT							
Course:- Bachelor of Technology (ELECTRICAL ENGINERING)							
Semester	Sixth	***Subject Title***		Electronics Design Lab		***Code***	PEE 653
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***
Core Course (CC)		01			00	00	02
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE: EVALUATION***	***CWA***	***MSE***	***ESE***
		00	03		25	25	50

Course Objectives	
CO 1	To Become **familiar** with electronic laboratory equipment and **Design** and **simulate** basic electronic circuits
CO2	To **Design** various oscillators and implement them using software and also observe their frequency responses.
CO3	To **Design** various amplifiers like CE, CC, common source FET amplifiers and implement them using software and also observe their frequency responses.
CO4	To **Design** and **Test** PCBs for various electronic circuits

Experiment No.	***Name of the Experiment*****
1	To Design basic electronic circuits on bread board and test their working through CRO/DSO.
2	To design and simulate the basic electronic circuits on ORCAD/PSPICE software and test their working through CRO/DSO.
3	To make the layout of center tapped full wave rectifier through ORCAD software
4	To make the layout of DC regulated power supply through ORCAD software
5	Simulate Hartley Oscillator and determine its frequency of oscillation
6	Simulate COLPITTS oscillator and determine its frequency of oscillation
7	Simulate Wein Bridge Oscillator and determine its frequency of oscillation
8	Simulate RC Phase shift Oscillator and determine its frequency of oscillation
9	Simulation of half wave and full wave center tapped rectifiers through ORCAD software
10	Simulation of DC regulated power supply through ORCAD software
11	Simulation of CE amplifier using PSPICE ORCAD software
12	Simulation of FET amplifier circuit using ORCAD and compute the gain and bandwidth.
13	To design the PCB of full wave center tapped rectifier/DC regulated power supply
14	To drill solder the components on the PCB of full wave center tapped rectifier/DC regulated power supply
15	Any experiment as suggested by the Faculty In-charge

ELECTRICAL ENGINEERING DEPARTMENT							
Course:- Bachelor of Technology (ELECTRICAL ENGINERING)							
Semester	Sixth	***Subject Title***		Power Electronics Lab		***Code***	PEE 651
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***
Core Course (CC)		01			00	00	02
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE: EVALUATION***	***CWA***	***MSE***	***ESE***
		00	03		25	25	50

Course Outcomes: After successful completion of this course, students will be able to	
CO 1	**Understand** the basic operation (including triggering and/or commutation) of various power semiconductor devices
CO2	**Elucidate** the behavior of various power semiconductor devices through their characteristics.
CO3	**Acquire** experience to **design** and assemble circuits with different types of power electronic devices for various types of power conversion and **Apply** the same for different loads
CO4	**Design** and **simulate** the various power electronics circuits for different types of loads and **Assess** their performance and characteristics using MATLAB/SIMULINK.

Experiment No.	***Name of the Experiment*****
1	To study triggering of (i) IGBT (ii) MOSFET (iii) Power Transistor
2	To study V-I characteristics of SCR.
3	To study the characteristics of TRAIC.
4	To study single-phase ac voltage regulator using TRAIC.
5	To study triggering circuits for SCR.
6	To study the commutation of SCR.
7	To study the performance of single phase half controlled bridge rectifier with resistive and inductive loads.
8	To study single phase full controlled bridge rectifier with resistive and inductive loads.
9	To study operation of step down chopper circuit
10	To study operation of step down chopper circuit
MATLAB/SIMULINK based experiments	
11	To simulate the model of a step down chopper
12	To simulate the model of a step up chopper
13	MATLAB simulation of single phase fully controlled bridge rectifier and draw load voltage and load current waveform for inductive load.
14	MATLAB simulation of single phase full wave ac voltage controller and draw load voltage and load current waveforms for inductive load.
15	To simulate the 1Ø half wave inverter with R load and obtain the corresponding waveforms
16	To simulate the 1Ø full wave inverter with R load and obtain the corresponding waveforms
**	At least two innovative experiments on recent advancements in power electronics to be given by the concerned Faculty In-charge.

Note: Any 10 of above experiments are to be conducted

ELECTRICAL ENGINEERING DEPARTMENT							
Course:- Bachelor of Technology (ELECTRICAL ENGINERING)							
Semester	Sixth	***Subject Title***		Power System – II Lab		***Code***	PEE 652
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***
Core Course (CC)		01			00	00	02
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE: EVALUATION***	***CWA***	***MSE***	***ESE***
		00	03		25	25	50

Course Objectives

CO 1	Analysis of the breakdown voltage of the transformer oil and study the characteristics of MCB
CO2	Evaluation of various operational characteristics of the IDMT, Earth fault, Instantaneous over current and Thermal relay for time and current setting
CO3	Assessment of the various parameter of the transmission line and study the LG & LLL fault analysis in transmission lines
CO4	Testing of various Underground fault in cables ,insulator testing and earth resistance testing

Experiment No.	***Name of the Experiment***
1	To test the breakdown voltage of the transformer oil.
2	Find operational characteristics of the earth fault relay for time and current setting.
3	Thermal relay a. Find operational characteristics of the relay. b. Determine the current characteristics of a given fuse.
4	Instantaneous over current relay a. Study the pick- up current of the relay. b. Study the current vs. time characteristics
5	IDMT over current relay Study the operating current & de-operating current of the disc. Study the time characteristics
6	To study the characteristics of MCB
7	To measure direct axis synchronous reactance of synchronous machine and measure quadrature axis synchronous reactance by slip test.
8	To study the single line to ground fault as practical application in transmission lines
9	To find out b. ABCD parameters. c. Hybrid parameters d. Image parameter of a given transmission line.
10	To study the three phase fault as practical application in transmission line.
11	To measure the earth electrode resistance using earth tester
12	To locate fault in a cable by murray loop test
13	To determine the voltage distribution across a string or 400 kV disk Insulator (Artificial) and to study the effect of pollution.
14	Study and performance of Differential Relay

ELECTRICAL ENGINEERING DEPARTMENT							
Course:- Bachelor of Technology (Electrical Engineering)							
Semester	Sixth	***Subject Title***		Career Skills - IV (Verbal+ Logical Reasoning)	***Code***	XCS 601	
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***
Career Skills (CK)		01			02	00	00
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE: EVALUATION***	***CWA***	***MSE***	***ESE***
		03	00		25	25	50

Course Objectives

CO 1	To develop inter personal skills and be an effective goal oriented team player.
CO2	To develop professionals with idealistic, practical and moral values.
CO3	To develop communication and problem solving skills
CO4	To re-engineer attitude and understand its influence on behavior

Unit No.	*Content*	*Hours*
Unit 1.	**Building Advanced Vocabulary** Sentence completion: Single and double vocabulary **Job Application**: Personal Interviews and C.V Writing Essential parts - Cover Letter and the 'resume'. Types of 'resumes ' (*Curriculum Vitae*) Chronological 'resume', functional 'resume'	7
Unit 2.	**Aptitude Section:** Number system, P& C, Probability, Log,	8
Unit 3.	**Aptitude Section**: Time & Work, S.I & C.I, Time & Distance, Mixture, Chain Rule, Pipes & Cisterns	6
Unit 4.	**Advanced Grammar:** Spotting errors, subject verb agreement based errors.	7
	Total	

References

For Verbal Section:
Spoken English for India by R.K.Bansal and J.B. Harrison- Orient Longman
A practical English Grammar by Thomson and Martinet-Oxford University Press
Professional Communication by MaltiAggarwal
English grammar, composition and correspondence by M.A.Pink and A.E.Thomas –S.Chand and Sons.Word Power by Blum Rosen-Cambridge University Press
A Dictionary of Modern Usage-Oxford University Press

For Aptitude Section:
Quantitative aptitude by R.S Agarwal
Verbal and Non Verbal Reasoning by R.S Agarwal
All books of puzzles to puzzle to puzzle you by Shakuntala Devi.
Question Bank on the practice exercise (Created for internal use)

<table>
<tr><td colspan="9">ELECTRICAL ENGINEERING DEPARTMENT</td></tr>
<tr><td colspan="9">Course: - Bachelor of Technology (Electrical Engineering)</td></tr>
<tr><td>Semester</td><td>Seventh</td><td colspan="2">Subject Title</td><td colspan="2">Electrical Drives</td><td>Code</td><td colspan="2">TEE 701</td></tr>
<tr><td colspan="2">Course Components</td><td colspan="2">Credits</td><td rowspan="2">Contact Hours</td><td>L</td><td>T</td><td colspan="2">P</td></tr>
<tr><td colspan="2">Core Course (CC)</td><td colspan="2">03</td><td>03</td><td>00</td><td colspan="2">00</td></tr>
<tr><td colspan="2" rowspan="2">Examination Duration (Hrs)</td><td>Theory</td><td>Practical</td><td rowspan="2">WEIGHTAGE: EVALUATION</td><td>CWA</td><td>MSE</td><td colspan="2">ESE</td></tr>
<tr><td>03</td><td>00</td><td>25</td><td>25</td><td colspan="2">50</td></tr>
</table>

Course Objectives:

CO1: **Understanding** of Electrical Drive and its component

CO2: **Acquiring** the knowledge of dynamics of electrical drive

CO3**: Identifying** suitable form of d.c drives system for Industry

CO4: **Appraise** different braking methods and transient analysis of electric motors.

CO5: **Analysis** of transient behavior of DC drives

CO6: **Appraise** the speed and frequency control method of Induction motor and synchronous motor.

Unit No.	***Content***	***Hours***
Unit -1	**Electric Drives - An Introduction:** Electric drives, advantage of electrical drives, components of electrical drives, choice of electric drives.	04
Unit -2	**Dynamics of electrical drives:** Fundamental torque equation, speed torque conventions and Multi-quadrant operation, equivalent values of drive parameters, moment of inertia measurement, components of load torques, nature and classification of load torques, calculation of time and energy-loss in transient operations, steady state stability, load equalization.	10
Unit -3	**DC Motor Drives-I:** DC motor and their performance (Shunt and Series motor), starting, breaking, transient analysis of dc motor. Energy losses during transient analysis.	6
Unit 4	**DC Motor Drives-II (Uncontrolled rectifier control of DC drive):** single phase fully controlled rectifier control of separately excited dc motor, single phase half controlled rectifier control of separately excited dc motor, three phase fully/half controlled of separately excited dc motor, chopper control.	8
Unit-5	**AC Motor Drives:** Variable frequency control from a current source, current source inverter control, rotor resistance control, slip power recovery, variable speed constant frequency generation and synchronous motor drives.	8
	Total Hours	36

Textbooks:

1. Fundamental of Electrical Drives, G.K. Dubey, New Age International Publication.
2. Electric Drives, Vedam Subrahmanyam, TMH
3. A first course on Electrical Drives, S.K. Pillai, , New Age International Publication.

Reference books:

1. Power Electronics – MD Singh and K B Khanchandani, Tata – McGraw-Hill Publishing company,1998
2. Modern Power Electronics and AC Drives by B.K.Bose, PHI.
3. Thyristor Control of Electric drives – Vedam Subramanyam Tata McGraw Hill Publilcations.

<table>
<tr><td colspan="9">ELECTRICAL ENGINEERING DEPARTMENT</td></tr>
<tr><td colspan="9">Course:- Bachelor of Technology (Electrical Engineering)</td></tr>
<tr><td>Semester</td><td>Seventh</td><td colspan="2">Subject Title</td><td colspan="2">Non-Conventional Energy Resources</td><td>Code</td><td colspan="2">TEE 702</td></tr>
<tr><td colspan="2">Course Components</td><td colspan="2">Credits</td><td rowspan="2">Contact Hours</td><td>L</td><td>T</td><td colspan="2">P</td></tr>
<tr><td colspan="2">Core Course (CC)</td><td colspan="2">03</td><td>03</td><td>00</td><td colspan="2">00</td></tr>
<tr><td colspan="2" rowspan="2">Examination Duration (Hrs)</td><td>Theory</td><td>Practical</td><td rowspan="2">WEIGHTAGE: EVALUATION</td><td>CWA</td><td>MSE</td><td colspan="2">ESE</td></tr>
<tr><td>03</td><td>00</td><td>25</td><td>25</td><td colspan="2">50</td></tr>
<tr><td colspan="9">Course Outcomes
CO1: Learn and justify the solar thermal applications.
CO2: Acquiring the knowledge of Solar Power Generation
CO3: Utilization of Geothermal energy for conversion in electrical energy
CO4: Assessment of the performance of Fuel cell and MHD
CO5:Understanding of wind energy and bio-mass system
CO6: Understanding of Maximum Power Point Tracking and load connections</td></tr>
<tr><td>UnitNo</td><td colspan="7">Content</td><td>Hours</td></tr>
<tr><td>Unit -1</td><td colspan="7">Solar Thermal Energy: Solar radiation flat plant collectors and their materials, application and performance, focusing of collectors and their materials, applications and performance solar thermal power plants, thermal energy storage for solar heating and cooling, limitations .</td><td>6</td></tr>
<tr><td>Unit -2</td><td colspan="7">Photo voltaic System-Solar cell characteristics, solar cell classifications, solar cell module, panel and Array constructions, Maximizing solar PV output and Load Matching, Maximum Power Point Tracking (MPPT), Balance of system components, Solar PV applications</td><td>8</td></tr>
<tr><td>Unit -3</td><td colspan="7">Fuel Cells: Principle of working of various types of fuel cells and their working, performance and limitations.
Thermo-electrical and thermionic Conversions : Principle of working, performance and limitations</td><td>6</td></tr>
<tr><td>Unit -4</td><td colspan="7">Wind Energy: Wind power and its sources , site selection , criterion , momentum theory, classification of rotors , concentrations and augments , wind characteristics . performance and limitations of energy conversion systems .</td><td>8</td></tr>
<tr><td>Unit-5</td><td colspan="7">Geothermal Energy: Resources of geothermal energy, thermodynamics of geo-thermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations. .
Magneto-hydrodynamics (M H D) : Principle of working of M H D Power plant, performance and limitations.
Bio-mass: Availability of bio-mass and its convention theory .</td><td>8</td></tr>
<tr><td></td><td colspan="7">Total Hours</td><td>36</td></tr>
</table>

Text Books

1. B.H Khan, “Non-Conventional Energy Resources” Tata McGraw-Hill Education 2nd edition
2. Andrea Gabdel , “A Handbook for Engineers and Economists.”
3. A. Mani , “Handbook of solar radiation Data for India .”
4. Peter Auer , “Advances in Energy System and Technology ”, Vol. I & II Edited by Academic Press
5. F.R. the MITTRE , “Wind Machines” by Energy Resources and Environmental Series

Reference books:

1. Frank Kreith , “Solar Energy Hand Book “.
2. N. Chermisinogg and Thomes , C. Reign , “Principles and Application of solar Energy ”

ELECTRICAL ENGINEERING DEPARTMENT							
Course:- Bachelor of Technology (ELECTRICAL ENGINERING)							
Semester	Seventh	***Subject Title***		Electrical Drives Lab		***Code***	PEE 751
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***
Core Course (CC)		01			00	00	02
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE: EVALUATION***	***CWA***	***MSE***	***ESE***
		00	03		20	30	50
CO1	**Estimation** of the various characteristics of DC drive						
CO2	**Assessment** of AC drive performance parameters						
CO3	**Analysis** of dynamic characteristics of DC drive						
CO4	**Application** of closed and open loop control						
Experiment No.	***Name of the Experiment*****						
Experiments on MATLAB/SIMULINK							
1	To obtain the characteristic curves of DC shunt motor and DC series motor.						
2	Speed Control of DC motor fed from single phase AC source Armature voltage control (using full controlled converter) Field flux control Armature resistance control.						
3	Obtain the slip-torque and slip-speed characteristics of induction motor.						
4	To obtain the speed-torque characteristics of an induction motor by stator voltage control method.						
5	To operate the given DC motor in 2-quadrant using chopper						
6	Study of braking in dc motor. Dynamic braking Plugging Regenerative braking						
7	Speed Control of Induction motor using slip power recovery method (static scherbius drive).						
8	MATLAB program for speed control of induction motor.						
Experiments on Hardware Panels							
9	Draw Speed-Torque Characteristics of Separately Excited DC motor using Open Loop Armature Voltage Variation						
10	Draw Speed-Torque Characteristics of Separately Excited DC motor using Closed Loop Armature Voltage Control (P/PI)						
11	Draw Speed-Torque Characteristics of series DC Motor using Open Loop Armature Voltage Variation						
12	Draw Speed-Torque Characteristics of series DC Motor using Proportional/Proportional – Integral (P/PI) Close Loop Control.						
13	Draw Speed-Torque Characteristics of shunt DC Motor using Open Loop Armature Voltage Variation						
14	Draw Speed-Torque Characteristics of shunt DC Motor using Proportional/Proportional – Integral (P/PI) Close Loop Control.						
15	Draw Speed-Torque Characteristics of AC motor using Open Loop Control						
16	Draw Speed-Torque Characteristics of AC motor using Proportional/Proportional – Integral (P/PI) Close Loop Control.						
17	To study Linear Induction Motor and perform traction test on it using PEC16LM01 trainer.						

Syllabus

Program Elective Courses

B. Tech (Electrical Engineering)

BoS - 2020

ELECTRICAL ENGINEERING DEPARTMENT							
Course:- Bachelor of Technology (Electrical Engineering)							
Semester	Fifth	***Subject Title***		Electrical Machine Design	***Code***	TEE 504	
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***
Program Elective – I		03			03	00	00
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE: EVALUATION***	***CWA***	***MSE***	***ESE***
		03	00		25	25	50

Course Objectives: After completion of this course, students will be able to:

CO1	**Study** MMF calculation and thermal rating of various types of electrical machines.
CO2	**Design** armature and field systems for D.C. machines.
CO3	**Design** core, yoke, windings and cooling systems of transformers.
CO4	**Design** stator and rotor of induction machines.
CO5	**Design** stator and rotor of synchronous machines and study their thermal behavior.
CO6	**Understand** the design of magnetic circuits.

Unit No.	***Content***	***Hours***
Unit – 1	**Design Considerations:** Principle of Design, Major considerations in Electrical Machine Design, Specifications and Standards, Constraints of Design, Dimensions and Rating of machines, Electrical Engineering Materials – Conducting, Resistive, Magnetic and Insulating materials, Space factor, Rating of machines, Standard specifications. **Thermal considerations –** Heat Dissipation Modes, Temperature rise and Fall, Types of Cooling (Ventilation), hydrogen cooling	8
Unit – 2	**Design of Magnetic Circuits:** Basic principles of magnetic circuits, Magnetic circuit calculations, Iron losses, Magnetic leakage calculations, Magnetic pull **Design of Transformers:** Introduction, Specifications, Types of transformers, Output Equation, Volt per turn of winding, Choice of flux density and current density, Design of Core, Design of Yoke, Window and Core properties, Window space factor, Design of windings, Overall dimensions, Operating characteristics, No load current, Temperature rise in Transformers, Design of Tank, Methods of cooling of Transformers.	10
Unit – 3	**Design of DC Machines** Introduction, Construction of Field (or excitation system) and Rotor, Specifications of DC machine, Output Equation, choice of specific electric and magnetic loadings, Choice of number of poles, Limitations of main dimensions (D and L), Separation of main dimensions (D and L), Estimation of length of air gap, Design of armature, Design of Commutator and Brushes, Design of Field system of DC machine, Design of Interpoles.	7
Unit – 4	**Design of Three-phase induction motors**: General considerations, output equation, choice of specific electric and magnetic loadings, No. of slots in stator and rotor, elimination of harmonic torques, design of stator and rotor windings, leakage reactance, equivalent resistance of squirrel cage rotor, magnetizing current, temperature rise and efficiency.	6
Unit – 5	**Design of Alternators:** Classification and their comparison, specific loadings, output coefficient, main dimensions, short circuit ratio, elimination of harmonics in generated EMF, stator winding design.	5
	Total Hours	36

Text Books:

- Sawhney, A.K., 'A Course in Electrical Machine Design', Dhanpat Rai & Sons, New Delhi, 1984.

- M.V.Deshpande "Design and Testing of Electrical Machine Design" Wheeler Publications, 2010.

Reference Books:

- V. Rajni and V.S. Nagarajan, "Electrical Machine Design" 1st ed., Person, 2018.
- A.Shanmuga Sundaram, G.Gangadharan, R.Palani 'Electrical Machine Design Data Book', New Age International Pvt. Ltd., Reprint, 2007.
- R.K.Agarwal " Principles of Electrical Machine Design" Esskay Publications, Delhi, 2002.
- Sen, S.K., 'Principles of Electrical Machine Designs with Computer Programmes', Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 1987.

ELECTRICAL ENGINEERING DEPARTMENT								
Course:- Bachelor of Technology (Electrical Engineering)								
Semester	Fifth	***Subject Title***		Electromagnetic waves			***Code***	TEE 505
Course Components		***Credits***		***Contact Hours***		***L***	***T***	***P***
Program Elective – I		03				03	00	00
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE:EVALUATION***		***CWA***	***MSE***	***ESE***
		03	00			25	25	50

Course Objectives	
CO 1	**Analyze** transmission lines and estimate voltage and current at any point on transmission line for different load conditions.
CO2	**Application** of Maxwell Equations
CO3	**Acquiring** the knowledge of plane wave
CO4	**Acquiring** the knowledge of the characteristics of plane wave
CO5	**Understand** and analyse radiation by antennas.

Unit No.	***Content***	***Hours***
Unit -1	**Transmission Lines** Introduction, Concept of distributed elements, Equations of voltage and current, Standing waves and impedance transformation, Lossless and low-loss transmission lines, Power transfer on a transmission line, Analysis of transmission line in terms of admittances, Transmission line calculations with the help of Smith chart, Applications of transmission line, Impedance matching using transmission lines.	8
Unit -2	**Maxwell's Equations** Basic quantities of Electromagnetics, Basic laws of Electromagnetics: Gauss's law, Ampere's Circuital law, Faraday's law of Electromagnetic induction. Maxwell's equations, Surface charge and surface current, Boundary conditions at media interface.	6
Unit -3	**Uniform Plane Wave** Homogeneous unbound medium, Wave equation for time harmonic fields, Solution of the wave equation, Uniform plane wave, Wave polarization, Wave propagation in conducting medium, Phase velocity of a wave, Power flow and Poynting vector.	6
Unit -4	**Plane Waves at Media Interface** Plane wave in arbitrary direction, Plane wave at dielectric interface, Reflection and refraction of waves at dielectric interface, Total internal reflection, Wave polarization at media interface, Brewster angle, Fields and power flow at media interface, Lossy media interface, Reflection from conducting boundary	8
Unit -5	**Waveguides and Antennas** Parallel plane waveguide: Transverse Electric (TE) mode, transverse Magnetic(TM) mode, Cut-off frequency, Phase velocity and dispersion. Transverse Electromagnetic (TEM) mode, Analysis of waveguide-general approach, Rectangular waveguides. Radiation parameters of antenna, Potential functions, Solution for potential functions, Radiations from Hertz dipole, Near field, Far field, Total power radiated by a dipole, Radiation resistance and radiation pattern of Hertz dipole, Hertz dipole in receiving mode.	8
	Total Hours	36

Text/References:

1. R. K. Shevgaonkar, "Electromagnetic Waves", Tata McGraw Hill, 2005.
2. D. K. Cheng, "Field and Wave Electromagnetics", Addison-Wesley, 1989.
3. M. N.O. Sadiku, "Elements of Electromagnetics", Oxford University Press, 2007.
4. C. A. Balanis, "Advanced Engineering Electromagnetics", John Wiley & Sons, 2012.

ELECTRICAL ENGINEERING DEPARTMENT							
Course:- Bachelor of Technology (Electrical Engineering)							
Semester	Fifth	***Subject Title***		Digital Signal Processing		***Code***	TEE 506
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***
Program Elective – I		03			03	01	00
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE: EVALUATION***	***CWA***	***MSE***	***ESE***
		03	00		25	25	50

Course Objectives	
CO 1	**Acquire** the knowledge of various types of signals and its characteristics
CO2	**Application** of discrete signals using Z-Transform
CO3	**Application** of discrete signals using Fourier Transform
CO4	**Realization** of FIR and IIR filters
CO5	**Design** of FIR and IIR filters
CO6	**Acquire** the fundamental knowledge about the different types of digital signal processors

Unit No.	***Content***	***Hours***
Unit -1	**Introduction:** Classification of systems: Continuous, discrete, linear, causal, stable, dynamic, recursive, time variance; classification of signals: continuous and discrete, energy and power; Mathematical representation of signals; spectral density; sampling techniques, quantization, quantization error, Nyquist rate, aliasing effect. Digital signal representation.	8
Unit -2	**Discrete time system analysis:** Z-transform and its properties, inverse z-transforms; difference equation – Solution by Z-transform, frequency response – Convolution.	6
Unit -3	**Discrete Fourier transform & computation:** Fourier transform of discrete sequence , Discrete Fourier series, DFT properties, magnitude and phase representation, Computation of DFT using FFT algorithm, DIT & DIF, FFT using radix 2, Butterfly structure.	8
Unit -4	**Design of digital filters:** FIR & IIR filter realization, Direct form – I & II, Parallel & cascade forms. **FIR design:** Windowing Techniques, Need and choice of windows, Linear phase characteristics. **IIR design:** Analog filter design, Butterworth and Chebyshev approximations, digital design using impulse invariant and bilinear transformation, Warping, prewarping, Frequency transformation	10
Unit -5	**Digital signal processors:** Introduction – Architecture – Features – Addressing Formats – Functional modes - Introduction to Commercial Processors.	4
	Total Hours	36

Text Books & Reference Readings:

1. John G. Prokias and D.G. manolakis, “Digital Signal Processing: Principles, Algorithms and Applications”, PHI, 1997.
2. A.V Oppenheim and Schafer, “Discrete time Signal Processing”, PHI, 1989.
3. S.K. Mitra, ‘Digital Signal Processing – A Computer Based Approach’, Tata McGraw Hill, New Delhi, 2001.
4. L.R. Rabiner and B.Gold, “Theory and Applications of digital Signal Processing”, PHI, 1992.
5. J.R. Johnson, “Introduction to Digital Signal Processing”, PHI, 1992.
6. D.J. DeFatta, J.G. Lucas and W.S Hodgkiss, “Digital Signal Processing”, J Wiley and sons, Singapore, 1988.

ELECTRICAL ENGINEERING DEPARTMENT							
Course:- Bachelor of Technology (Electrical Engineering Department)							
Semester	Third	***Subject Title***		Electrical Engineering Material		***Code***	TEE 507
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***
Core Course (CC)		03			03	00	00
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE: EVALUATION***	***CWA***	***MSE***	***ESE***
		03	00		25	25	50

Course Objectives

CO 1	Assess different structures of materials
CO2	Analyze performance of materials by their different properties
CO3	Distinguish between metals, semiconductors and non-metals by different applications
CO4	Understand the concept of dielectric materials and their properties
CO5	Identification of magnetic materials by their classification
CO6	Formulation of different mathematical expressions based on types and properties of materials

Unit No.	*Content*	*Hours*
Unit -1	**Crystal Structure of Materials:** Bonds in solids, crystal structure, co-ordination number, atomic packing factor, Miller Indices, Bragg's law and x-ray diffraction, structural Imperfections, crystal growth. Energy bands in solids, classification of materials using energy band.	8
Unit -2	**Properties of Materials:** Properties and application of electrical conducting, semiconducting, insulating and super conducting materials. Mechanical properties of metals, optical properties of solids.	6
Unit -3	**Conductivity in Metals and semiconductor materials:** Electron theory of metals, factors affecting electrical resistance of materials, thermal conductivity of metals, heat developed in current carrying conductors, thermoelectric effect. Types of semiconductors, current carriers in semiconductors, Hall effect, Drift and Diffusion currents, continuity equation, P-N junction diode, junction transistor, FET & IGFET.	8
Unit -4	**Dielectric Properties of Materials:** Polarization and dielectric constant, dielectric constant of mono-atomic, poly atomic gases and solids, dipolar relaxation, dielectric loss, piezoelectricity, ferroelectric materials.	6
Unit -5	**Magnetic Properties of Materials:** Origin of permanent magnetic dipoles in matters, Classification: Diamagnetism, Para magnetism, Ferromagnetism, Anti-ferromagnetism and Ferri-magnetism. Magnetostriction. Soft and hard magnetic materials, permanent magnetic material	8
	Total Hours	36

Text Books:

1. A.J. Dekker, "Electrical Engineering Materials", Prentice Hall of India
2. R.K. Rajput, "Electrical Engg. Materials", Laxmi Publications.
3. C.S. Indulkar & S.Triruvagdan, "An Introduction to Electrical Engg. Materials", S. Chand& Co.
4. Solymar, "Electrical Properties of Materials", Oxford University Press.

References:

1. Ian P. Hones, "Material Science for Electrical and Electronic Engineering", Oxford University Press.
2. Narula, "Material Science", Tata McGraw Hill..

<table>
<tr><td colspan="8">ELECTRICAL ENGINEERING DEPARTMENT</td></tr>
<tr><td colspan="8">Course:- Bachelor of Technology (Electrical Engineering)</td></tr>
<tr><td>Semester</td><td>Sixth</td><td colspan="2">Subject Title</td><td colspan="2">Industrial Electrical Systems</td><td>Code</td><td>TEE 604</td></tr>
<tr><td colspan="2">Course Components</td><td colspan="2">Credits</td><td rowspan="2">Contact Hours</td><td>L</td><td>T</td><td>P</td></tr>
<tr><td colspan="2">Program Elective - II</td><td colspan="2">03</td><td>03</td><td>00</td><td>00</td></tr>
<tr><td colspan="2" rowspan="2">Examination Duration (Hrs)</td><td>Theory</td><td>Practical</td><td rowspan="2">WEIGHTAGE: EVALUATION</td><td>CWA</td><td>MSE</td><td>ESE</td></tr>
<tr><td>03</td><td>00</td><td>25</td><td>25</td><td>50</td></tr>
<tr><td colspan="8">Course Objectives</td></tr>
<tr><td>CO 1</td><td colspan="7">Application of electrical wiring components, such as, Fuse, Cable, MCB, etc.</td></tr>
<tr><td>CO2</td><td colspan="7">Understand various components of industrial electrical systems.</td></tr>
<tr><td>CO3</td><td colspan="7">Acquiring the knowledge of various types of wiring and general rule and guidelines of installation</td></tr>
<tr><td>CO4</td><td colspan="7">Application of Industrial electrical systems</td></tr>
<tr><td>CO5</td><td colspan="7">Application of DG system, UPS system, Battery banks</td></tr>
<tr><td>CO6</td><td colspan="7">Understand the use of automation in electrical systems.</td></tr>
<tr><td>Unit No.</td><td colspan="6">Content</td><td>Hours</td></tr>
<tr><td>Unit -1</td><td colspan="6">Electrical System Components
LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices</td><td>8</td></tr>
<tr><td>Unit -2</td><td colspan="6">Residential and Commercial Electrical Systems
Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, earthing system calculations, requirements of commercial installation, deciding lighting scheme and number of lamps, earthing of commercial installation, selection and sizing of components.</td><td>8</td></tr>
<tr><td>Unit -3</td><td colspan="6">Industrial Electrical Systems - I
HT connection, industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction – kVAR calculations, type of compensation, Introduction to PCC, MCC panels. Specifications of LT Breakers, MCB and other LT panel components.
Industrial Electrical Systems II
DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG, UPS and Battery Banks, Selection of UPS and Battery Banks.</td><td>12</td></tr>
<tr><td>Unit -4</td><td colspan="6">Industrial Electrical System Automation
Study of basic PLC, Role of in automation, advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation.</td><td>6</td></tr>
<tr><td></td><td colspan="6">Total Hours</td><td>34</td></tr>
</table>

Text/Reference Books

1. S.L. Uppal and G.C. Garg, “Electrical Wiring, Estimating & Costing”, Khanna publishers, 2008.
2. K. B. Raina, “Electrical Design, Estimating & Costing”, New age International, 2007.
3. S. Singh and R. D. Singh, “Electrical estimating and costing”, Dhanpat Rai and Co., 1997.
4. Web site for IS Standards.
5. H. Joshi, “Residential Commercial and Industrial Systems”, McGraw Hill Education, 2008.

ELECTRICAL ENGINEERING DEPARTMENT								
Course:- Bachelor of Technology (Electrical Engineering)								
Semester	Sixth	***Subject Title***		Digital Control Systems		***Code***	TEE 605	
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***	
Program Elective – II		03			03	00	00	
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE:EVALUATION***	***CWA***	***MSE***	***ESE***	
		03	00		25	25	50	

Course Objectives: Upon successful completion of this course, students will be able to:	
CO1	**Acquire** the fundamental concept of digital control systems
CO2	**Apply** z-transform to **Analyze** stability, transient response and steady state behavior of linear discrete-time systems
CO3	**Analyse** discrete time systems through state space representation
CO4	**Describe** and **Assess** the controllability and observability of linear discrete-time systems.
CO5	**Analyse** Stability of linear discrete time systems through pole placement and state observers
CO6	**Design** digital control systems using transform techniques and state-space methods.

Unit No.	***Content***	***Hours***
Unit -1	**Discrete Representation of Continuous Systems** Basics of Digital Control Systems. Discrete representation of continuous systems. Sample and hold circuit. Mathematical Modelling of sample and hold circuit. Effects of Sampling and Quantization. Choice of sampling frequency. ZOH equivalent.	08
Unit -2	**Discrete System Analysis:** Z-Transform and Inverse Z-Transform, Pulse Transfer Function, Mapping from s-plane to z-plane, solution of discrete time system, time response of discrete time system **Stability analysis of discrete time systems:** Stability analysis by Jury test. Stability analysis using bilinear transformation.	08
Unit -3	**State Space Approach for discrete time systems** State variable representation, conversion of state variable models to transfer function and of transfer function to canonical state variable models, Eigen values and Eigen vectors, Solution of state difference equations, controllability and Observability.	08
Unit -4	**Pole-placement Design and State Observers:** Stability improvement by state feedback, Necessary and sufficient conditions for arbitrary pole-placement. State regulator design, Design of state observer.	6
Unit -5	**Design of Digital Control System** Design of Discrete PID Controller, Design of discrete state feedback controller. Design of set point tracker. Design of Discrete Observer for LTI System. Design of Discrete compensator.	6
	Total Hours	36

Text/References:

1. K. Ogata, "Digital Control Engineering", Prentice Hall, Englewood Cliffs, 1995.
2. M. Gopal, "Digital Control Engineering", Wiley Eastern, 1988.
3. B.C. Kuo, "Digital Control System", Holt, Rinehart and Winston, 1980.

ELECTRICAL ENGINEERING DEPARTMENT							
Course:- Bachelor of Technology (Electrical Engineering)							
Semester	Sixth	***Subject Title***		Computer Architecture		***Code***	TEE 606
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***
Program Elective - III		03			03	00	00
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE:EVALUATION***	***CWA***	***MSE***	***ESE***
		03	00		25	25	50

Course Objectives	
CO 1	**Understand** the concepts of microprocessors, their principles and practices.
CO2	**Understand** the concepts of memory organisation.
CO3	**Write** efficient programs in assembly language of the 8086 family of microprocessors.
CO4	**Organize** a modern computer system and be able to relate it to real examples.
CO5	**Develop** the programs in assembly language for 80286, 80386 and MIPS processors in real and protected modes.
CO6	**Implement** embedded applications using ATOM processor.

Unit No.	***Content***	***Hours***
Unit -1	**Introduction to computer organization** Architecture and function of general computer system, CISC Vs RISC, Data types, Integer Arithmetic - Multiplication, Division, Fixed and Floating-point representation and arithmetic, Control unit operation, Hardware implementation of CPU with Micro instruction, microprogramming, System buses, Multi-bus organization.	8
Unit -2	**Memory organization** System memory, Cache memory - types and organization, Virtual memory and its implementation, Memory management unit, Magnetic Hard disks, Optical Disks.	8
Unit -3	**Input – output Organization** Accessing I/O devices, Direct Memory Access and DMA controller, Interrupts and Interrupt Controllers, Arbitration, Multilevel Bus Architecture, Interface circuits - Parallel and serial port. Features of PCI and PCI Express bus.	8
Unit -4	**16 and 32 microprocessors** 80x86 Architecture, IA – 32 and IA – 64, Programming model, Concurrent operation of EU and BIU, Real mode addressing, Segmentation, Addressing modes of 80x86, Instruction set of 80x86, I/O addressing in 80x86	6
Unit -5	**Pipelining** Introduction to pipelining, Instruction level pipelining (ILP), compiler techniques for ILP, Data hazards, Dynamic scheduling, Dependability, Branch cost, Branch Prediction, Influence on instruction set.	6
	Total Hours	36

Text/Reference Books

1. V. Carl, G. Zvonko and S. G. Zaky, “Computer organization”, McGraw Hill, 1978.
2. B. Brey and C. R. Sarma, “The Intel microprocessors”, Pearson Education, 2000.
3. J. L. Hennessy and D. A. Patterson, “Computer Architecture A Quantitative Approach”, Morgan Kauffman, 2011.
4. W. Stallings, “Computer organization”, PHI, 1987.
5. P. Barry and P. Crowley, “Modern Embedded Computing”, Morgan Kaufmann, 2012.
6. N. Mathivanan, “Microprocessors, PC Hardware and Interfacing”, Prentice Hall, 2004.
7. Y. C. Lieu and G. A. Gibson, “Microcomputer Systems: The 8086/8088 Family”, Prentice Hall India, 1986.

<table>
<tr><td colspan="9">ELECTRICAL ENGINEERING DEPARTMENT</td></tr>
<tr><td colspan="9">Course:- Bachelor of Technology (Electrical Engineering)</td></tr>
<tr><td>Semester</td><td>Sixth</td><td colspan="2">Subject Title</td><td colspan="2">Computational Electromagnetics</td><td>Code</td><td colspan="2">TEE 607</td></tr>
<tr><td colspan="2">Course Components</td><td colspan="2">Credits</td><td rowspan="2">Contact Hours</td><td>L</td><td>T</td><td colspan="2">P</td></tr>
<tr><td colspan="2">Program Elective - III</td><td colspan="2">03</td><td>03</td><td>00</td><td colspan="2">00</td></tr>
<tr><td colspan="2" rowspan="2">Examination Duration (Hrs)</td><td>Theory</td><td>Practical</td><td rowspan="2">WEIGHTAGE:EVALUATION</td><td>CWA</td><td>MSE</td><td colspan="2">ESE</td></tr>
<tr><td>03</td><td>00</td><td>25</td><td>25</td><td colspan="2">50</td></tr>
<tr><td colspan="9">Course Objectives</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand the basic concepts of Electromagnetics.</td></tr>
<tr><td>CO2</td><td colspan="8">Computation of computing fields.</td></tr>
<tr><td>CO3</td><td colspan="8">Application of Finite Difference Method</td></tr>
<tr><td>CO4</td><td colspan="8">Understand the basic concepts Uniqueness and convergence</td></tr>
<tr><td>CO5</td><td colspan="8">Application of Finite Elements Method</td></tr>
<tr><td>Unit No.</td><td colspan="7">Content</td><td>Hours</td></tr>
<tr><td>Unit -1</td><td colspan="7">Introduction
Conventional design methodology, Computer aided design aspects – Advantages. Review of basic fundamentals of Electrostatics and Electromagnetics. Development of Helmholtz equation, energy transformer vectors- Poynting and Slepian, magnetic Diffusion-transients and time-harmonic.</td><td>10</td></tr>
<tr><td>Unit -2</td><td colspan="7">Analytical Methods
Analytical methods of solving field equations, method of separation of variables, Roth’s method, integral methods- Green’s function, method of images.</td><td>8</td></tr>
<tr><td>Unit -3</td><td colspan="7">Finite Difference Method (FDM)
Finite Difference schemes, treatment of irregular boundaries, accuracy and stability of FD solutions, Finite-Difference Time-Domain (FDTD) method- Uniqueness and convergence.</td><td>8</td></tr>
<tr><td>Unit -4</td><td colspan="7">Finite Element Method (FEM)
Overview of FEM, Variational and Galerkin Methods, shape functions, lower and higher order elements, vector elements, 2D and 3D finite elements, efficient finite element computations.</td><td>8</td></tr>
<tr><td></td><td colspan="7">Total Hours</td><td>34</td></tr>
</table>

Text/References:

1. P. P. Silvester and R. L. Ferrari “Finite Element for Electrical Engineers”, Cambridge University press, 1996
2. M. N. O. Sadiku, “Numerical Techniques in Electromagnetics”, CRC press, 2001.

ELECTRICAL ENGINEERING DEPARTMENT							
Course:- Bachelor of Technology (Electrical Engineering)							
Semester	Sixth	***Subject Title***		High Voltage Engineering		***Code***	TEE 608
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***
Program Elective – III		03			03	00	00
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE:EVALUATION***	***CWA***	***MSE***	***ESE***
		03	00		25	25	50

Course Objectives	
CO 1	**Understand** breakdown phenomena in gases, liquid, solid, vacuum and composite dielectrics
CO2	**Elucidate** the concepts used for the measurement of high voltages and currents and design corresponding circuits.
CO3	**Interpret** high voltage testing techniques of Power apparatus and causes of over voltage in Power systems.
CO4	**Design** the layout of Gas Insulated substations and to **know** the concepts of insulation coordination.
CO5	**Understand** Over-voltage phenomenon
CO6	**Elucidate** the concepts used for the generation of high voltages and currents.

Unit No.	***Content***	***Hours***
Unit-1	**Break down Phenomenon:** Basic Process of breakdown, breakdown phenomenon of: gaseous, liquid, solid, vacuum and composite dielectrics	6
Unit-2	**Generation of high-test voltages:** Generation of high DC voltage by voltage multiplier circuit and electrostatic generators, generation of high AC voltage by cascade transformer and resonant transformers.	6
Unit -3	**Measurement of High Voltage and Current:** Series Resistance micro-ammeter, capacitance and resistance potential dividers, sphere gap, electrostatic voltmeter, Generating voltmeter.	8
Unit -4	**High Voltage Testing:** Requirement of high voltage test circuit, IS specifications; impulse and power frequency test of transformer, lighting, arrester, bushing, power cables, circuits breakers and isolator; measurement of resistivity, dielectric constant and loss factor.	8
Unit -5	**Over Voltage Phenomenon and Insulation Coordination:** Lightning and switching phenomenon as causes of over voltage, protection of transmission line and substation against over voltage, insulation coordination.	8
	Total Hours	36

Text/References:

1. M. S. Naidu and V. Kamaraju, "High Voltage Engineering", McGraw Hill Education, 2013.
2. C. L. Wadhwa, "High Voltage Engineering", New Age International Publishers, 2007.
3. D. V. Razevig (Translated by Dr. M. P. Chourasia), "High Voltage Engineering Fundamentals", Khanna Publishers, 1993

<table>
<tr><td colspan="8">ELECTRICAL ENGINEERING DEPARTMENT</td></tr>
<tr><td colspan="8">Course:- Bachelor of Technology (Electrical Engineering)</td></tr>
<tr><td>Semester</td><td>Sixth</td><td colspan="2">Subject Title</td><td colspan="2">Optimisation Techniques</td><td>Code</td><td>TEE 609</td></tr>
<tr><td colspan="2">Course Components</td><td colspan="2">Credits</td><td rowspan="2">Contact Hours</td><td>L</td><td>T</td><td>P</td></tr>
<tr><td colspan="2">Program Elective - VI</td><td colspan="2">03</td><td>03</td><td>00</td><td>00</td></tr>
<tr><td colspan="2" rowspan="2">Examination Duration (Hrs)</td><td>Theory</td><td>Practical</td><td rowspan="2">WEIGHTAGE:EVALUATION</td><td>CWA</td><td>MSE</td><td>ESE</td></tr>
<tr><td>03</td><td>00</td><td>25</td><td>25</td><td>50</td></tr>
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Course Objectives: Upon successful completion of this course, students will be able to	
CO1	**Understand** the Concept of optimization and classification of optimization problems.
CO2	**Understand** and **apply** unconstrained optimization theory for continuous problems,
CO3	**Understand** and **apply** constrained optimization theory for continuous problems
CO4	**Enumerate** fundamentals of Dynamic programming
CO5	**Understand** and **apply** the Queuing Model, poison and exponential distributions
CO6	**Use** and **apply** Genetic Algorithm on real applications

Unit No.	***Content***	***Hours***
Unit -1	**Introduction:** Mathematical Background, including convex sets and functions. Need for constrained methods in solving constrained problems.	04
Unit -2	**Unconstrained optimization:** Optimality conditions, Line Search Methods, Quasi Newton Methods, Trust Region Methods. Conjugate Gradient Methods. Least Squares Problems.	08
Unit -3	**Constrained Optimization:** Optimality Conditions and Duality. Convex Programming Problem. Linear Programming Problem. Quadratic Programming. Dual Methods, Penalty and Barrier Methods, Interior Point Methods.	08
Unit -4	**Dynamic Programming:** Multistage decision problems, computation procedure and case studies. Fundamentals of queuing system, Poisson process, the birth and death process, special queuing methods.	08
Unit -5	**Genetic Algorithms:** Fundamentals, basic concepts, working principle, encoding, fitness function, reproduction, Genetic modeling: Inheritance operator, cross over, inversion & deletion, mutation operator, Bitwise operator, Generational Cycle, Convergence of GA, Applications & advances in GA	08
	Total Hours	36

Text Books:

1. S.S. Rao - "Optimisation Theory and Applications", Wiley Eastern Limited, New Delhi. 1991
2. Chong, E.K.P.and Zak, S. H.. An Introduction to Optimisation, John Wiley & Sons, N.Y.
3. Hadely,G., 'Linear Programming', Addition Wesley, 1962.

Reference Readings :

1. Pierre, D.A. 'Optimisation Theory with Applications' John Wiley & Sons, 1969
2. Peressimi A.L., Sullivan F.E., Vhl, J.J..Mathematics of Non-linear Programming, Springer – Verlag.
3. Fletcher R. Practical methods of Optimisation, John Wiley. 1980

<table>
<tr><td colspan="9">ELECTRICAL ENGINEERING DEPARTMENT</td></tr>
<tr><td colspan="9">Course: - Bachelor of Technology (Electrical Engineering)</td></tr>
<tr><td colspan="2">Semester</td><td>Sixth</td><td colspan="2">Subject Title</td><td colspan="2">Industrial Instrumentation</td><td>Code</td><td>TEE 610</td></tr>
<tr><td colspan="3">Course Components</td><td colspan="2">Credits</td><td rowspan="2">Contact Hours</td><td>L</td><td>T</td><td>P</td></tr>
<tr><td colspan="3">Program Elective – III</td><td colspan="2">03</td><td>03</td><td>00</td><td>00</td></tr>
<tr><td colspan="3" rowspan="2">Examination Duration (Hrs)</td><td>Theory</td><td>Practical</td><td rowspan="2">WEIGHTAGE: EVALUATION</td><td>CWA</td><td>MSE</td><td>ESE</td></tr>
<tr><td>03</td><td>00</td><td>25</td><td>25</td><td>50</td></tr>
<tr><td>Unit No.</td><td colspan="7">Content</td><td>Hours</td></tr>
<tr><td>Unit -1</td><td colspan="7">MEASUREMENT OF FORCE, TORQUE AND SPEED: Different types of load cells: Hydraulic, Pneumatic, Strain gauge, Magneto-elastic and Piezoelectric load cells - Different methods of torque measurement: Strain gauge, Relative angular twist. Speed measurement: Capacitive tacho, Drag cup type tacho, D.C and A.C tacho generators - Stroboscope.</td><td>6</td></tr>
<tr><td>Unit -2</td><td colspan="7">MEASUREMENT OF ACCELERATION, VIBRATION AND DENSITY
Accelerometers: LVDT, Piezoelectric, Strain gauge and Variable reluctance type accelerometers - Mechanical type vibration instruments - Seismic instruments as accelerometer – Vibration sensor - Calibration of vibration pickups - Units of density and specific gravity – Baume scale and API scale – Densitometers: Pressure type densitometers, Float type densitometers, Ultrasonic densitometer and gas densitometer.</td><td>8</td></tr>
<tr><td>Unit -3</td><td colspan="7">MEASUREMENT OF VISCOSITY, HUMIDITY AND MOISTURE
Viscosity: Saybolt viscometer - Rotameter type and Torque type viscometers – Consistency Meters – Humidity: Dry and wet bulb psychrometers – Resistive and capacitive type hygrometers – Dew cell – Commercial type dew meter. Moisture: Different methods of moisture measurements –Thermal, Conductivity and Capacitive sensors, Microwave, IR and NMR sensors, Application of moisture measurement - Moisture measurement in solids.</td><td>8</td></tr>
<tr><td>Unit -4</td><td colspan="7">TEMPERATURE MEASUREMENT
Definitions and standards – Primary and secondary fixed points – Different types of filled in system thermometers – Sources of errors in filled in systems and their compensation – Bimetallic thermometers – IC sensors – Thermocouples: Laws of thermocouple, Fabrication of industrial thermocouples, Reference junctions compensation, Signal conditioning for thermocouple, Commercial circuits for cold junction compensation, Response of thermocouple, Special techniques for measuring high temperature using thermocouple</td><td>8</td></tr>
<tr><td>Unit – 5</td><td colspan="7">PRESSURE MEASUREMENT
Units of pressure – Manometers: Different types, Elastic type pressure gauges: Bourdon tube, Bellows, Diaphragms and Capsules - Electrical methods: Elastic elements with LVDT and strain gauges - Capacitive type pressure gauge - Piezo resistive pressure sensor-Resonator pressure sensor - Measurement of vacuum: McLeod gauge, Thermal conductivity gauge, lionization gauges, Cold cathode type and hot cathode type.</td><td>6</td></tr>
<tr><td></td><td colspan="7">Total Hours</td><td>36</td></tr>
</table>

TEXT BOOKS/REFERENCES

1. Doebelin, E.O. and Manik, D.N., “Measurement systems Application and Design”, 6th McGraw-Hill Education Pvt. Ltd, 2011.

2. Jones, B.E., “Instrument Technology”, Vol.2, Butterworth-Heinemann, International Edition, 2003.
3. Liptak, B.G., “Instrumentation Engineers Handbook (Measurement)”, CRC Press, 2005. 2. Patranabis, D., “Principles of Industrial Instrumentation”, 3rd Edition, McGraw-Hill Education, 2017.
4. Eckman D.P., “Industrial Instrumentation”, Wiley Eastern Limited, 1990.
5. Singh,S.K., “Industrial Instrumentation and Control”, Tata Mc-Graw-Hill Education Pvt. Ltd., New Delhi, 2009.

<table>
<tr><td colspan="6">ELECTRICAL ENGINEERING DEPARTMENT</td></tr>
<tr><td colspan="6">Course:- Master of Technology (Control System)</td></tr>
<tr><td>Semester | Sixth</td><td>Subject Title</td><td colspan="2">Special Electrical Machines</td><td>Code</td><td>TEE 611</td></tr>
<tr><td>Course Components</td><td>Credits</td><td rowspan="2">Contact Hours</td><td>L</td><td>T</td><td>P</td></tr>
<tr><td>Program Elective – III</td><td>03</td><td>03</td><td>00</td><td>00</td></tr>
<tr><td rowspan="2">Examination Duration (Hrs)</td><td>Theory | Practical</td><td rowspan="2">WEIGHTAGE: EVALUATION</td><td>CWA</td><td>MSE</td><td>ESE</td></tr>
<tr><td>03 | 00</td><td>25</td><td>25</td><td>50</td></tr>
</table>

Unit No.	***Content***	***Hours***
Unit -1	**SYNCHRONOUS RELUCTANCE MOTORS** Constructional features – Types – Axial and Radial flux motors – Operating principles – Variable Reluctance Motors – Voltage and Torque Equations – Phasor diagram – performance characteristics – Applications.	6
Unit -2	**STEPPER MOTORS** Constructional features – Principle of operation – Variable reluctance motor – Hybrid motor – Single and multi-stack configurations – Torque equations – Modes of excitation – Characteristics – Drive circuits – Microprocessor control of stepper motors – Closed loop control-Concept of lead angle– Applications.	8
Unit -3	**SWITCHED RECLUCTANCE MOTORS** constructional features – Rotary and Linear SRM – Principle of operation – Torque production – Steady state performance prediction- Analytical method **-**Power Converters and their controllers – Methods of Rotor position sensing – Sensor less operation – Characteristics and Closed loop control – Applications.	8
Unit -4	**PERMANENT MAGNET BRUSHLESS D.C. MOTORS** Permanent Magnet materials – Minor hysteresis loop and recoil line-Magnetic Characteristics – Permeance coefficient -Principle of operation – Types – Magnetic circuit analysis – EMF and torque equations –Commutation – Power Converter Circuits and their controllers – Motor characteristics and control– Applications.	8
Unit – 5	**PERMANENT MAGNET SYNCHRONOUS MOTORS** Principle of operation – Ideal PMSM – EMF and Torque equations – Armature MMF – Synchronous Reactance – Sine wave motor with practical windings – Phasor diagram – Torque/speed characteristics – Power controllers – Converter Volt-ampere requirements– Applications.	6
	Total Hours	36

1. Kenjo T., Sugawara A, ***Stepping Motors and their Microprocessor Control***, Clarendon Press, Oxford, 1994
2. Miller T. J. E., ***Switched Reluctance Motor and Their Control***, Clarendon Press, Oxford, 1993.
3. Miller T. J. E., ***Brushless Permanent Magnet and Reluctance Motor Drives***, Clarendon Press, Oxford, 1989.
4. B K Bose, ***Modern Power Electronics & AC drives***, Pearson, 2002.
5. Janardanan E.G, "Special Electrical Machines" Prentice Hall India Learning Private Limited (2014)

ELECTRICAL ENGINEERING DEPARTMENT							
Course:- Bachelor of Technology (Electrical Engineering)							
Semester	Seventh	***Subject Title***		Advanced Power Electronics	***Code***	TEE 703	
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***
Program Elective - IV		03			03	00	00
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE:EVALUATION***	***CWA***	***MSE***	***ESE***
		03	00		25	25	50

Course Objectives		
CO 1	**Analyse** controlled rectifier circuits for various loads and with various types of filters.	
CO2	**Understand** and **Analyse** the operation of multiphase converter	
CO3	**Understand** and **Analyse** operation of Single-phase ac-dc single-switch boost converter	
CO4	**Understand** and **Analyse** operation of ac-dc bi-directional boost converter	
CO5	**Understand** and **Analyse** operation of Isolated single-phase ac-dc fly back converter	
CO6	**Apply** the knowledge to design the advanced power electronic circuits for various applications.	
Unit No.	***Content***	***Hours***
Unit -1	**Thyristor rectifiers with passive filtering** Half-wave thyristor rectifier with RL and RC loads; 1-phase thyristor rectifier with L and LC filter; 3-phase thyristor rectifier with L and LC filter; continuous and discontinuous conduction, input current wave-shape.	07
Unit -2	**Multi-Pulse converter** Review of transformer phase shifting, generation of 6-phase ac voltage from 3-phase ac, 6-pulse converter and 12-pulse converters with inductive loads, steady state analysis, commutation overlap, notches during commutation.	07
Unit -3	**Single-phase ac-dc single-switch boost converter** Review of dc-dc boost converter, power circuit of single-switch ac-dc converter, steady state analysis, unity power factor operation, closed-loop control structure.	06
Unit -4	**Ac-dc bidirectional boost converter** Review of 1-phase inverter and 3-phase inverter, power circuits of 1-phase and 3-phase ac-dc boost converter, steady state analysis, operation at leading, lagging and unity power factors. Rectification and regenerating modes. Phasor diagrams, closed-loop control structure.	08
Unit -5	**Isolated single-phase ac-dc fly back converter** Dc-dc flyback converter, output voltage as a function of duty ratio and transformer turns ratio. Power circuit of ac-dc flyback converter, steady state analysis, unity power factor operation, closed loop control structure.	08
	Total Hours	36

Text/ References:

1. G. De, "Principles of Thyristorised Converters", Oxford & IBH Publishing Co, 1988.
2. J.G. Kassakian, M. F. Schlecht and G. C. Verghese, "Principles of Power Electronics", Addison-Wesley,
1991.
3. L. Umanand, "Power Electronics: Essentials and Applications", Wiley India, 2009.
4. N. Mohan and T. M. Undeland, "Power Electronics: Converters, Applications and Design", John Wiley
& Sons, 2007.
5. R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science & Business Media, 2001.

ELECTRICAL ENGINEERING DEPARTMENT								
Course:- Bachelor of Technology (Electrical Engineering)								
Semester	Seventh	***Subject Title***		Electrical and Hybrid Vehicles		***Code***		TEE 704
Course Components		***Credits***		***Contact Hours***	***L***	***T***		***P***
Program Elective - IV		03			03	00		00
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE:EVALUATION***	***CWA***	***MSE***		***ESE***
		03	00		25	25		50

Course Objectives	
CO1	**Understand** the models to describe hybrid vehicles and their performance.
CO2	**Analysis** of Electric Traction
CO3	**Understand** the different possible ways of energy storage.
CO4	**Understand** the different strategies related to energy storage systems.
CO5	**Application** various energy management schemes.
CO6	**Design different electrical vehicles**

Unit No.	***Content***	***Hours***
Unit -1	**Introduction to Hybrid Electric Vehicles**: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive- train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.	10
Unit -2	**Electric Trains** Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives.	8
Unit -3	**Energy Storage** Energy Storage: Analysis of Battery/ fuel cell/ super capacitor/ flywheel-based energy storage system. Hybridization of different energy storage devices. Matching the electric machine and the internal combustion engine (ICE), sizing of drive system	6
Unit -4	**Energy Management Strategies** Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.	8
Unit -5	**Case Studies:** Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).	4
	Total Hours	36

Text/References:

1. C. Mi, M. A. Masrur and D. W. Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons, 2011.
2. S. Onori, L. Serrao and G. Rizzoni, "Hybrid Electric Vehicles: Energy Management Strategies", Springer, 2015.
3. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press, 2004.

ELECTRICAL ENGINEERING DEPARTMENT								
Course:- Bachelor of Technology (Electrical Engineering)								
Semester	Seventh	***Subject Title***		Modern Control System		***Code***	TEE 705	
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***	
Program Elective – IV		03			03	00	00	
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE: EVALUATION***	***CWA***	***MSE***	***ESE***	
		03	00		25	25	50	

Course Objectives

CO 1	**Understand** the concept of state space approach.
CO2	**Analyze** discrete data control system
CO3	**Estimate** stability and **Design** state observers and controllers
CO4	**Formulate** optimal control problem and its solution.
CO5	**Apply** different adaptive control system techniques and optimization.
CO6	**Analyze** different nonlinear control schemes

Unit No.	***Content***	***Hours***
Unit -1	**State Space analysis:** introduction, state space representation of continuous linear time invariant system, transfer function and state variables, state transition matrix (STM), solution of state equations.	06
Unit -2	**State feedback control and observer design:** Pole placement (state variable feedbac State and output controllability and observability, design of state observers a controllers.	06
Unit -3	**Analysis of Discrete Systems:** Introduction to discrete time systems; sample and hold circuits; representation by difference equations and its solution using Z-Transform, pulse transfer function, representation of discrete system in state variable form and its solution.	08
Unit -4	**Introduction to Optimal Control & Adaptive Control:** Introduction, formation of optimal control problem, calculus of variations, minimization of functions& functionals. Constrained optimization, Introduction to adaptive control, modal reference adaptive control systems, controller structure self-tuning regulators, various adaptive control systems.	10
Unit -5	**Non-Linear Systems:** Linearization techniques of non-linear systems, Lyapunov's method, methods for generating Lyapunov's function, phase-plane and describing function techniques.	06
	Total Hours	36

Text Books:

1. N. S. Nise: Control Systems Engineering, 4th Ed., Wiley, 2004.
2. K. Ogata: Modern Control Engineering, 3rd Ed., Prentice Hall, 1999.
3. M. Gopal: Modern Control System Theory, 2nd Ed., New Age International, 1993

Reference Readings:

1. M. Gopal: Control Systems – Principles and Design, 3rd Ed., Tata McGraw Hill, 2002.
2. B. Friedland: Control System Design, McGraw Hill, 1986.
3. E. Bryson and Y-C Ho: Applied Optimal Control, Taylor and Francis, 1975

<table>
<tr><td colspan="10">ELECTRICAL ENGINEERING DEPARTMENT</td></tr>
<tr><td colspan="10">Course:- Bachelor of Technology (Electrical Engineering)</td></tr>
<tr><td colspan="2">Semester</td><td>Seventh</td><td colspan="2">Subject Title</td><td colspan="2">Utilization of Electrical Energy</td><td>Code</td><td colspan="2">TEE 706</td></tr>
<tr><td colspan="3">Course Components</td><td colspan="2">Credits</td><td rowspan="2">Contact Hours</td><td>L</td><td>T</td><td colspan="2">P</td></tr>
<tr><td colspan="3">Program Elective - IV</td><td colspan="2">03</td><td>03</td><td>00</td><td colspan="2">00</td></tr>
<tr><td colspan="3" rowspan="2">Examination Duration (Hrs)</td><td>Theory</td><td>Practical</td><td rowspan="2">WEIGHTAGE: EVALUATION</td><td>CWA</td><td>MSE</td><td colspan="2">ESE</td></tr>
<tr><td>03</td><td>00</td><td>25</td><td>25</td><td colspan="2">50</td></tr>
<tr><td colspan="10">Course Objectives</td></tr>
<tr><td>CO1</td><td colspan="9">Understanding concept of Utilization of electric power in various fields</td></tr>
<tr><td>CO2</td><td colspan="9">Application of various characteristics in illumination</td></tr>
<tr><td>CO3</td><td colspan="9">Understand different types heating</td></tr>
<tr><td>CO4</td><td colspan="9">Comprehend the different issues related to heating welding</td></tr>
<tr><td>CO5</td><td colspan="9">Understanding of concept of Traction and Electrification</td></tr>
<tr><td>CO6</td><td colspan="9">Analyzing various characteristics of electrical traction motor</td></tr>
</table>

Unit No.	***Content***	***Hours***
Unit -1	**Illumination:** Laws of illumination, Polar curves, Photometry, Integrating sphere, Types of Lamps: Conventional and Energy Efficient, Basic principle of Light control, Different lighting scheme & their design methods, Flood and Street lighting.	8
Unit -2	**Heating:** Types of heating, Resistance heating, Induction heating, Arc furnace, Dielectric heating, Microwave heating	6
Unit -3	**Welding:** Resistance welding, Arc welding, Ultrasonic welding, Electron beam welding, Laser beam welding, Requirement for good welding, Power supplies for different welding schemes	6
Unit -4	**Traction:** System of Traction Electrification, Train movement & energy consumption (Speed-time curves, Crest speed, Average speed & Schedule speed), Tractive effort, Factors affecting energy consumption (Dead weight, Acceleration weight & Adhesion weight), Protective devices.	8
Unit -5	**Electric Traction motor & their control:** Starting, braking with special emphasis on power electronic controllers, Current collector, Interference with telecommunication circuit. A brief outline of linear Induction motor principle in Traction.	8
	Total Hours	36

Text Books:

1. Wadha C L: Generation, Distribution and Utilization of electrical energy - New Age International Ltd.
2. Partab H: Art and Science of Utilization of Electrical Energy, DhanpatRai& Sons.

References:

1. E.Openshaw Taylor – Utilisation of Electric Energy – Orient Longman

<table>
<tr><td colspan="8">ELECTRICAL ENGINEERING DEPARTMENT</td></tr>
<tr><td colspan="8">Course:- Bachelor of Technology (Electrical Engineering)</td></tr>
<tr><td>Semester</td><td>Seventh</td><td colspan="2">Subject Title</td><td colspan="2">Electrical Energy Management and Auditing</td><td>Code</td><td>TEE 707</td></tr>
<tr><td colspan="2">Course Components</td><td colspan="2">Credits</td><td rowspan="2">Contact Hours</td><td>L</td><td>T</td><td>P</td></tr>
<tr><td colspan="2">Program Elective – V</td><td colspan="2">03</td><td>03</td><td>00</td><td>00</td></tr>
<tr><td colspan="2" rowspan="2">Examination Duration (Hrs)</td><td>Theory</td><td>Practical</td><td rowspan="2">WEIGHTAGE: EVALUATION</td><td>CWA</td><td>MSE</td><td>ESE</td></tr>
<tr><td>03</td><td>00</td><td>25</td><td>25</td><td>50</td></tr>
</table>

Course Objectives		
CO 1	**Understand** the current energy scenario and importance of energy conservation.	
CO2	**Understand** the concepts of energy management.	
CO3	**Understand** the concepts of energy audit.	
CO4	**Understand** the methods of improving energy efficiency in different electrical systems.	
CO5	**Understand** the concepts of different energy efficient devices.	
CO6	**Analysis** of the air type compressor.	
Unit No.	***Content***	***Hours***
Unit -1	**Energy Scenario** Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment, energy security, energy conservation and its importance, restructuring of the energy supply sector, energy strategy for the future, air pollution, climate change. Energy Conservation Act-2001 and its features.	8
Unit -2	**Basics of Energy and its various forms** Electricity tariff, load management and maximum demand control, power factor improvement, selection & location of capacitors, Thermal Basics-fuels, thermal energy contents of fuel, temperature & pressure, heat capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity & heat transfer, units and conversion.	8
Unit -3	**Energy Management & 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 & energy substitution, energy audit instruments.	8
Unit -4	**Energy Efficiency in Electrical and Industrial Systems** Electrical system: Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit, selection and location of capacitors, performance assessment of PF capacitors, distribution and transformer losses.	6
Unit -5	**Compressed Air and HVAC System:** Types of air compressors, compressor efficiency, efficient compressor operation, Compressed air system components, capacity assessment, leakage test, factors affecting the performance and savings opportunities in HVAC.	6
	Total Hours	36

Text/References:

1. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects (available online)
2. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-3, Electrical Utilities (available online)
3. S. C. Tripathy, “Utilization of Electrical Energy and Conservation”, McGraw Hill, 1991.
4. Success stories of Energy Conservation by BEE, New Delhi (www.bee-india.org)

ELECTRICAL ENGINEERING DEPARTMENT								
Course: - Bachelor of Technology (Electrical Engineering)								
Semester	Seventh	***Subject Title***		HVDC Transmission Systems		***Code***	TEE 708	
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***	
Program Elective - V		03			03	00	00	
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE: EVALUATION***	***CWA***	***MSE***	***ESE***	
		03	00		25	25	50	

Course Objectives

CO 1	**Application** of dc transmission and ac transmission.
CO2	**Analysis** of HVDC converter
CO3	**Analysis** of control strategies used in HVDC transmission system.
CO4	**Understand** the various characteristics of HVDC systems
CO5	Stability **analysis** of HVDC system
CO6	Understand reactive power and control strategies

Unit No.	***Content***	***Hours***
Unit -1	**DC Transmission Technology:** Comparison of AC and DC Transmission (Economics, Technical Performance and Reliability). Application of DC Transmission. Types of HVDC Systems. Components of a HVDC system. Modern trends in DC transmission.	6
Unit -2	**Analysis of HVDC converters**: Pulse number, Choice of converter configuration, Simplified analysis of Graetz circuit, Converter bridge characteristics, Characteristics of a twelve-pulse converter, Detailed analysis of converters with and without overlap. **Converter and HVDC system control**: General, Principles of DC link control, Converter control characteristics, System control hierarchy, firing angle control, Current and extinction angle control, Starting and stopping of DC link, Power control.	10
Unit -3	**Components of HVDC systems:** Smoothing Reactors, Reactive Power Sources and Filters in LCC HVDC systems DC line: Corona Effects. Insulators, Transient Over-voltages. dc line faults in LCC systems. dc line faults in VSC systems. dc breakers.	6
Unit -4	**Stability Enhancement using HVDC Control** Basic Concepts: Power System Angular, Voltage and Frequency Stability. Power Modulation: basic principles – synchronous and asynchronous links. Voltage Stability Problem in AC/dc systems.	6
Unit 5	**Reactive power control:** Reactive power requirements in steady state, Sources of reactive power, Static VAR systems, Reactive power control during transients, Harmonics and filters, Generation of harmonics, Design of AC filters, DC filters.	8
	Total Hours	36

Text/References:

1. K. R. Padiyar, "HVDC Power Transmission Systems", New Age International Publishers,2011.
2. J. Arrillaga, "High Voltage Direct Current Transmission", Peter Peregrinus Ltd.,1983.
3. E. W. Kimbark, "Direct Current Transmission", Vol.1, Wiley-Interscience,1971.
4. Arrillaga, J., HVDC Transmission, IEE Press (2007).

ELECTRICAL ENGINEERING DEPARTMENT								
Course:- Bachelor of Technology (Electrical Engineering)								
Semester	Seventh	***Subject Title***		Electrical Design Estimation and Costing		***Code***	TEE 709	
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***	
Program Elective - V		03			03	00	00	
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE: EVALUATION***	***CWA***	***MSE***	***ESE***	
		03	00		25	25	50	

Course Objectives

CO 1	**Analyze** principle of estimation, costing, surveying and source selection.
CO2	**Understand** the concept of electrification of residential.
CO3	**Understand** the concept of electrification of commercial buildings.
CO4	**Understand** the concept of electrical installation for power circuits.
CO5	**Comprehend** the concept of Substation design.
CO6	**Understand** the application of switchgear and auxiliaries in substation.

Unit No.	***Content***	***Hours***
Unit -1	**General principle of estimation:** Introduction to estimation & costing, Electrical Schedule, Catalogues, Market Survey and source selection, Recording of estimates, Determination of required quantity of material, Labour conditions, Determination of cost material and labour, Contingencies, Overhead charges, Profit, Purchase system, Purchase enquiry and selection of appropriate purchase mode, Comparative statement, Purchase orders, Payment of bills, Tender form.	08
Unit -2	**Electrification of residential and commercial buildings:** General rules for wiring, Determination of number of points, Determination of total load, Determination of number of sub circuits, Determination of ratings of main switch/isolator, Distribution Board, Single line diagram using standard electrical signs and symbols of single phase/three phase circuits. Wiring estimation for single phase/three phase residential/ commercial consumers, Earthing of the electrical installation.	12
Unit -3	**Electrical installation for power circuits:** Introduction, Important considerations regarding motor installation wiring, Determination of input power, Determination of input current to motors, Determination of rating of cables, determination of rating of fuse, Determination of size of Conduit, distribution Board main switch and starter.	08
Unit -4	**Design and estimation of substations:** Introduction, Classification of substation, Indoor substations, Outdoor substations, Selection and location of site for substation, Main	04
Unit -5	**Substation Electrical Connections:** Graphical symbols for various types of apparatus and circuit elements on substation main connection diagram, Key diagram of typical substations, Equipment for substation and switchgear installations, Substation auxiliaries supply, Substation Earthing.	04
	Total Hours	36

Text Books

1. .K.B.Raina, S.K.Bhattacharya, ***Electrical Design Estimating and Costing***, 2nd Edition, New Age International (P) Ltd.

Reference Readings:

1. J.B.Gupta, ***Electrical Installation Estimating & Costing***, 8th Edition S.K. Katria& Sons.
*2.*Uppal, ***Electrical Wiring Estimating and Costing,*** Khanna Publishers, New Delhi.
3. ***National Electric Code,*** Bureau of Indian Standard Publications.

ELECTRICAL ENGINEERING DEPARTMENT								
Course:- Bachelor of Technology (Electrical Engineering)								
Semester	Seventh	***Subject Title***		Power Quality and FACTS			***Code***	TEE 710
Course Components		***Credits***		***Contact Hours***		***L***	***T***	***P***
Program Elective - V		03				03	00	00
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE:EVALUATION***		***CWA***	***MSE***	***ESE***
		03	00			25	25	50

Course Objectives	
CO1	**Analysis** of the characteristics of ac transmission system. shunt and series reactive compensation.
CO2	**Analysis** of shunt and series reactive compensation.
CO3	**Understand** the working principles of FACTS devices and their operating characteristics.
CO4	**Analysis** of STATCOM
CO5	**Understand** the working principles of devices to improve power quality.
CO6	**Understand** the basic concepts of power quality.

Unit No.	***Content***	***Hours***
Unit -1	**Transmission Lines and Series/Shunt Reactive Power Compensation** Basics of AC Transmission. Analysis of uncompensated AC transmission lines. Passive Reactive Power Compensation. Shunt and series compensation at the mid-point of an AC line. Comparison of Series and Shunt Compensation.	8
Unit -2	**Thyristor-based Flexible AC Transmission Controllers (FACTS)** Description and Characteristics of Thyristor-based FACTS devices: Static VAR Compensator (SVC), Thyristor Controlled Series Capacitor (TCSC), Thyristor Controlled Braking Resistor and Single Pole Single Throw (SPST) Switch.	8
Unit -3	**Voltage Source Converter based (FACTS) controllers** Voltage Source Converters (VSC): Six Pulse VSC, Multi-pulse and Multi-level Converters, Pulse-Width Modulation for VSCs. Selective Harmonic Elimination, Sinusoidal PWM and Space Vector Modulation.	6
Unit-4	**STATCOM:** Principle of Operation, Reactive Power Control: Type I and Type II controllers, Static Synchronous Series Compensator (SSSC) and Unified Power Flow Controller (UPFC)	6
Unit -5	**Power Quality Problems in Distribution** Power Quality problems in distribution systems: Transient and Steady state variations in voltage and frequency. Unbalance, Sags, Swells, Interruptions, Wave-form Distortions: harmonics, noise, notching, dc-offsets, fluctuations.	8
	Total Hours	36

Text/References:

1. N. G. Hingorani and L. Gyugyi, “Understanding FACTS: Concepts and Technology of FACTS Systems”, Wiley-IEEE Press, 1999.
2. K. R. Padiyar, “FACTS Controllers in Power Transmission and Distribution”, New Age International (P) Ltd. 2007.
3. T. J. E. Miller, “Reactive Power Control in Electric Systems”, John Wiley and Sons, New York, 1983.
4. R. C. Dugan, “Electrical Power Systems Quality”, McGraw Hill Education, 2012.
5. G. T. Heydt, “Electric Power Quality”, Stars in a Circle Publications, 1991

<table>
<tr><td colspan="9">ELECTRICAL ENGINEERING DEPARTMENT</td></tr>
<tr><td colspan="9">Course:- Bachelor of Technology (Electrical Engineering)</td></tr>
<tr><td>Semester</td><td>Seventh</td><td colspan="2">Subject Title</td><td colspan="2">Industry 4.0</td><td>Code</td><td colspan="2">TEE 711</td></tr>
<tr><td colspan="2">Course Components</td><td colspan="2">Credits</td><td rowspan="2">Contact Hours</td><td>L</td><td>T</td><td colspan="2">P</td></tr>
<tr><td colspan="2">Program Elective – IV</td><td colspan="2">03</td><td>03</td><td>00</td><td colspan="2">00</td></tr>
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<tr><td>03</td><td>00</td><td>25</td><td>25</td><td colspan="2">50</td></tr>
<tr><td colspan="9">Course Outcomes:</td></tr>
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CO1	Understand the drivers and enablers of Industry 4.0	
CO2	Appreciate the smartness in Smart Factories, Smart cities, smart products and smart services	
CO3	Able to outline the various systems used in a manufacturing plant and their role in an Industry 4.0 world	
CO4	Appreciate the power of Cloud Computing in a networked economy	
CO5	Understand the opportunities, challenges brought about by Industry 4.0 and how organisations and individuals should prepare to reap the benefits	
Unit No.	***Content***	***Hours***
Unit -1	**Introduction to Industry 4.0** The Various Industrial Revolutions, Digitalisation and the Networked Economy, Drivers, Enablers, Compelling Forces and Challenges for Industry 4.0, The Journey so far: Developments in USA, Europe, China and other countries, Comparison of Industry, Factory and Today's Factory, Trends of Industrial Big Data and Predictive Analytics for Smart Business Transformation	10
Unit -2	**Road to Industry 4.0** Internet of Things (IoT) & Industrial Internet of Things (IIoT) & Internet of Services, Smart Manufacturing, Smart Devices and Products, Smart Logistics, Smart Cities, Predictive Analytics	6
Unit -3	**Related Disciplines, System, Technologies for enabling Industry 4.0** Cyberphysical Systems, Robotic Automation and Collaborative Robots, Support System for Industry 4.0, Mobile Computing, Related Disciplines, Cyber Security	6
Unit -4	**Role of data, information, knowledge and collaboration in future organizations** Resource-based view of a firm, Data as a new resource for organizations, Harnessing and sharing knowledge in organizations, Cloud Computing Basics, Cloud Computing and Industry 4.0	8
Unit – 5	**Other Applications and Business issues in Industry 4.0** Industry 4.0 laboratories, IIoT case studies, Opportunities and Challenges, Future of Works and Skills for Workers in the Industry 4.0 Era, Strategies for competing in an Industry 4.0 world	6
	Total Hours	36

Text Books / Reference Readings

1. Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", Apress; 1st ed. edition (4 January 2017)
2. Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat, "Industrial Internet of Things: Cyber manufacturing Systems", 1ST ed., Springer, 2017
3. Research Papers

ELECTRICAL ENGINEERING DEPARTMENT						
Course:- Bachelor of Technology (Electrical Engineering)						
Semester	Eighth	***Subject Title***	Power Plant Instrumentation		***Code***	TEE 801
Course Components		***Credits***	***Contact Hours***	***L***	***T***	***P***
Program Elective - VI		03		03	00	00
Examination Duration (Hrs)	***Theory***	***Practical***	***WEIGHTAGE: EVALUATION***	***CWA***	***MSE***	***ESE***
	03	00		25	25	50

Course Objectives

CO 1	**Application** of instrumentation in power generation
CO2	**Analysis** of control method in thermal power plant
CO3	**Analysis** of burner tilting, up bypass damper super heater Spray and gas re circulation controls, etc
CO4	**Understand the concept of** Turbine monitoring and control
CO5	**Analysis** in power plant
CO6	**Understand** the role of computers in instrumentation

Unit No.	***Content***	***Hours***
Unit -1	**An Overview** Dependence of instrumentation on the method of power generation thermal power plants general structures, pulverization and burners fans, dampers and actuators super heaters stern traps- Economizer, Recirculation and regenerators, Cooling towers feed water generators Turbine cooling system radiation detectors	8
Unit -2	**Control loops and inter and Annunciation systems:** Combustion control of main header, pressure, air, fuel ratio control, furnace and excess control drum level (three element control) main and re-heat systems temperature control, burner tilting up bypass damper super heater Spray and gas re circulation controls, hot well level control inter lock – MFT Turbine trip conditions pulverizes control.	8
Unit -3	**Turbine monitoring and control:** Condenser vacuum control, gland steam exhaust, pressure control, speed vibration shell temperature monitoring, lubricating oil temperature control, hydrogen generator cooling system.	6
Unit -4	**Analysis in power plant:** Thermal conductive type paramagnetic type oxygen analyzer, hydrogen purity meter chromatography, PH meter fact analyzer, pollution monitoring and control.	8
Unit -5	**Computer in power plants:** load dispatching computer, generation station computer, mini computers, and supervisory control	6
	Total Hours	36

Text Books

1. El wakil, MM, power plant technology, Mc Graw hill.1984
2. Richard Delezal and ludrikVarcop, Process Dynamics Automatic Control of steam Generation plant, ElevierPulishing Co Amesternam 1972.

Reference books:

1. J Balsubramnian and RK Jain Modern power plant engineering, Khanna Publisher, New Delhi 1987
2. Stephen Michael Elonka&antomyLawerencekohal / standard Boiler operation, question and answer TMH

ELECTRICAL ENGINEERING DEPARTMENT								
Course: - Bachelor of Technology (Electrical Engineering)								
Semester	Eighth	***Subject Title***		Wind and Solar Energy Systems		***Code***	TEE 802	
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***	
Program Elective - VI		03			03	00	00	
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE: EVALUATION***	***CWA***	***MSE***	***ESE***	
		03	00		25	25	50	

Course Objectives	
CO 1	**Understand** the energy scenario and the consequent growth of the power generation from renewable energy sources.
CO2	**Understand** the basic physics of wind and solar power generation.
CO3	**Understand** the power electronic interfaces for wind and solar generation.
CO4	**Understand** the issues related to the grid-integration of solar and wind energy systems.
CO5	**Understand** the issues related to power quality
CO6	**Understand** the concepts of MPPT for generation of solar Photo Voltaic power

Unit No.	***Content***	***Hours***
Unit -1	**Physics of Wind Power** History of wind power, Indian and Global statistics, Wind physics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power-cumulative distribution functions.	4
Unit -2	**Wind generator topologies** Review of modern wind turbine technologies, Fixed and Variable speed wind turbines, Induction Generators, Doubly-Fed Induction Generators and their characteristics, Permanent-Magnet Synchronous Generators, Power electronics converters. Generator-Converter configurations, Converter Control.	8
Unit -3	**The Solar Resource** Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability. **Solar photovoltaic** Technologies-Amorphous, monocrystalline, polycrystalline; V-I characteristics of a PV cell, PV module, array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms. Converter Control.	8
Unit -4	***Grid-Connected Distributed Generation Systems*** Global scenario of Distributed Generators (DGs) *Characteristics of different Renewable Energy Source based Distributed Generators* Power Electronics Structure for grid interfacing of different DGs Standards and guidelines for Integration of DGs [1547] Criteria for synchronizing DGs utility grid Challenges related to PV based DGs and wind based DGs	8
Unit 5	**Network Integration Issues** Overview of grid code technical requirements. Fault ride-through for wind farms - real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behaviour during grid disturbances. Power quality issues. Grid Synchronization of PV based DGs Hybrid and isolated operations of solar PV and wind systems.	8
	Total Hours	36

Text / References:

1. T. Ackermann, "Wind Power in Power Systems", John Wiley and Sons Ltd., 2005.
2. G. M. Masters, "Renewable and Efficient Electric Power Systems", John Wiley and Sons, 2004.
3. S. P. Sukhatme, "Solar Energy: Principles of Thermal Collection and Storage", McGraw Hill, 1984.
4. H. Siegfried and R. Waddington, "Grid integration of wind energy conversion systems" John Wiley and Sons Ltd., 2006.
5. G. N. Tiwari and M. K. Ghosal, "Renewable Energy Applications", Narosa Publications, 2004.

ELECTRICAL ENGINEERING DEPARTMENT							
Course: - Bachelor of Technology (Electrical Engineering)							
Semester	Eighth	***Subject Title***		Advanced Electric Drives	***Code***	TEE 803	
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***
Program Elective - VI		03			03	00	00
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE: EVALUATION***	***CWA***	***MSE***	***ESE***
		03	00		25	25	50

Course Objectives		
CO 1	**Understand** the operation of power electronic converters.	
CO2	**Understand** various control strategies for different converters	
CO3	**Understand** the vector control strategies for ac motor drives	
CO4	**Modelling** of synchronous motor drive	
CO5	**Understand** the basics of permanent magnet motors	
C06	**Understand** the basics of reluctance motor drive	
Unit No.	***Content***	***Hours***
Unit -1	**Power Converters for AC drives** PWM control of inverter, selected harmonic elimination, space vector modulation, current control of VSI, three level inverter, Different topologies, SVM for 3 level inverter, Diode rectifier with boost chopper, PWM converter as line side rectifier, current fed inverters with self-commutated devices.	8
Unit -2	**Induction motor drives** Different transformations and reference frame theory, modeling of induction machines, voltage fed inverter control-v/f control, vector control, direct torque and flux control(DTC).	8
Unit -3	**Synchronous motor drives** Modeling of synchronous machines, open loop v/f control, vector control, direct torque control, CSI fed synchronous motor drives.	8
Unit -4	**Permanent magnet motor drives** Introduction to various PM motors, BLDC and PMSM drive configuration, comparison, block diagrams, Speed and torque control in BLDC and PMSM.	6
Unit-5	**Switched reluctance motor drives** Evolution of switched reluctance motors, various topologies for SRM drives, comparison, Closed loop speed and torque control of SRM.	6
	Total Hours	36

Text/References:

1. K. Bose, "Modern Power Electronics and AC Drives", Pearson Education, Asia, 2003.
2. P.C. Krause, O. Wasynczuk and S.D. Sudhoff, "Analysis of Electric Machinery and Drive Systems", John Wiley & Sons, 2013.
3. H. A. Taliyat and S. G. Campbell, "DSP based Electromechanical Motion Control", CRC press, 2003.

ELECTRICAL ENGINEERING DEPARTMENT							
Course: - Bachelor of Technology (Electrical Engineering)							
Semester	eighth	***Subject Title***		Power System Dynamics and Control		***Code***	TEE 804
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***
Program Elective - VI		03			03	00	00
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE: EVALUATION***	***CWA***	***MSE***	***ESE***
		03	00		25	25	50

Course Objectives

CO1	**Analysis** of linear dynamic system
CO2	**Analysis** of power system stability
CO3	**Designing** of Synchronous machine and controllers
CO4	**Modelling** of power system components
CO5	**Understand** the methods to improve stability.

Unit No.	***Content***	***Hours***
Unit -1	**Introduction:** Introduction to power system stability. Power System Operations and Control. Stability problems in Power System. Impact on Power System Operations and control.	6
Unit -2	**Analysis of Linear Dynamical System and Numerical Methods** Analysis of dynamical System, Concept of Equilibrium, Small and Large Disturbance Stability. Modal Analysis of Linear System. Analysis using Numerical Integration Techniques. Issues in Modeling: Slow and Fast Transients, Stiff System	6
Unit-3	**Modeling of Synchronous Machines and Associated Controllers** Modeling of synchronous machine: Physical Characteristics. Rotor position dependent model. D-Q Transformation. Model with Standard Parameters. Steady State Analysis of Synchronous Machine. Short Circuit Transient Analysis of a Synchronous Machine. Synchronization of Synchronous Machine to an Infinite Bus. Modeling of Excitation and Prime Mover Systems. Automatic Voltage Regulator. Prime Mover Control Systems. Speed Governors.	8
Unit -4	**Modeling of other Power System Components** Modeling of Transmission Lines and Loads. Transmission Line Physical Characteristics. Transmission Line Modeling. Load Models - induction machine model. Frequency and Voltage Dependence of Loads. Other Subsystems – HVDC and FACTS controllers, Wind Energy Systems.	8
Unit -5	**Stability Analysis and Enhancing System Stability** Frequency Stability: Centre of Inertia Motion. Load Sharing: Governor droop. Single Machine Load Bus System: Voltage Stability. Introduction to signal Oscillations and the SSR phenomenon. Stability Analysis Tools: Transient Stability Programs, Small Signal Analysis Programs.	8
	Total Hours	36

Text/References:

1. K.R. Padiyar, "Power System Dynamics, Stability and Control", B. S. Publications, 2002.
2. P. Kundur, "Power System Stability and Control", McGraw Hill, 1995.
3. P. Sauer and M. A. Pai, "Power System Dynamics and Stability", Prentice Hall, 1997.

Syllabus

Open Elective Courses

B. Tech (Electrical Engineering)

BoS - 2020

ELECTRICAL ENGINEERING DEPARTMENT								
Course: - Bachelor of Technology (Electrical Engineering)								
Semester	Fifth	***Subject Title***		Data Structure		***Code***	TOE 501	
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***	
Open Elective Course		03			03	00	00	
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE: EVALUATION***	***CWA***	***MSE***	***ESE***	
		03	00		25	25	50	

Course Objectives

CO 1	Describe the concept of Data Structures and assess how the choice of data structures impacts the performance of programs.
CO2	Compare and contrast merits and demerits of various data structures in terms of time and memory complexity.
CO3	Identify and propose appropriate data structure for providing the solution to the real world problems.
CO4	Implement operations like searching, insertion, deletion, traversing mechanism etc. on various data structures
CO5	Be familiar with advanced data structures such as balanced search trees, hash tables, AVL trees, priority queues, ADT etc.
CO6	To augment merits of particular data structures on other data structure to develop innovation in subject of study.

Unit	***Content***	***Hours***
Unit -1	**Introduction:** Basic Terminology, Pointer and dynamic memory allocation, Elementary Data Organization, Data Structure operations, Algorithm Complexity and Time-Space trade-off Arrays: Array Definition, Representation and Analysis, Single and Multidimensional Arrays, address calculation, application of arrays, Array as Parameters, Ordered List, Sparse Matrices. Stacks: Array. Representation and Implementation of stack, Operations on Stacks: Push & Pop, Array Representation of Stack, Linked Representation of Stack, Operations Associated with Stacks, Application of stack: Conversion of Infix to Prefix and Postfix Expressions, Evaluation of postfix expression using stack. Recursion: Recursive definition and processes, recursion in C, example of recursion, Tower of Hanoi Problem, tail recursion.	8
Unit -2	**Queues**: Array and linked representation and implementation of queues, Operations on Queue: Create, Add, Delete, Full and Empty. Circular queue, Dequeue, and Priority Queue. **Linked list:** Representation and Implementation of Singly Linked Lists, Two-way Header List, Traversing and Searching of Linked List, Overflow and Underflow, Insertion and deletion to/from Linked Lists, Insertion and deletion Algorithms, doubly linked list, Linked List in Array, Polynomial representation and addition, Generalized linked list.	8
Unit -3	**Trees:** Basic terminology, Binary Trees, Binary tree representation, algebraic Expressions, Complete Binary Tree. Extended Binary Trees, Array and Linked Representation of Binary trees, Traversing Binary trees, Threaded Binary trees. Traversing Threaded Binary trees, Huffman algorithm & Huffman tree. Searching and Hashing: Sequential search, binary search, comparison and analysis, Hash Table, Hash Functions, Collision Resolution Strategies, Hash Table Implementation	8
Unit -4	Sorting: Insertion Sort, Bubble Sorting, Quick Sort, Two Way Merge Sort, Heap Sort, Sorting on Different Keys, Practical consideration for Internal Sorting.	6

	Binary Search Trees: Binary Search Tree (BST), Insertion and Deletion in BST, Complexity of Search Algorithm, Path Length, AVL Trees	
Unit -5	File Structures: Physical Storage Media File Organization, Organization of records into Blocks, Sequential Files, Indexing and Hashing, Primary indices, Secondary indices, B+ Tree index Files, B Tree index Files, Indexing and Hashing Comparisons, Graph, Traversal (DFS,BFS) ,Minimum spanning tree	6
	Total Hours	36

Text/ Reference Books:

1. Horowitz and Sahani, “Fundamentals of data Structures”, Galgotia Publication Pvt. Ltd., New Delhi.
2. R. Kruse etal, “Data Structures and Program Design in C”, Pearson Education Asia, Delhi-2002
3. A. M. Tenenbaum, “Data Structures using C & C++”, Prentice-Hall of India Pvt. Ltd., New Delhi.
4. K Loudon, “Mastering Algorithms with C”, Shroff Publisher & Distributors Pvt. Ltd.
5. Bruno R Preiss, “Data Structures and Algorithms with Object Oriented Design Pattern in C++”, Jhon Wiley & Sons, Inc.
6. Adam Drozdek, “Data Structures and Algorithms in C++”, Thomson Asia Pvt

<table>
<tr><td colspan="9">ELECTRICAL ENGINEERING DEPARTMENT</td></tr>
<tr><td colspan="9">Course:- Bachelor of Technology (Electrical Engineering)</td></tr>
<tr><td>Semester</td><td>Fifth</td><td colspan="2">Subject Title</td><td colspan="2">Computer Based Numerical and Statistical Techniques</td><td>Code</td><td colspan="2">TOE 502</td></tr>
<tr><td colspan="2">Course Components</td><td colspan="2">Credits</td><td rowspan="2">Contact Hours</td><td>L</td><td>T</td><td colspan="2">P</td></tr>
<tr><td colspan="2">Open Elective - I</td><td colspan="2">3</td><td>3</td><td>0</td><td colspan="2">0</td></tr>
<tr><td colspan="2" rowspan="2">Examination Duration (Hrs)</td><td>Theory</td><td>Practical</td><td rowspan="2">WEIGHTAGE:EVALUATION</td><td>CWA</td><td>MSE</td><td colspan="2">ESE</td></tr>
<tr><td>3</td><td>0</td><td>25</td><td>25</td><td colspan="2">50</td></tr>
<tr><td colspan="9">Course Objectives</td></tr>
<tr><td>CO 1</td><td colspan="8">Be aware of the use of numerical methods in modern scientific computing as well as various errors in numerical computation.</td></tr>
<tr><td>CO2</td><td colspan="8">Master using the bisection method, Newton's method, and the secant method in single variable root finding.</td></tr>
<tr><td>CO3</td><td colspan="8">Be familiar with numerical interpolation and approximation of functions</td></tr>
<tr><td>CO4</td><td colspan="8">Be familiar with numerical integration and differentiation</td></tr>
<tr><td>CO5</td><td colspan="8">Be familiar with numerical solution of ordinary differential equations</td></tr>
</table>

Unit No.	*Content*	*Hours*
Unit -1	**Introduction:** Numbers and their accuracy, Errors, Type of Error and their Computation, General error formula, Error in series approximations. **Solution of Algebraic and Transcendental Equation:** Bisection Method, Iteration method, Method of false position, Secant Method, Newton-Raphson method, Muller's method, Rate of convergence of Iterative methods	10
Unit -2	**Interpolation:** Finite Differences, Difference tables, Polynomial Interpolation: Newton's forward and backward formula, Central difference formulae: Gauss forward and backward formula. Interpolation with unequal intervals: Lagrange's interpolation, Newton divided difference formula.	10
Unit -3	**Numerical Differentiation and Integration:** Numerical differentiation of interpolation formulae, Numerical Integration: Trapezoidal rule, Simpson's 1/3 and 3/8 rule, Boole's Rule ,Weddle's rule, Euler –Maclarian formula.	8
Unit -4	**Numerical Solution of differential Equations:** Taylor's Method, Picard's Method, Euler's and modified Euler's method, Runge-Kutta Method, Milne's Predictor Corrector Method	8
	Total Hours	36

Text Books:

1. Numerical MethodsM.K. Jain, S.R.K. Iyenger and R.K. Jain
2. Schaum's Outline of Theory and Problems of Statistics: Murray R. Spiegel

References:

1. Applied Numerical Analysis: Curtis F. Gerald and Patrick O. Wheatley

ELECTRICAL ENGINEERING DEPARTMENT							
Course:- Bachelor of Technology (Electrical Engineering)							
Semester	Fifth	***Subject Title***		Electronic Devices		***Code***	TOE 503
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***
Open Elective - I		3			3	0	0
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE:EVALUATION***	***CWA***	***MSE***	***ESE***
		3	0		25	25	50

Course Objectives

CO 1	Understand the principles of semiconductor Physics
CO2	Understand the basics of Junction diodes
CO3	Understand and utilize the mathematical models of semiconductor junctions and BJT/MOS transistors for circuits and systems.
CO4	Analysis of the characteristics of BJT/MOS transistors for circuits and systems.
CO5	Understand the IC fabrication processes

Unit No.	***Content***	***Hours***
Unit -1	Introduction to Semiconductor Physics: Review of Quantum Mechanics, Electrons in periodic Lattices, E-k diagrams. Energy bands in intrinsic and extrinsic silicon; Carrier transport: diffusion current, drift current, mobility and resistivity; sheet resistance, design of resistors	9
Unit -2	Generation and recombination of carriers; Poisson and continuity equation P-N junction characteristics, I-V characteristics, and small signal switching models; Avalanche breakdown, Zener diode, Schottky diode	9
Unit -3	Bipolar Junction Transistor, I-V characteristics, Ebers-Moll Model, MOS capacitor, C-V characteristics, MOSFET, I-V characteristics, and small signal models of MOS transistor, LED, photodiode and solar cell;	9
Unit -4	Integrated circuit fabrication process: oxidation, diffusion, ion implantation, photolithography, etching, chemical vapor deposition, sputtering, twin-tub CMOS process.	9
	Total Hours	36

Text /Reference Books:

1. G. Streetman, and S. K. Banerjee, “Solid State Electronic Devices,” 7th edition, Pearson,2014.
2. D. Neamen , D. Biswas "Semiconductor Physics and Devices," McGraw-Hill Education
3. S. M. Sze and K. N. Kwok, “Physics of Semiconductor Devices,” 3rd edition, John Wiley &Sons, 2006.
4. C.T. Sah, “Fundamentals of solid state electronics,” World Scientific Publishing Co. Inc, 1991.
5. Y. Tsividis and M. Colin, “Operation and Modeling of the MOS Transistor,” Oxford Univ.Press,
2011.

ELECTRICAL ENGINEERING DEPARTMENT								
Course:- Bachelor of Technology (ELECTRICAL ENGINERING)								
Semester	Fifth	***Subject Title***		Data Structure Lab		***Code***	POE 501	
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***	
Open Elective Course		1			0	0	2	
Examination Duration (Hrs)		***Theory***	***Practical***	***Weightage: Evaluation***	***CWA***	***MSE***	***ESE***	
		0	3		25	25	50	

Course Objectives

CO1	This will boost the basic programming skills of the student in C and C++ programming.
CO2	Better understanding to the concept of the stacks and queue and their use with dynamic memory allocation.
CO3	Learning and understanding in a better way to sort the arrays and lists.
CO4	Implementation of various algorithms.

Experiment No.	***Name of the Experiment***
1	Write Program in C or C++ for Array implementation of Stack, Queue, Circular Queue, List.
2	Write Program in C or C++ for Implementation of Stack, Queue, Circular Queue, List using Dynamic memory Allocation.
3	Write Program in C or C++ for Implementation of Tree Structures, Binary Tree, Tree Traversal, Binary Search Tree, Insertion and Deletion in BST.
4	Write Program in C or C++ for Implementation of Searching and Sorting Algorithms.
5	Write Program in C or C++ for Graph Implementation, BFS, DFS, Min. cost spanning tree, shortest path algorithm.

ELECTRICAL ENGINEERING DEPARTMENT								
Course:- Bachelor of Technology (Electrical Engineering)								
Semester	Fifth	***Subject Title***		Industrial Engineering		***Code***	TOE 504	
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***	
Open Elective - I		3			3	0	0	
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE:EVALUATION***	***CWA***	***MSE***	***ESE***	
		3	0		25	25	50	

Course Objectives

CO 1	Productivity and Partial Productivity calculation for an organization.
CO2	Design a method for manufacturing for a new Process and Modify the existing Process,
CO3	Draw the flow process charts for a given process
CO4	Apply work measurement techniques for a given job
CO5	Identify and perform time study for simple applications.
CO6	Apply ergonomic concepts in work environment.

Unit No.	***Content***	***Hours***
Unit -1	**INTRODUCTION:** Definition and scope of Industrial engineering role of an industrial engineer in industry, functions of industrial engineering department and its organization, qualities of an industrial engineer.	6
Unit -2	**PRODUCTIVITY AND WORK STUDY:** Productivity concept and definition: Introduction, definitions of productivity, Productivity measurement at national, industrial and enterprise level, Benefits of higher productivity. Productivity in the individual enterprise: Introduction, Productivity measurement approaches at the enterprise level, Productivity of materials, Productivity of land, buildings, machines and manpower, Factors contributing to productivity improvement Techniques for productivity improvement: Introduction, Work content and ineffective time, Improving productivity for reducing work content, Improving productivity by reducing ineffective time, Management of productivity	8
Unit -3	**WORK STUDY:** Introduction, basic procedure, prerequisites of conducting a work study. The human factor in application of work study: Introduction, management and supervisor; their role in work study, the works study man. The influence of working conditions on work study: Introduction, factors affecting working conditions, occupational safety and health, fire prevention and protection, layout and housekeeping, lightning and climate conditioning, noise and vibrations, ergonomics, arrangement of working time, conclusion	8
Unit -4	**METHOD STUDY:** Introduction to method study and the selection of job: Introduction, definition and objective of method study, procedure of method study. Flow and handling of materials: Introduction, plant layout, developing the new layout, the handling of materials Tools for recording the movement of worker: Introduction, string diagram, flow process chart; man type, travel chart, multiple activity chart. Introduction, the principles of motion economy, classification of movements, further notes on workplace layout, notes on the design of jigs, tools and fixtures, machine controls and displays of dials, the two handed process chart, Simo chart.	6
Unit -5	**WORK MEASUREMENT:** Purpose of work measurement, the basic procedure, the techniques of work measurements, Work sampling: Introduction, basic concept and procedure,	8

	Time study: rating: Introduction, the quality worker, the average worker, standard rating and standard performance. Predetermined time standards (PTS): Introduction, definition, advantages of PTS system, Criticisms of PTS system, different forms of PTS system, use of PTS system, and application of PTS system.	
	Total Hours	36

Text /Reference Books:

- “Work study”, ILO, Second Edition, Oxford and IBH Publishing 2010
- “Industrial Engineering and management”, O.P. Khanna, Dhanpat Rai Publisher. 2010
- “Industrial Engineering and Production management”, Martand Telsang, S. Chand Publisher.

ELECTRICAL ENGINEERING DEPARTMENT									
Course:- Bachelor of Technology (Electrical Engineering)									
Semester	Sixth	**Subject Title**		Computer Networks			**Code**	TOE 601	
Course Components		**Credits**		**Contact Hours**		**L**	**T**	**P**	
Open Elective - II		3				3	0	0	
Examination Duration (Hrs)		**Theory**	**Practical**	**WEIGHTAGE:EVALUATION**		**CWA**	**MSE**	**ESE**	
		3	0			25	25	50	

Course Objectives	
CO 1	Understand the concepts of networking thoroughly.
CO2	Design a network for a particular application.
CO3	Analyze the performance of the network.
CO4	Understanding of transport layer
CO5	Understanding of Network layer

Unit No.	**Content**	**Hours**
Unit -1	Introduction to computer networks and the Internet: Application layer: Principles of network applications, The Web and Hyper Text Transfer Protocol, File transfer, Electronic ail, Domain name system, Peer-to-Peer file sharing, Socket programming, Layering concepts.	8
Unit -2	Switching in networks: Classification and requirements of switches, a generic switch, Circuit Switching, Time-division switching, Space-division switching, Crossbar switch and evaluation of blocking probability, 2-stage, 3-stage and n-stage networks, Packet switching, Blocking in packet switches, Three generations of packet switches, switch fabric, Buffering, Multicasting, Statistical Multiplexing.	10
Unit -3	Transport layer: Connectionless transport - User Datagram Protocol, Connection-oriented transport – Transmission Control Protocol, Remote Procedure Call. Congestion Control and Resource Allocation: Issues in Resource Allocation, Queuing Disciplines, TCP congestion Control, Congestion Avoidance Mechanisms and Quality of Service.	10
Unit -4	Network layer: Virtual circuit and Datagram networks, Router, Internet Protocol, Routing algorithms, Broadcast and Multicast routing Link layer: ALOHA, Multiple access protocols, IEEE 802 standards, Local Area Networks, addressing, Ethernet, Hubs, Switches.	8
	Total Hours	36

Text Reference books:

1. J.F. Kurose and K. W. Ross, “Computer Networking – A top down approach featuring the
2. Internet”, Pearson Education, 5th Edition
3. L. Peterson and B. Davie, “Computer Networks – A Systems Approach” Elsevier Morgan
4. Kaufmann Publisher, 5th Edition.
5. T. Viswanathan, “Telecommunication Switching System and Networks”, Prentice Hall
6. S. Keshav, “An Engineering Approach to Computer Networking” , Pearson Education
7. B. A. Forouzan, “Data Communications and Networking”, Tata McGraw Hill, 4th Edition
8. Andrew Tanenbaum, “Computer networks”, Prentice Hall
9. D. Comer, “Computer Networks and Internet/TCP-IP”, Prentice Hall
10. William Stallings, “Data and computer communications”, Prentice Hall

ELECTRICAL ENGINEERING DEPARTMENT							
Course:- Bachelor of Technology (Electrical Engineering)							
Semester	Sixth	***Subject Title***		Object Oriented programming and C++		***Code***	TOE 602
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***
Open Elective - II		3			3	0	0
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE:EVALUATION***	***CWA***	***MSE***	***ESE***
		3	0		25	25	50

Course Objectives

CO 1	Explain the benefits of object oriented design and understand when it is an appropriate methodology to use.
CO2	Apply good programming style and understand the impact of style on developing and maintaining programs.
CO3	Understand the different models of object oriented programming: abstract data types, encapsulation, inheritance and polymorphism
CO4	Analyze the Fundamental features of an object oriented language in context to object classes and interfaces, exceptions and libraries of object collections
CO5	Design object oriented solutions for small systems involving multiple objects.

Unit No.	*Content*	*Hours*
Unit -1	Object & classes, Links and Associations, Generalization and Inheritance, Aggregation, Abstract classes, Generalization, Multiple Inheritance, Meta data.	6
Unit -2	Events and States, Operations and Methods, Nested state diagrams, Concurrency, Relation of Object and Dynamic Models.	8
Unit -3	Functional Models, Data flow diagrams, Specifying Operations, Constraints, OMT Methodologies, examples and case studies to demonstrate methodology	8
Unit -4	Principles of object oriented programming, Tokens, Expressions, classes, Functions, Constructors, Destructors, Functions overloading, Operator Overloading, I/O Operations. Real life applications, Inheritance Extended Classes, Pointer. Virtual functions, Polymorphisms, Working with files, Class templates, Function templates, Exception handling, String manipulation. Translating object oriented design into implementations.	8
Unit -5	Introduction to Unix/Linux operating systems. Concept of file system, handling ordinary files, concept of shell, vi editor, Basicile attributes, concept of process, Basic system administration.	6
	Total Hours	36

Text Books:

1. Rambaugh James etal, "Object Oriented Design and Modeling",PHI-1997
2. Balagurusamy E," Object Oriented Programming with C++", TMH,2001 '
3. Sumitabha Das “Unix concepts & application” TMH

References:

1. Dillon and Lee, "Object Oriented Conceptual Modeling", New Delhi PHI-1993
2. Lipman, Stanley B, JonsceLajoie, *C++* Primer Reading", AWL, 1999
3. Stephen R. Shah, "Introduction to Object Oriented Analysis and Design", TMH
4. Berzin Joseph, "Data Abstraction: the object oriented approach using *C++",* McGraw Hill
5. Budd, Timothy, "An Introduction to Object Oriented Programming", Pearson 2000

ELECTRICAL ENGINEERING DEPARTMENT								
Course:- Bachelor of Technology (Electrical Engineering)								
Semester	Sixth	***Subject Title***		Industrial Automation			***Code***	TOE 603
Course Components		***Credits***		***Contact Hours***		***L***	***T***	***P***
Open Elective - II		3				3	0	0
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE:EVALUATION***		***CWA***	***MSE***	***ESE***
		3	0			25	25	50

Course Objectives

CO1	Describe working of various blocks of basic industrial automation system
CO2	Use various PLC functions and develop small PLC programs
CO3	Acquire the knowledge of Distributed control system and interfacing with PLCs
CO4	Acquire the knowledge of SCADA system and interfacing with PLCs
CO5	Consider such aspects of the automation system as network communication, human machine interface, safety and protection against interference.

Unit No.	*Content*	*Hours*
1	**Introduction:** Automation systems, Advantages of automation, Components of process control systems, Evolution of Control systems. Single loop control, Centralized control, Distributed control systems, Open systems, SCADA systems. Types of data available, Analog, Digital, Pulse data, Redundancy. Data communication components and protocols.	**10**
2	**Programmable Logic Controllers:** Introduction of Advanced PLC programming, Selection of processor, Input/output modules, Interfacing of Input/output devices, Operator Interface, study of SCADA software, Interfacing of PLC with SCADA software.	**8**
3	**Distributed Control Systems (DCS**): PLC Vs DCS systems, DCS architecture, Local control units, dedicated card controllers, Unit Operations controllers, DCS multiplexers, DCS system integration, Automation Standards, salient features.	**8**
4	**Supervisory Control and Data acquisition (SCADA) Systems**: Types of supervisory systems, Components of SCADA Systems. Remote terminal unit (RTU), Communication subsystem, Protocols, Logic subsystem, termination subsystem, test and power supply subsystem, Phasor measurement Units, Phasor Data concentrator and communication, Intelligent Electronic Devices.	**10**
	Total Hours	**36**

Text Books:

1. Bela G. Liptak, "Automation Handbook Vol I", CRC Press.
2. B.G. Liptak, 'Handbook of Instrumentation- Process Control' ,4th edition,2012
3. Gary Dunning, 'Introduction to Programmable logic Controllers' , Delmar Publisher, 2009
4. Webb & Reis, 'Programmable logic Controllers' , 5th edition , Prentice Hall of India ,2009

Reference Books:

1. Fundamentals of Supervisory systems, IEEE tutorial
2. Statistical Process Control –ISA Handbook

<table>
<tr><td colspan="9">ELECTRICAL ENGINEERING DEPARTMENT</td></tr>
<tr><td colspan="9">Course:- Bachelor of Technology (Electrical Engineering)</td></tr>
<tr><td>Semester</td><td>Sixth</td><td colspan="2">Subject Title</td><td colspan="3">Communication Engineering</td><td>Code</td><td>TOE 604</td></tr>
<tr><td colspan="2">Course Components</td><td colspan="2">Credits</td><td colspan="2" rowspan="2">Contact Hours</td><td>L</td><td>T</td><td>P</td></tr>
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<tr><td>3</td><td>0</td><td>25</td><td>25</td><td>50</td></tr>
<tr><td colspan="9">Course Objectives</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand the fundamentals concepts of elements of communication system and need of modulation</td></tr>
<tr><td>CO2</td><td colspan="8">Analysis of various analog modulation techniques</td></tr>
<tr><td>CO3</td><td colspan="8">Evaluate fundamental communication system parameters, such as bandwidth, power, signal to quantization noise ratio, and data rate.</td></tr>
<tr><td>CO4</td><td colspan="8">Convert analog signals to digital while satisfying certain specs.</td></tr>
<tr><td>CO5</td><td colspan="8">Analysis of various digital modulation techniques</td></tr>
</table>

Unit No.	*Content*	*Hours*
Unit -1	**Amplitude Modulation:** Amplitude modulation and detection, Generation and detection of DSB-SC, SSB and vestigial side band modulation, carrier acquisition AM transmitters and receivers, super heterodyne receiver, IF amplifiers, AGC circuits Frequency Division multiplexing	8
Unit -2	**Angle Modulation:** Basic definitions, Narrow band and wideband frequency modulation, transmission bandwidth of FM Signals, Generation and detection of frequency modulation, External noise, internal noise, noise calculations, signal to noise ratio, noise in AM and FM systems.	8
Unit -3	**Pulse Modulation & Waveform coding Techniques:** Introduction, sampling process, Analog Pulse Modulation Systems-Pulse Amplitude Modulation, Pulse width modulation and Pulse Position Modulation, Discretization in time and amplitude, Quantization process, quantization noise, Pulse code Modulation, Differential Pulse code Modulation, Delta Modulation and Adaptive Delta Modulation.	10
Unit -4	**Digital Modulation Techniques & Information Theory:** Types of digital modulation, waveforms for amplitude, frequency and phase shift keying, methods of generation and detection of ASK, FSK and PSK, comparison of above digital techniques, TDM & PCM, Measure of information, Entropy & Information rate.	10
	Total Hours	36

Text Books

1. R.P.Singh& S.D. Sapre, "Communication Systems Analog and Digital" Tata McGraw Hill.
2. Simon Haykin, "Communication Systems" John Wiley & Sons 4th Edition
3. G.Kennedy and B. Davis," Electronic Communication Systems" 4th Edition, Tata McGraw Hill
4. Simon Haykin, "Digital Communications" John Wiley & Sons

Reference Readings:

1. B.P. Lathi, "Modern Analog & Digital Communication Systems" Oxford University Press.
2. Taub& Schilling, "Communication System: Analog and Digital" Tata McGraw Hill.

<table>
<tr><td colspan="9">ELECTRICAL ENGINEERING DEPARTMENT</td></tr>
<tr><td colspan="9">Course:- Bachelor of Technology (Electrical Engineering)</td></tr>
<tr><td colspan="2">Semester</td><td>Seventh</td><td colspan="2">Subject Title</td><td colspan="2">Condition Monitoring and Diagnostics</td><td>Code</td><td>TOE 701</td></tr>
<tr><td colspan="3">Course Components</td><td colspan="2">Credits</td><td rowspan="2">Contact Hours</td><td>L</td><td>T</td><td>P</td></tr>
<tr><td colspan="3">Open Elective Course</td><td colspan="2">3</td><td>3</td><td>0</td><td>0</td></tr>
<tr><td colspan="3" rowspan="2">Examination Duration (Hrs)</td><td>Theory</td><td>Practical</td><td rowspan="2">WEIGHTAGE:EVALUATION</td><td>CWA</td><td>MSE</td><td>ESE</td></tr>
<tr><td>3</td><td>0</td><td>25</td><td>25</td><td>50</td></tr>
<tr><td colspan="9">Course Objectives</td></tr>
<tr><td>CO 1</td><td colspan="8">To impart knowledge about diagnostic</td></tr>
<tr><td>CO2</td><td colspan="8">Understand maintenance and various techniques for condition monitoring</td></tr>
<tr><td>CO3</td><td colspan="8">Assessment of the various health monitoring equipment</td></tr>
<tr><td>CO4</td><td colspan="8">Understand different condition monitoring equipment</td></tr>
<tr><td>CO5</td><td colspan="8">Assessment of the various characteristics of machine vibration and hydraulic system</td></tr>
<tr><td colspan="2">Unit No.</td><td colspan="6">Content</td><td>Hours</td></tr>
<tr><td colspan="2">Unit -1</td><td colspan="6">Productivity, quality circles in maintenance, Reliability, Reliability Assurance, Maintainability vs Reliability, Failure analysis, equipment downtime analysis, breakdown analysis.</td><td>8</td></tr>
<tr><td colspan="2">Unit -2</td><td colspan="6">Maintenance type, Breakdown Maintenance, Corrective Maintenance, Opportunity maintenance, Routine maintenance, Preventive and predictive maintenance, Condition based maintenance system, Design out maintenance</td><td>8</td></tr>
<tr><td colspan="2">Unit -3</td><td colspan="6">Equipment health monitoring, Signals, Online and Offline monitoring, Visual and temp. monitoring, Leakage monitoring, Lubricating monitoring.</td><td>6</td></tr>
<tr><td colspan="2">Unit -4</td><td colspan="6">Ferrography, Spectroscopy, Crack monitoring, Corrosion monitoring, thickness monitoring, noise monitoring, smell/odour monitoring, thermography.</td><td>6</td></tr>
<tr><td colspan="2">Unit -5</td><td colspan="6">Vibration characteristics, vibration monitoring causes, identification, measurement of machine vibration. C.M of lubes and hydraulic systems, C.M of pipelines, selection of C.M techniques, advantages.</td><td>8</td></tr>
<tr><td colspan="2"></td><td colspan="6">Total Hours</td><td>36</td></tr>
</table>

Text books:

1. Mechanical Fault Diagnosis and condition monitoring by R.A. Collacott, Chapman and Hall, London
2. Designing Knowledge – Based System by T R Addis, Prentice-Hall, New Jersey.

Reference :

1. ASM Handbook, Volume 11, Failure Analysis and Prevention, published in 2002
2. Handbook of Reliability, Availability, Maintainability and Safety in Engineering Design by Rudolph Frederick Stapelberg, Springer-Verlag London Limited, London
3. Maintenance Engineering Handbook, 7th Edition, by R. Keith Mobley (Editor in Chief), McGraw-Hill Companies, Inc.

ELECTRICAL ENGINEERING DEPARTMENT							
Course:- Bachelor of Technology (Electrical Engineering)							
Semester		***Subject Title***		IT in Business		***Code***	TOE 702
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***
Open Elective Course		03			03	00	00
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE: EVALUATION***	***CWA***	***MSE***	***ESE***
		03	00		25	25	50

Course Objectives

CO1	Understanding the concept of strategic management
CO2	Development of Strategic management thinking.
CO3	Understanding Electronic commerce and market system
CO4	Understanding of corporate IT strategy.
CO5	Knowledge of Impact of IT in competitive strategy.

Unit No.	***Content***	***Hours***
Unit -1	Business drivers IT's Competitive Potential, Strategic Alignment , Strategic Management and Competitive strategy	08
Unit -2	Rethinking Business through IT Development a Competitive Strategy, Inter organization information system business to business system, Electronic Commerce and Market System.	10
Unit -3	Forming a corporate IT strategy, Developing and Information Architecture	08
Unit -4	Incorporating business innovation into the corporate IT strategy, The changing role of IT in International business, The changing global IT Practices	10
	Total Hours	36

Text Book:

1. Cellion, Jack D. "Competitve Advantage Through Information Technology" Mc Graw Hill.

Reference Book:

2. Ttapscott Don, "The Digital Economy" Mc Graw Hill, 1996

<table>
<tr><td colspan="9" align="center">ELECTRICAL ENGINEERING DEPARTMENT</td></tr>
<tr><td colspan="9">Course:- Bachelor of Technology (Electrical Engineering)</td></tr>
<tr><td>Semester</td><td>Seventh</td><td colspan="2">Subject Title</td><td colspan="2">Bio-Medical Electronics</td><td>Code</td><td colspan="2">TOE 703</td></tr>
<tr><td colspan="2">Course Components</td><td colspan="2">Credits</td><td rowspan="2">Contact Hours</td><td>L</td><td>T</td><td colspan="2">P</td></tr>
<tr><td colspan="2">Open Elective Course</td><td colspan="2">03</td><td>03</td><td>00</td><td colspan="2">00</td></tr>
<tr><td colspan="2" rowspan="2">Examination Duration (Hrs)</td><td>Theory</td><td>Practical</td><td rowspan="2">WEIGHTAGE: EVALUATION</td><td>CWA</td><td>MSE</td><td colspan="2">ESE</td></tr>
<tr><td>03</td><td>00</td><td>25</td><td>25</td><td colspan="2">50</td></tr>
<tr><td colspan="9">Course Objectives</td></tr>
<tr><td>CO 1</td><td colspan="8">To familiarize students with various medical equipment and their technical aspects</td></tr>
<tr><td>CO2</td><td colspan="8">Understand the various types of transducers and electrodes used for biomedical applications,</td></tr>
<tr><td>CO3</td><td colspan="8">To introduce students to the measurements involved in some medical equipment (such as: ECG, EEG, EMG etc) and patient care monitoring</td></tr>
<tr><td>CO4</td><td colspan="8">Acquired knowledge about the measurement in respiratory system</td></tr>
<tr><td>CO5</td><td colspan="8">Have a firm understanding of the diagnostic techniques.</td></tr>
</table>

Unit No.	*Content*	*Hours*
Unit -1	**Introduction:** The age of biomedical engineering, development of biomedical instrumentation, man instrumentation system, components physiological system of the body, Problem encountered in measuring a living system.	8
Unit -2	**Transducers & electrodes:** The transducers & transduction principles active transducers, passive transducers, transducer for biomedical applications. **Sources of bioelectric potentials**: Resting & action potentials, propagation of active potential, The bioelectric potentials-ECG, EEG, EMG and evoked responses. **Electrodes**: Electrode theory, Bio potential Electrode-Microelectrodes Body surface Electrode, needle electrodes, biochemical transducers, Reference electrodes, **Cardiovascular Measurements:** Electrocardiography -ECG amplifiers, electrodes and leads, ECG recorders- three channel, vector cardiographs, continuous ECG recording (Holter recording), Blood pressure measurements, Blood flow measurement, Heart sound measurement.	12
Unit -3	**Measurements in Respiratory system:** Physiology of respiratory system measurement of breathing mechanics – Spiro meter, Respiratory therapy equipments: inhalators ventilators & Respirators, Humidifiers, Nebulizers & Aspirators.	08
Unit -4	**Diagnostic Techniques:** Ultrasonic diagnosis Eco- cardiography, Eco encephalography, ophthalmic scans, X-Ray & Radio-isotope Instrumentation, CAT scan, Emission Computerized Tomography, and MRI.	08
	Total Hours	36

Textbooks:

1. Khandpur R.S, "Biomedical Instrumentation", TMH
2. Cromwell, "Biomedical Instrumentation and Measurements", PHI.

Reference Book:

1. Tompkins, "Biomedical DSP: C language Examples and Laboratory Experiments for the IBM PC", PHI

ELECTRICAL ENGINEERING DEPARTMENT							
Course:- Bachelor of Technology (Electrical Engineering)							
Semester	Seventh	***Subject Title***		Fundamentals of IoT		***Code***	TOE 704
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***
Open Elective Course		03			03	00	00
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE:EVALUATION***	***CWA***	***MSE***	***ESE***
		03	00		25	25	50

Course Objectives	
CO 1	Explain the terms used in IoT.
CO2	Describe key technologies in Internet of Things.
CO3	Identify components needed to provide a solution for certain applications.
CO4	Analyze security requirements in an IoT system.
CO5	Design wireless sensor network architecture and its framework along with WSN applications.
CO6	Understand business models for the Internet of Things.

Unit No.	***Content***	***Hours***
Unit -1	**INTRODUCTION** Introduction to Internet of Things: History of IoT, About IoT, Overview and Motivations, Examples of Applications, Internet of Things Definitions and Frameworks: IoT Definitions, IoT Architecture, General Observations, ITU-T Views, Working Definition, IoT Frameworks, Basic Nodal Capabilities	6
Unit -2	**FUNDAMENTAL IoT MECHANISMS AND KEY TECHNOLOGIES** Identification of IoT Objects and Services, Structural Aspects of the IoT, Environment Characteristics, Traffic Characteristics, Scalability, Interoperability, Security and Privacy, Open Architecture, Key IoT Technologies, Device Intelligence, Communication Capabilities, Mobility Support, Device Power, Sensor Technology, RFID Technology, Satellite Technology.	6
Unit -3	**RADIO FREQUENCY IDENTIFICATION TECHNOLOGY** RFID: Introduction, Principle of RFID, Components of an RFID system, Issues EPCGlobal Architecture Framework: EPCIS & ONS, Design issues, Technological challenges, Security challenges, IP for IoT, Web of Things. Wireless Sensor Networks: History and context, WSN Architecture, the node, connecting nodes, Networking Nodes, Securing Communication WSN specific IoT applications, challenges: Security, QoS, Configuration, Various integration approaches, Data link layer protocols, routing protocols and infrastructure establishment.	8
Unit -4	**RESOURCE MANAGEMENT IN THE INTERNET OF THINGS** Clustering, Software Agents, Clustering Principles in an Internet of Things Architecture, Design Guidelines, and Software Agents for Object Representation, Data Synchronization. Identity portrayal, Identity management, various identity management models: Local, Network, Federated and global web identity, user-centric identity management, device centric identity management and hybrid-identity management, Identity and trust.	8
Unit -5	**INTERNET OF THINGS PRIVACY, SECURITY AND GOVERNANCE** Vulnerabilities of IoT, Security requirements, Threat analysis, Use cases and misuse cases, IoT security tomography and layered attacker model, Identity establishment, Access control, Message integrity, Non-repudiation and availability, Security model for IoT. Internet of Things Application: Smart Metering Advanced Metering Infrastructure, e-Health Body Area Networks, City Automation, Automotive Applications, Home Automation, Smart Cards.	8
	Total Hours	36

Text Books

1. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications
2. Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things", ISBN 978-3- 642-19156-5 e-ISBN 978-3-642-19157-2, Springer
3. Parikshit N. Mahalle& Poonam N. Railkar, "Identity Management for Internet of Things", River Publishers, ISBN: 978-87-93102-90-3 (Hard Copy), 978-87-93102-91-0 (ebook).

Reference Books

1. HakimaChaouchi, "The Internet of Things Connecting Objects to the Web" ISBN : 978-1- 84821-140-7, Willy Publications
2. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key Applications and Protocols, ISBN: 978-1-119-99435-0, 2 nd Edition, Willy Publications

ELECTRICAL ENGINEERING DEPARTMENT							
Course:- Bachelor of Technology (Electrical Engineering)							
Semester	Eight	***Subject Title***		Quality Control		***Code***	TOE 705
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***
Open Elective Course		03			03	00	00
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE: EVALUATION***	***CWA***	***MSE***	***ESE***
		03	00		25	25	50

Course Objectives

CO 1	Understand the basic concepts of Quality Control (QC).
CO2	Describe, distinguish and use the several techniques and quality management tools.
CO3	Explain and distinguish the normalisation, homologation and certification activities.
CO4	Identify the elements that are part of the quality measuring process in the industry.
CO5	Predict the errors in the measuring process, distinguishing its nature and the root causes.
CO6	Understand and calculate the correction and uncertainty parameters as a result of an instrument calibration.

Unit No.	***Content***	***Hours***
Unit -1	Concepts of quality: Quality - Quality control - Quality assurance - Quality management- Quality costs Total Quality Management: Axioms - Management commitment- Deming's approach - Quality council - Customer satisfaction and retention - Employee involvement and empowerment-Suggestion system - Quality circle -Continuous process improvement - Juran's trilogy - PDSA cycle - Kaizen - Six-sigma -Crosby's quality treatment	8
Unit -2	Management tools and techniques: Benchmarking - ISO quality management systems -Quality function deployment - Quality by design -	6
Unit -3	Failure mode and effect analysis -Affinity diagram - Block diagram - Pareto chart - Fish bone diagram - Flow chart - Run chart - Scatter diagram - Tree diagram - Matrix Diagram.	7
Unit -4	Statistical tools 1-control charts: Basic concepts - Attributes and variables - Random and assignable causes of variations- Patterns of variation - Measures of central tendency and dispersion - Probability distributions: Binomial, Poisson and Normal Control charts for variables : $\bar{X}$, R and sigma charts - Details of construction and uses Control charts for attributes: p, np, c and u charts - Details of construction and uses (Numerical problems included).	8
Unit -5	Statistical tools 2- Acceptance sampling, Reliability and Life testing: Sampling Vs inspection - OC curve - Single and double sampling plans - ATI - AOQL - Life testing -Bathtub curve - MTBF - OC curve for Life testing - System reliability (Numerical problems included).	7
	Total Hours	36

Text/ Reference Books:

- Bester Field, Dale H, Carol Boeterfreld - Muchna, Glen H, Boeterfreld MeryBoeterfeld-Scare, 2003, Total Quality Management,3rd edition, Pearson, Education, New Delhi.
- Grant.E.L., Stastical Quality Control, McGraw Hill
- Juran J.M, Gryna I.M., Quality Planning and Analysis, Tata McGraw Hill Publishing Company
- Gerals M Smith- 2004, Statistical Process Control and Quality Improvement- 5th edition

<table>
<tr><th colspan="8">ELECTRICAL ENGINEERING DEPARTMENT</th></tr>
<tr><td colspan="8">Course:- Bachelor of Technology (Electrical Engineering)</td></tr>
<tr><td>Semester</td><td>Eight</td><td colspan="2">Subject Title</td><td colspan="2">Optical Fiber Communication</td><td>Code</td><td>TOE 706</td></tr>
<tr><td colspan="2">Course Components</td><td colspan="2">Credits</td><td rowspan="2">Contact Hours</td><td>L</td><td>T</td><td>P</td></tr>
<tr><td colspan="2">Open Elective Course</td><td colspan="2">03</td><td>03</td><td>00</td><td>00</td></tr>
<tr><td colspan="2" rowspan="2">Examination Duration (Hrs)</td><td>Theory</td><td>Practical</td><td rowspan="2">WEIGHTAGE: EVALUATION</td><td>CWA</td><td>MSE</td><td>ESE</td></tr>
<tr><td>03</td><td>00</td><td>25</td><td>25</td><td>50</td></tr>
</table>

Course Objectives	
CO 1	Understanding Block diagram and different types of optical waveguides and merits of OFC, types and propagation mechanism.
CO2	Analysis of attenuation, losses and polarization for different types of optical fiber
CO3	Analysing different optical transmitter sources.
CO4	Understanding genesis of optical detectors with noise considerations.
CO5	Analysis of optical fiber link by integrating optical transmitter and receiver circuits with application in multiplexing and optical networking.
CO6	Successful completion of this course enables students to apply concepts of optical communication to build optical networks.

Unit	***Content***	***Hours***
Unit -1	**Introduction:** Block diagram of optical fiber communication system, Advantages of optical fiber communication, Optical fiber waveguides: Structure of optical wave guide, Step Index fiber, Graded Index Fiber, Single mode, Multimode, light propagation in optical fiber using ray theory, acceptance angle, numerical aperture, skew rays, wave theory for optical propagation, modes in a planar and cylindrical guide, mode volume, single mode fibers, cutoff wavelength, mode field diameter, effective refractive index and group and mode delay factor for single mode fiber.	8
Unit -2	**Attenuation in optical fibers:** Intrinsic and extrinsic absorption, linear and nonlinear scattering losses, fiber bend losses. Dispersion and pulse broadening, intramodal and intermodal dispersion for step and graded index fibers, modal noise, over all fiber dispersion for multimode and monomode fiber, modal birefringence and polarization maintaining fibers.	8
Unit -3	**Optical Sources:** LED structures and Characteristics, LASER, Nd: YAG LASER, He Ne Laser, CO2 Laser, Distributed Feedback Laser.	8
Unit -4	**Optical detectors:** Requirement for photo detections p-n photodiode, characteristics of photo detections, p-i-n and avalanche photodiodes, phototransistors & photoconductors. Direct detection receivers. Performance considerations: Noise sources in optical fiber communication, noise in p-n, p-i-n and APD receivers.	6
Unit -5	**Receiver structure Optical fiber communication systems:** Principal components of an optical fiber communication system, optical transmitter circuits, LED and laser drive circuits, optical receiver block diagram, simple circuits for pre-amplifier, automatic gain control and equalization, optical system design, Multiplexing, Coherent and noncoherent detection, WDM, OTDM, Introduction to Optical Network.	6
	Total Hours	36

Text Books

1. Optical fiber Communication: John M.S Senior PHI, 3rd Ed. 2009

Reference Books

1. Optical Communication: J. Gowar PHI, 2nd Ed 2002
2. Optical fiber Communication: G.E. Keiser Mc Graw-Hill, 4rd Ed. 2010
3. Optoelectronics: Wilson & Hawkes PHI, 3rd Ed.

<table>
<tr><td colspan="9">ELECTRICAL ENGINEERING DEPARTMENT</td></tr>
<tr><td colspan="9">Course:- Bachelor of Technology (Electrical Engineering)</td></tr>
<tr><td>Semester</td><td>Eight</td><td colspan="2">Subject Title</td><td colspan="2">Artificial Intelligence</td><td>Code</td><td colspan="2">TOE 707</td></tr>
<tr><td colspan="2">Course Components</td><td colspan="2">Credits</td><td rowspan="2">Contact Hours</td><td>L</td><td>T</td><td colspan="2">P</td></tr>
<tr><td colspan="2">Open Elective Course</td><td colspan="2">03</td><td>03</td><td>00</td><td colspan="2">00</td></tr>
<tr><td colspan="2" rowspan="2">Examination Duration (Hrs)</td><td>Theory</td><td>Practical</td><td rowspan="2">WEIGHTAGE: EVALUATION</td><td>CWA</td><td>MSE</td><td colspan="2">ESE</td></tr>
<tr><td>03</td><td>00</td><td>25</td><td>25</td><td colspan="2">50</td></tr>
<tr><td colspan="9">Course Objectives</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand the basics of the theory and practice of Artificial Intelligence.</td></tr>
<tr><td>CO2</td><td colspan="8">Learn the basics of Artificial Intelligence programming.</td></tr>
<tr><td>CO3</td><td colspan="8">Understand various searching techniques use to solve the AI problems.</td></tr>
<tr><td>CO4</td><td colspan="8">Apply knowledge representation techniques and problem-solving strategies to common AI applications.</td></tr>
<tr><td>CO5</td><td colspan="8">Build self-learning and research skills to tackle a topic of interest on his/her own or as part of a team.</td></tr>
<tr><td>CO6</td><td colspan="8">Apply the knowledge of AI and agents in developing multidisciplinary real world projects</td></tr>
<tr><td>Unit</td><td colspan="7">Content</td><td>Hours</td></tr>
<tr><td>Unit -1</td><td colspan="7">Introduction Introduction to Artificial Intelligence, Simulation of sophisticated & Intelligent Behavior indifferent area, problem solving in games, natural language, automated reasoning visual perception, heuristic algorithm versus solution guaranteed algorithms</td><td>6</td></tr>
<tr><td>Unit -2</td><td colspan="7">Understanding Natural Languages Parsing techniques, context free and transformational grammars, transition nets, augmented transition nets, Fillmore's grammars, Shanks Conceptual Dependency, grammar free
analyzers, sentence generation, and translation.</td><td>8</td></tr>
<tr><td>Unit -3</td><td colspan="7">Knowledge Representation
First order predicate calculus, Horn Clauses, Introduction to PROLOG, Semantic Nets Partitioned Nets, Minskey frames, Case Grammar Theory, Production Rules Knowledgebase, The Inference System, Forward & Backward Deduction</td><td>8</td></tr>
<tr><td>Unit -4</td><td colspan="7">Expert System
Existing Systems (DENDRAL, MYCIN), domain exploration, Meta Knowledge, Expertise Transfer, Self-Explaining System</td><td>6</td></tr>
<tr><td>Unit -5</td><td colspan="7">Pattern Recognition
Introduction to pattern Recognition, Structured Description, Symbolic Description, Machine perception, Line Finding, Interception, Semantic, & Model, Object Identification, Speech Recognition.
Programming Language: Introduction to programming Language, LISP, PROLOG</td><td>8</td></tr>
<tr><td></td><td colspan="7">Total Hours</td><td>36</td></tr>
</table>

Text/ Reference Books:

1. Charnick "Introduction to Artificial Intelligence." Addision Wesley.
2. Rich & Knight, "Artificial Intelligence".TMH
3. Winston, "LISP", Addison Wesley.
4. Marcellous, "Expert Systems Programming", PHI.

<table>
<tr><td colspan="9">ELECTRICAL ENGINEERING DEPARTMENT</td></tr>
<tr><td colspan="9">Course:- Bachelor of Technology (Electrical Engineering)</td></tr>
<tr><td colspan="2">Semester</td><td>Eight</td><td colspan="2">Subject Title</td><td colspan="2">Mechatronics</td><td>Code</td><td>TOE 708</td></tr>
<tr><td colspan="3">Course Components</td><td colspan="2">Credits</td><td rowspan="2">Contact Hours</td><td>L</td><td>T</td><td>P</td></tr>
<tr><td colspan="3">Open Elective Course</td><td colspan="2">03</td><td>03</td><td>00</td><td>00</td></tr>
<tr><td colspan="3" rowspan="2">Examination Duration (Hrs)</td><td>Theory</td><td>Practical</td><td rowspan="2">WEIGHTAGE: EVALUATION</td><td>CWA</td><td>MSE</td><td>ESE</td></tr>
<tr><td>03</td><td>00</td><td>25</td><td>25</td><td>50</td></tr>
<tr><td colspan="9">Course Objectives</td></tr>
<tr><td>CO 1</td><td colspan="8">Construct the block diagram of any physical mechatronics device used in day-to- day life.</td></tr>
<tr><td>CO2</td><td colspan="8">Calculate the output to input relation of any physical model in the form of a transfer function.</td></tr>
<tr><td>CO3</td><td colspan="8">Evaluate the performance of any physical system in terms of its performance parameters.</td></tr>
<tr><td>CO4</td><td colspan="8">Develop the mathematical model of any physical model from any engineering domain.</td></tr>
<tr><td>CO5</td><td colspan="8">Understand several types of sensors and actuators used in mechatronic systems.</td></tr>
<tr><td>Unit No.</td><td colspan="7">Content</td><td>Hours</td></tr>
<tr><td>Unit -1</td><td colspan="7">Introduction: Definition of mechatronics, Evolution of mechatronics, Integration of mechanical, electronics, control and computer science engineering, Elements of mechatronics system, Importance of Mechatronics, Open-loop and closed-loop system.</td><td>6</td></tr>
<tr><td>Unit -2</td><td colspan="7">Physical and Mathematical Modelling of Dynamic Systems: Equations of motion of mechanical, electrical, pneumatic and hydraulic systems, Transforming physical model to mathematical model, Linearization, Frequency response. Modelling of different motors and generators.</td><td>8</td></tr>
<tr><td>Unit -3</td><td colspan="7">Control Systems: Laplace transformations, Block diagram reduction, Signal flow graph, Performance specifications, Transfer functions, Stability, Sensitivity of the open-loop and closed-loop systems, Types of controller, Controller design using frequency domain and Laplace domain methods.</td><td>8</td></tr>
<tr><td>Unit -4</td><td colspan="7">Sensors: Displacement, Position and Proximity sensors, Flow sensors, Pressure and force sensors, Motion sensors, Optical, Mechanical and Thermal sensors, selection of sensors
Actuators in Mechatronics System: Electric actuators, Stepper motors, DC motors, and AC motors.</td><td>8</td></tr>
<tr><td>Unit -5</td><td colspan="7">Electronic Elements in Mechatronic System: Analog to digital and digital to analog converters, Operational amplifiers, Introduction to Microcontrollers and Microprocessors.</td><td>6</td></tr>
<tr><td></td><td colspan="7">Total Hours</td><td>36</td></tr>
</table>

Text Books/ References:

Alciatore, D. G., Histand, M. B., & Alciatore, D. G. Introduction to mechatronics and measurement systems. Tata McGraw-Hill Education.

Bolton, W., Mechatronics: A Multidisciplinary Approach, Pearson Education, New Delhi.

Bishop, R. H. (Ed.). Mechatronics: an introduction. CRC Press.

Nagrath, I. J. and Gopal, M., Control System Engineering, New AgeInternational.

ELECTRICAL ENGINEERING DEPARTMENT							
Course:- Bachelor of Technology (Electrical Engineering)							
Semester	Eight	***Subject Title***		Expert System & Fuzzy Logic		***Code***	TOE 801
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***
Open Elective Course		04			03	00	00
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE: EVALUATION***	***CWA***	***MSE***	***ESE***
		03	00		25	25	50

Course Objectives	
CO 1	Understand expert systems and their tools with methodology for building expert system.
CO2	Understand fuzzy logic basics and operations, Fuzzy arithmetic and representations and classical logic.
CO3	To equip students with the knowledge and skills in logic programming
CO4	To understand the working of controller based on classical as well as fuzzy logic
CO5	To understand contingency analysis, and applications like control of inverted pendulum and aircraft control

Unit No.	***Content***	***Hours***
Unit -1	**Expert Systems – Introduction & Tools:** Introduction, Characteristics, Acquiring, representing knowledge reasoning. Nature of ES tools, stages in development of ES tools. EMYCIN, EXPERT, OPSS, ROSIE, Block board architecture, Rule based Systems, Associative nets and symbolic computing.	06
Unit -2	**Building an Expert System:** Building an Expert System, Difficulties in development of ES, Common pitfalls, pitfalls during development, Expert systems in market place, commercial implications.	08
Unit -3	**Introduction of Fuzzy Sets and Relations:** Crisp set-vagueness, uncertainty and imprecision, fuzzy set-fuzzy operators, properties, crisp versus fuzzy sets, representation of fuzzy sets, fuzzy complements, union, intersection, combination of operators, crisp and fuzzy relations, compositions of fuzzy relations.	10
Unit -4	**Fuzzy Logic and Controllers:** Fuzzy logic-classical logic-fuzzy propositions and quantifiers, linguistic hedges, fuzzification and its types de-fuzzification methods, data base, rule base, inference engine structure of FLC. **Applications of Expert Systems and Fuzzy Logic:** Applications of expert systems and fuzzy logic in ac and dc drives. VAR control, contingency analysis, control system-inverted pendulum and aircraft control application.	12
	Total Hours	36

Text Books:

1. Timothy J. Ross, Fuzzy Logic with Engineering Applications, International edition, McGraw Hill, 2000.
2. Donald A. Waterman, A guide to Expert System, Addison Wiley, 1999.

References:

1. Dan W. Patterson, Introduction to AI and expert systems, Pearson education.
2. John yen and rezalansari, Fuzzy logic. Fuzzy logic intelligence, control and information-Pearson’s education.

Course:- Bachelor of Technology (Electrical Engineering)							
Semester	Eight	***Subject Title***		Intelligent Sensors and Instrumentation		***Code***	TOE 802
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***
Open Elective Course		03			03	00	00
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE: EVALUATION***	***CWA***	***MSE***	***ESE***
		03	00		25	25	50

Course Objectives	
CO 1	Acquire basic knowledge about sensors and actuators.
CO2	Understand the fundamental principles of various types of sensors and their general characteristics, terminologies, sensing and transduction principles
CO3	Acquire knowledge about the fabrication techniques of sensors
CO4	Understand the techniques used to interface computers with various sensors
CO5	design intelligent sensors as per IEEE standard

Unit No.	***Content***	***Hours***
Unit -1	Basic concept, semiconductor sensors, MEM sensors, actuators	06
Unit -2	Network sensor, smart sensor & sensor networking, neuro sensors, Bio-sensors.	06
Unit -3	Sensor material, fabrication of sensors: thin /relatively thick film depositon techniques, wet / dry etching techniques, high aspect ratio techniques of fabrication of sensor.	08
Unit -4	Intelligent instrumentation system, soft computing techniques, coding techniques of binary signals.	08
Unit -5	IEEE 1451 Standards, STIM, TEDS Calibration, NAC Network technologies.	08
	Total Hours	36

References:

1. Science and engineering of microelectronics fabrication by Stephen A, Campbell,
2. Intelligent instrumentation by Bhuyan
3. Modern inertial sensors and system by Amitava Bose, Somnath Puri, Paritosh Banerjee.

ELECTRICAL ENGINEERING DEPARTMENT								
Course:- Bachelor of Technology (Electrical Engineering)								
Semester	**Eighth**	***Subject Title***		Engineering Economics			***Code***	TOE 803
Course Components		***Credits***		***Contact Hours***	***L***		***T***	***P***
Open Elective Course		03			03		00	00
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE: EVALUATION***	***CWA***		***MSE***	***ESE***
		03	00		25		25	50

Course Objectives	
CO 1	**Apply** knowledge of mathematics, economics, and engineering principles to solve engineering problems
CO2	**Understand** the major capabilities and limitations of cash flow analysis for evaluating proposed capital investments.
CO3	**Recognize**, **formulate**, **analyze** and **solve** cash flow models in practical situations.
CO4	**Develop** the ability to account for time value of money using engineering economy factors and formulas
CO5	**Communicate** the results of the modeling process to management and other non-specialist users in a lucid, informative manner (graphs, tables and/or text).

Unit No.	***Content***	***Hours***
Unit -1	**Introduction to Economics:** Definitions, Nature, Scope, Difference between Microeconomics & Macroeconomics	**06**
Unit -2	**Theory of Demand & Supply:** meaning, determinants, law of demand, law of **s**upply, equilibrium between demand & supply. **Elasticity:** elasticity of demand, price elasticity, income elasticity, cross elasticity, **Theory of production:** production function, meaning, factors of production, (meaning & characteristics of Land, Labour, capital & entrepreneur).	**10**
Unit -3	**Law of variable proportions & law of returns to scale Cost:** meaning, short run & long run cost, fixed cost, variable cost, total cost, average cost, marginal cost, opportunity cost. **Break even analysis:** meaning, explanation **Markets:** meaning, types of markets & their characteristics (Perfect Competition, Monopoly, Monopolistic Completion, Oligopoly)	**10**
Unit -4	**National Income:** meaning, stock and flow concept, NI at current price, NI at constant price, GNP, GDP, NNP,NDP, Personal income, disposal income. **Basic economic problems** Poverty-meaning, absolute & relative poverty, causes, measures to reduce Unemployment: meaning, types, causes, remedies **Inflation:** meaning, types, causes, measures to control	**10**
	Total Hours	**36**

Text Books/ References

1. Engineering Economics, R.Paneerselvam, PHI publication
2. Principles and Practices of Management by L.M.Prasad.
3. Fundamentals of Management: Essential Concepts and Applications, Pearson Education, Robbins S.P. and Decenzo David A.
4. Economics: Principles of Economics, N Gregory Mankiw, Cengage Learning
5. Principles of Management by Tripathy and Reddy
6. Modern Economic Theory, By Dr. K. K. Dewett& M. H. Navalur, S. Chand Publications

ELECTRICAL ENGINEERING DEPARTMENT							
Course:- Bachelor of Technology (Electrical Engineering)							
Semester	Eight	***Subject Title***		Advanced Welding Technology		***Code***	TOE 804
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***
Open Elective Course		03			03	00	00
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE: EVALUATION***	***CWA***	***MSE***	***ESE***
		03	00		25	25	50

Course Objectives

CO 1	Course Outcome 1: Understand the welding, its process classification and other limitations of the process.
CO2	Course Outcome 2: Understand and review brief technologies aspect of conventional welding techniques.
CO3	Course Outcome 3: Understand and analyze different advance welding techniques and their applications.
CO4	Course Outcome 4: Analyze and understand welding design and metallurgical aspects.
CO5	Course Outcome 5: Understand principle and application of arc fusion welding.
CO6	Course Outcome 6: Describe different testing and inspection methods of welding joints and their applications.

Unit No.	Content	***Hours***
Unit -1	**Introduction:** Definition, Classification, Application, Advantages & limitations of welding, Selection guidelines for relevant welding process, Comparison of welding with other joining methods Brief technological review of conventional welding techniques: Oxy-acetylene gas welding, Introduction to welding torch & filler rod, Principle of arc welding, Inert Gas Welding (MIG and TIG),Submerged arc welding (SAW), Atomic hydrogen arc welding, Various types of Resistance Welding, Soldering, Brazing techniques and their applications, Types of welding electrodes, Classification and coding of mild steel and low alloy steel electrodes, American system and Indian system, types of fluxes used for fusion welding, soldering and brazing.	8
Unit -2	**Advanced welding Techniques I**:Principle, techniques, problems (limitations), working and applications of advanced welding techniques such as Plasma Arc Welding (Key-hole and non-keyhole techniques), Electro-slag welding, Laser beam welding, Electron beam welding, Ultrasonic welding, Friction stir welding, Explosive welding, Underwater welding, Welding of Plastics and Dissimilar metals , Need and Technology of Cladding, Hard-facing , Surfacing, Oxy-acetylene gas cutting, Electric arc cutting	8
Unit -3	**Welding Design and Metallurgical Factors:** Heat input, net heat utilized in melting, heat flow, relative plate thickness factor, transverse shrinkage, longitudinal shrinkage, Angular distortion, control of distortion, Weldability, Effects of alloying elements on Weldability, Weldability tests such as Hot-cracking test, the Murex test, Cold-cracking or Hydrogen-induced cracking test, Effect of carbon content on structure and properties of steel, Carbon-equivalent and its relation with cooling rate, Carbon-equivalent based statistical evaluation of hot-cracking tendency.	8
Unit -4	**Principle of Arc fusion welding:** Electrons thermionic emission, thermionic work function and ionization potential, Cathode spot, cathode space, arc column, anode space and anode spot, Various Modes of Metal Transfer in arc welding, Welding defects, detection, Various causes & remedy, Heat-affected-zone (HAZ) and its effects on weld properties, Hydrogen embrittlement, Phenomenon of Arc blow, its effects in welding and its control.	7

Unit -5	**Inspection Methods -** Testing and inspection of welding joints, Methods used for Inspection of welding, Hardness test, Visual, Magnetic particle, Fluorescent particle, Ultrasonic, Radiography, methods of Inspection. Basic welding symbols and location of weld, Measurement of heat input in arc welding, Heat flow.	5
	Total Hours	36

Reference Books:

- O.P. Khanna, A Text Book of Welding Technology, Dhanpat Rai Publications , New Delhi
- Dr. Parmar R.S. ,Welding Engineering and technology; Khanna Publisher.
- P. N. Rao, Manufacturing Technology (Foundary, Forming and Welding), Tata McGraw-Hill Publications, New Delhi.
- Amithab Ghosh, Manufacturing Science, Tata McGraw-Hill Publications, New Delhi.

ELECTRICAL ENGINEERING DEPARTMENT								
Course:- Bachelor of Technology (Electrical Engineering)								
Semester	Eight	***Subject Title***		Robotics		***Code***	TOE 805	
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***	
Open Elective Course		3			3	0	0	
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE:EVALUATION***	***CWA***	***MSE***	***ESE***	
		3	0		25	25	50	

Course Objectives

CO 1	Understand different aspects in the field of robotics and its interdisciplinary approach.
CO2	Develop the direct and inverse kinematic models of different robotic configurations.
CO3	Analyze differential motion and singularities in robotic manipulators.
CO4	Develop dynamic model of robotic manipulators.
CO5	Develop trajectory planning and control schemes for robotic manipulators.

Unit No.	Content	***Hours***
Unit -1	**INTRODUCTION:** Definition, classification of robots, historical evolution, characteristics of robots, industrial robot anatomy, manipulators, actuators, sensors, end-effectors, robot configurations.	6
Unit -2	**MANIPULATOR KINEMATICS:** Coordinate frames, mapping and transformation, Denavit—Hartenberg notation, direct kinematic modeling, inverse kinematics.	8
Unit -3	**MANIPULATORDIFFERENTIAL MOTION:** Differential translation and rotation, Derivatives of homogeneous transformations, manipulator Jacobian, inverse Jacobian, singularities, static force and moment analysis.	8
Unit -4	**MANIPULATOR DYNAMICS:** Acceleration of a rigid body, mass distribution, Newton's and Euler's equations, iterative Newton-Euler formulation, Lagrange-Euler formulation of manipulator dynamics.	7
Unit -5	**TRAJECTORY PLANNING AND CONTROL OF MANIPULATORS:** Introduction to trajectory planning techniques, joint-space scheme, introduction to control schemes, control law partitioning, force and torque control.	7
	Total Hours	36

Text/ Reference Books

1. Craig, J. J. (2005). Introduction to robotics: mechanics and control. Pearson Prentice Hall
2. Niku, S. B. (2001). Introduction to robotics: analysis, systems, applications. Prentice Hall.
3. Mittal, R. K., & Nagrath, I. J. (2003). Robotics and control. New Delhi: Tata McGraw-Hill.

<table>
<tr><td colspan="9">ELECTRICAL ENGINEERING DEPARTMENT</td></tr>
<tr><td colspan="9">Course:- Bachelor of Technology (Electrical Engineering)</td></tr>
<tr><td>Semester</td><td>Eight</td><td colspan="2">Subject Title</td><td colspan="3">Mobile Computing</td><td>Code</td><td>TOE 806</td></tr>
<tr><td colspan="2">Course Components</td><td colspan="2">Credits</td><td colspan="2" rowspan="2">Contact Hours</td><td>L</td><td>T</td><td>P</td></tr>
<tr><td colspan="2">Open Elective Course</td><td colspan="2">3</td><td>3</td><td>0</td><td>0</td></tr>
<tr><td colspan="2" rowspan="2">Examination Duration (Hrs)</td><td>Theory</td><td>Practical</td><td colspan="2" rowspan="2">WEIGHTAGE:EVALUATION</td><td>CWA</td><td>MSE</td><td>ESE</td></tr>
<tr><td>3</td><td>0</td><td>25</td><td>25</td><td>50</td></tr>
<tr><td colspan="9">Course Objectives</td></tr>
<tr><td>CO 1</td><td colspan="8">Exemplify the concepts, techniques, protocols and architecture employed in wireless local area networks, cellular networks, and Adhoc Networks based on the standards</td></tr>
<tr><td>CO2</td><td colspan="8">Describe and analyze the network infrastructure requirements to support mobile devices and users.</td></tr>
<tr><td>CO3</td><td colspan="8">Design and implement mobile applications to realize location-aware computing</td></tr>
<tr><td>CO4</td><td colspan="8">Asses the important issues and concerns on security and Data management</td></tr>
<tr><td>CO5</td><td colspan="8">Development of various scenarios for mobile computing system.</td></tr>
<tr><td>CO6</td><td colspan="8">Evaluate the concepts of mobile agents and mobile Adhoc algorithms with the help of NS2.</td></tr>
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Unit No.	Content	***Hours***
Unit -1	Introduction, issues in mobile computing, overview of wireless telephony: cellular concept, GSM: air-interface, channel structure, location management: HLR-VLR, hierarchical, handoffs, channel allocation in cellular systems, CDMA, GPRS	6
Unit -2	Wireless Networking, Wireless LAN Overview: MAC issues, IEEE 802.11, Blue Tooth, Wireless multiple access protocols, TCP over wireless, Wireless applications, data broadcasting, Mobile IP, WAP: Architecture, protocol stack, application environment, applications	8
Unit -3	Data management issues, data replication for mobile computers, adaptive clustering for mobile wireless networks, File system, Disconnected operations	8
Unit -4	Mobile Agents computing, security and fault tolerance, transaction processing in mobile computing environment.	6
Unit -5	Ad Hoc networks, localization, MAC issues, Routing protocols, global state routing (GSR), Destination sequenced distance vector routing (DSDV), Dynamic source routing (DSR), Ad Hoc on demand distance vector routing (AODV), Temporary ordered routing algorithm (TORA), QoS in Ad Hoc Networks, applications	8
	Total Hours	36

Text/ Reference Books:

1. J. Schiller," Mobile Communications", Addison Wesley.
2. A. Mehrotra , "GSM System Engineering".
3. M. V. D. Heijden, M. Taylor, "Understanding WAP", Artech House