

1st Year 1st Semester

Sl. No.	Category	Course Code	Course Name	Contact Hours/Week				Credit Points
				L	T	P	Total	
A. THEORY								
1	CC-1	DEMA101	Mathematics-I	2	1	0	3	3
2	CC-2	DPHYC101	Applied Physics-I	2	1	0	3	3
3	CC-3	DCHMC101	Applied Chemistry-I	2	1	0	3	3
4	AECC-1	HU101	Communication Skills in English	2	0	0	2	2
Total of Theory							11	11
B. PRACTICAL								
5	SEC-1	DCES181	Engineering Graphics	0	0	3	3	1.5
6	SEC-2	DMES181	Engineering Workshop Practice	0	0	3	3	1.5
7	CC-2	DPHYC191	Applied Physics-I Lab	0	0	2	2	1
8	CC-3	DCHMC191	Applied Chemistry Lab	0	0	2	2	1
9	SEC-3	DCSTS101	Sports and Yoga	0	0	2	2	1
10	AECC-1	HU191	Communication Skills in English Lab	0	0	2	2	1
Total of Practical							14	7

1st Year 2nd Semester

Sl. No.	Category	Course Code	Course Name	Contact Hours/Week				Credit Points
				L	T	P	Total	
A. THEORY								
1	CC-4	DEMA202	Mathematics-II	3	1	0	4	4
2	CC-5	DPHYC201	Applied Physics-II	2	1	0	3	3

3	CC-6	DCSTC20 1	Introduction to IT Systems	2	0	0	2	2
4	CC-7	DECEEC 201	Fundamentals of Electrical & Electronics Engineering	2	1	0	3	3
5	SEC-4	DMES20 1	Engineering Mechanics	2	1	0	3	3
6	CC-8	DEVSC20 1	Environmental Science	2	0	0	2	0
Total of Theory							17	15
B. PRACTICAL								
7	CC-5	DPHYC2 91	Applied Physics-II Lab	0	0	2	2	1
8	CC-6	DCSTC29 1	Introduction to IT Systems Lab	0	0	4	4	2
9	CC-7	DECEE2 91	Fundamentals of Electrical & Electronics Engineering Lab	0	0	2	2	1
10	SEC-4	DMES29 1	Engineering Mechanics Lab	0	0	2	2	1
Total of Practical							10	5

2nd Year 3rd Semester

Sl. No.	Category	Course Code	Course Name	Contact Hours/Week				Credit Points
				L	T	P	Total	
A. THEORY								
1	C1	DEEC301	Introduction to Electric Generation Systems	3	0	0	3	3
2	C1	DEEC391	Introduction to Electric Generation Systems Laboratory	0	0	2	2	1
3	C2	DEEC302	Electrical Circuits	2	1	0	3	3
4	C3	DEEC303	Electrical and Electronic Measurements	2	1	0	3	3
5	C4	DEEC304	Electric Motors and Transformers	2	1	0	3	3
6	C5	DEEC305	Renewable Energy Power Plants	3	0	0	3	3
Total of Theory							17	16
B. PRACTICAL								

7	C2	DEEC392	Electrical Circuits Laboratory	0	0	2	2	1
8	C3	DEEC393	Electrical and Electronic Measurements Laboratory	0	0	2	2	1
9	C4	DEEC394	Electric Motors and Transformers Laboratory	0	0	2	2	1
10	C5	DEEC395	Renewable Energy Power Plants Laboratory	0	0	2	2	1
11	S1	DEES381	Summer Internship - I	0	0	0	0	2
Total of Practical							8	6

2nd Year 4th Semester

Sl. No.	Category	Course Code	Course Name	Contact Hours/Week				Credit Points
				L	T	P	Total	
A. THEORY								
1	C6	DEEC401	Fundamentals of Power Electronics	3	0	0	3	3
2	C7	DEEC402	Electric Power Transmission and Distribution	3	0	0	3	3
3	C8	DEEC403	Induction, Synchronous and Special Electrical Machines	2	1	0	3	3
4	AEC3	DEEA481	Essence of Indian Knowledge and Tradition	2	0	0	2	0
5	DSE1	DEED401 (1-10)	Elective I	3	0	0	3	3
6	DSE2	DEED402 (1-10)	Elective II	3	0	0	3	3
Total of Theory							17	15
B. PRACTICAL								
7	C6	DEEC491	Fundamentals of Power Electronics Lab- oratory	0	0	2	2	1
8	C7	DEEC492	Electric Power Transmission and Distribution Laboratory	0	0	2	2	1
9	C8	DEEC493	Induction, Synchronous and Special Electrical Machines Laboratory	0	0	2	2	1
10	DSE1	DEED491 (1-10)	Elective I Laboratory	0	0	2	2	1

11	DSE2	DEED492 (1-10)	Elective II Laboratory	0	0	2	2	1
12	SEC2	DEES482	Minor Project	0	0	4	4	2
Total of Practical							14	7

3rd Year 5th Semester								
Sl. No.	Category	Course Code	Course Name	Contact Hours/Week				Credit Points
				L	T	P	Total	
A. THEORY								
1	C9	DEEC501	Microcontroller Applications	3	0	0	3	3
2	C10	DEEC502	Energy Conservation and Audit	3	0	0	3	3
3	DSE5	DEED505 (11-26)	Open Elective I	3	0	0	3	3
4	DSE3	DEED503 (1-10)	Elective III	3	0	0	3	3
5	DSE4	DEED504 (1-10)	Elective IV	3	0	0	3	3
Total of Theory							15	15
B. PRACTICAL								
6	C9	DEEC591	Microcontroller Applications Laboratory	0	0	2	2	1
7	C10	DEEC592	Energy Conservation and Audit Laboratory	0	0	2	2	1
8	DSE3	DEED593 (1-10)	Elective III Laboratory	0	0	2	2	1
9	DSE4	DEED594 (1-10)	Elective IV Laboratory	0	0	2	2	1
10	SEC 3	DEES583	Summer Internship - II	0	0	0	0	3
11	SEC4	DEES584	Major Project	0	0	2	2	^
Total of Practical							10	7

3 rd Year 6 th Semester								
Sl. No.	Category	Course Code	Course Name	Contact Hours/Week				Credit Points
				L	T	P	Total	
A. THEORY								
1	C11	DEEC601	Building Electrification	3	0	0	3	3
2	AECC2	DEEA602	Indian Constitution	2	0	0	2	0
3	SEC5	DEES685	Entrepreneurship and Start -ups	3	1	0	4	4
4	DSE6	DEED606 (11-26)	Open Elective II	3	0	0	3	3
5	DSE7	DEED607 (11-26)	Open Elective III	3	0	0	3	3
Total of Theory							15	13
B. PRACTICAL								
6	C11	DEEC691	Building Electrification Laboratory	0	0	2	2	1
7	SEC6	DEES686	Major Project	0	0	6	6	4 [^]
8	SEC7	DEES687	Seminar	1	0	0	1	1
Total of Practical							9	6

Program Elective Courses [PE]

S. No.	Course Code	Course Title	Hours per Week			Credits (L+T+P)
			L	T	P	
1.	EEPE***	Industrial Instrumentation and Condition Monitoring	3	0	0	3
2.	EEPE***	Industrial Instrumentation and Condition Monitoring Laboratory	0	0	2	1
3.	EEPE***	Industrial Automation & Control	3	0	0	3
4.	EEPE***	Industrial Automation & Control Laboratory	0	0	2	1

5.	EEPE***	Industrial Drives	3	0	0	3
6.	EEPE***	Industrial Drives Laboratory	0	0	2	1
7.	EEPE***	Communication Technologies	3	0	0	3
8.	EEPE***	Communication Technologies Laboratory	0	0	2	1
9.	EEPE***	Electrical Testing and Commissioning	3	0	0	3
10.	EEPE***	Electrical Testing and Commissioning Laboratory	0	0	2	1

Open Elective Courses [OE]

11.	EEPE***	Electrical Estimation and Contracting	3	0	0	3
12.	EEPE***	Electrical Estimation and Contracting Laboratory	0	0	2	1
13.	EEPE***	Illumination Practices	3	0	0	3
14.	EEPE***	Illumination Practices Laboratory	0	0	2	1
15.	EEPE***	Switchgear and Protection	3	0	0	3
16.	EEPE***	Switchgear and Protection Laboratory	0	0	2	1
17.	EEPE***	Solar Power Technologies	3	0	0	3
18.	EEPE***	Solar Power Technologies Laboratory	0	0	2	1
19.	EEPE***	Wind Power Technologies	3	0	0	3
20.	EEPE***	Wind Power Technologies Laboratory	0	0	2	1
21.	EEPE***	Biomass and Micro-hydro Power Plants	3	0	0	3
22.	EEPE***	Biomass and Micro-hydro Power Plants Laboratory	0	0	2	1
23.	EEPE***	Electric Vehicles	3	0	0	3
24.	EEPE***	Electric Vehicles Laboratory	0	0	2	1
25.	EEPE***	Electric Traction	3	0	0	3
26.	EEPE***	Electric Traction Laboratory	0	0	2	1

Semester I

Course Name: Mathematics – I	Duration: 6 months
Course Code: DEMA101	Contact: 2L+1T
Semester: I	Credit: 3

Prerequisites:

Course Objective: The purpose of this course is to provide...

Course Outcome: On successful completion of the course, student will be able to

CO1.

CO2.

CO3.

Course Content

Unit No	Module Name	Content	Hrs
I	Algebra	<p>Logarithm: Definition of natural and common logarithm. General Properties of logarithm and simple problems</p> <p>Complex Numbers: Definition of Complex numbers, Real and Imaginary parts of a complex number, Equality of two complex numbers, Conjugate of a complex number, Modulus and Argument of a complex number and simple problems, Polar and Cartesian forms of a complex number and their relation. Algebraic operations (Addition, Subtraction, multiplication, Division) of complex numbers De Moivre's Theorem (without proof) and simple problems. Cube roots of unity and their properties with problems.</p> <p>Quadratic Equations: Definition of Quadratic Equations. Finding the roots of a quadratic equation, conjugate roots & simple problems, Nature of the roots using discriminant & problems, Relation between roots and co-efficient & problems, Formation of quadratic equations if roots are given.</p> <p>Binomial Theorem: Definition of factorial of a number, permutation (nPr) & combination (nCr) with formula only Binomial Theorem (without proof) for any index, simple problems on positive index only</p> <p>General Term and Middle Term and problems</p> <p>Expansion of $(1 + x)^{-1}$, $(1 - x)^{-1}$, where $x < 1$, exponential & logarithmic series only (no problem).</p>	16
II		<p>Determinants and Matrices Elementary properties of determinants up to 3rd order, consistency of equations, Cramer's rule. Algebra of matrices, Inverse of a matrix, matrix inverse method to solve a system of linear equations in 3 variables.</p>	7
III	Trigonometry	<p>Concept of trigonometrical angles, measurement of angles in degree, radian and grade & their relation only. Trigonometrical ratios of angles, associated angles, Trigonometric ratios of some standard angles, problems of Compound angles formula (without proof), multiple, sub-multiple angles & simple problems of Solutions of Trigonometrical Equations, simple problems (angle lies between 0</p>	10

		and 2π) of Inverse Circular Function & simple problems of Properties of triangle, basic formulae only.	
IV	Function, Limit & Continuity, Derivative	<p>Function: Definition of variables & constants, Definition of function with examples, domain and range of a function, Types of functions (even-odd, increasing-decreasing, inverse, periodic) with simple examples, Graph of trigonometric functions, $\sin x$, $\cos x$, $\tan x$ only.</p> <p>Limit & Continuity: Definition of limit (with left hand limit & righthand limit), Fundamental Theorem on limit (only statement), standard limits and simple problems Continuity of functions, elementary test for continuity of functions (finite limit).</p> <p>Derivative: Definition of derivatives, Derivatives of standard functions. Rules of differentiation of sum, difference, product and quotient of functions. Derivatives of composite functions (Chain Rule), Derivatives of inverse circular functions, implicit functions and logarithmic differentiation</p> <p>Derivative of parametric functions, derivative of a function with respect to another function</p> <p>Second order derivatives with simple problems</p> <p>Application of derivatives –Physical & Geometrical interpretation of derivative, checking increasing-decreasing functions, finding velocity & acceleration, Maxima- Minima of function of single variable with simple problems.</p>	12

Text Books:

1. Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, New Delhi.
2. Engineering Mathematics, Konch & Dey, Bhagabati Publication.
3. Engineering Mathematics, Babu Ram, Pearson.

Reference Books:

1. Higher Algebra: Classical, S.K. Mapa, Sarat Book House.
2. Introduction to Real Analysis, S.K. Mapa, Sarat Book House.
3. Engineering Mathematics, Reena Garg, Khanna Publishing House, New Delhi.

Course Name: Applied Physics - I	Duration: 6 months
Course Code: DPHYC101	Contact: 2L+1T
Semester: I	Credit: 3

Prerequisites:

Course Objective: The purpose of this course is to provide...

Diploma EE

Course Outcome: On successful completion of the course, student will be able to

CO1.

CO2.

CO3.

Course Content

Unit No	Module Name	Content	Hrs
I	Physical world, Units and Measurements	Physical quantities; fundamental and derived, Units and systems of units (CGS and SI units), Dimensions and dimensional formulae of physical quantities, Principle of homogeneity of dimensions, Dimensional equations and their applications (conversion from one system of units to other, checking of dimensional equations and derivation of simple equations), Limitations of dimensional analysis. Measurements: Need, measuring instruments, least count, types of Measurement (direct, indirect), Errors in Measurements (systematic and random), absolute error, relative error, error propagation, error estimation and significant figures.	11
II	Force and Motion	Force, Momentum, Conservation of linear momentum, its applications such as recoil of gun, numerical problems rockets (concept only), Impulse and impulsive force. Circular motion, definition of angular displacement, angular velocity, angular acceleration, frequency, time period, relation between linear and angular velocity, linear acceleration and angular acceleration (related numerical), concept of Centripetal and centrifugal forces with examples (No derivation, only formula) banking of roads and bending of cyclist, concept and formula and numerical problems.	10
III	Work, Power and Energy	Work: Concept and units, examples of zero work, positive and negative work. Friction: concept, types, laws of limiting friction, coefficient of friction, reducing friction and its engineering applications, Work done in moving an object on rough inclined plane. Energy and its units, kinetic energy and potential energy, Conservation of mechanical energy for freely falling bodies (simple numerical problems), transformation of energy (examples only). Power and its units, power and work relationship, calculation of power (numerical problems).	6
IV	Rotational Motion	Translational and rotational motion with examples, Definition of torque and angular momentum and their relation, Conservation of angular momentum	6

		(quantitative) and its applications. Moment of inertia and its physical significance, radius of gyration for rigid body, Theorems of parallel and perpendicular axes (statements only), Moment of inertia of rod, disc, ring and sphere (hollow and solid); (Formulae only). Simple numerical problems.	
V	Properties of Matter	Elasticity: definition of stress and strain, moduli of elasticity, Hooke's law, significance of stress- strain curve. Surface tension; Concept, units, cohesive and adhesive forces, angle of contact, Capillary rise (formula only), applications of surface tension, effect of temperature and impurity on surface tension. Viscosity and coefficient of viscosity: terminal velocity, Stoke's law and effect of temperature on viscosity. Hydrodynamics: Fluid motion, stream line and turbulent flow, Reynold's number Equation of continuity, Bernoulli's Theorem (only formula and numericals) and its applications (mention name only).	6
VI	Heat and Thermometry	Concept of heat and temperature, basic concepts of measurements of heat and temperature, modes of heats transfer (conduction, convection and radiation with examples), Co-efficient of thermal conductivity simple numerical problems. Expansion of solids, liquids and gases, coefficient of linear, surface and cubical expansions of solids and relation amongst them, specific heats C_p & C_v of a gas and their relationship (Mention only).	6

Text Books

1. Applied Physics, Vol. I and Vol. II, TTTI Publications, Tata McGraw Hill, Delhi.
2. Concepts in Physics by HC Verma, Vol. I & II, Bharti Bhawan Ltd. New Delhi.

Reference Books

1. Engineering Physics by DK Bhattacharya & Poonam Tandan; Oxford University Press, New Delhi.
2. Comprehensive Practical Physics, Vol,I & II, JN Jaiswal, Laxmi Publications (P) Ltd., New Delhi.

Course Name: Applied Chemistry - I	Duration: 6 months
Course Code: DCHMC101	Contact: 2L+1T
Semester: I	Credit: 3

Prerequisites:

Course Objective: The purpose of this course is to provide...

Course Outcome: On successful completion of the course, student will be able to

CO1.

CO2.

CO3.

Course Content

Unit No	Module Name	Content	Hrs
I	Atomic Structure, Chemical Bonding and Solutions	Rutherford model of atom, Bohr's theory (expression of energy and radius to be omitted), and hydrogen spectrum explanation based on Bohr's model of atom, Heisenberg uncertainty principle, Quantum numbers - orbital concept. Shapes of s, p and d orbitals Pauli's exclusion principle, Hund's rule of maximum multiplicity Aufbau rule, electronic configuration. Type of chemical bonding: ionic, covalent, metallic and hydrogen bonds. Example of each type. Hybridization, sp ³ , sp ² , sp, example: BeCl ₂ , BF ₃ , CH ₄ , NH ₃ , H ₂ O; structure of diamond, graphite. Solution - idea of solute, solvent and solution, methods to express the concentration of solution- molarity (M = mole per liter), ppm, mass percentage, volume percentage and mole fraction.	9
II	Water	Graphical presentation of water distribution on Earth (pie or bar diagram). Classification of soft and hard water based on soap test, salts causing water hardness, unit of hardness and simple numerical on water hardness. Cause of poor lathering of soap in hard water, problems caused by the use of hard water in boiler (scale and sludge, foaming and priming, corrosion etc), and quantitative measurement of water hardness by ETDA method, total dissolved solids (TDS) alkalinity estimation. Water softening techniques - soda lime process, zeolite process and ion exchange process. Municipal water treatment (in brief only) - sedimentation, coagulation, filtration, sterilization. Water for human consumption for drinking and cooking purposes from any water sources and enlist	9

		Indian standard specification of drinking water (collect data and understand standards).	
III	Engineering Materials	<p>Natural occurrence of metals - minerals, ores of iron, aluminium and copper, gangue (matrix), flux, slag, metallurgy - brief account of general principles of metallurgy. Extraction of iron from haematite ore using blast furnace, aluminium from bauxite along with reactions, reactions during copper extraction. Alloys – definition, purposes of alloying, ferrous alloys and non-ferrous with suitable examples, properties and applications.</p> <p>General chemical composition, composition based applications (elementary idea only details omitted): Portland cement and hardening, Glasses Refractory and Composite materials.</p> <p>Polymers - monomer, homo and co polymers, degree of polymerization, simple reactions involved in preparation and their application of thermoplastics and thermosetting plastics (using PVC, PS, PTFE, nylon - 6, nylon - 66, Bakelite only), rubber and vulcanization of rubber.</p>	9
IV	Chemistry of Fuels and Lubricants	<p>Definition of fuel and combustion of fuel, classification of fuels, calorific values (HCV and LCV), calculation of HCV and LCV using Dulong's formula.</p> <p>Proximate analysis and ultimate analysis of coal solid fuel petrol and diesel - fuel rating (octane and cetane numbers),</p> <p>Chemical composition, calorific values and applications of LPG, CNG, water gas, coal gas, producer gas and biogas.</p> <p>Lubrication - function and characteristic properties of good lubricant, classification with examples, lubrication mechanism - hydrodynamic and boundary lubrication, physical properties (viscosity and viscosity index, oiliness, flash and fire point, cloud and pour point only) and chemical properties (coke number, total acid number saponification value) of lubricants.</p>	9
V	Electro Chemistry	<p>Electronic concept of oxidation, reduction and redox reactions.</p> <p>Definition of terms: electrolytes, non-electrolytes with suitable examples, Faradays laws of electrolysis and simple numerical problems.</p> <p>Elementary concept of pH and buffer. Industrial Application of Electrolysis – Electrometallurgy, Electroplating, Electrolytic refining.</p> <p>Application of redox reactions in electrochemical cells – Primary cells - dry cell, Secondary cell -</p>	9

		commercially used lead storage battery, fuel and Solar cells. Introduction to Corrosion of metals – definition, types of corrosion (chemical and electrochemical), H ₂ liberation and O ₂ absorption mechanism of electrochemical corrosion, factors affecting rate of corrosion. Internal corrosion preventive measures – Purification, alloying and heat treatment and External corrosion preventive measures: a) metal (anodic, cathodic) coatings, b) organic inhibitors.	
--	--	---	--

Text Books

1. Agarwal, & Shikha, Engineering Chemistry, Cambridge University Press; New Delhi, 2015.
2. C.N. R. Rao, Understanding Chemistry, Universities Press (India) Pvt. Ltd., 2011.

Reference Books

1. G. H. Hugar & A. N. Pathak, Applied Chemistry Laboratory Practices, Vol. 1 and Vol. II, NITTTTR, Chandigarh, Publications, 2013-14.
2. Rajesh Agnihotri, Chemistry for Engineers, Wiley India Pvt.Ltd., 2014.

Course Name: Communication Skills in English	Duration: 6 months
Course Code: HU101	Contact: 2L
Semester: 1	Credit: 2

Course Content

Unit No	Module Name	Content	Hrs
I	Communication	Basics of communication: Introduction, meaning and definition, process of communication etc. Types of communication: formal and informal, verbal, non-verbal and written. Barriers to effective communication 7 Cs for effective communication (considerate, concrete, concise, clear, complete, correct, courteous). Art of Effective communication, <ul style="list-style-type: none"> • Choosing words • Voice • Modulation • Clarity • Time • Simplification of words Technical Communication	6
II	Soft Skills for	Introduction: Soft Skills and Hard Skills,	6

	Professional Excellence	Importance of Soft Skills. Life skills: Self-awareness and Self-analysis, adaptability, social skills, emotional intelligence, Interpersonal relationship and empathy etc. Applying soft skills across cultures – Corporate work culture, Work persona, Professionalism, Time Management Case Studies	
III	Reading Comprehension	Note Taking, Comprehension, vocabulary enhancement and grammar exercises based on reading of texts.	6
IV	Professional Writing	The art of writing Report and Memo CVs Letters: Job Application and Business Drafting e-mail, minutes of a meeting, etc	6
V	Vocabulary and Grammar	Remedial Grammar and Exercises, Professional Workplace, Communication Parts of speech, active and passive voice, tenses etc.	6

Course Name: Engineering Graphics	Duration: 6 months
Course Code: DCES181	Contact: 3P
Semester: 1	Credit: 1.5

Course Content

Unit No	Module Name	Content	Hrs
I	Letters and numerals (Single Stroke Vertical)	Conventions of lines and their applications, Concept of Representative Fraction (R.F), Reduced scale, Enlarged scale & Full Scale, Engineering Scale such as Plain Scale & Diagonal Scale. Dimensional Techniques, Unidirectional System and Aligned System.	3
II	Geometrical Construction	a) Draw Regular Polygons, Ellipse, Parabola, hyperbola b) Draw Curve passing through given no. of points, cycloid, involute of a circle and polygon	2
III	Orthographic Projection	Introduction to Orthographic Projection: Concept of First Angle & Third Angle of projection. Projections of lines (limited to both ends in 1st quadrant): parallel to the reference planes, inclined to the reference planes (1st Angle Method). Projections of solid body: Regular Polygonal	3

		Pyramid, Cylinder, Cone - inclined to only one reference plane (1st Angle Method).	
IV	Pictorial Projection	Conversion of Pictorial Views into orthographic views (Simple Objects & First Angle Projection Method Only).	3
V	Isometric Projection	Introduction to Isometric Projections, Concept of Isometric Scale and Isometric Views Conversion of Orthographic views into Isometric Views/Projections: Simple Objects e.g. regular prism, pyramid, cone, cylinder.	3
VI	Engineering Element	Free hand sketches of engineering elements such as thread profile, nuts, bolts, studs, set screws, washers, locking arrangements etc. and their conventional representation (For branches other than Mechanical Engineering, the teachers should select branch specific elements for free hand sketching)	3
VII	AutoCAD	<p>Introduction to different commands and toolbars of AutoCAD</p> <ul style="list-style-type: none"> a) Draw command: Lines, Circle, Polygon, Arc, Ellipse, Polyline, Fillet, Chamfer, Hatch, Array (Rectangular & Polar) etc. b) Modify Command: Offset, Trim, Extend, Erase, Fillet, Chamfer, Break, Lengthen, Copy, Move, Mirror, Stretch, Match Properties, Pedit etc. c) View: Zoom All, Zoom Window, Zoom Extent etc. d) Dimensioning: Dimension Setting, Linear, Aligned, Radial, Diameter, Leader, Angular etc. e) Text: Text Style, Dtext, Mtext, DDedit etc. f) Format: Limits, Layers, Pan etc. <p>Making a few simple 2D drawings in AutoCAD.</p>	3

Text Books

1. N.D.Bhatt, Engineering Drawing, 53rd Edition, Charotkar Publishing House
2. R.K.Dhawan, Engineering Drawing, Revised Edition 2015, S.Chand & Co.

Reference Books

1. S.P.Dey, AutoCAD 2014, Vikas Publisher
2. P.S. Gill, Engineering Drawing, S.K.Kataria & Sons.

Course Name: Engineering Workshop Practice	Duration: 6 months
Course Code: DMES181	Contact: 3P
Semester: I	Credit: 1.5

Course Content

Unit No	Module Name	Content	Hrs
I	Electrical Wiring	<ul style="list-style-type: none"> • Safety precautions to be followed in Electrical Works • Electric shock, methods of shock treatment • Safety measure: Earthing, Fuse, circuit breakers, etc. • Different types of wire-gauge & strands and their applications • Different tools used in Electrical wiring works • General wiring accessories & their uses. • Types of switches and their application. • Types of wiring and joints. • <p>Practical (any three)- Group works</p> <ol style="list-style-type: none"> 1. Study/ demonstration of single phase electrical service connection from pole to house including consumer installation. 2. Study of different types of wiring and connection of Single Phase Motor (Fan). 3. Circuits for one lamp controlled by one switch by surface conduit wiring, 4. Lamp circuits- connection of lamp and socket by separate switches, Connection of Fluorescent lamp/tube light, 5. Simple lamp circuits- install bedroom lighting 6. Simple lamp circuits- install stair case wiring. 7. Wiring of calling-bell 	
II	Fitting	<ul style="list-style-type: none"> • Demonstration of different tools and equipment used in fitting shop. • Study of different precious measuring instrument such as micro meter, vernier calipers, bevel protectors. • Care and maintenance of the above mentioned tools and equipment. • Study of drilling machines and power tools used in fitting shop. • Safety measure to be followed in Fitting shop. <p>Practical/ Demonstration</p> <ol style="list-style-type: none"> 1. Demonstration of different fitting job operations like chipping, filing, drilling, tapping, sawing, cutting etc. 	

		<p>Job Preparation -Individual Works</p> <ol style="list-style-type: none"> 1. One simple fitting job involving practice of chipping, filing, marking, drilling, tapping, cutting etc. 	
III	Welding	<ul style="list-style-type: none"> • Purpose of welding, advantages & disadvantages of it over other joining processes. • Types of welding processes (in brief) • Specification, usage, care & maintenance of various welding machines, tools & equipment used in the shop. • Selection of welding methods and electrodes. • Safety measures & equipment required while working in welding shop. <p>Job Preparation (Any One)</p> <ul style="list-style-type: none"> • Individual Works • Job 1 – Butt Joint • Job 2 – Lap Joint • Job 3 – ‘T’ Joint 	
IV	Carpentry	<ul style="list-style-type: none"> • Raw materials used in carpentry shop: wood & alternative materials. • Specification, usage, care & maintenance of various tools, equipment and machineries used in the Carpentry shop. • Types of wood. Difference between hard and soft wood. • Timber: characteristics, usage and defects. Difference between wood and timber. • Seasoning of wood. • Different types of joints such as cross half-lap joint, through tenon and mortise joint, dove tail joints, etc. • Safety measures to be taken in carpentry shop. <p>Practical/Demonstration</p> <ol style="list-style-type: none"> 1. Demonstration of use of different tools, equipment and machineries. 2. Demonstration of different wood working processes, like planing, marking, chiseling, grooving, turning of wood etc. <p>Job Preparation -Individual Works</p> <ol style="list-style-type: none"> 1. One simple job involving any one joint. 	
V	Sheet Metal Working	<ul style="list-style-type: none"> • Briefing on different types of sheet metal, like Stainless Steel Sheet Metal, Copper 	

		<p>Sheet Metal, Brass Sheet Metal, Corrugated Sheet Metal, Galvanized Sheet Metals etc., and their uses.</p> <ul style="list-style-type: none"> • Demonstration of different types of Tools & machines and their use in sheet metal work. • Demonstration of different types sheet metal joints and their applications. • Demonstration of different types of sheet metal working: cold working, hot working, warm working, bending, drawing, end curling, shearing, piercing, sheet metal presses, etc. • Sheet metal joining operation like welding, brazing, soldering and riveting. • Safety measure to be followed in sheet metal work. <p>Practical</p> <ol style="list-style-type: none"> 1. Making of any simple job(example: sheet metal mug) involving different sheet metal operations including soldering and riveting. 	
--	--	--	--

Text Books

1. S.K. Hazra Chaudhary, Workshop Technology, Volume I&II, Media Promoters and Publishers, Mumbai.
2. B.S. Raghuwanshi, Workshop Technology, Volume I&II, Dhanpath Rai and Sons, New Delhi 2014

Reference Books

1. H.S. Bawa, Workshop Practice, Mcgrawhill HED
2. R.P. Singh, Electrical Workshop: Safety, Commissioning, Maintenance & Testing of Electrical Equipment, Wiley

Course Name: Applied Physics-I Lab	Duration: 6 months
Course Code: DPHYC191	Contact: 2P
Semester: I	Credit: 1

Course Content

Unit No	Module Name	Content	Hrs
I	List of Practical's/Activities (To perform minimum 8 practical's)	<ol style="list-style-type: none"> 1. To measure the volume of the material of a given hollow cylinder, using a Vernier calipers. 2. To determine the area of cross section of a thin wire using a screw gauge. 3. To determine radius of curvature of a convex and a concave mirror/ surface using a spherometer. 4. To find the co-efficient of friction between 	

		wood and glass using a horizontal board. 5. To determine force constant of a spring using Hook's law. 6. To find the moment of inertia of a flywheel. 7. To find the viscosity of a given liquid (Glycerin) by Stoke's law 8. To find the co-efficient of linear expansion of the material of a rod. 9. To verify Boyle's law. 10. To determine the relative density of sand by using a sp. gr. Bottle.	
--	--	---	--

Text Books

1. Physics for Class-XI & XII (Part-I & II); N.C.E.R.T., Delhi.
2. Comprehensive Practical Physics, Vol-I & II, JN Laxmi Publications (P) Ltd.

Reference Books

1. Practical Physics by C.L. Arora, S. Chand Publication.
2. Optics, Ghatak, McGraw Hill Education India Private Limited

Course Name: Applied Chemistry-1 Lab	Duration: 6 months
Course Code: DCHMC191	Contact: 2P
Semester: I	Credit: 1

Course Content

Unit No	Module Name	Content	Hrs
I	Perform any 12 (twelve) Laboratory Practicals	Volumetric and Gravimetric analysis 1. Preparation of standard oxalic acid and standard potassium dichromate solution. 2. To determine strength of given sodium hydroxide solution by titrating against standard oxalic acid solution and phenolphthalein as indicator. 3. Standardization of potassium permanganate solution using standard oxalic acid and determination of percentage of iron present in given Hematite ore by $KMnO_4$ solution. 4. a) Standardization of sodium thiosulphate using standard potassium dichromate	

		<p>solution by IODOMETRY.</p> <p>b) Iodometric estimation of copper in copper pyrite ore.</p> <p>5. Volumetric estimation of total acid number (TAN) of given oil.</p> <p>6. Volumetric estimation of</p> <p>a) Total hardness of given water sample using standard EDTA solution.</p> <p>b) Alkalinity of given water sample using 0.01N sulphuric acid.</p> <p>7. Proximate analysis of coal</p> <p>a) Gravimetric estimation moisture in given coal sample.</p> <p>b) Gravimetric estimation ash in given coal sample.</p> <p>Instrumental analysis</p> <p>8. Determine the conductivity of given water sample.</p> <p>9. Determination of the Iron content in given cement sample using colorimeter.</p> <p>10. Determination of viscosity of lubricating oil using Redwood viscometer.</p> <p>11. Determination of flash and fire point of lubricating oil using Able's flash point apparatus.</p> <p>12. To verify the first law of electrolysis of copper sulfate using copper electrode.</p> <p>13. Construction and measurement of emf of electrochemical cell (Daniel cell).</p> <p>14. To study the effect of dissimilar metal combination on cell emf.</p> <p>15. To apply thin layer chromatography for separation of mixture of inorganic/organic compounds.</p> <p>16. Qualitative detection of ARSENIC in a given sample of water (~5 ppm solution of sodium arsenite)</p> <p>17. Determination of dissolved oxygen in a sample of water.</p> <p>18. Determination of pH value of unknown solution.</p>	
--	--	--	--

Course Name: Sports and Yoga Course	Duration: 6 months
-------------------------------------	--------------------

Course Code: DCSTS101	Contact: 2P
Semester: I	Credit: 1

Course Content

Unit No	Module Name	Content	Hrs
I	Introduction to Physical Education	<ul style="list-style-type: none"> • Meaning & definition of Physical Education • Aims & Objectives of Physical Education • Changing trends in Physical Education 	1
II	Olympic Movement	<ul style="list-style-type: none"> • Ancient & Modern Olympics (Summer & Winter) • Olympic Symbols, Ideals, Objectives & Values • Awards and Honours in the field of Sports in India (Dronacharya Award, Arjuna Award, Dhayanchand Award, Rajiv Gandhi Khel Ratna Award etc.) 	2
III	Physical Fitness, Wellness & Lifestyle	<ul style="list-style-type: none"> • Meaning & Importance of Physical Fitness & Wellness • Components of Physical fitness • Components of Health related fitness • Components of wellness • Preventing Health Threats through Lifestyle Change • Concept of Positive Lifestyle • Fundamentals of Anatomy & Physiology in Physical Education, Sports and Yoga • Define Anatomy, Physiology & Its Importance • Effect of exercise on the functioning of Various Body Systems. (Circulatory System, Respi- ratory System, Neuro-Muscular System etc.) 	1
IV	Kinesiology, Biomechanics & Sports	<ul style="list-style-type: none"> • Meaning & Importance of Kinesiology & Biomechanics in Physical Edu. & Sports • Newton's Law of Motion & its application in sports. • Friction and its effects in Sports. 	1
V	Postures	<ul style="list-style-type: none"> • Meaning and Concept of Postures. • Causes of Bad Posture. • Advantages & disadvantages of weight training. • Concept & advantages of Correct Posture. • Common Postural Deformities – Knock Knee; Flat Foot; Round Shoulders; Lordosis, 	1

		<p>Kyphosis, Bow Legs and Scoliosis.</p> <ul style="list-style-type: none"> • Corrective Measures for Postural Deformities 	
VI	Yoga	<ul style="list-style-type: none"> • Meaning & Importance of Yoga • Elements of Yoga • Introduction-Asanas, Pranayama, Meditation & Yogic Kriyas. • Yoga for concentration & related Asanas (Sukhasana; Tadasana; Padmasana & Shashankasana) • Relaxation Techniques for improving concentration - Yog-nidra 	1
VII	Yoga & Lifestyle	<ul style="list-style-type: none"> • Asanas as preventive measures. • Hypertension: Tadasana, Vajrasana, Pavanuktasana, Ardha Chakrasana, Bhujangasana, Sharasana. • Obesity: Procedure, Benefits & contraindications for Vajrasana, Hastasana, Trikonasana, Ardh Matsyendrasana. • Back Pain: Tadasana, Ardh Matsyendrasana, Vakrasana, Shalabhasana, Bhujangasana. • Diabetes: Procedure, Benefits & contraindications for Bhujangasana, Paschimottasana, Pavan Muktasana, Ardh Matsyendrasana. • Asthema: Procedure, Benefits & contraindications for Sukhasana, Chakrasana, Gomukhasana, Parvatasana, Bhujangasana, Paschimottasana, Matsyasana. 	2
VIII	Training and Planning in Sports	<ul style="list-style-type: none"> • Meaning of Training • Warming up and limbering down • Skill, Technique & Style • Meaning and Objectives of Planning. • Tournament – Knock-Out, League/Round Robin & Combination. 	1
IX	Psychology & Sports	<ul style="list-style-type: none"> • Definition & Importance of Psychology in Physical Edu. & Sports • Define & Differentiate Between Growth & Development • Adolescent Problems & Their Management • Emotion: Concept, Type & Controlling of emotions • Meaning, Concept & Types of Aggressions in Sports. 	1

		<ul style="list-style-type: none"> • Psychological benefits of exercise. • Anxiety & Fear and its effects on Sports Performance. • Motivation, its type & techniques. • Understanding Stress & Coping Strategies. 	
X	Doping	<ul style="list-style-type: none"> • Meaning and Concept of Doping • Prohibited Substances & Methods • Side Effects of Prohibited Substances 	1
XI	Sports Medicine	<ul style="list-style-type: none"> • First Aid – Definition, Aims & Objectives. • Sports injuries: Classification, Causes & Prevention. • Management of Injuries: Soft Tissue Injuries and Bone & Joint Injuries 	1
XII	Sports / Games	<p>Following sub topics related to any one Game/Sport of choice of student out of: Athletics, Badminton, Basketball, Chess, Cricket, Kabaddi, Lawn Tennis, Swimming, Table Tennis, Vol- leyball, Yoga etc.</p> <ul style="list-style-type: none"> • History of the Game/Sport. • Latest General Rules of the Game/Sport. • Specifications of Play Fields and Related Sports Equipment. • Important Tournaments and Venues. • Sports Personalities. • Proper Sports Gear and its Importance. 	2

Text Books

1. Modern Trends and Physical Education by Prof. Ajmer Singh.
2. Light On Yoga By B.K.S. Iyengar.

References Books

1. Health and Physical Education – NCERT (11th and 12th Classes)

Course Name: Communication Skills in English Lab	Duration: 6 months
Course Code: HU191	Contact: 2P
Semester: I	Credit: 1

Course Content

Unit No	Module Name	Content	Hrs
---------	-------------	---------	-----

I	Basic	Basic Common Communication Problems and their Solutions	3
II	Introduction to Phonetics	Sounds: consonant, vowel. Transcription of words (IPA), weak forms etc.	3
III	Speaking and Listening Skills	Standard and Formal Speech: Oral presentations, Group Discussions, Public Speaking, Business presentations etc. Conversation practice and role playing, Job interviews, Note taking etc.	6
IV	Non-verbal Communication	Proxemics, Haptics and Kinesics	3

Semester II

Course Name: Mathematics-II	Duration: 6 months
Course Code: DEMA202	Contact: 3L+1T
Semester: II	Credit: 4

Prerequisites:

Course Objective: The purpose of this course is to provide...

Course Outcome: On successful completion of the course, student will be able to

CO1.

CO2.

CO3.

Course Content

Unit No	Module Name	Content	Hrs
I		Definition of vector and types of vectors Concept of a position vector and Ratio formula & simple problems Rectangular resolution of a vector Equality, addition, subtraction of vectors and multiplication of a vector by a scalar Scalar (dot) and Vector (cross) product of two vectors with properties & simple problems Application of dot product -- work done by a force, projection of a vector upon another Application of cross product -- finding area of a triangle and parallelogram, moment of a force	12
II		Integral Calculus Integration as inverse operation of differentiation. Simple integration by substitution, by parts and by partial fractions (for linear factors only). Use of formulas, and for solving problems Where m and n are positive integers. Applications of integration for i. Simple problem on evaluation of	12

		area bounded by a curve and axes. ii. Calculation of Volume of a solid formed by revolution of an area about axes. (Simple problems).	
III		Co-Ordinate Geometry Equation of straight line in various standard forms (without proof), inter section of two straight lines, angle between two lines. Parallel and perpendicular lines, perpendicular distance formula. General equation of a circle and its characteristics. To find the equation of a circle, given: i. Centre and radius, ii. Three points lying on it and iii. Coordinates of end points of a diameter; Definition of conics (Parabola, Ellipse, Hyperbola) their standard equations without proof. Problems on conics when their foci, directories or vertices are given.	12
IV		Vector Algebra Definition notation and rectangular resolution of a vector. Addition and subtraction of vectors. Scalar and vector products of 2 vectors. Simple problems related to work, moment and angular velocity.	12
V		Differential Equations Solution of first order and first-degree differential equation by variable separation method (simple problems). MATLAB – Simple Introduction.	12

Text Books

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, New Delhi, 40th Edition, 2007.
2. G. B. Thomas, R. L. Finney, Calculus and Analytic Geometry, Addison Wesley, 9th Edition, 1995.

References Books

1. Comprehensive Mathematics, Vol. I & II by Laxmi Publications, Delhi.
2. Reena Garg & Chandrika Prasad, Advanced Engineering Mathematics, Khanna Publishing House, New Delhi.

Course Name: Applied Physics-II	Duration: 6 months
Course Code: DPHYC201	Contact: 2L+1T
Semester: II	Credit: 3

Prerequisites:

Course Objective: The purpose of this course is to provide...

Course Outcome: On successful completion of the course, student will be able to

CO1.**CO2.**

CO3.

Course Content

Unit No	Module Name	Content	Hrs
I		Wave motion and its applications Wave motion, transverse and longitudinal waves with examples, definitions of wave velocity, frequency and wave length and their relationship, Sound and light waves and their properties, wave equation ($y = r \sin \omega t$) amplitude, phase, phase difference, principle of superposition of waves and beat formation. Simple Harmonic Motion (SHM): definition, expression for displacement, velocity, acceleration, time period, frequency etc. Simple harmonic progressive wave and energy transfer, study of vibration of cantilever and determination of its time period, Free, forced and resonant vibrations with examples. Acoustics of buildings – reverberation, reverberation time, echo, noise, coefficient of absorption of sound, methods to control reverberation time and their applications, Ultrasonic waves – Introduction and properties, engineering and medical applications of ultrasonic.	7
II		Optics Basic Optical laws; reflection and refraction, refractive index, Images and image formation by mirrors, lens and thin lenses, lens formula, power of lens, magnification and defects. Total internal reflection, Critical angle and conditions for total internal reflection, applications of total internal reflection in optical fiber. Optical Instruments; simple and compound microscope, astronomical telescope in normal adjustment, magnifying power, resolving power, uses of microscope and telescope, optical projection systems.	6
III		Electrostatics Coulombs law, unit of charge, Electric field, Electric lines of force and their properties, Electric flux, Electric potential and potential difference, Gauss law: Application of Gauss law to find electric field intensity of straight charged conductor, plane charged sheet and charged sphere. Capacitor and its working, Types of capacitors, Capacitance and its units. Capacitance of a parallel plate capacitor, Series and parallel combination of capacitors (related numerical), dielectric and its effect on capacitance, dielectric break down.	6

IV		Current Electricity Electric Current and its units, Direct and alternating current, Resistance and its units, Specific resistance, Conductance, Specific conductance, Series and parallel combination of resistances. Factors affecting resistance of a wire, carbon resistances and colour coding. Ohm's law and its verification, Kirchhoff's laws, Wheatstone bridge and its applications (slide wire bridge only), Concept of terminal potential difference and Electro motive force (EMF) Heating effect of current, Electric power, Electric energy and its units (related numerical problems), Advantages of Electric Energy over other forms of energy.	7
V		Electromagnetism Types of magnetic materials; dia, para and ferromagnetic with their properties, Magnetic field and its units, magnetic intensity, magnetic lines of force, magnetic flux and units, magnetization. Concept of electromagnetic induction, Faraday's Laws, Lorentz force (force on moving charge in magnetic field). Force on current carrying conductor, force on rectangular coil placed in magnetic field. Moving coil galvanometer; principle, construction and working, Conversion of a galvanometer into ammeter and voltmeter.	6
VI		Semiconductor Physics Energy bands in solids, Types of materials (insulator, semi-conductor, conductor), intrinsic and extrinsic semiconductors, p-n junction, junction diode and V-I characteristics, types of junction diodes. Diode as rectifier – half wave and full wave rectifier (centre taped). Transistor; description and three terminals, Types- pnp and npn, some electronic applications (list only). Photocells, Solar cells; working principle and engineering applications.	7
VII		Modern Physics Lasers: Energy levels, ionization and excitation potentials; spontaneous and stimulated emission; population inversion, pumping methods, optical feedback, Types of lasers; Ruby, He-Ne and semiconductor, laser characteristics, engineering and medical applications of lasers. Fiber Optics: Introduction to optical fibers, light propagation, acceptance angle and numerical aperture, fiber types, applications in; telecommunication, medical and sensors. Nanoscience and Nanotechnology: Introduction, nanoparticles and nanomaterials, properties at nanoscale, nanotechnology, nanotechnology based devices and applications.	6

--	--	--	--

Text Books

1. Introduction to Electrodynamics, David J. Griffiths, Pearson Education India, Learning Private Limited.
2. Principles of Physics, 10ed, David Halliday, Robert Resnick Jearl Walker , Wiley.

Reference Books

1. Electricity, Magnetism, and Light, Wayne M. Saslow, Academic Press.
2. Engineering Mechanics (In SI Units) (SIE), S. Timoshenko, D.H. Young, J.V. Rao, Sukumar Pati McGraw Hill Education.

Course Name: Introduction to IT Systems	Duration: 6 months
Course Code: DCSTC201	Contact: 2L
Semester: II	Credit: 2

Prerequisites:

Course Objective: The purpose of this course is to provide...

Course Outcome: On successful completion of the course, student will be able to

CO1.

CO2.

CO3.

Course Content

Unit No	Module Name	Content	Hrs
I		Basic Internet skills: Understanding browser, efficient use of search engines, awareness about Digital India portals (state and national portals) and college portals. General understanding of various computer hardware components – CPU, Memory, Display, Keyboard, Mouse, HDD and other Peripheral Devices.	6
II		OS Installation (Linux and MS Windows), Unix Shell and Commands, vi editor	6
III		HTML4, CSS, making basic personal webpage.	6
IV		Office Tools: OpenOffice Writer, OpenOffice Spreadsheet (Calc), OpenOffice Impress.	6
V		Information security best practices. Class lectures will only introduce the topic or demonstrate the tool, actual learning will take place in the Lab by practicing regularly.	6

Text Books

1. R.S. Salaria, Computer Fundamentals, Khanna Publishing House
2. Ramesh Bangia, PC Software Made Easy – The PC Course Kit, Khanna Publishing House

References Books

1. Online Resources, Linux man pages, Wikipedia
2. Mastering Linux Shell Scripting: A practical guide to Linux command-line, Bash scripting, and Shell programming, by Mokhtar Ebrahim, Andrew Mallett

Course Name: Fundamentals of Electrical & Electronics Engineering	Duration: 6 months
Course Code: DECEE201	Contact: 2L+1T
Semester: II	Credit: 3

Prerequisites:

Course Objective: The purpose of this course is to provide...

Course Outcome: On successful completion of the course, student will be able to

CO1.

CO2.

CO3.

Course Content

Unit No	Module Name	Content	Hrs
I	Overview of Electronic Components & Signals	Passive Active Components: Resistances, Capacitors, Inductors, Diodes, Transistors, FET, MOS and CMOS and their Applications. Signals: DC/AC, voltage/current, periodic/non-periodic signals, average, rms, peak values, different types of signal waveforms, Ideal/non-ideal voltage/current sources, independent/dependent voltage current sources.	7
II	Overview of Analog Circuits	Operational Amplifiers-Ideal Op-Amp, Practical op amp, Open loop and closed loop configurations, Application of Op-Amp as amplifier, adder, differentiator and integrator.	7
III	Overview of Digital Electronics	Introduction to Boolean Algebra, Electronic Implementation of Boolean Operations, Gates-Functional Block Approach, Storage elements-Flip Flops-A Functional block approach, Counters: Ripple, Up/down and decade, Introduction to digital IC Gates (of TTL Type).	8
IV	Electric and Magnetic Circuits	EMF, Current, Potential Difference, Power and Energy; M.M.F, magnetic force, permeability, hysteresis loop, reluctance, leakage factor and BH curve; Electromagnetic induction, Faraday's laws of electromagnetic induction, Lenz's law; Dynamically induced emf; Statically induced emf; Equations of	8

		self and mutual inductance; Analogy between electric and magnetic circuits.	
V		A.C. Circuits	8
VI	Transformer and Machines	General construction and principle of different type of transformers; Emf equation and transformation ratio of transformers; Auto transformers; Construction and Working principle of motors; Basic equations and characteristic of motors. Cycle, Frequency, Periodic time, Amplitude, Angular velocity, RMS value, Average value, Form Factor Peak Factor, impedance, phase angle, and power factor; Mathematical and phasor representation of alternating emf and current; Voltage and Current relationship in Star and Delta connections; A.C in resistors, inductors and capacitors; A.C in R-L series, R-C series, R-L-C series and parallel circuits; Power in A. C. Circuits, power triangle.	7

Text Books

1. Ritu Sahdev, Basic Electrical Engineering, Khanna Publishing House
2. Mittle and Mittal, Basic Electrical Engineering, McGraw Education, New Delhi, 2015, ISBN : 978-0-07-0088572-5

References Books

1. Saxena, S. B. Lal, Fundamentals of Electrical Engineering, Cambridge University Press, latest edition ISBN : 9781107464353
2. Theraja, B. L., Electrical Technology Vol – I, S. Chand Publications, New Delhi, 2015, ISBN: 9788121924405

Course Name: Engineering Mechanics	Duration: 6 months
Course Code: DMES201	Contact: 2L+1T
Semester: II	Credit: 3

Prerequisites:

Course Objective: The purpose of this course is to provide...

Course Outcome: On successful completion of the course, student will be able to

CO1.**CO2.****CO3.****Course Content**

Unit No	Module Name	Content	Hrs
I	Basics of mechanics and force system	Significance and relevance of Mechanics, Applied mechanics, Statics, Dynamics. Space, time, mass, particle, flexible body and rigid body. Scalar and	11

		vector quantity, Units of measurement (SI units) - Fundamental units and derived units. Force – unit, representation as a vector and by Bow's notation, characteristics and effects of a force, Principle of transmissibility of force, Force system and its classification. Resolution of a force - Orthogonal components of a force, moment of a force, Varignon's Theorem. Composition of forces – Resultant, analytical method for determination of resultant for concurrent, non-concurrent and parallel co-planar force systems – Law of triangle, parallelogram and polygon of forces.	
II	Equilibrium Equilibrium and Equilibrant	Free body and Free body diagram, Analytical and graphical methods of analysing equilibrium Lami's Theorem – statement and explanation, Application for various engineering problems. Types of beam, supports (simple, hinged, roller and fixed) and loads acting on beam (vertical and inclined point load, uniformly distributed load, couple), Beam reaction for cantilever, simply supported beam with or without overhang – subjected to combination of Point load and uniformly distributed load. Beam reaction graphically for simply supported beam subjected to vertical point loads only.	12
III	Centroid and centre of gravity	Centroid of geometrical plane figures (square, rectangle, triangle, circle, semi-circle, quarter circle) Centroid of composite figures composed of not more than three geometrical figures Centre of Gravity of simple solids (Cube, cuboid, cone, cylinder, sphere, hemisphere) Centre of Gravity of composite solids composed of not more than two simple solids.	11
IV	Simple lifting machine	Simple lifting machine, load, effort, mechanical advantage, applications and advantages. Velocity ratio, efficiency of machines, law of machine. Ideal machine, friction in machine, maximum Mechanical advantage and efficiency, reversible and non-reversible machines, conditions for reversibility Velocity ratios of Simple axle and wheel, Differential axle and wheel, Worm and worm wheel, Single purchase and double purchase crab winch, Simple screw jack, Weston's differential pulley block, geared pulley block.	11

Text Books

1. D.S. Bedi, Engineering Mechanics, Khanna Publications, New Delhi (2008)
2. Khurmi, R.S., Applied Mechanics, S. Chand & Co. New Delhi.

Reference Books

1. Bansal R K, A text book of Engineering Mechanics, Laxmi Publications.

2. Ramamrutham, Engineering Mechanics, S. Chand & Co. New Delhi.

Course Name: Applied Physics-II Lab	Duration: 6 months
Course Code: DPHYC291	Contact: 2P
Semester: II	Credit: 1

Prerequisites:

Course Objective: The purpose of this course is to provide...

Course Outcome: On successful completion of the course, student will be able to

CO1.

CO2.

CO3.

Course Content

Unit No	Module Name	Content	Hrs
I	Experiments in Optics	<ol style="list-style-type: none"> 1. Determination of dispersive power of the material of a prism 2. Determination of wavelength of a monochromatic light by Newton's ring 3. Determination of wavelength of a monochromatic light by Fresnel's bi-prism 4. Determination of wavelength of the given laser source by diffraction method 5. Electricity & Magnetism experiments 6. Determination of thermo electric power of a given thermocouple. 7. Determination of specific charge (e/m) of electron by J.J. Thompson's method. 8. Determination of dielectric constant of a given dielectric material. 9. Determination of Hall coefficient of a semiconductor by four probe method. 10. To study current voltage characteristics, load response, areal characteristic and spectral response of 	

		<p>a photovoltaic solar cell.</p> <ol style="list-style-type: none"> Determination of resistance of ballistic galvanometer by half deflection method and study of variation of logarithmic decrement with series resistance. Determination of unknown resistance using Carey Foster's bridge Study of Transient Response in LR, RC and LCR circuits using expeyes Generating sound from electrical energy using expeyes 	
II	Experiments in Quantum Physics	<ol style="list-style-type: none"> Determination of Stefan-Boltzmann constant. Determination of Planck constant using photocell. Determination of Lande-g factor using Electron spin resonance spectrometer. Determination of Rydberg constant by studying Hydrogen spectrum. Determination of Band gap of semiconductor. To study current voltage characteristics, load response, areal characteristic and spectral response of a photovoltaic solar cell. 	
III	Miscellaneous experiments	<ol style="list-style-type: none"> Determination of Young's modulus of elasticity of the material of a bar by the method of flexure. Determination of bending moment and shear force of a rectangular beam of uniform cross-section. Determination of modulus of rigidity of the material of a rod by static method. Determination of rigidity modulus of the material of a wire by dynamic method. To determine the moment of inertia of a body about an axis passing through its centre of gravity and to determine the modulus of rigidity of the material of the suspended wire. Determination of coefficient of viscosity by Poiseulle's capillary flow method. 	

Course Name: Introduction to IT Systems Lab	Duration: 6 months
--	---------------------------

Course Code: DCSTC291	Contact: 4P
Semester: II	Credit: 2

Prerequisites:

Course Objective: The purpose of this course is to provide...

Course Outcome: On successful completion of the course, student will be able to

CO1.

CO2.

CO3.

Course Content

Unit No	Module Name	Content	Hrs
I	DOS and UNIX	Week – 1: DOS Operating System and its basic commands. Week – 2: UNIX Operating System and its basic commands.	
II	WINDOWS	Week – 3: Windows Operating System and its basic applications.	
III	Word Processing Software	Week – 4: Introduction to Word Processing and its applications. Week – 5: Introduction to Word Processing and its applications. Week – 6: Introduction to Word Processing and its applications.	
IV	Spreadsheet	Week – 7: Introduction to Spreadsheet and its applications. Week – 8: Introduction to Spreadsheet and its applications. Week – 9: Introduction to Spreadsheet and its applications.	
V	Presentation Software	Week – 10: Introduction to Presentation and its applications.	
VI	HTML	Week – 11: Basic HTML Tags. Week – 12: HTML Forms	

Course Name: Fundamentals of Electrical & Electronics Engineering Lab	Duration: 6 months
Course Code: DECEE291	Contact: 2P
Semester: II	Credit: 1

Prerequisites:

Course Objective: The purpose of this course is to provide...

Course Outcome: On successful completion of the course, student will be able to

- CO1.
- CO2.
- CO3.

Course Content

Unit No	Module Name	Content	Hrs
I		<ol style="list-style-type: none"> 1. Verification of Kirchoff's laws. 2. Verification of All Theorems (Thevenin's theorem, Norton's theorem, Maximum power transfer theorem) 3. Transient analysis of RL and RC series circuits 4. Load test on single phase transformer 5. Demo of DC/AC machines & Parts 6. Types of wiring (fluorescent lamp wiring, staircase wiring) 7. Characteristics of semiconductor devices (PN junction, Zener diode, BJT) 8. Wave shaping circuits (Half and full wave rectifier, clipper) 9. Displacement measurement using LVDT and pressure measurement using Strain gauge 10. Verification and interpretation of Logic Gates. 11. Reduction of Boolean expression using K-map 12. Study of modulation and demodulation techniques. 	

Course Name: Engineering Mechanics Lab Lab	Duration: 6 months
Course Code: DMES291	Contact: 2P
Semester: II	Credit: 1

Prerequisites:

Course Objective: The purpose of this course is to provide...

Course Outcome: On successful completion of the course, student will be able to

- CO1.
- CO2.
- CO3.

Course Content

Unit No	Module Name	Content	Hrs
---------	-------------	---------	-----

<p>I</p>	<p>Smithy/Forging</p>	<ul style="list-style-type: none"> • Purpose of Smithy / Forging Works • Different types of Hearths used for Smithy / Forging works • Specification, usage, care and maintenance of various tools and equipment used in the shop. • Types of raw materials used in Smithy / Forging shop & their required temperature for it. • Types of fuel used in hearth and the respective maximum temperature obtained. • Uses of Fire Bricks & Clays in Smithy/Forging Work Shop. • Types of heat treatment processes involved in Smithy / Forging shop and its effect on forged items. • Hot forge & cold forge utility. • Safety measures & equipment required while working in Smithy / Forging Shop. • <p>Practical/ Demonstration</p> <ol style="list-style-type: none"> 1. Practice / Demonstration of firing of hearth / Furnace, Cleaning of Clinkers and Temperature Control of Fire. 2. Practice / Demonstration on different basic Smithy / Forging operations such as Upsetting, Drawing down, Setting down, Necking, Cutting, Bending, Fullering, Swaging, Punching and Drifting etc. 3. Demonstration on making of Cube, hexagonal cube, hexagonal bar from round bar. 4. Hexagonal /octagonal flat chisel including tempering of edges. 	
<p>II</p>	<p>Machine shop Practice</p>	<ul style="list-style-type: none"> • Purpose of a machine shop/ workshop in industry. • Demonstration of all available tools & tackles of machine shop. • Inculcation of basic idea of machine tool; differentiation between machine & machine tool. • Familiarization of all machine tools in the machine shop. • Safety precautions for working in a machine shop. <p>Practice in Machine Shop</p>	

		<ol style="list-style-type: none"> 1. Identification of different parts of a lathe and utility of those parts. 2. Demonstration of all possible machining operation on a lathe, e.g. turning, facing, parting, taper turning, drilling, threading etc. 3. Demonstration to operate a drilling machine or shaping machine and identifying different parts of that m/c tool. <p>Job Practice- (Individual work)</p> <ol style="list-style-type: none"> 1. Preparation of one job in Lathe, involving simple machining operations (e.g. turning, facing, grooving, threading, knurling etc.). 	
III	Electronic Shop	<ul style="list-style-type: none"> • Discussion on active and passive electronic components. • Discussion on soldering and its use. • Introduction on multi-meter and its use. • Discussion on use of test equipment in fault finding. • Discussion on resistor, capacitor, amplifiers, relay, diodes, zener diode and LEDs. • Safety measure to be followed in electronic shop. <p>Practical/ Demonstration</p> <ol style="list-style-type: none"> 1. Familiarization, identification and testing of active and passive components. 2. Soldering and de-soldering practice. 3. Use of Multi meter (both Analog and digital). 4. Demonstration of resistor, capacitor, amplifiers, relay, diodes, zener diode and LEDs 	
IV	Demonstration	<p>Following demonstration may be conducted:</p> <ol style="list-style-type: none"> 1. Demonstration of measurement of Current, Voltage, Power and Energy for an electrical system/ wiring. 2. Demonstration of advanced power tools such as pneumatic tools, electrical portable grinding tools and accessories. 3. Demonstration of bourdon tube pressure gauge. 4. Demonstration of ball bearing and roller bearing. 5. Demonstration of portable power tools for Cutting and drilling, etc. 	

Course Name: Engineering Mechanics Lab	Duration: 6 months
---	---------------------------

Course Code: DMES291	Contact: 2P
Semester: II	Credit: 1

Prerequisites:

Course Objective: The purpose of this course is to provide...

Course Outcome: On successful completion of the course, student will be able to

CO1.

CO2.

CO3.

Course Content

Unit No	Module Name	Content	Hrs
I		Basic ideas of environment, basic concepts, man, society & environment, their interrelationship Mathematics of population growth and associated problems, Importance of population study in Environmental engineering, definition of resource, types of resource, renewable, non- renewable, potentially renewable, effect of excessive use vis-à-vis population growth, Sustainable Development.	5
II		Materials balance: Steady state conservation system, steady state system with non-conservative pollutants, step function. Environmental degradation: Natural environmental Hazards like Flood, earthquake, Landslide-causes, effects and control/management; Anthropogenic degradation like Acid rain-cause, effects and control. Nature and scope of Environmental Science and Engineering. Elements of ecology: System, open system, closed system, definition of ecology, species, population, community, definition of ecosystem- components types and function.	5
III		Structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems, Mangrove ecosystem (special reference to Sundar ban); Food chain [definition and one example of each food chain], Food web. Biogeochemical Cycle- definition, significance, flow chart of different cycles with only elementary reaction [Oxygen, carbon, Nitrogen, Phosphate, Sulphur].	5
IV		Biodiversity- types, importance, Endemic species, Biodiversity Hot-spot, Threats to biodiversity, Conservation of biodiversity. Atmospheric Composition: Troposphere, Stratosphere,	5

		Mesosphere, Thermosphere, Tropopause and Mesopause. Energy balance: Conductive and Convective heat transfer, radiation heat transfer, simple global temperature model [Earth as a black body, earth as albedo], Problems. Green house effects: Definition, impact of greenhouse gases on the global climate and consequently on sea water level, agriculture and marine food. Global warming and its consequence, Control of Global warming. Earth's heat budget.	
V		Lapse rate: Ambient lapse rate Adiabatic lapse rate, atmospheric stability, temperature inversion (radiation inversion). Atmospheric dispersion: Maximum mixing depth, ventilation coefficient, effective stack height, smokestack plumes and Gaussian plume model. Definition of pollutants and contaminants, Primary and secondary pollutants: emission standard, criteria pollutant. Sources and effect of different air pollutants Suspended particulate matter, oxides of carbon, oxides of nitrogen, oxides of sulphur, particulate, PAN. Smog, Photochemical smog and London smog. Depletion Ozone layer: CFC, destruction of ozone layer by CFC, impact of other green-house gases, effect of ozone modification.	5
VI		Standards and control measures: Industrial, commercial and residential air quality standard, control measure (ESP, cyclone separator, bag house, catalytic converter, scrubber (ventury), Statement with brief reference). Hydrosphere, Hydrological cycle and Natural water. Pollutants of water, their origin and effects: Oxygen demanding wastes, pathogens, nutrients, Salts, thermal application, heavy metals, pesticides, volatile organic compounds. River/Lake/ground water pollution: River: DO, 5-day BOD test, Seeded BOD test, BOD reaction rate constants, Effect of oxygen demanding wastes on river [deoxygenation, reaeration], COD, Oil, Greases, pH. Lake: Eutrophication [Definition, source and effect].	5

Text books

1. M.P. Ponia & S.C. Sharma, Environmental Studies, Khanna Publishing House (AICTE Recommended Textbook – 2018)
2. Masters, G. M., “Introduction to Environmental Engineering and Science”, Prentice-Hall of India Pvt. Ltd.,1991.

Reference books

1. De, A. K., "Environmental Chemistry", New Age International
2. Environmental Science: Toward a Sustainable Future Book by Dorothy F. Boorse and Richard T. Wright

Semester III

Course Name: Introduction To Electric Generation Systems	Duration: 6 months
Course Code: DEEC301	Contact:
Semester: III	Credit: 3

Course Objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain the efficient operation of various electric power generating plants.

Course Content

Unit No	Module Name	Content	Hrs
I	Thermal Power Plants: Coal, Gas/ Diesel and Nuclear-based	Layout and working of a typical thermal powerplant with steam turbine and electric generators. Properties of conventional fuels used in the energy conversion equipment used in thermal powerplants: Coal, Gas/diesel, Nuclear fuels—fusion and fission reaction Safe Practices and working of various thermal power plants: coal-based, gas-based, diesel-based, nuclear-based. Functions of the following types of thermal power plants and their major auxiliaries: Coal fired boilers: fire tube and water tube. Gas/diesel based combustion engines. Types of nuclear reactors: Disposal of nuclear waste and nuclear shielding. Thermal power plants in Maharashtra.	
II	Large and Micro-Hydro Power Plants	Energy conversion process of hydro power plant. Classification of hydro power plant: High, medium and low head. Construction and working of hydro turbines used in different types of hydro power plant: <ol style="list-style-type: none"> a. High head—Pelton turbine b. Medium head—Francis turbine c. Low head – Kaplan turbine. Safe Practices for hydro power plants. Different types of micro-hydro turbines for different heads: Pelton, Francis and Kaplan turbines Locations of these different types of large and micro-hydro power plants in Maharashtra Potential locations of	

		micro-hydropower plants in Maharashtra.	
III	Solar and Biomass based Power Plants	<p>Solar Map of India: Global solar power radiation.</p> <p>Solar Power Technology</p> <ol style="list-style-type: none"> Concentrated Solar Power(CSP) plants, construction and working of: Power Tower, Parabolic Trough, Parabolic Dish, Fresnel Reflectors Solar Photovoltaic (PV) powerplant: layout, construction, working. <p>Biomass-based Power Plants</p> <ol style="list-style-type: none"> Layout of a Bio-chemical based (e.g. biogas) powerplant: Layout of a Thermo-chemical based (e.g. Municipal waste) powerplant Layout of an Agro- chemical based (e.g. bio-diesel) powerplant <p>Features of the solid, liquid and gas biomasses as fuel for biomass power plant.</p>	
IV	Wind Power Plants	<p>Wind Map of India: Wind power density in watts per square meter</p> <p>Layout of Horizontal axis large wind powerplant:</p> <p>Geared wind power plant. Direct-drive wind powerplant.</p> <p>Salient Features of electric generators used in large wind power plants: Constant Speed Electric Generators: Squirrel Cage Induction Generators (SCIG), Wound Rotor Induction Generator (WRIG)</p> <p>Variable Speed Electric Generators: Doubly-fed induction generator (DFIG), wound rotor synchronous generator (WRSG), permanent magnet synchronous generator (PMSG)</p>	
V	Economics of Power Generation and Interconnected Power System	<p>Related terms: connected load, firm power, cold reserve, hot reserve, spinning reserve. Base load and peak load plants; Load curve, load duration curve, integrated duration curve</p> <p>Cost of generation: Average demand, maximum demand, demand factor, plant capacity factor, plant use factor, diversity factor, load factor and plant load factor. Choice of size and number of generator units, combined operation of power station. Causes and Impact and reasons of Grid system fault: State grid, national grid, brown out and blackout; sample blackouts at national and international level</p>	

References:

- Nag, P.K. Power Plant Engineering, McGraw Hill, New Delhi, ISBN: 978-9339204044
- Tanmoy Deb, Electrical Power Generation, Khanna Publishing House, Delhi (Ed. 2018)
- Gupta, B.R., Generation of Electrical Energy, S. Chand & Co. New Delhi
- Rachel, Sthuthi; Earnest, Joshua – Wind Power Technologies, PHI Learning, New Delhi, ISBN: 978-93-88028-49-3; E-book 978-93-88028-50-9
- Solanki, Chetan Singh – Solar Photovoltaics: Fundamentals, Technologies and Applications, PHI Learning, New Delhi, ISBN: 9788120351110
- Hau, Erich, Wind Turbines, Springer-Verlag, Berlin Heidelberg, Germany, ISBN: 978-3-642-27150-2
- Gipe, Paul, Wind Energy Basics, Chelsea Green Publishing Co; ISBN: 978-1603580304
- Wizelius, Tore; Earnest, Joshua – Wind Power Plants and Project Development, PHI
- Gupta, J.B. A Course in Electrical Power – S.K Kataria and Sons, New Delhi. 2014
- Soni, Gupta, Bhatnagar, A Course in Electrical Power – Dhanpat Rai and Sons

11. System, S. Chand & Co. New Delhi, 2005, ISBN: 9788121924962

Course Outcomes:

The theory, practical experiences and relevants of t skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented Cos associated with the above mentioned competency:

- a) Maintain the optimised working of the thermal powerplant.
- b) Maintain the optimised working of large and micro hydropower plants.
- c) Maintain the optimised working of solar and biomass-based powerplants.
- d) Maintain the optimised working of wind powerplants.
- e) Select the adequate mix of power generation based on economic operation

Course Name: Introduction to electric generation systems Laboratory	Duration: 6 months
Course Code: DEEC391	Contact:
Semester: III	Credit: 1

Course Objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain the efficient operation of various electric power generating plants.

Practical:

1. Identify the routine maintenance parts of the coal fired thermal power plant after watching a video programme.
2. Identify the routine maintenance parts of the gas fired thermal power plant after watching a video programme.
3. Assemble and dismantle a small diesel generator power plant.
4. Identify the routine maintenance parts of the nuclear fired thermal power plant after watching a video programme.
5. Identify the routine maintenance parts of the large hydro power plant after watching a video programme
6. Identify the routine maintenance parts of the micro hydro power plant after watching a video programme.
7. Assemble a micro hydro power plant and then dismantle it.
8. Assemble the parabolic trough or parabolic dish Concentrated Solar Power (CSP)plant.
9. Dismantle the parabolic trough or parabolic dish CSP plant.
10. Assemble the solar PV plant to produce electric power and then dismantle it.
11. Assemble a small biogas plant to generate electric power.
12. Dismantle the biogas plant.
13. Identify the routine maintenance parts of the large wind power plant after watching a video programme.
14. Assemble a horizontal axis small wind turbine to produce electric power.
15. Dismantle a horizontal axis small wind turbine.
16. Assemble a vertical axis small wind turbine to produce electric power and then dismantle it.
17. Identify the routine maintenance parts of the horizontal axis small wind turbine after watching

a video programme.

18. Identify the routine maintenance parts of the vertical axis small wind turbine after watching a video programme.

Course Outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented Cos associated with the above mentioned competency:

- a) Maintain the optimised working of the thermal powerplant.
- b) Maintain the optimised working of large and micro hydro powerplants.
- c) Maintain the optimised working of solar and biomass-based powerplants.
- d) Maintain the optimised working of wind powerplants.
- e) Select the adequate mix of power generation based on economic operation.

Course Name: Electric Circuits	Duration: 6 months
Course Code: DEEC302	Contact:
Semester: III	Credit: 3

Course Objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain electrical systems applying AC and DC circuit fundamentals.

Course Content

Unit No	Module Name	Content	Hrs
I	Single Phase A.C Series Circuits	Generation of alternating voltage, Phasor representation of sinusoidal quantities R,L,C circuit elements its voltage and current response R-L, R-C, R-L-C combination of A.C series circuit, impedance, reactance, impedance triangle, Power factor, active power, reactive power, apparent power, power triangle and vector diagram Resonance, Bandwidth, Quality factor and voltage magnification in series R-L, R-C, R- L-C circuit.	
II	Single Phase A.C Parallel Circuits	R-L, R-C and R-L-C parallel combination of A.C circuits. Impedance, reactance, phasor diagram, impedance triangle R-L, R-C, R-L-C parallel A.C. circuits power factor, active power, apparent power, reactive power, power triangle Resonance in parallel R-L, R-C, R-L-C circuit, Bandwidth, Quality factor and voltage magnification.	
III	Three Phase Circuits	Phasor and complex representation of three phase supply Phase sequence and polarity Types of three-phase connections, Phase and line quantities in	

		three phase star and delta system. Balanced and unbalanced load, neutral shift in unbalanced load Three phase power, active, reactive and apparent power in star and delta system.	
IV	Network Reduction and Principles of Circuit Analysis	Source transformation Star/delta and delta/star transformation Mesh Analysis Node Analysis.	
V	Network Theorems	Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Reciprocity theorem, Duality in electric circuits.	

References:

1. Ashfaq Husain, Networks & Systems, Khanna Book Publishing, New Delhi.
2. Gupta, B.R; Singhal, Vandana; Fundamentals of Electrical Network, S. Chand and Co., New Delhi, ISBN: 978-81-219-2318-7
3. Saxena, S.B Lal; Dasgupta, K; Fundamentals of Electrical Engineering, Cambridge University Press Pvt. Ltd., New Delhi, ISBN: 978-11-0746-435-3
4. Theraja, B.L.; Theraja, A.K; A Text Book of Electrical Technology Vol-I, S. Chand & Co., Ramnagar, New Delhi, ISBN: 9788121924405
5. Sudhakar, A.; Shyamamohan, S. Palli; Circuit and Network, McGraw Hill Education, New Delhi, ISBN: 978-93-3921-960-4
6. Bell, David A., Electric Circuits, Oxford University Press New Delhi, ISBN: 978-01-954-2524-6
7. Boylested, R.L., Introductory Circuit Analysis, Wheeler, New Delhi, ISBN: 978-00-231-3161-5
8. Mittle, V.N.; Mittle, Arvind; Basic Electrical Engineering, McGraw Hill Education, Noida, ISBN: 978-00-705-9357-2
9. Sivanandam, S.N, Electric Circuit Analysis, Vikas Publishing House Pvt. Ltd, Noida, ISBN: 978-81259-1364-1
10. Salivahanan, S.; Pravinkumar, S; Circuit Theory, Vikas Publishing House Pvt. Ltd, Noida, ISBN: 978-93259-7418-0

Course Outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented Cos associated with the above mentioned competency:

- a) Troubleshoot problems related to single phase A.C series circuits.
- b) Troubleshoot problems related to single phase A.C parallel circuits.
- c) Troubleshoot problems related to three phase circuits.
- d) Use principles of circuit analysis to troubleshoot electric circuits.
- e) Apply network theorems to troubleshoot electric circuits.

Course Name: Electric Circuits Laboratory	Duration: 6 months
Course Code: DEEC392	Contact:
Semester: III	Credit: 1

Course objectives:

The aim of this course is to help the student to attain the following industry identified competency
Diploma EE

through various teaching learning experiences:

- Maintain electrical systems applying AC and DC circuit fundamentals.

Practical:

1. Use dual trace oscilloscope to determine A.C voltage and current response in given R,L,C circuit.
2. Use voltmeter, ammeter, wattmeter to determine active, reactive and apparent power consumed in given R-L series circuit. Draw phasor diagram.
3. Use voltmeter, ammeter to determine active, reactive and apparent power consumed in given R-C series circuit. Draw phasor diagram.
4. Use voltmeter, ammeter, wattmeter to determine active, reactive and apparent power consumed in given R-L-C series circuit. Draw phasor diagram.
5. Use variable frequency supply to create resonance in given series R-L-C circuit or by using variable inductor or variable capacitor.
6. Use voltmeter, ammeter, wattmeter to determine current, pf., active, reactive and apparent power in R-C parallel A.C. circuit.
7. Use voltmeter, ammeter, wattmeter, pf meter to determine current, pf, active, reactive and apparent power for given R-L-C parallel circuit with series connection of resistor and inductor in parallel with capacitor.
8. Use variable frequency supply create resonance in given parallel R-L-C circuit or by using variable inductor or capacitor.
9. Use voltmeter, ammeter, wattmeter, pf meter to determine line and phase quantities of voltage and current for balanced three phase star and delta connected load and calculate active, reactive, and apparent power. Draw phasor diagram.
10. Use voltmeter, ammeter, wattmeter, pf meter to determine line and phase quantities of voltage and current for unbalanced three phase star and delta connected load and calculate active, reactive, and apparent power. Draw phasor diagram.
11. Use voltmeter, ammeter to determine current through the given branch of a electric network by applying mesh analysis.
12. Use voltmeter, ammeter to determine current through the given branch of a electric network by applying node analysis.
13. Use voltmeter, ammeter to determine current through the given branch and voltage across the given element of circuit by applying superposition theorem.
14. Use voltmeter, ammeter to determine equivalent circuit parameter in a given circuit by applying Thevenin's theorem.
15. Use voltmeter, ammeter to determine equivalent circuit parameter in a given circuit by applying Norton's theorem.
16. Use voltmeter, ammeter to determine load resistance for maximum power transfer for a given circuit by applying maximum power transfer theorem.

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented Cos associated with the above mentioned competency:

- a) Troubleshoot problems related to single phase A.C series circuits.
- b) Troubleshoot problems related to single phase A.C parallel circuits.
- c) Troubleshoot problems related to three phase circuits.
- d) Use principles of circuit analysis to trouble shoot electric circuits.
- e) Apply network theorems to trouble shoot electric circuits.

Course Name: Electrical And Electronic Measurements	Duration: 6 months
Course Code: DEEC303	Contact:
Semester: III	Credit: 3

Course objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Use relevant measuring instrument in different electrical applications.

Course Content

Unit No	Module Name	Content	Hrs
I	Fundamentals of Measurements	Measurement: Significance, units, fundamental quantities and standards Classification of Instrument Systems: Null and deflection type instruments Absolute and secondary instruments Analog and digital instruments Static and dynamic characteristics, types of errors Calibration: need and procedure. Classification of measuring instruments: indicating, recording and integrating instruments. Essential requirements of an indicating instruments	
II	Measurement of voltage and current	DC Ammeter: Basic, Multi range, Universal shunt, DC Voltmeter: Basic, Multi-range, concept of loading effect and sensitivity AC voltmeter: Rectifier type (half wave and full wave) CT and PT: construction, working and applications. Clamp-on meter.	
III	Measurement of Electric Power	Analog meters: Permanent magnet moving coil (PMMC) and Permanent magnet moving iron (PMMI) meter, their construction, working, salient features, merits and demerits Dynamometer type wattmeter: Construction and working Range: Multiplying factor and extension of range using CT and PT Errors and compensations. Active and reactive power measurement: One, two and three wattmeter method. Effect of Power factor on watt meter reading in two wattmeter method. Maximum Demand indicator	
IV	Measurement of Electric Energy	Single and three phase electronic energy meter: Constructional features and working principle. Errors and their compensations. Calibration of single phase electronic energy meter using direct loading.	
V	Circuit Parameter Measurement, CRO and Other Meters	Measurement of resistance: Low resistance: Kelvin's double bridge, Medium Resistance: Voltmeter and ammeter method High resistance: Megger and Ohm meter: Series and shunt Measurement of inductance using Anderson bridge (no derivation and phasor diagram). Measurement of capacitance using Schering bridge (no derivation and phasor diagram).	

		<p>Single beam/single trace CRO, Digital storage Oscilloscope: Basic block diagram, working, Cathode ray tube, electrostatic deflection, vertical amplifier, time base generator, horizontal amplifier, measurement of voltage/amplitude/time period/frequency/phase angle delay line, specifications.</p> <p>Other meters: Earth tester, Digital Multi meter; L-C-R meter, Frequency meter (ferromagnetic and Weston type), Phase sequence indicator, power factor meter (single phase and three phase dynamometer type), Synchroscope, Tri-vector meter.</p> <p>Signal generator: need, working and basic block diagram.</p> <p>Function generator: need, working and basic block diagram, function of symmetry.</p>	
--	--	--	--

References:

1. Theraja B.L., Theraja A.K., A Text Book of Electrical Technology Vol-I(BasicElectricalEngg.), S. Chand and Co. New Delhi, ISBN:9788121924405
2. Mittle V.N., Basic Electrical Engineering, McGraw-Hill New Delhi, ISBN:978-0-07-0088572-5,
3. Edward Hughes, Electrical Technology, Pearson Education, New Delhi, ISBN-13:978-0582405196
4. Rajput R.K., Electrical and Electronic Measurement and Instrumentation, S. Chand and Co. New Delhi, ISBN :9789385676017
5. Sawhney A.K., Electrical and Electronics Measurements and Instrumentation.,Dhanpai Raiand Sons, New Delhi, ISBN :9780000279744
6. Suryanarayna N.V., Electrical Measurements and Measuring Instruments, S. Chandand Co. New Delhi, ISBN:8121920116

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented Cos associated with the above mentioned competency:

- a) Check the working of the electrical measuring instrument.
- b) Use different types of measuring instruments for measuring voltage and current.
- c) Use different types of measuring instruments for measuring electric power.
- d) Use different types of measuring instruments for measuring electric energy.
- e) Use different types of electrical instruments for measuring various ranges of electrical parameters.

Course Name: Electrical And Electronic Measurements Laboratory	Duration: 6 months
Course Code: DEEC393	Contact:
Semester: III	Credit: 1

Course objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Use relevant measuring instrument in different electrical applications.

Practical:

1. Identify measuring instruments on the basis of symbols on dial, type, accuracy, class position and scale.

2. Identify the components of PMMC and MI instruments.
3. Troubleshoot PMMC and MI instruments.
4. Measure AC and DC quantities in a working circuit.
5. Extend range of ammeter and voltmeter by using (i) shunt and multiplier(ii) CT and PT.
6. Use Clamp-on meter for measurement of AC/DC current, AC/DC voltage.
7. Use electro-dynamic watt-meter for measurement of power in a single phase circuit.
8. Troubleshoot electro dynamic watt-meter for measurement of power in a single phase circuit.
9. Use single wattmeter for measurement of active and reactive power of three phase balanced load.
10. Use two watt-meters for measuring active power of three-phase balanced load.
11. Calibrate single phase electronic energy meter by direct loading.
12. Troubleshoot single phase electronic energy meter.
13. Use digital multi-meter for measurement of AC/DC current, AC/DC voltage.
14. Use Kelvin's double bridge for measurement of low resistance.
15. Use voltmeter and ammeter method for measurement of medium resistance.
16. Use Megger for insulation resistance measurements.
17. Use earth tester for measurement of earth resistance.
18. Use CRO for the Measurement of supply frequency in single-phase circuit.
19. Use Tri-vector meter for measuring kW, kVAR and kVA of a powerline.

Course Outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented Cos associated with the above mentioned competency:

- a) Check the working of the electrical measuring instrument.
- b) Use different types of measuring instruments for measuring voltage and current.
- c) Use different types of measuring instruments for measuring electric power.
- d) Use different types of measuring instruments for measuring electric energy.
- e) Use different types of electrical instruments for measuring electrical parameters of various ranges.

Course Name: Electric Motors And Transformers	Duration: 6 months
Course Code: DEEC304	Contact:
Semester: III	Credit: 3

Course objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain electric motors and transformers.

Course Content

Unit No	Module Name	Content	Hrs
I	DC Generators	DC generator: construction, parts, materials and their functions. Principle of operation of DC generator: Fleming's right hand rule, schematic diagrams, e.m.f. equation of generator, armature	

		reaction, commutation and. Applications of DC generators. Classification of measuring instruments: indicating, recording and integrating instruments.	
II	D.C. Motors	DC motor: Types of DC motors. Fleming's left hand rule, Principle of operation of, Back e.m.f. and its significance, Voltage equation of DC motor. Torque and Speed; Armature torque, Shaft torque, BHP, Brake test, losses, efficiency. DC motor starters: Necessity, two point and three point starters. Speed control of DC shunt and series motor: Flux and Armature control. Brushless DC Motor: Construction and working.	
III	Single Phase Transformers	Types of transformers: Shell type and core type; Construction: Parts and functions, materials used for different parts: CRGO, CRNGO, HRGO, amorphous cores, Transformer: Principle of operation, EMF equation of transformer: Derivation, Voltage transformation ratio, Significance of transformer ratings Transformer No-load and on-load phasor diagram, Leakage reactance, Equivalent circuit of transformer: Equivalent resistance and reactance. Voltage regulation and Efficiency: Direct loading, OC/SC method, All day efficiency.	
IV	Three Phase Transformers	Bank of three single phase transformers, Single unit of three phase transformer Distribution and Power transformers. Construction, cooling, Three phase transformers connections as per IS:2026 (part IV)-1977, Three phase to two phase conversion (Scott Connection), Selection of transformer as per IS:10028 (PartI)-1985, Criteria for selection of distribution transformer, and power transformer, Amorphous Core type Distribution Transformer, Specifications of three-phase distribution transformers as per IS:1180 (partI)-1989 Need of parallel operation of three phase transformer, Conditions for parallel operation. Polarity tests on mutually inductive coils and single phase transformers; Polarity test, Phasing out test on Three-phase transformer.	
V	Special Purpose Transformers	Single phase and three phase auto transformers: Construction, working and applications. Instrument Transformers: Construction, working and applications of Current transformer and Potential transformer.	

		<p>Isolation transformer: Constructional Features and applications.</p> <p>Single phase welding transformer: constructional features and applications. Pulse transformer: constructional features and applications.</p> <p>'K' factor of transformers: overheating due to non-linear loads and harmonics.</p>	
--	--	---	--

References:

1. G. C. Garg & P. S. Bimbhra, Electrical Machines, Vol- I, II, Khanna Book Publishing House (ISBN: 978-9386173-447, 978-93-86173-607), New Delhi
2. Mittle, V. N. and Mittle, Arvind, Basic Electrical Engineering, McGraw Hill Education, New Delhi, ISBN: 9780070593572
3. Kothari, D. P. and Nagrath, I. J., Electrical Machines, McGraw Hill Education, New Delhi, ISBN: 9780070699670
4. Bhattacharya, S. K., Electrical Machines, McGraw Hill Education, New Delhi, ISBN: 9789332902855
5. Mehta, V. K. and Mehta, Rohit, Principles of Electrical Machines, S. Chand and Co. Ltd., New Delhi, ISBN: 9788121930888
6. Theraja, B. L., Electrical Technology Vol- II (AC and DC machines), S. Chand and Co. Ltd., New Delhi, ISBN: 9788121924375
7. Bandyopadhyay, M. N., Electrical Machines Theory and Practice, PHI Learning Pvt. Ltd., New Delhi, ISBN: 9788120329973
8. Murugesh Kumar, K., DC Machines and Transformers, ISBN: 9788125916055

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented Cos associated with the above mentioned competency:

- a) Maintain different types of DC generators.
- b) Maintain different types of DC motors.
- c) Maintain single phase transformer.
- d) Maintain three phase transformers.
- e) Maintain different types of special purpose transformers used in different applications.

Course Name: Electric Motors And Transformers Laboratory	Duration: 6 months
Course Code: DEEC394	Contact:
Semester: III	Credit: 1

Course objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Use electric motors and transformers.

Practical:

1. Dismantle a DC machine.
2. Reverse the direction of rotation of the DC shunt motor.
3. Perform brake test on DC shunt motor.
4. Control the speed of DC shunt motor by different methods.
5. Control the speed of DC series motor by different methods.

6. Perform the brake test on DC series motor.
7. Check the functioning of single phase transformer.
8. Determine regulation and efficiency of single phase transformer by direct loading.
9. Perform open circuit and short circuit test on single phase transformer to determine equivalent circuit constants, voltage regulation and efficiency.
10. Perform parallel operation of two single phase transformers to determine the load current sharing.
11. Perform parallel operation of two single phase transformers and determine the apparent and real power load sharing.
12. Perform polarity test on a single phase transformer whose polarity markings are masked.
13. Perform phasing out test on a three phase transformer whose phase markings are masked.
14. Connect the auto-transformer in step-up and step-down modes noting the input/output readings.
15. Check the functioning of the CT, PT and isolation transformer.
16. Test the pulse transformer.

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented Cos associated with the above mentioned competency:

- a) Maintain different types of DC generators.
- b) Maintain different types of DC motors.
- c) Maintain single phase transformer.
- d) Maintain three phase transformers.
- e) Maintain different types of special purpose transformers used in different applications.

Course Name: Renewable Energy Power Plants	Duration: 6 months
Course Code: DEEC305	Contact:
Semester: III	Credit: 3

Course objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain the efficient operation of various types of renewable energy powerplants.

Course Content

Unit No	Module Name	Content	Hrs
I	Solar PV and Concentrated Solar Power Plants	Solar Map of India: Global solar power radiation, Solar PV Concentrated Solar Power (CSP) plants, construction and working of: Power Tower, Parabolic Trough, Parabolic Dish, Fresnel Reflectors Solar Photovoltaic (PV) power plant: components layout, construction, working. Rooftop solar PV power system.	
II	Large Wind Power Plants	Wind Map of India: Wind power density in watts per square meter Lift and drag principle; long path theory.	

		<p>Geared type wind power plants: components, layout and working. Direct drive type wind powerplants: components, layout and working.</p> <p>Constant Speed Electric Generators: Squirrel Cage Induction Generators (SCIG), Wound Rotor Induction Generator (WRIG); Variable Speed Electric Generators: Doubly-fed induction generator (DFIG), wound rotor synchronous generator (WRSG), permanent magnet synchronous generator (PMSG).</p>	
III	Small Wind Turbines	<p>Horizontal axis small wind turbine: direct drive type, components and working</p> <p>Horizontal axis small wind turbine: geared type, components and working</p> <p>Vertical axis small wind turbine: direct drive and geared, components and working</p> <p>Types of towers and installation of small wind turbines on roof tops and open fields. Electric generators used in small wind powerplants</p>	
IV	Micro-hydro Power Plants	<p>Energy conversion process of hydro power plant.</p> <p>Classification of hydro powerplant: High, medium and low head. Layouts of micro-hydro powerplants.</p> <p>Construction and working of hydro turbines used in different types of hydro power plant:</p> <ul style="list-style-type: none"> ○ High head–Pelton turbine ○ Medium head–Francis turbine ○ Low head – Kaplan turbine. <p>Safe Practices for micro hydro power plants.</p>	
V	Biomass-based Power Plants	<p>Properties of solid fuel for biomass powerplants: bagasse, woodchips, rice husk, municipal waste</p> <p>Properties of liquid and gaseous fuel for biomass power plants: Jatropha, bio-diesel, gobargas.</p> <p>Layout of a Bio-chemical based (e.g. biogas) power plant:</p> <p>Layout of a Thermo-chemical based (e.g. Municipal waste) powerplant</p> <p>Layout of a Agrochemical based (e.g. bio-diesel) powerplant.</p>	

References:

1. Deambi, Suneel: From Sunlight to Electricity: a practical hand book on solar photovoltaic application; TERI, New Delhi ISBN:9788179935736
2. David M. Buchla, Thomas E. Kissell, Thomas L. Floyd-Renewable Energy Systems, Pearson Education New Delhi, ISBN:9789332586826,
3. Rachel, Sthuthi; Earnest, Joshua–Wind Power Technologies, PHI Learning, New Delhi, ISBN: 978-93-88028-49-3; E-book 978-93-88028-50-9
4. Khoiyangbam, R S Navindu; Gupta and Sushil Kumar; Biogas Technology: Towards Sustainable Development; TERI, New Delhi; ISBN:9788179934043
5. Gipe, Paul: Wind Energy Basics, Chelsea Green Publishing Co; ISBN:978-1603580304
6. Wizelius, Tore & Earnest, Joshua- PHI Learning, New Delhi, ISBN:978-8120351660
7. Kothari, D. P. et al: Renewable Energy Sources and Emerging Technologies, PHI Learning, New Delhi, ISBN:-978-81-203-4470-9

8. Bhadra, S. N., Kastha, D., Banerjee, S, Wind Electrical Systems installation; Oxford University Press, New Delhi, ISBN:9780195670936.
9. O.P.Gupta, Energy Technology, Khanna Publishing House, New Delhi (ISBN:978-9386173-683)

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented Cos associated with the above mentioned competency:

- a) Maintain the optimised working of solar PV and CS powerplants.
- b) Maintain the optimised working of large wind powerplants
- c) Maintain the optimised working of small wind turbines.
- d) Maintain the optimised working of micro hydro powerplants.
- e) Maintain the optimised working of biomass-based powerplants.

Course Name: Renewable Energy Power Plants Laboratory	Duration: 6 months
Course Code: DEEC395	Contact:
Semester: III	Credit: 1

Course objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain the efficient operation of various renewable energy powerplants.

Practical:

1. Dismantle the parabolic trough CSP plant.
2. Assemble the parabolic trough Concentrated Solar Power (CSP) plant.
3. Assemble the parabolic dish CSP plant.
4. Dismantle the parabolic dish CSP plant.
5. Assemble the solar PV plant to produce electric power.
6. Dismantle the solar PV plant.
7. Identify the routine maintenance parts of the large wind powerplant after watching a video programme.
8. Assemble a horizontal axis small wind turbine to produce electric power.
9. Dismantle a horizontal axis small wind turbine.
10. Assemble a vertical axis small wind turbine to produce electric power.
11. Dismantle a vertical axis small wind turbine.
12. Identify the routine maintenance parts of the micro hydro powerplant after watching a video programme.
13. Assemble a micro hydro powerplant.
14. Dismantle a micro hydro powerplant.
15. Assemble a small biogas plant to generate electric power.
16. Dismantle the biogas plant.

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented Cos associated with the above mentioned competency:

- a. Maintain the optimised working of solar PV and CS powerplants.
- b. Maintain the optimised working of large wind powerplants
- c. Maintain the optimised working of small wind turbines.

- d. Maintain the optimised working of micro hydro powerplants.
- e. Maintain the optimised working of biomass-based powerplants.

Semester IV

Course Name: Fundamentals of Power Electronics	Duration: 6 months
Course Code: DEEC401	Contact:
Semester: IV	Credit: 3

Course objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain the proper functioning of power electronic devices.

Course Content

Unit No	Module Name	Content	Hrs
I	Power Electronic Devices	Power electronic devices, Power transistor: construction, working principle, V-I characteristics and uses. IGBT: Construction, working principle, V-I characteristics and uses. Concept of single electron transistor (SET) - aspects of Nano- technology.	
II	Thyristor Family Devices	SCR: construction, two transistor analogy, types, working and characteristics. SCR mounting and cooling. Types of Thyristors: SCR, LASCR, SCS, GTO, UJT, PUT, DIAC and TRIAC. Thyristor family devices: symbol, construction, operating principle and V-I characteristics. Protection circuits: over-voltage, over-current, Snubber, Crowbar.	
III	Turn-on and Turn-off Methods of Thyristors	SCR Turn-On methods: High Voltage thermal triggering, Illumination triggering, dv/dt triggering, Gate triggering. Gate trigger circuits – Resistance and Resistance-Capacitance circuits. SCR triggering using UJT, PUT: Relaxation Oscillator and Synchronized UJT circuit. Pulse transformer and opto-coupler based triggering. SCR Turn-Off methods: Class A- Series resonant commutation circuit, Class B-Shunt Resonant commutation circuit, Class C- Complimentary Symmetry commutation circuit, Class D- Auxiliary commutation, Class E-External pulse commutation, Class F- Linear natural commutation.	

IV	Phase Controlled Rectifiers	Phase control: firing angle, conduction angle. Single phase half controlled, full controlled and midpoint controlled rectifier with R, RL load: Circuit diagram, working, input-output waveforms, equations for DC output and effect of free wheeling diode. Different configurations of bridge controlled rectifiers: Full bridge, half bridge with common anode, common cathode, SCR sin one arm and diode sin another arm.	
V	Industrial Control Circuits	Applications: Burglar's alarm system, Battery charger using SCR, Emergency light system, Temperature controller using SCR and; Illumination control/fan speed control TRIAC, SMPS, UPS: Offline and Online SCR based AC and DC circuit breakers.	

References:

1. Ramamoorthy M., An Introduction to Thyristors and their applications, East-West Press Pvt. Ltd., New Delhi, ISBN:8185336679.
2. Sugandhi, Rajendra Kumarand Sugandhi, Krishna Kumar, Thyristors: Theory and Applications, New Age International(P)ltd.Publishers,NewDelhi,ISBN:978-0-85226-852-0.
3. Bhattacharya, S. K., Fundamentals of Power Electronics, Vikas Publishing House Pvt. Ltd. Noida. ISBN:978-8125918530.
4. Jain& Alok, Power Electronics and its Applications, Penram International Publishing (India) Pvt. Ltd, Mumbai, ISBN:978-8187972228.
5. Rashid, Muhammad, Power Electronics Circuits Devices and Applications, Pearson Education India, Noida, ISBN:978-0133125900.
6. Singh, M. D. and Khanchandani, K. B., Power Electronics, Tata Mc Graw Hill Publishing Co. Ltd, New Delhi, 2008 ISBN:9780070583894.
7. Zbar, PaulB., Industrial Electronics: A Text–Lab Manual, Mc Graw Hill Publishing Co. Ltd., New Delhi, ISBN:978-0070728226.
8. Grafham D. R., SCR Manual, GeneralElectricCo.,ISBN:978-0137967711.

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented Cos associated with the above mentioned competency:

- a) Select power electronic devices for specific applications.
- b) Maintain the performance of Thyristors.
- c) Troubleshoot turn-on and turn-off circuits of Thyristors.
- d) Maintain phase controlled rectifiers.
- e) Maintain industrial control circuits.

Course Name: Fundamentals Of Power Electronics Laboratory	Duration: 6 months
Course Code: DEEC491	Contact:
Semester: IV	Credit: 1

Course objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain the proper functioning of power electronic devices.

Practical:

1. Test the proper functioning of power transistor.
2. Test the proper functioning of IGBT.
3. Test the proper functioning of DIAC to determine the break over voltage.
4. Determine the latching current and holding current using V-I characteristics of SCR.
5. Test the variation of R, C in R and RC triggering circuits on firing angle of SCR.
6. Test the effect of variation of R, C in UJT triggering technique.
7. Perform the operation of Class–A, B, C, turn off circuits.
8. Perform the operation of Class– D,E,F turn off circuits.
9. Use CRO to observe the output wave form of half wave controlled rectifier with resistive load and determine the load voltage.
10. Draw the output wave form of Full wave controlled rectifier with R load, RL load, freewheeling diode and determine the load voltage.
11. Determine the firing angle using DIAC and TRIAC phase controlled circuit on output power under different loads such as lamp, motor or heater.
12. Simulate above firing angle control on SCILAB software
13. Test the performance of given SMPS, UPS.
14. Troubleshoot the Burglar’s alarm, Emergency light system, Speed control system, Temperature control system.

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented Cos associated with the above mentioned competency:

- a) Select power electronic devices for specific applications.
- b) Maintain the performance of Thyristors.
- c) Troubleshoot turn-on and turn-off circuits of Thyristors.
- d) Maintain phase controlled rectifiers.
- e) Maintain industrial control circuits.

Course Name: Electric Power Transmission And Distribution	Duration: 6 months
Course Code: DEEC402	Contact:
Semester: IV	Credit: 3

Course objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain the proper functioning of the electrical transmission and distribution systems.

Course Content

Unit No	Module Name	Content	Hrs
I	Basics of Transmission and Distribution	<p>Single line diagrams with components of the electric supply transmission and distribution systems.</p> <p>Classification of transmission lines: Primary and secondary transmission; standard voltage level used in India.</p> <p>Classification of transmission lines: based on type of voltage, voltage level, length and others</p> <p>Characteristics of high voltage for power transmission.</p> <p>Method of construction of electric supply transmission system–110kV,220kV,400kV.</p> <p>Method of construction of electric supply distribution systems–220V,400V,11kV,33kV</p>	
II	Transmission Line Parameters and Performance	<p>Line Parameters: Concepts of R, L and C of line parameters and types of lines. Performance of short line: Efficiency, regulation and its derivation, effect of power factor, vector diagram for different power factor. Performance of medium line: representation, nominal 'T', nominal 'π' and end condenser methods. Transposition of conductors and its necessity. Skin effect and proximity effect.</p>	
III	Extra High Voltage Transmission	<p>Extra High Voltage AC (EHVAC) transmission line: Necessity, high voltage substation components such as transformers and other switchgears, advantages, limitations and applications and lines in India. Ferranti and Corona effect. High Voltage DC (HVDC) Transmission Line: Necessity, components, advantages, limitations and applications. Layout of monopolar, bi-Polar and homo-polar transmission lines. Lines in India.</p> <p>Features of EHVAC and HVDC transmission line.</p> <p>Flexible AC Transmission line: Features, d types of FACTS controller. New trends in wireless transmission of electrical power.</p>	

IV	A.C Distribution System	<p>AC distribution: Components classification, requirements of an ideal distribution system, primary and secondary distribution system.</p> <p>Feeder and distributor, factors to be considered in design of feeder and distributor.</p> <p>Types of different distribution schemes: radial, ring, and grid, layout, advantages, disadvantages and applications.</p> <p>Voltage drop, sending end and receiving end voltage.</p> <p>Distribution Sub-Station: Classification, site selection, advantages, disadvantages and applications.</p> <p>Single Line diagram (layout) of 33/11KV SubStation, 11KV/400V sub-station, Symbols and functions of their components.</p>	
V	Components of Transmission and Distribution Line	<p>Overhead Conductors: Properties of material, types of conductor with trade names, significance of sag.</p> <p>Line supports: Requirements, types of line structures and their specifications, methods of erection.</p> <p>Line Insulators: Properties of insulating material, selection of material, types of insulators and their applications, causes of insulator failure, derivation of equation of string efficiency for string of three suspension insulator, methods of improving string efficiency.</p> <p>Underground Cables: Requirements, classification, construction, comparison with overhead lines, cable laying and cable jointing.</p>	

References:

1. G.C.Garg, Utilization of Electric Power & Electric Traction, Khanna Book Publishing Co., New Delhi (ISBN:978-93-86173-355)
2. Mehta, V. K., Principles of Power System, S. Chand and Co. New Delhi, ISBN:9788121924962
3. Soni; Gupta; Bhatnagar, A Course in Electrical Power, Dhanpat Rai and Sons New Delhi, ISBN: 9788177000207
4. Gupta, J.B., A Course in Power Systems, S. K. Kataria and sons, New Delhi, ISBN:9788188458523
5. Theraja, B. L.; Theraja, A. K., A Text book of Electrical Technology Vol. III, S. Chand and Co. New Delhi, ISBN :9788121924900
6. Uppal, S.L., A Course in Electrical Power, S.K. Khanna Publisher New Delhi, ISBN:9788174092380
7. Sivanagaraju S.; Satyanarayana S., Electrical Power Transmission and Distribution, Pearson Education, New Delhi, ISBN:9788131707913
8. Ned Mohan, Electrical Power System: A First Course, Wiley India Pvt. Ltd. New Delhi, ISBN:9788126541959
9. Gupta, B. R., Power System Analysis and Design, S. Chand and Co. New Delhi, ISBN:9788121922388
10. Kamraju, V., Electrical Power Distribution System, Tata McGraw-Hill, New Delhi, ISBN:9780070151413

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented Cos associated with the above mentioned competency:

- a) Interpret the normal operation of the electric transmission and distribution systems.
- b) Maintain the functioning of the medium and high voltage transmission system.
- c) Interpret the parameters of the extra high voltage transmission system.
- d) Maintain the functioning of the low voltage AC distribution system.
- e) Maintain the components of the transmission and distribution lines.

Course Name: Electric Power Transmission And Distribution Laboratory	Duration: 6 months
Course Code: DEEC492	Contact:
Semester: IV	Credit: 1

Course objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain the proper functioning of the electrical transmission and distribution systems.

Course contents:

Laboratory work is not applicable for this course.

Following are the suggested student-related co-curricular activities which can be undertaken to accelerate the attainment of the various out comes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their(student's) portfolio which will be useful for their placement interviews:

- a. Prepare a report based on transmission line network in Maharashtra.
- b. Collect the information on components of transmission line.
- c. Evaluate transmission line performance parameters of a given line.
- d. Library/Internet survey of electrical high voltage line and HVDC lines.
- e. Visit to 33/11KV and 11KV/400V Distribution Substation and write a report.

Also one micro-project can be assigned to the student. A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

- a. Prepare a model showing:
 - i. Single line diagram of electric supply system.
 - ii. Single line diagram of a given distribution system.
 - iii. Short line and medium transmission line.
 - iv. Write a report on the same by giving the details of lines in Maharashtra State.
- b. Collect different samples of Overhead Conductors, Underground Cables, Line supports and Line Insulators.
- c. Prepare a power point presentation:
 - i. Extra High Voltage AC Transmission line.
 - ii. High Voltage DC Transmission line.
 - iii. Flexible AC Transmission line.
 - iv. New trend sin wireless transmission of electrical power.
- d. Collect information on:
 - i. A.C Distribution System adjacent to your institute.
 - ii. Draw a layout diagram of 11KV/400V substation in your campus/adjacent substation.

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented Cos associated with the above mentioned competency:

- a) Interpret the normal operation of the electric transmission and distribution systems.
- b) Maintain the functioning of the medium and high voltage transmission system.
- c) Interpret the parameters of the extra high voltage transmission system.
- d) Maintain the functioning of the low voltage AC distribution system.
- e) Maintain the components of the transmission and distribution lines.

Course Name: Induction, Synchronous And Special Electric Machines	Duration: 6 months
Course Code: DEEC403	Contact:
Semester: IV	Credit: 3

Course objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain Induction, Synchronous and FHP Machines used in different applications.

Course Content

Unit No	Module Name	Content	Hrs
I	Three Phase Induction Motor	<p>Working principle: production of rotating magnetic field, Synchronous speed, rotor speed and slip.</p> <p>Constructional details of 3 phase induction motors: Squirrel cage induction motor and Slip ring induction motor.</p> <p>Rotor quantities: frequency, induced emf, power factor at starting and running condition.</p> <p>Characteristics of torque versus slip(speed), Torques: starting, full load and maximum with relations among them.</p> <p>Induction motor as a generalized transformer with phasor diagram. Four quadrant operation, Power flow diagram.</p> <p>Starters: need and types; stator resistance, auto transformer, star delta, rotor resistance and soft starters.</p> <p>Speed control methods: stator voltage, pole changing, rotor resistance and VVVF. Motor selection for different applications as per the load torque-speed requirements. Maintenance of three phase induction motors</p>	
II	Single phase induction motors	Double field revolving theory, principle of making these motors self-start.	

		<p>Construction and working: Resistance start induction run, capacitor start induction run, capacitor start capacitor run, shaded pole, repulsion type, series motor, universal motor, hysteresis motor.</p> <p>Torque-speed characteristics for all of the above motors.</p> <p>Motor selection for different applications as per the load torque-speed requirements. Maintenance of single phase induction motors</p>	
III	Three phase Alternators	<p>Principle of working, moving and stationary armatures.</p> <p>Constructional details: parts and their functions, rotor constructions. Windings: Single and Double layer.</p> <p>E.M.F. equation of an Alternator with numerical by considering short pitch factor and distribution factor.</p> <p>Alternator loading: Factors affecting the terminal voltage of alternator; Armature resistance and leakage reactance drops.</p> <p>Armature reaction at various power factors and synchronous impedance. Voltage regulation: direct loading and synchronous impedance methods.</p> <p>Maintenance of alternators.</p>	
IV	Synchronous motors	<p>Principle of working /operation, significance of load angle.</p> <p>Torques: starting torque, running torque, pull in torque, pull out torque. Synchronous motor on load with constant excitation(numerical), effect of excitation at constant load(numerical).</p> <p>V-Curves and Inverted V-Curves. Hunting and Phases winging.</p> <p>Methods of Starting of Synchronous Motor.</p> <p>Losses in synchronous motors and efficiency (no numerical). Applications areas</p>	
V	Fractional horse power (FHP) Motors	<p>Construction and working: Synchronous Reluctance Motor, Switched Reluctance Motor, BLDC, Permanent Magnet Synchronous Motors, stepper motors, AC and DC servomotors.</p> <p>Torque speed characteristics of above motors.</p> <p>Applications of above motors.</p>	

References:

1. P.S. Bimbhra, Electric Machines, Khanna Book Publishing Co., New Delhi (ISBN:978-93-86173-294)
2. Mittle, V. N. and Mittle, Arvind., Basic Electrical Engineering, Mc Graw Hill Education New Delhi, ISBN:9780070593572
3. Kothari, D.P. and Nagrath,I.J., Electrical Machines, Mc Graw Hill Education. New Delhi,ISBN:9780070699670
4. Bhattacharya, S.K., Electrical Machines, Mc Graw Hill Education, New Delhi, ISBN:9789332902855
5. Theraja,B.L.,ElectricalTechnologyVol-II(ACandDCmachines),S.ChandandCo.Ltd.,NewDelhi, ISBN :9788121924375
6. Sen, S. K., Special Purpose Electrical Machines, Khanna Publishers, New Delhi, ISBN: 9788174091529
7. Janardanan E. G, Special Electrical Machines, Prentice Hall India, New DelhiISBN:9788120348806
8. Hughes E., Electrical Technology, ELBS.
9. Cotton H., Electrical Technology, ELBS.

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented Cos associated with the above mentioned competency:

- a) Maintain three phase induction motor used in different applications.
- b) Maintain single phase induction motor used in different applications.
- c) Maintain three phase alternators used in different applications.
- d) Maintain synchronous motors used in different applications.
- e) Maintain FHP motors used in different applications.

Course Name: Induction, Synchronous and special electric machines laboratory	Duration: 6 months
Course Code: DEEC493	Contact:
Semester: IV	Credit: 1

Course objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain Induction, Synchronous and FHP Machines used in different applications.

Practical:

1. Identify the different parts (along with function and materials) for the given single phase and three phase induction motor.
2. Connect and run the three phase squirrel cage induction motors (in both directions) using the DOL, star-delta, auto-transformer starters (any two).
3. Perform the direct load test on the three phase squirrel cage induction motor and plot the i) efficiency versus output, ii) power factor versus output, iii) power factor versus motor current and iv) torque–slip/speed characteristics.
4. Conduct the No-load and Blocked-rotor tests on given 3 phase squirrel cage induction motor and

- determine the equivalent circuit parameters.
5. Conduct the No-load and Blocked- rotor tests on given 3 phase squirrel cage induction motor and plot the Circle diagram.
 6. Control the speed of the given three phase squirrel cage / slip ring induction motor using the applicable methods: i) auto-transformer, ii) VVVF.
 7. Measure the open circuit voltage ratio of the three phase slipring induction motor.
 8. Conduct the direct load test to determine the efficiency and speed regulation for different loads on the given single phase induction motor; plot the efficiency and speed regulation curves with respect to the output power.
 9. Perform the direct loading test on the given three phase alternator and determine the regulation and efficiency.
 10. Determine the regulation and efficiency of the given three phase alternator from OC and SC tests (Synchronous impedance method)
 11. Conduct the test on load or no load to plot the 'V' curves and inverted 'V' curves (at no-load) of 3-phase synchronous motor.
 12. Dismantling and reassembling of single phase motors used for ceiling fans, universal motor for mixer.
 13. Control the speed and reverse the direction of stepper motor.
 14. Control the speed and reverse the direction of the AC servo motor.
 15. Control the speed and reverse the direction of the DC servo motor.

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented Cos associated with the above mentioned competency:

- a) Maintain three phase induction motor used in different applications.
- b) Maintain single phase induction motor used in different applications.
- c) Maintain three phase alternators used in different applications.
- d) Maintain synchronous motors used in different applications.
- e) Maintain FHP motors used in different applications.

Semester V

Course Name: Microcontroller Applications	Duration: 6 months
Course Code: DEEC501	Contact:
Semester: V	Credit: 3

Course objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain different types of microcontroller based systems.

Course Content

Unit No	Module Name	Content	Hrs
I	Introduction to Microcontrollers	Evolution of Microcontrollers, Block diagram of Microcomputer, elements of Microcomputer, types of	

		buses Von Neuman and Harward Architecture Compare Microprocessor and Microcontrollers Need of Microcontroller. Family of Microcontrollers and their specifications Versions of Microcontroller 8951, 89C1051, 89C2051, 89C4051 with their specifications and comparison.	
II	Architecture of Microcontroller 8051	Block diagram of 8051, function of each block Pin diagram, function of each pin. Concept of Internal memory and External memory (RAM and ROM) Internal RAM structure, Reset and clock circuit, Various registers and SFRs of 8051	
III	8051 Instruction Set and Programs	Overview of 8051 instruction set Various addressing modes Classification of instructions Data transfer instructions Arithmetic instructions Logical instructions Branching instructions. Bit manipulation instructions Stack, sub routine and interrupt related instructions Programs based on above instructions.	
IV	Assembly Language Programming	Software development steps, Software development tools like Editor, Assembler, Linker, Loader and Hex converters. Role of various files created at various levels in running assembly program using simulators like RIDE or KEIL. Various directives of Assembly language programming Programs using directives.	
V	8051 Internal Peripherals and Related Programs	I/O ports- List, diagram, read write operation, instructions and related SFRs Timers/counters – list, related SFRs, programming modes, operations with diagram. Serial communication- Basics of serial communication, baudrate, related SFRs, programming modes, operations with diagram. Interrupts- related SFRs, types, operations with diagram. Power saving operation- modes, related SFR.	

References:

1. Kenneth, Ayala, 8051 Microcontroller Architecture Programming and Application, PHI Learning, New Delhi, ISBN:978-1401861582
2. Mazidi, Mohmad Ali; Mazidi, Janice Gelispe; MckinlayRoline D., The 8051 Microcontroller and Embedded system, Pearson Education, Delhi, ISBN978-8177589030
3. Pal, Ajit, Microcontroller Principle and Application, PHI Learning, New Delhi, ISBN13: 978-81-203-4392-4
4. Deshmukh, Ajay, Microcontroller Theory and Application, McGraw Hill., New Delhi, ISBN-9780070585959
5. Kamal, Raj, Microcontroller Architecture Programming, Interfacing and System Design, Pearson Education India, Delhi, ISBN:9788131759905
6. Mathur; Panda, Microprocessors and Microcontrollers, PHI Learning, New Delhi, ISBN:978-81-

203-5231-5

7. KrishnaKant, Microprocessors and Microcontrollers: Architecture programming and System Design, PHI Learning, New Delhi, ISBN:978-81-203-4853-0

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented Cos associated with the above mentioned competency:

- a) Interpret the salient features of various types of microcontrollers.
- b) Interpret the salient features of archetype of type smicrocontrollersIC8051.
- c) Maintain the program features of the Microcontroller based application.
- d) Develop assembly language program.
- e) Develop programs to interface 8051microcontrollers with LED/SWITCH.

Course Name: Microcontroller Applications Laboratory	Duration: 6 months
Course Code: DEEC591	Contact:
Semester: V	Credit: 1

Course objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain microcontroller based systems.

Practical:

1. Interpret details of Hard ware kit for Microcontroller and practice to write and execute programs.
2. Identify different menus available in a simulator software RIDE/KEIL and demonstrate their use.
3. Develop and execute Assembly language programs using Arithmetic Instructions and demonstrate outcome for a given input data.
4. Develop and execute Assembly language programs using Logical Instructions and demonstrate outcome for a given input
5. Develop and execute an Assembly language program for Addition of series of 8 bit no's,16 bit result and demonstrate outcome for a given input data.
6. Develop and execute Assembly language program for addition/subtraction of 16 bit no/multi byte no's. and demonstrate outcome for a given input data.
7. Develop and execute Assembly language program for Block transfer from and to Internal/External memory using directives and demonstrate outcome for a given input data.
8. Develop and execute Assembly language program Largest/smallest of given series of no. from Internal/External memory and demonstrate outcome for a given input data.
9. Develop and execute Assembly language program arrange no in ascending/descending order from Internal/External memory and demonstrate outcome for a given input data.
10. Develop and execute Assembly language program for LED blinking/LED sequences using delay/timer mode.
11. Develop and execute Assembly language program to interface LED with microcontroller.

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented Cos associated with the

above mentioned competency:

- Interpret the salient features of various types of microcontrollers.
- Interpret the salient features of architype of types microcontrollers IC 8051.
- Maintain the program features of the Microcontroller based application.
- Develop assembly language program.
- Develop program to interface 8051 microcontrollers with LED/SWITCH.

Course Name: Energy Conservation And Audit	Duration: 6 months
Course Code: DEEC502	Contact:
Semester: V	Credit: 3

Course objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Under take energy conservation and energy audit.

Course Content

Unit No	Module Name	Content	Hrs
I	Energy Conservation Basics	Energy Scenario: Primary and Secondary Energy, Energy demand and supply, National scenario. Energy conservation and Energy audit; concepts and difference Indian Electricity Act2001; relevant clauses of energy conservation BEE and its Roles MEDA and its Roles Star Labelling: Need and its benefits.	
II	Energy Conservation in Electrical Machines	Need for energy conservation in induction motor and transformer. Energy conservation techniques in induction motor by: Improving Power quality. Motor survey. Matching motor with loading. Minimizing the idle and redundant running of motor. Operating in star mode. Rewinding of motor. Replacement by energy efficient motor Periodic maintenance. Energy conservation techniques in Transformer. Loading sharing. Parallel operation Isolating techniques. Replacement by energy efficient transformers. Periodic maintenance. Energy Conservation Equipment: Soft starters, Automatic star delta convertor, Variable Frequency Drives, Automatic p.f. controller (APFC), Intelligent p.f. controller (IPFC) Energy efficient motor; significant features, advantages, applications and limitations. Energy efficient transformers, amorphous transformers; epoxy Resin cast transformer/Dry	

		type of transformer.	
III	Energy conservation in Electrical Installation systems	<p>Aggregated Technical and commercial losses (ATC); Power system at state, regional, national and global level.</p> <p>Technical losses; causes and measures to reduce by.</p> <ol style="list-style-type: none"> Controlling I^2R losses. Optimizing distribution voltage Balancing phase currents Compensating reactive power flow <p>Commercial losses: pilferage, causes and remedies.</p> <p>Energy conservation equipment: Maximum Demand Controller, kVAR Controller, Automatic Power Factor controller (APFC)</p> <p>Energy Conservation in Lighting System</p> <ol style="list-style-type: none"> Replacing Lamp sources. Using energy efficient luminaries. Using light controlled gears. Installation of separate transformer/servo stabilizer for lighting. Periodic survey and adequate maintenance programs. Energy Conservation techniques in fans, Electronic regulators. 	
IV	Energy conservation through Cogeneration and Tariff	<p>Co-generation and Tariff; concept, significance for energy conservation co-generation. Types of co-generation on basis of sequence of energy use (Topping cycle, Bottoming cycle). Types of co-generation basis of technology (Steam turbine co-generation, Gas turbine co-generation, Reciprocating engine co-generation).</p> <p>Factors governing the selection of co-generation system. Advantages of co-generation.</p> <p>Tariff: Types of tariff structure: Special tariffs; Time-off-day tariff, Peak-off-day tariff, Power factor tariff, Maximum Demand tariff, Load factor tariff.</p> <p>Application of tariff system to reduce energy bill.</p>	
V	Energy Audit of Electrical System	<p>Energy audit (definition as per Energy Conservation Act) Energy audit instruments and their use.</p> <p>Questionnaire for energy audit projects. Energy flow diagram (Sankey diagram).</p> <p>Simple payback period, Energy Audit procedure (walk through audit and detailed audit).</p> <p>Energy Audit report format.</p>	

References:

1. Guide Books No. 1 and 3 for National Certification Examination for Energy Managers and Energy Auditors, Bureau of Energy Efficiency (BEE), Bureau of Energy Efficiency (A Statutory body
Diploma EE Page 67 of 111

- under Ministry of Power, Government of India)(Fourth Edition 2015).
2. O.P. Gupta, Energy Technology, Khanna Publishing House, New Delhi.
 3. Henderson, P. D., India - The Energy Sector, University Press, Delhi, 2016. ISBN: 978-0195606539.
 4. Turner, W.C., Energy Management Handbook, Fairmount Press, 2012, ISBN 9781304520708
 5. Sharma, K. V., Venkataseshaiyah; P., Energy Management and Conservation, I K International Publishing House Pvt. Ltd; 2011 ISBN 9789381141298
 6. Mehta, V.K., Principles of Power System, S. Chand & Co. New Delhi, 2016, ISBN 9788121905947
 7. Singh, Sanjeev; Rathore, Umesh, Energy Management, SK Kataria & Sons, New Delhi ISBN-13: 9789350141014.
 8. Desai, B. G.; Rana, J. S.; A. Dinesh, V.; Paraman, R., Efficient Use and Management of Electricity in Industry, Devki Energy Consultancy Pvt. Ltd.
 9. Chakrabarti, Aman, Energy Engineering And Management, e-books Kindle Edition.

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented Cos associated with the above mentioned competency:

- a) Interpret energy conservation policies in India.
- b) Implement energy conservation techniques in electrical machines.
- c) Apply energy conservation techniques in electrical installations.
- d) Use Co-generation and relevant tariff for reducing losses in facilities.
- e) Under take energy audit for electrical system.

Course Name: Energy Conservation And Audit Laboratory	Duration: 6 months
Course Code: DEEC592	Contact:
Semester: V	Credit: 1

Course objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Under take energy conservation and energy audit.

Practical:

1. Identify star labelled electrical apparatus and compare the data for various star ratings.
2. Determine the ‘% loading’ of the given loaded Induction motor.
3. Determine the reduction in power consumption in star mode operation of Induction motor compared to delta mode.
4. Use APF Cunit for improvement of p.f. of electrical load.
5. Compare power consumption of different types of TL with choke, electronic ballast and LED lamps by direct measurements.
6. Determine the reduction in power consumption by replacement of lamps in a class room / laboratory.
7. Determine the reduction in power consumption by replacement of Fans and regulators in a class room /laboratory.
8. Collect electricity bill of an industrial consumer and suggest suitable tariff for energy conservation audits impact on energy bill.
9. Collect electricity bill of a commercial consumer and suggest suitable tariff for conservation and

- reduction of its energy bill.
10. Collect electricity bill of a residential consumer and suggest suitable means for conservation and reduction of the energy bill.
 11. Estimate energy saving by improving power factor and load factor for given cases.
 12. Prepare a sample energy audit questionnaire for the given industrial facility.
 13. Prepare an energy audit report (Phase-I)
 14. Prepare an energy audit report (Phase-II)
 15. Prepare an energy audit report (Phase-III)

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented Cos associated with the above mentioned competency:

- a) Interpret energy conservation policies in India.
- b) Implement energy conservation techniques in electrical machines.
- c) Apply energy conservation techniques in electrical installations.
- d) Use Co-generation and relevant tariff for reducing losses in facilities.
- e) Under take energy audit for electrical system.

Semester VI

Course Name: Building Electrification	Duration: 6 months
Course Code: DEEC601	Contact:
Semester: VI	Credit: 3

Course objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Design electrical installation systems in building complexes.

Course Content

Unit No	Module Name	Content	Hrs
I	Wiring Tools and Accessories	<p>Various tools required for wiring- screwdrivers, pliers, Try square, saws, hacksaw, chisel, hammers, mallet, rawlpunch, hand drill machine, portable drilling machine, files, plumb bob, line thread, electricians knife, test lamp, tester and their BIS specifications, application, care & maintenance of tools.</p> <p>Classification of electrical accessories- controlling, holding, safety, outlet BIS symbols of following electrical accessories.</p> <p>Switch—Their types according to construction such as surface switch, flush switch, and pull switch, rotary switch, knife switch, pendent switch, Main-switch(ICDP,ICTP).Their types according to working such as single pole, double pole, two-way,</p>	

		<p>two-way centre off, intermediate, series parallel switch</p> <p>Holders- Their types such as bayonet cap lamp holder, pendent holder, batten lamp holder, angle holder, bracket holder, tube light holder, screw type Edison and goliath Edison lamp holder, swivel lamp holder.</p> <p>Socket outlets and plugs- two pin, three-pin, multi pin sockets, two-pin and three-pin plug.</p> <p>Others- Iron connector, adaptor, and ceiling rose, distribution box, neutral link, bus-bar chamber. Wooden/ mica boards, Moulded/ MS Concealed boxes of different sizes. Modular accessories.</p>	
II	Electrical Wires and Underground Cables	<p>Conductors: - wire, cable, bus bar, stranded conductor, cable, armoured cable, flexible cable, solid conductor, PVC wires, CTS wire, LC wire, FR (Fire retardant) wire, Size of wire according to BIS. Tools used for measurement of wire size, Wire jointing methods.</p> <p>Classification of cables, low tension, high tension, and extra high tension cables, solid, oil filled and gas filled type.</p> <p>Cable insulation materials–vulcanized rubber (VIR), polyvinylchloride (PVC), cross linked polythene (XLPE), impregnated paper, Selection of suitable cable size and type from standard data. Cable jointing methods Cable laying methods. Factors determining selection of electric cables</p>	
III	Wiring Methods and wiring layout	<p>Factors determining these lection of wiring methods. Classification of wiring methods.</p> <p>PVC casing-capping wiring- wiring rules according to IS: 732-1983.</p> <p>Conduit wiring- Types of conduit, comparison between Metal and PVC conduit, types of conduit wiring (Surface/Concealed). Conduit wiring accessories, BIS rules for Metal and PVC conduit wiring. Comparison of various wiring systems. General BIS rules for domestic installations. Design, working and drawing of following electrical circuits: Simple light and fan circuits, Stair case wiring, Go-down wiring circuit, Bedroom lighting circuit, Corridor lighting circuit, Series parallel circuit, Master switch control circuit, Different lighting circuit using- Intermediate switch, Call bell circuit using bell indicator, Design of wiring circuits according to user's requirement.</p>	
IV	Residential Building Electrification	Domestic Dwellings/Residential Buildings: reading of Civil Engineering building drawing,	

		<p>Interpretation of electrical installation plan and electrical diagrams, electrical symbols as per IS:732. Electrical installation for residential building as per part I section 9 of NEC-2011.</p> <p>Difference between residential and industrial load, rules/requirements related to lighting load followed in electrical installations, Positioning of equipment. Lighting and power circuits: Light and fan circuit, Power circuit.</p> <p>Wiring and circuit Schematic diagram according to IS:2042(Part-I)-1962: multiline and single line representation.</p> <p>Load assessment: Selection of size of conductor, Selection of rating of main switch and protective switchgear.</p> <p>Design and drawing, estimation and costing of a residential installation having maximum 5KW load; Sequence to be followed for preparing estimate; Calculation of length of wire and other materials, labour cost.</p> <p>Testing of wiring installation as per IS:732-1982: Insulation resistance-between earth and conductors, between conductors, polarity test of single pole switches. Testing of earth continuity path.</p> <p>Residential building Service Connection-types Underground and overhead. Calculation of Material required for service connection</p>	
V	Protection of Electrical Installation	<p>Fuse in electric circuit: fuse element, fuse current rating, minimum fusing current, cut-off current, fusing factor, Fuse material.</p> <p>Types of fuses–Re-wirable, cartridge fuses (HRC and LRC), Fuse material Selection of fuse.</p> <p>Miniature circuit Breaker (MCB)-Construction, Principle rating and uses, Earth Leakage Circuit Breaker (ELCB)-Construction, Principle rating and uses. System and equipment earthing and its requirements, Earth, earth electrode, earth current, earth terminal, earthing wire, earthing lead, fault current, leakage current, Measurement of earth resistance using earth tester, Methods of reducing earth resistance, Methods of earthing as per IS3043: 1987 and their procedure- Driven pipe, pipe and plate earthing, modern methods of earthing,</p>	
VI	Illumination in Residential Installation	<p>Concept of Luminous flux, Luminous intensity, Lumen, Illumination or illuminance, Lux, Space-height ratio, utilization factor, depreciation factor, luminous efficiency-values for different luminaries.</p>	

		<p>Laws of Illumination-Inverse Square Law, Cosine Law, illumination received directly underneath, horizontal screen and screen moved horizontally at certain distance.</p> <p>Factors affecting the illumination. Different types of lighting arrangements,</p> <p>Luminous flux of different types of light sources, Lux level required for different places as per SP 72:2010.</p>	
--	--	---	--

References:

1. Raina, K.B. and S.K. Bhattacharya, Electrical Design Estimating and Costing, New Age International Ltd., New Delhi, ISBN 978-81-224-0363-3
2. Allagappan, N. S. Ekambarram, Electrical Estimating and Costing, New Delhi, ISBN-13: 9780074624784
3. Singh, Surjit, Electrical Estimating and Costing, Dhanpat Rai and Co. New Delhi, ISBN: 1234567150995
4. Gupta, J.B.: A Course in Electrical Installation Estimating and Costing, SK Kataria and Sons, New Delhi, ISBN: 978-93-5014-279-0
5. Bureau of Indian Standard, IS: 732-1989, Code of practice for electrical wiring installation
6. Bureau of Indian Standard, SP 30 National Electrical Code 2010
7. Bureau of Indian Standard, SP 72 National Lighting Codes 2010
8. E-REFERENCES:-
 - <http://nptel.ac.in/courses/108108076/1> , assessed on 18th January 2016
 - <http://www.electrical4u.com>, assessed on 18th January 2016
 - <https://www.youtube.com/watch?v=A9KSGAnjo2U>, assessed on 18th January 2016
 - <http://www.electricaltechnology.org/2015/09>, assessed on 30 Jan 2016
 - www.slideshare.net/bawaparam/made-by-param assessed on 30 Jan 2016
 - www.electricaltechnology.org/2013/09/electrical-wiring.html assessed on 16 March 2016.

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented Cos associated with the above mentioned competency:

- a) Select accessories, wires, cables and wiring systems for electrification.
- b) Design electrical wiring installation system for residential unit.
- c) Design proper illumination scheme for residential unit.
- d) Prepare wiring layouts on wiring board.
- e) Locate and diagnose faults in electrical wiring installation.
- f) Do proper earthing for building electrification.

Course Name: Building Electrification Laboratory	Duration: 6 months
Course Code: DEEC691	Contact:
Semester: VI	Credit: 1

Course objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Design electrical installation systems in building complexes.

Practical:

1. Prepare series testing board.
2. Select the electric wire using measuring and testing instruments for particular applications.
3. Identify cables of different current ratings.
4. Prepare wiring installation on a board showing control of one lamp, one fan and one socket from one switch board in PVC surface conduit wiring system.
5. Prepare wiring installation on a board.
6. Control one lamp from two different places using PVC surface conduit wiring system.
7. Prepare wiring installation on a board. Control one lamp from three different places using PVC surface conduit wiring system.
8. Prepare wiring installation on a board.
9. Perform go-down wiring for three blocks using PVC casing capping.
10. Design 2BHK residential installation scheme and estimate the material required. And draw the details required for installation on A4 size sheet.
11. Test wiring installation using megger.

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented Cos associated with the above mentioned competency:

- a) Select accessories, wires, cables and wiring systems for electrification.
- b) Design electrical wiring installation system for residential unit.
- c) Design proper illumination scheme for residential unit.
- d) Prepare wiring layouts on wiring board.
- e) Locate and diagnose faults in electrical wiring installation.
- f) Do proper earthing for building electrification.

Programme Elective Courses (Eepe*) Courses**

Course Name: Industrial Instrumentation And Condition Monitoring	Duration: 6 months
Course Code: EEPE***	Contact:
Semester:	Credit: 3

Course objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Use instrumentation equipment for condition monitoring and control.

Course Content

Unit No	Module Name	Content	Hrs
I	Fundamentals of instrumentation	Basic purpose of instrumentation. Basic block diagram (transduction, signal conditioning, signal presentation) and their function. Construction, working and application of switching devices-Push button, limit switch, float switch, pressure switch, thermostat, electromagnetic relay.	

II	Transducers	<p>Distinguish between Primary and Secondary, Electrical and Mechanical, Analog and Digital, Active and Passive. Mechanical devices pry. And sec. transducers.</p> <p>Advantages of electric transducers Required characteristics of transducers. Factors affecting the choice of transducers.</p> <p>Construction and principle of resistive transducer- Potentiometer– variac and strain gauges- No derivation. Only definition and formula for gauge factor Types of strain gauges like unbonded, bonded and semiconductor.</p> <p>Construction and principle of Inductive transducers- L.V.D.T. and R.V.D.T, their applications.</p> <p>Construction, principle and applications of transducers–Piezo-Electric transducer, photo-conductive cells, photo voltaic cells.</p>	
III	Measurement of Non-Electrical Quantities	<p>Temperature measurement- Construction and Working of RTD, Thermistor and Thermocouple, radiation pyrometer, technical specifications and ranges.</p> <p>Pressure measurement– Construction and working of bourdon tube, bellow diaphragm and strain gauge, Combination of diaphragm and inductive transducer, Bourdon tube and LVDT, bellow and LVDT, diaphragm capacitance and bridge Circuit.</p> <p>Construction and Working of Speed Measurement by contacting and non Contact Type-DC tachometer, photo- electric tachometer, toothed rotor tachometer Generator - magnetic pick- up and Stroboscope.</p> <p>Construction and Working of Vibration measurement by accelerometer-LVDT accelerometer, Piezo electric type.</p> <p>Construction and Working of Flow measurement by electromagnetic and Turbine Flow meter.</p> <p>Construction and Working of Liquid level measurement by resistive, inductive, Capacitive gamma rays and Ultrasonic methods.</p> <p>Construction and Working of Thickness measurement by resistive, inductive, capacitive, ultrasonic and Nuclear methods.</p>	
IV	Signal Conditioning	<p>Basic Concept of signal conditioning System. Draw pin configuration of IC 741.</p> <p>Define Ideal OP-AMP and Electrical Characteristics of OP-AMP.</p> <p>Different Parameters of op-amp:- Input offset voltage, Input offset current, Input bias current, Differential input resistance, CMMR, SVRR, voltage gain, output voltage, slew rate, gain band- width.</p>	

		<p>Output, short circuit current.</p> <p>Use of op-amp as inverting, non-inverting mode, adder, subtractor, and Working of Differential amplifier and instrumentation amplifier.</p> <p>Filters: Types of RC filters and frequency response- no derivation. Sample and hold circuits-operation and its application.</p>	
V	Data Acquisition System	<p>Generalized DAS-Block diagram and description of Transducer, signal conditioner, multiplexer, converter and recorder</p> <p>Draw Single Channel and Multi-channel DAS- Block diagram only. Difference between Signal Channel and Multi-Channel DAS.</p> <p>Data conversion-Construction and Working of Analog to digital conversion- successive approximation method, ramp type method.</p> <p>Digital to Analog conversion-Construction and Working of binary weighted resistance method.</p> <p>Concept and methods of data transmission of electrical and electronic transmission. Construction and principle of telemetry system and its type- Electrical telemetering system-</p> <p>Digital display device-operation and its application of seven segment display, dot matrix display and concept of $3\frac{1}{2}$, $4\frac{1}{2}$ digits, LED and LCD applications</p>	
VI	Condition Monitoring and Diagnostic Analysis	<p>Definition of condition monitoring Insulation deterioration Mechanism-factors affecting occurrence and rate of deterioration, types of stresses responsible for deterioration.</p> <p>Different tests on transformer, their purpose, and the necessary condition of machine. Tests on Circuit breaker, purpose and required condition of machine Tests on CT, purpose, item to be tested and required condition of machine. Power factor, capacitance/tan delta test.</p> <p>Insulation and Polarization index, DC winding resistance test, Turns Ratio test Tools and equipment used in Condition monitoring</p>	

References:

1. Sawhney, A.K. Electric and Electronic Measurement and instrumentation, Dhanpat Rai and Co. Author, Nineteenth revised edition 2011 reprint, 2014, ISBN:10:8177001000
2. Rangan, C.S.G.R. Sharma. and V.S.V. Mani, Instrumentation devices and system, Penram International Publishing India Pvt. Ltd. Fifth edition, ISBN:10:0074633503
3. Mehta, V.K. Electronics and instrumentation, Third edition - S. Chand and company Pvt Ltd Reprint, 2010, ISBN:81-219-2729-3
4. Singh, S.K. Industrial instrumentation and control, Tata McGraw-Hill, 1987. ISBN:007451914X, 9780074519141.
5. J.G. Joshi, Electronic Measurement and Instrumentation, Khanna Publishing House, New Delhi (ISBN:978-93-86173-621)

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented Cos associated with the above mentioned competency:

- a) Select relevant instruments used for measuring electrical and non-electrical quantities.
- b) Select relevant transducers/sensors for various applications.
- c) Use relevant instruments for measuring non-electrical quantities.
- d) Check the signal conditioning and telemetry system for their proper functioning.
- e) Use data acquisition systems in various applications.
- f) Under take condition monitoring for diagnostic analysis of electrical equipment.

Course Name: Industrial instrumentation and condition monitoring Laboratory	Duration: 6 months
Course Code: EEPE***	Contact:
Semester:	Credit: 1

Course objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Use instrumentation equipment for condition monitoring and control.

Practical:

1. Identify different switches used in instrumentation system.
2. Measure linear displacement by L.V.D.T.
3. Measure the strain with the help of strain gauge
4. Measure temperature by PT-100, thermistor, thermocouple along with simple resistance bridge.
5. Use Thermocouple to control the temperature of a furnace/machine.
6. Measure pressure using pressure sensor kit.
7. Measure angular speed using stroboscope and tachometer.
8. Measure the flow using flowmeter.
9. Use op-amp as inverter, non-inverting mode, adder, differentiator and integrator.
10. Convert digital data into analog data by using analog to digital converters and analog data into digital data by digital to analog converter.
11. Visit to testing center of electrical testing lab for tan delta and diagnostic tests and determine polarization index.
12. Prepare a Report on various tools and equipment used for condition monitoring of electrical machines] I9KYI

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented Cos associated with the above mentioned competency:

- a) Select relevant instruments used for measuring electrical and non-electrical quantities.

- b) Select relevant transducers/sensors for various applications.
- c) Use relevant instruments for measuring non-electrical quantities.
- d) Check the signal conditioning and telemetry system for their proper functioning.
- e) Use data acquisition systems in various applications.
- f) Under take condition monitoring for diagnostic analysis of electrical equipment.

Course Name: Industrial Automation And Control	Duration: 6 months
Course Code: EEPE***	Contact:
Semester:	Credit: 3

Course objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain Industrial Automation Systems.

Course Content

Unit No	Module Name	Content	Hrs
I	Introduction to Industrial Automation	Automation: Need and benefits. Types of automation system: Fixed, Programmable, Flexible. Different systems used for Industrial automation: PLC, HMI, SCADA, DCS, Drives. Evolution of PLC.	
II	PLC Fundamentals	Building blocks of PLC: CPU, Memory organization, Input-output modules (discrete and analog), Specialty I/O Modules, Power supply. Fixed and Modular PLC and their types, Redundancy in PLC module. I/O module selection criteria. Interfacing different I/O devices with appropriate I/O modules	
III	PLC Programming and Applications	PLC I/O addressing PLC programming Instructions: Relay type instructions, Timer instructions: On delay, off delay, retentive, Counter instructions: Up, Down, High speed, Logical instructions, Comparison Instructions, Data handling Instructions, Arithmetic instructions. PLC programming language: Functional Block Diagram (FBD), Instruction List. Structured text, Sequential Function Chart (SFC), Ladder Programming. Simple Programming examples using ladder logic: Language based on relay, timer counter, logical, comparison, arithmetic and data handling	

		instructions. PLC Based Applications: Motor sequence control, Traffic light control, Elevator control, Tank Level control, Conveyor system, Stepper motor control, Reactor Control Gate trigger circuits. – Resistance and Resistance-Capacitance circuits.	
IV	Electric Drives and special machines	Electric drives: Types, functions, characteristics, four quadrant operation. DC and AC drive controls: V/F control, Parameters, direct torque control. Drives: Specifications, Applications-Speed control of AC motor/DC Motor.	
V	Supervisory Control and Data Acquisition System (SCADA)	Introduction to SCADA: Typical SCADA architecture/block diagram, Benefits of SCADA Various editors of SCADA. Interfacing SCADA system with PLC: Typical connection diagram, Object Linking & embedding for Process Control (OPC) architecture, Steps in Creating SCADA Screen for simple object, Steps for Linking SCADA object (defining Tags and Items) with PLC ladder program using OPC. Applications of SCADA: Traffic light control, water distribution, pipeline control.	

References:

1. Dunning, G., Introduction to Programmable Logic Controllers, Thomson /Delmar learning, New Delhi, 2005,ISBN 13 :9781401884260
2. Jadhav, V. R., Programmable Logic Controller, Khanna publishers, New Delhi, 2017, ISBN: 9788174092281
3. Petruzella, F.D., Programmable Logic Controllers, McGraw Hill India, NewDelhi,2010,ISBN: 9780071067386
4. Hackworth, John; Hackworth, Federic, Programmable Logic Controllers, PHI Learning, New Delhi, 2003, ISBN :9780130607188
5. StenersonJon,Industrial automation and Process control, PHI Learning,NewDelhi,2003,ISBN 6. : 9780130618900
7. Mitra,Madhuchandra;Sengupta,Samarjit,Programmable Logic Controllers and Industrial Automation- An introduction,PenramInternationalPublication,2015,ISBN:9788187972174
8. Boyar, S. A., Supervisory Control and Data Acquisition, ISA Publication, USA, ISBN: 978-1936007097
9. BaileyDavid;WrightEdwin,PracticalSCADAforindustry,Newnes(animprintofElsevier),UK 2003,ISBN:0750658053

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented Cos associated with the above mentioned competency:

- a) Identify different types of automation systems.
- b) Interface I/O devices with the PLC modules.
- c) Develop PLC ladder programs for various applications.
- d) Select the suitable motor drives for different applications
- e) Prepare simple SCADA applications.

Course Name: Industrial Automation And Control Laboratory	Duration: 6 months
Course Code: EEPE***	Contact:
Semester:	Credit: 1

Course objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain Industrial Automation Systems.

Practical:

1. Identify various automation systems available in different appliances/devices/machines in day to day use.
2. Identify various parts of the given PLC and front panel status indicators.
3. Use PLC to test the START STOP logic using two inputs and one output.
4. Develop/Execute a ladder program for the given application using following:- timer, counter, comparison, logical, arithmetic instructions.
5. Use PLC to control the following devices like lamp, motor, push button switches, proximity sensor
6. Measure the temperature of the given liquid using RTD or Thermocouple and PLC.
7. Develop/test ladder program to blink the LED/lamp.
8. Develop/test the Ladder program for sequential control application of lamps/DC motors.
9. Develop ladder program for Traffic light control system.
10. Develop and test ladder program for pulse counting using limit switch/Proximity sensor.
11. Develop/test ladder program for Automated car parking system.
12. Develop/test ladder program for Automated elevator control.
13. Develop/test ladder program for rotating stepper motor in forward and reverse direction at constant speed.
14. Develop/test ladder program for tank water level control.
15. Develop/test ladder program for control of speed of stepper motor with suitable drivers.
16. Identify various front panel controls of VFD (smart drive).
17. Control speed of AC/DC motor using VFD.(VFD-Variable Frequency Drive)
18. Use various functions of SCADA simulation editors to develop simple project.
19. Develop a SCADA mimic diagram for Tank level control.
20. Develop SCADA mimic diagram for Flow control in a given system.
21. Simulate Tank level control using available SCADA system.

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented Cos associated with the above mentioned competency:

- a) Identify different types of automation systems.
- b) Interface I/O devices with the PLC modules.
- c) Develop PLC ladder programs for various applications.
- d) Select the suitable motor drives for different applications.

e) Prepare simple SCADA applications.

Course Name: Industrial Drives	Duration: 6 months
Course Code: EEPE***	Contact:
Semester:	Credit: 3

Course Objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain electric AC and DC Drives.

Course Content

Unit No	Module Name	Content	Hrs
I	Electric Drives	Need of Electric Drives, Functional Block diagrams of an electric drives. DC Motors, Motor Rating a. Series, Shunt and compound DC motors. b. Universal motor c. Permanent magnet motor d. DC servomotor e. Moving coil motor f. Torque motor. Starting and Braking of DC Motors. Brushless DC Motors for servo applications. Maintenance procedure.	
II	AC Motors	Single phase AC Motors a. Resistance split phase motors b. Capacitor run motors c. Capacitor start motors d. Shaded pole motors Three phase Induction Motors. a. Squirrel cage Induction motor b. Slip ring Induction Motor c. Starting methods of Induction Motor d. Braking methods of Induction Motor. Determination of Motor Rating. Maintenance procedure.	
III	DC Drives	Single phase SCR Drives a) Half wave converter	

		<p>b) Full wave converter c) Semi converter d) Dual converter</p> <p>Three Phase SCR Drives</p> <p>a) Half wave converter b) Full wave converter c) Semi converter d) Dual converter</p> <p>Reversible SCR Drives. Speed control methods of DC series Motor. Chopper Controlled DC Drives. Solar and battery powered vehicles Maintenance procedure.</p>	
IV	AC Drives	<p>Starting and Braking of Induction motors. Stator voltage control. Variable Frequency Control Voltage Source Inverter Control Current Source Inverter Control Rotor Resistance Control. Slip Power Recovery. Solar powered pump drives Maintenance procedure for AC drives. Sequences of stages & drives required in each stage for following applications:</p> <p>a) Textile mills b) Steel rolling mills c) Paper mills d) Sugar mills</p>	
V	Advanced Techniques of Motor Control	<p>Microcontroller/ Microprocessor based control for drives Phase locked loop control of DC motor. AC/DC motor drive using Microcomputer control. AC/DC motor drive using Microcontroller control. Synchronous Motor drives. Ratings & specifications of stepper motor. Stepper motor drives employing microcontroller (No programming).</p>	

References:

1. P.S.Bimbhra, Electric Machines, Khanna Book Publishing Co., New Delhi (ISBN:978-93-86173-294)
2. Saxena, S. B. Lal; Dasgupta, K., Fundamentals of Electrical Engineering, Cambridge university press pvt. Ltd., New Delhi, ISBN:9781107464353
3. Theraja, B.L.; Theraja, A.K., A Text Book of Electrical Technology Vol-II, S. Chand and Co. Ramnagar, New Delhi, ISBN:9788121924405
4. Mittle, V.N. ; Mittle, Arvind, Basic Electrical Engineering, McGraw Hill Education, Noida, ISBN: 9780070593572
5. Sen P.C., Power Electronics, Mcgraw-Hill Publishing Company Limited, New Delhi. ISBN:9780074624005
6. Dubey Gopal K., Fundamentals of Electrical Drives, Second Edition, Narosa Publishing House, New Delhi. ISBN:9788173194283

7. Subrahmanyam, Vedam, Electrical Drives Concepts and Applications, Mcgraw-Hill Publishing Company Limited, New Delhi. ISBN:9780070701991
8. Agrawal, Jai P., Power Electronic Systems Theory and Design, Pearson Education, Inc. ISBN9788177588859.
9. Deshpande M. V., Design and Testing of Electrical Machines, PHI Publication, ISBN: 9788120336452
10. Pillai, S.K., A first course on Electrical Drives, Wiley Eastern Ltd. New Delhi, ISBN:13:978-0470213995

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented Cos associated with the above mentioned competency:

- a) Select relevant DC motor for various electric drive applications.
- b) Select relevant AC motor for various electric drive applications.
- c) Maintain DC Drives.
- d) Maintain AC Drives.
- e) Maintain microprocessor/ micro controlled electric motors.

Course Name: Industrial Drives Laboratory	Duration: 6 months
Course Code: EEPE***	Contact:
Semester:	Credit: 1

Course objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain electric AC and DC Drives.

Practical:

1. Dismantle the given DC motor and identify its different parts
2. Dismantle the given AC motor and identify its different parts
3. Control the speed of DC Motor using armature voltage control method
4. Control the speed of DC Motor using field current control method
5. Measure the output voltage of chopper for resistive load by varying the frequency and/or duty cycle of chopper.
6. Control the speed of three phase squirrel cage induction motor using stator voltage control method.
7. Effect on speed of given D.C. series motor by varying armature voltage using step down chopper.
8. Observe the effect on speed of the given D.C. separately excited motor by varying voltage using step down chopper.
9. Control the speed of the given separately excited motor by changing the firing angle of SCR using single phase semi converter and measure the speed.
10. Control the speed of the given separately excited motor by changing the firing angle of SCR using single phase full converter and measure the speed
11. Control the speed of the given three phase induction motor by using constant V/f method and plot the graph between speed and frequency.
12. Control the speed of the given three phase induction motor by varying frequency and plot the graph between speed and frequency
13. Control the speed of the given synchronous motor drives using microcontroller.
14. Demonstrate High power SCR/power device and Heat sink and write their specifications and

- rating.
15. Control the speed of single phase capacitor split phase induction motor using DIAC–TRIAC circuit.
 16. Control the speed of DC motor drives using microcontroller.
 17. Identify different parts and assemble the given DC motor.
 18. Identify different parts and assemble the given AC motor.

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented Cos associated with the above mentioned competency:

- a) Select relevant DC motor for various electric drive applications.
- b) Select relevant AC motor for various electric drive applications.
- c) Maintain DC Drives.
- d) Maintain AC Drives.
- e) Maintain microprocessor/micro controlled electric motors.

Course Name: Communication Technologies	Duration: 6 months
Course Code: EEPE***	Contact:
Semester:	Credit: 3

Course objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Use relevant data communication technique.

Unit No	Module Name	Content	Hrs
I	Data Communication and Modulation	Data Communication and Modulation. Block diagram of communication system. Types of communication system: synchronous and asynchronous, simplex, half-duplex, full duplex, serial and parallel communication. Classification of communication technique: AM, FM, & PM on the basis of definition, waveform, bandwidth, modulation index. Modulation and demodulation: Block diagram of AM, FM, and PM. Pulse Modulation: Block diagram for waveform generation of PAM, PWM & PPM, working principle, advantages, disadvantages, and applications. Advantages of pulse modulation over AM and FM.	
II	Digital Modulation Techniques	Digital Communication: Block diagram and working principle, waveforms, strength and limitations. Sampling process, Nyquist sampling theorem, quantization process, quantization error, quantization noise. PCM: Block diagram, working principle, waveforms,	

		advantages, disadvantages, application of PCM. Principle of ASK, PSK, FSK. Application of ASK, PSK, FSK.	
III	Data Communication Media	Baud rate, Bit rate, types of errors in data communication and error correction techniques. Types of communication media and frequency band of operation. Guided media: Types of cable - twisted pair cable, coaxial cable, fiber optic cable. Unguided media: Microwave communication, Infrared communication.	
IV	Fibre Optics	Introduction to Fiber optic communication. Strength and limitations of fiber optic system. Light propagation: reflection, refraction, Snell's law. Light propagation through cable: Mode of propagation, index profile. Fibre optic cables: cable construction, fibre optics cable modes, single mode, step index fibre, multimode index fibre, multimode graded index fibre, fibre cable losses. Light source and Detector: Light emitting diode (LED), Photo Transistor, Laser diode, opto-coupler.	
V	Data Communication Protocols and Interfacing Standard	OSI (Open Systems Interconnection) Reference model. Introduction to protocol, FTP, SMTP, TCP/IP, UDP. LAN standards. Introduction to IEEE Standards for LAN and GPIB. RS-232 standard: Introduction, and working principle. Network topologies: introduction star, ring, tree, bus, mesh, hybrid. Basic functions of networking devices: modem, switches, routers, repeaters, hubs, bridges, gateway.	
VI	Advanced Data Communication	Introduction to Wi-Fi and Wi-Max. Bluetooth architecture and its layers, Universal serial bus (USB) architecture. Bluetooth and USB.	

References:

1. Wayne Tomasi, Electronic Communication System, Prentice Hall of India, ISBN 13: 9780130494924
2. Reynders D., Steve Macky, Wright Edvin, Practical Industrial Data Communications, Newnes publication, ISBN 10: 07506639523
3. George F. Kennedy, Barnard Davis, Electronic Communication System, Tata McGraw Hill, ISBN 13: 9780074636824
4. Forouzan B. A., Data Communication & Networking, McGraw Hill Education; 5 edition ISBN-13: 0073376226-978
5. Prasad K. V. K. K., Principles of Digital communications systems and computer networks, Dreamtech press, New Delhi, ISBN 13: 9788177223620
6. Tanenbaum, Andrew S. David J. Wetherall, Computer Networks, Pearson; 5 edition ISBN 13: 9788121924252
7. Kumar A., Text Book of Communication Engineering, Umesh Publication, ISBN 13: 978818114160

8. Kumar, D. Manjunath, Joy Kuri, Communication Networking, Academic Press Publication ISBN 13: 9780124287518
9. Hemant Kumar Garg, Soni Manish, Electronic Communication & Data Communication, University Book House Private Ltd., ISBN 13: 9788181980717
10. Kao, Charles K., Optical Fiber Systems: Technology, Design, and Applications, Published by McGraw-Hill Inc., US ISBN 13: 9780070332775
11. Agrawal, Govind P., Fiber Optic Communication System, Wiley; 4 edition ISBN: 13 9780470505113
12. Keiser, Gerd, Optical communications essentials, McGraw-Hill, New Delhi - 2003, ISBN 13: 9780071412049

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry-oriented COs associated with the above-mentioned competency:

- a) Identify the different types of data communication equipment and techniques.
- b) Use relevant digital modulation techniques.
- c) Interpret the specifications of the data communication media.
- d) Maintain the fibre optics networks for data communication.
- e) Use OSI model and relevant data communication protocols.
- f) Maintain wireless network environment.

Course Name: Communication Technologies Laboratory	Duration: 6 months
Course Code: EEPE***	Contact:
Semester:	Credit: 1

Course objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Use relevant data communication technique.

Practical:

1. Measure the modulation index of amplitude modulated wave and observe the effect of modulating signal voltage on it.
2. Measure the modulation index of the frequency modulated wave and observe the effect of modulating and Carrier signal voltage on Frequency Modulation.
3. Test Pulse Amplitude Modulation (PAM) signal.
4. Test Pulse Width Modulation signal.
5. Test Pulse Position Modulation Signal.
6. Test Pulse Code Modulation Signal.
7. Test Amplitude Shift Keying Signal.
8. Test Frequency Shift Keying Signal.
9. Test Phase shift Keying Signal.
10. Plot the V-I Characteristics of given Infra-Red Light Source (IR-LED).
11. Test UTP/STP cable in straight and crossover mode and by line tester.
12. Plot the V-I Characteristics of given Light Source (LED) and detector (phototransistor).
13. Use OFT trainer Kit given 1 mm diameter Plastic optical fiber at 650 nm to determine the Numerical Aperture (NA).
14. Create the scenario and study the performance of token ring LAN protocol through simulation and using trainer kit.

15. Install and configure TCP/IP protocol.
16. Perform the transfer of files from PC to PC using Windows.
17. Perform the transfer of a file from PC to another PC using Serial port RS-232.
18. Establish star topology using transmission media and network control device.
19. Establish Wireless Communication between five computers using wireless LAN.
20. Establish Bluetooth communication using 4G mobile and laptop.

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry-oriented COs associated with the above-mentioned competency:

- a) Identify the different types of data communication equipment and techniques.
- b) Use relevant digital modulation techniques.
- c) Interpret data communication media.
- d) Use fibre optics in data communication.
- e) Use OSI model and relevant data communication protocols.
- f) Maintain wireless network environment.

Course Name: Electrical Testing And Commissioning	Duration: 6 months
Course Code: EEPE***	Contact:
Semester:	Credit: 3

Course objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Follow standards safety procedures in testing and commissioning of electrical equipment.

Course Content

Unit No	Module Name	Content	Hrs
I	Electrical Safety and Insulation	<p>Do's and don'ts regarding safety in domestic electrical appliances as well for substation/ power station operators.</p> <p>Electrical safety in industry/power stations/substations at the time of operation/control/maintenance. Fire detection alarm, fire-fighting equipment.</p> <p>Factors affecting life of insulating materials, classifications of insulating materials as per IS:1271-1958.</p> <p>Measuring insulation resistance by different methods such as</p> <ol style="list-style-type: none"> i) Polarization ii) Dielectric absorption iii) Megger and to predict the condition of insulation <p>Reconditioning of insulation, Insulating oil - properties of insulating oil, causes of</p>	

		deterioration of oil, testing of transformer oil as per IS 1866-1961.	
II	Installation and Erection	<p>Concept of foundation for installation of machinery. Requirements of foundation for static and rotating electrical machinery.</p> <p>Concept of levelling and aligning. Procedure for levelling and aligning alignment of direct coupled drive, effects of mis-alignment.</p> <p>Installation of transformer as per I.S.-1886-1967 and procedure of installation of transformer. Requirements of installation of pole-mounted transformer.</p> <p>Requirements of installation of rotating electrical machines as per I.S. 900 – 1965.</p> <p>Devices and tools required for loading, unloading, lifting, and carrying heavy equipment and precautions to be taken while handling them.</p>	
III	Testing and Commissioning	<p>Concept of testing, objectives of testing. Roles of I.S.S. in testing of electrical equipment, types of tests and concepts, routine tests, type tests, supplementary tests, special tests, methods of testing - Direct/Indirect/Regenerative testing.</p> <p>Tolerances for the various items for equipment – transformer, induction motor, DC motor, synchronous machines.</p> <p>Commissioning, tests before commissioning for transformer, induction motor, alternator. Testing of transformer as per I.S. 1886-1967 and I.S. 2026-1962.</p> <p>Testing of three-phase induction motor as per I.S. 325-1970. Testing of single-phase induction motor as per I.S. 990-1965. Testing of synchronous machines as per I.S.S.</p> <p>Testing of D.C. machines.</p>	
IV	Troubleshooting Plans	<p>Internal and external causes for failure / abnormal operation of equipment.</p> <p>List of mechanical faults, electrical faults and magnetic faults in the electrical equipment remedies, applications.</p> <p>Use of tools like bearing puller, filler gauges, dial indicator, spirit level, megger, earth tester, and growler. Common troubles in electrical equipment and machines.</p> <p>Preparation of trouble shooting charts for D.C. Machines, AC Machines and transformers.</p>	
V	Maintenance	Concept of maintenance, types of maintenance, routine, preventive and breakdown maintenance.	

		<p>Causes of failure of electrical machines. Preventive maintenance - procedure for developing maintenance schedules for electrical machines. Factors affecting preventive maintenance schedules, concept of TPM, pillars of TPM. Identification of different types of faults developed such as mechanical/electrical/magnetic faults. Maintenance schedules of the following as per I.S.S.:</p> <p>a) Distribution transformer as per I.S. 1886-1967 b) Single-phase and three-phase induction motors as per I.S. 900-1965 c) Batteries</p>	
--	--	--	--

References:

1. Deshpande. M. V. PHILearning Pvt. Ltd., 2010, Design and Testing of Electrical Machines ISBN No 8120336453, 9788120336452.
2. Rao, BVS Asia Club House, First Reprint, 2011, Operation and Maintenance of Electrical Equipment Vol-I, ISBN No 8185099022
3. Rosenberg. McGRAW-HILL, 1st Edition, May 2003, Maintenance and Repairs, ISBN No 9780071396035
4. Sharotri, S. K. Glencoe/Mcgraw-Hill; 2nd Edition, June 1969; Preventive Maintenance of Electrical Apparatus, ISBN No 10:007030839X 13:978-0070308398

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry-oriented COs associated with the above mentioned competency:

- a) Follow safety procedures with respect to earthing and insulation of electrical equipment.
- b) Select proper tools, equipment, for installation, testing, maintenance of electrical machines and transformers.
- c) Test and commission electrical equipment in accordance with IS codes.
- d) Make plans for troubleshooting electrical machines.
- e) Undertake regular preventive and breakdown maintenance.

Course Name: Electrical testing and commissioning laboratory	Duration: 6 months
Course Code: EEPE***	Contact:
Semester:	Credit: 1

Course objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Follow standard safety procedures in testing and commissioning of electrical equipment.

Practical:

1. Determine breakdown strength of transformer oil.
2. Perform insulation resistance test on any one motor/transformer.
3. Prepare troubleshooting charts for electrical machines such as Transformer, D.C. machines,

Induction motor, and Synchronous machines.

4. Measure impedance voltage and load losses of three-phase transformer.
5. Find regulation and efficiency of single-phase transformer by direct loading and back-to-back connection method and compare the results.
6. Determine efficiency of D.C. machine by Swinburne's test.
7. Determine efficiency of D.C. machine by Hopkinson's test.
8. Perform reduced voltage running up test on three-phase Induction motor as per I.S. 325-1967.
9. Measure no load losses and no load current of a transformer as per IS.
10. Perform no load test on single-phase Induction motor for the measurements of no load current, power input, and speed at rated voltage as per I.S.
11. Perform temperature rise test on single-phase transformer.
12. Find efficiency of M.G. set.

Course Outcomes:

The theory, practical experiences, and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry-oriented COs associated with the above-mentioned competency:

- a) Follow safety procedures with respect to earthing and insulation of electrical equipment.
- b) Select proper tools, equipment, for installation, testing, maintenance of electrical machines and transformers.
- c) Test and commission electrical equipment in accordance with IS codes.
- d) Make plans for troubleshooting electrical machines.
- e) Undertake regular preventive and breakdown maintenance.

Course Name: Electrical Estimation And Contracting	Duration: 6 months
Course Code: EEPE***	Contact:
Semester:	Credit: 3

Course objectives:

The aim of this course is to help the student to attain the following industry-identified competency through various teaching and learning experiences:

- Design electrical installation with costing for tendering.

Course Content

Unit No	Module Name	Content	Hrs
I	Electric Installation and Safety	Scope and features of National Electric Code 2011 Types of electrical installation. Fundamental principles for electrical installation. Permit to work, safety instructions, and safety practices. Purpose of estimating and costing.	
II	Estimation and Costing	Meaning and purpose of: Rough estimate, detailed estimate, supplementary estimate, annual maintenance estimate, and revised estimate. Factors to be considered while preparation of detailed estimate and economical execution of work	

		<p>Contracts: Concepts of contracts, types of contracts, contractor, role of contractor.</p> <p>Tenders and Quotations: Type of tender, tender notice, preparation of tender document, and method of opening of tender.</p> <p>Quotation, quotation format, comparison between tender and quotation.</p> <p>Comparative statement: Format comparative statement, order format, placing of purchasing order.</p> <p>Principles of execution of works: Planning, organizing, and completion of work, billing of work.</p>	
III	Non-Industrial Installations	<p>Types of Non-industrial installations -- Office buildings, shopping and commercial centre, residential installation, Electric service and supply</p> <p>Design consideration of electrical installation in commercial buildings. Design procedure of installation -- steps involved in detail, Estimating and costing of unit Earthing of commercial installation. Design electrical installation scheme of commercial complex. Erection, Inspection and testing of installation as per NEC</p>	
IV	Industrial Installation	<p>Classification of industrial buildings Classification based on power consumption, Drawing of wiring diagram and single line diagram for single phase and three phase Motors. Design consideration in industrial installations Design procedure of installation -- detailed steps Design electrical installation scheme of factory/small industrial unit, Preparation of material schedule and detailed estimation Installation and estimation of agricultural pump and flour mill.</p>	
V	Public Lighting Installation	<p>Classification of outdoor installations streetlight/public lighting installation Streetlight pole structure. Selection of equipment, sources used in streetlight installations. Cables, recommended types and sizes of cable. Control of streetlight installation. Design, estimation and costing of streetlight Preparation of tenders and abstracts.</p>	
VI	Distribution Lines and LT Substation	<p>Introduction to overhead and underground distribution line. Materials used for distribution line HT and LV Cables used for distribution line, factors determining selection of LT/HT power Cables, cable laying and cable termination method according to IS Design, estimation and costing of HT LT overhead line and underground cabling. Types of 11KV Distribution substations their line diagram, Estimation of load, Load factor, diversity factor and determination of rating of distribution Transformer.</p>	

		Design, estimation and costing of outdoor and indoor 11 KV substation.	
--	--	--	--

References:

1. Raina, K. B.; Dr. S. K. Bhattacharya New Age International Publisher First, Reprint 2010, Electrical Design Estimating and Costing ISBN: 978-81-224-0363-3
2. Allagappan, N. S. Ekambarram, Tata Mc-Graw Hill Publishing Co. Ltd, Electrical Estimating and Costing, ISBN 13: 9780074624784
3. Singh, Surjit Ravi Deep Singh, Dhanpat Rai and Sons, Electrical Estimating and Costing, ISBN 13: 1234567150995
4. Gupta, J. B. S. K. Kataria and Sons Reprint Edition, A Course in Electrical Installation Estimating and Costing ISBN 10: 9350142791 13: 978-9350142790
5. Bureau of Indian Standard. IS: 732-1989, Code of Practice for Electrical Wiring Installation
6. Bureau of Indian Standard. SP-30: 2011, National Electrical Code 2011

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

- a) Follow National Electrical Code 2011 in electrical installations.
- b) Estimate the electrical installation works.
- c) Estimate the work of non-industrial electrical installations.
- d) Estimate the work of industrial electrical installations.
- e) Prepare abstract, tender, quotation of public lighting and other installations.
- f) Prepare abstract, tender, quotation of low tension (LT) substations.

Course Name: Electrical Estimation And Contracting Laboratory	Duration: 6 months
Course Code: EEPE***	Contact:
Semester:	Credit: 1

Course objectives:

The aim of this course is to help the student to attain the following industry-identified competency through various teaching and learning experiences:

- Design electrical installation with costing for tendering.

Practical:

1. Prepare a tender notice for purchasing a transformer of 200 KVA for commercial installation.
2. Prepare a quotation for purchasing different electrical material required.
3. Prepare a comparative statement for above material. Prepare purchase order for the same.
4. Design drawing, estimating and costing of hall/cinema theater/commercial installation. Prepare report and draw sheet.
5. Design electrical installation scheme for any one factory/small industrial unit. Draw detailed wiring diagram. Prepare material schedule and detailed estimate. Prepare report and draw sheet.
6. Estimate with a proposal of the electrical installation of street light scheme for small premises

after designing.

7. Estimate with a proposal of the L.T. line installation. Prepare report and draw sheet.
8. Estimate with a proposal of the 500 KVA, 11/0.433 KV outdoor substation and prepare a report.

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry-oriented COs associated with the above mentioned competency:

- a) Follow National Electrical Code 2011 in electrical installations.
- b) Estimate the electrical installation works.
- c) Estimate the work of non-industrial electrical installations.
- d) Estimate the work of industrial electrical installations.
- e) Prepare abstract, tender, quotation of public lighting and other installations.
- f) Prepare abstract, tender, quotation of low tension (LT) substations.

Course Name: Illumination Practices	Duration: 6 months
Course Code: EEPE***	Contact:
Semester:	Credit: 3

Course objectives:

The aim of this course is to help the student to attain the following industry-identified competency through various teaching-learning experiences:

- Design illumination schemes and associated electrification of buildings.

Course Content

Unit No	Module Name	Content	Hrs
I	Fundamentals of Illumination	Basic illumination, Terminology, Laws of illumination, Polar curves, Polar curve: its meaning and applications for designing the lamp. Concept of Photometry, Measurement of illumination. Lighting calculation methods, Watt/m ² method, Lumens or light flux method, Point to point method, Standards for illumination.	
II	Types of Lamps	Incandescent lamp, ARC lamps – AC and DC arc lamps, Fluorescent lamp. Types of other lamps: Mercury vapour lamp, HPMV lamp, Mercury iodide lamp, Sodium vapour lamp,	

		Halogen lamps, Ultraviolet lamps, Neon lamps, Neon sign tubes, Metal halides, HID and Arc lamps LED lamps, CFL, Lasers. Selection criteria for lamps.	
III	Illumination Control and Control Circuits	Purpose of lighting control, and Dimmer, Resistive type saltwater Dimmer. Working principle and operation of Dimmer. Transformer and their types, Dimmer Transformer, Autotransformer dimmer, Two-winding transformer dimmer. Electronic Dimmer: working principle and operation a. Thyristor operated dimmer b. Triac operated dimmer Control of Enhanced Lighting, Methods used for light control, Control circuits for lamps (refer): ON/OFF control. Control circuits for lamps: single lamp controlled by single switch, two switches. Single lamp control by two-point method, three-point method, and four-point method.	
IV	Illumination for Interior Applications	Standard for various locations of Interior Illumination. Design considerations for Interior location of residences (1/2/3/4 BHK), Commercial, Industrial premises. Illumination scheme for different Interior locations of Residential, Commercial, industrial units.	
V	Illumination for Exterior Applications	Factory Lighting, Street Lighting (Latest Technology), Flood Lighting, Railway Lighting Lighting for advertisement / Hoardings / Sports lighting, Agriculture and Horticulture lighting, Healthcare Centres / Hospitals, Decorating Purposes, Stage Lighting, Aquariums and Shipyards. Special purpose lamps used in photography, video films.	

References:

1. Lindsey, Jack L., Applied Illumination Engineering, The Fairmont Press Inc.
2. Simons, R. H., Bean, Robert; Lighting Engineering: Applied Calculations, Architectural Press. ISBN: 0750650516.
3. Casimer M. Decusatis, Handbook of Applied Photometry, Springer, ISBN 1563964163.
4. Butterworths, Lyons Stanley, Handbook of Industrial Lighting, Butterworths.
5. Simpson Robert S., Lighting Control Technology and Applications, Focal Press.
6. Kao Chen, Energy Management in Illuminating Systems, CRC Press.

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

- a) Select relevant lamps for various applications considering illumination levels.
- b) Select the lighting accessories required for selected wiring scheme.
- c) Design relevant illumination schemes for interior applications.
- d) Design illumination schemes for various applications.
- e) Design illumination schemes for various outdoor applications.

Course Name: Illumination Practices Laboratory	Duration: 6 months
Course Code: EEPE***	Contact:
Semester:	Credit: 1

Course Objectives:

The aim of this course is to help the student to attain the following industry-identified competency through various teaching and learning experiences:

- Design illumination schemes and associated electrification of buildings.

Practical:

1. Conduct illumination level assessment in workplace using lux meter.
2. Fit the given lamp in the selected mounting.
3. Interpret the polar curves of the given type of lamp and verify it using the lux meter.
4. Measure the illumination output of different lamps (Incandescent, Fluorescent, CFL, LED, HPSV, HPMV) and compare it with their wattage.
5. Measure illumination level with and without reflectors used in the various Luminaries.
6. Estimate and compare luminous efficiency of incandescent and compact fluorescent lamp.
7. Prepare light dimmer arrangement using the relevant dimmer type of transformer.
8. Identify the given types of dimmer transformer and their parts.
9. Build an electronic dimmer – Part I.
10. Build another type of electronic dimmer – Part II.
11. Build a single lamp control by single switch.
12. Build a single lamp control by two switches.
13. Build a single lamp control circuit for two-point method.
14. Build a lamp control circuit for three-point method.
15. Build a lamp control circuit for four-point method.

Course Outcomes:

The theory, practical experiences, and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry-oriented COs associated with the above mentioned competency:

- a) Select the relevant illumination levels for various applications.
- b) Select relevant lamps for various applications.
- c) Select the lighting accessories required for selected wiring scheme.
- d) Design relevant illumination schemes for interior applications.
- e) Design illumination schemes for various applications.
- f) Design illumination schemes for various outdoor applications.

Course Name: Switchgear And Protection	Duration: 6 months
Course Code: EEPE***	Contact:
Semester:	Credit: 3

Course objectives:

The aim of this course is to help the student to attain the following industry-identified competency through various teaching-learning experiences:

- Maintain switch gear and protection schemes used in electrical power systems.

Course Content

Unit No	Module Name	Content	Hrs
I	Basics of Protection	Necessity, functions of protective system. Normal and abnormal conditions. Types of faults and their causes. Protection zones and backup protection. Short circuit fault calculations in lines fed by generators through transformers. Need of current limiting reactors and their arrangements.	
II	Circuit Interruption Devices	Isolators - Vertical break, Horizontal break and Pantograph type. HRC fuses - Construction, working, characteristics and applications. Arc formation process, methods of arc extinction (High resistance and Low resistance), Arc voltage, Recovery voltage, Re-striking voltage, RRRV. HT circuit breakers (Sulphur-hexa Fluoride (SF ₆), Vacuum circuit breaker) - Working, construction, specifications and applications. L.T. circuit breaker (Air circuit breakers (ACB), Miniature circuit breakers (MCB), Moulded case circuit breakers (MCCB) and Earth leakage circuit breaker (ELCB)) - Working and applications. Selection of LT and HT circuit breakers (ratings), Selection of MCCB for motors. Gas insulated switchgear.	
III	Protective Relays	Fundamental quality requirements: Selectivity, Speed, Sensitivity, Reliability, Simplicity, Economy. Basic relay terminology - Protective relay, Relay time, Pickup, Reset current, current setting, Plug setting multiplier, Time setting multiplier. Protective relays: Classification, principle of working, construction and operation of - Electromagnetic (Attracted armature type, Solenoid type, Watt-hour meter type) relay, Thermal relay. Block diagram and working of Static relay. Overcurrent relay - Time current characteristics. Microprocessor based overcurrent relays: Block diagram, working. Distance relaying - Principle,	

		operation of Defined distance relays. Directional relay: Need and operation. Operation of current and voltage differential relay.	
IV	Protection of Alternator and Transformer	<p>Alternator Protection Faults, Differential protection, Overcurrent, earth fault, overheating and field failure, protection. Reverse power protection.</p> <p>Transformer Protection Faults, Differential, over current, earth fault, overheating protection, Limitations of differential protection. Buchholz relay: Construction, operation, merits and demerits.</p>	
V	Protection of Motors, Bus-bar and Transmission Line	<p>Motor Faults. Short circuit protection, Overload protection, Single phase preventer.</p> <p>Bus bar and Transmission Line Faults on Bus bar and Transmission Lines. Bus bar protection: Differential and Fault bus protection. Transmission line: Overcurrent, Distance and Pilot wire protection.</p>	

References:

1. Mehta V. K.; Rohit Mehta, Principles of Power System, S. Chand and Co., New Delhi., ISBN: 978-81-2192-496-2.
2. Rao. Sunil S., Switchgear and Protection, Khanna Publishers, New Delhi, ISBN: 978-81-7409-232-3.
3. Singh, R. P., Switchgear and Power System Protection, PHI Learning, New Delhi, ISBN: 978-81-203-3660-5.
4. Gupta, J. B., Switchgear and Protection, S. K. Kataria and Sons, New Delhi, ISBN: 978-93-5014-372-8.
5. Veerapan, N., Krishnamurthy, S. R., Switchgear and Protection, S. Chand and Co., New Delhi. ISBN: 978-81-2193-212-7.
6. Ram, Badri; Vishwakarma, D. N., Power System Protection and Switchgear, McGraw-Hill, New Delhi. ISBN: 978-07-107774-X

Course Outcomes:

The theory, practical experiences, and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry-oriented COs associated with the above-mentioned competency:

- a) Identify various types of faults in power system.
- b) Select suitable switchgears for different applications.
- c) Test the performance of different protective relays.
- d) Maintain protection systems of alternators and transformers.
- e) Maintain protection schemes for motors and transmission lines.
- f) Maintain protection schemes for power system against over voltages.

Course Name: Switchgear And Protection Laboratory	Duration: 6 months
Course Code: EEPE***	Contact:

Semester:	Credit: 1
------------------	------------------

Course Objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain switchgear and protection schemes used in electrical power systems.

Course Contents:

1. Identify various switchgears in the laboratory and write their specifications.
2. Test HRC fuse by performing the load test.
3. Test MCB by performing the load test.
4. Dismantle MCCB/ELCB and identify various parts.
5. Dismantle ACB/VCB and identify different parts.
6. Set the plug and time (with PSM, TSM) of induction type electromagnetic relay.
7. Test electromagnetic over-current relay by performing load test.
8. Simulate differential protection scheme for transformer with power system simulation kit.
9. Test the working of the single phasing preventer using a three-phase induction motor.
10. Simulate transmission line protection by using the impedance relay/over-current relay for various faults. (On transmission line protection simulation kit).
11. Dismantle Thyrite type arrester and identify different parts.
12. Perform neutral earthing at different substations/locations.

Course Outcomes:

The theory, practical experiences, and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry-oriented COs associated with the above mentioned competency:

- a) Identify various types of faults in power systems.
- b) Select suitable switchgears for different applications.
- c) Test the performance of different protective relays.
- d) Maintain protection systems of alternators and transformers.
- e) Maintain protection schemes for motors and transmission lines.
- f) Maintain protection schemes for power systems against over voltages.

Course Name: Solar Power Technologies	Duration: 6 months
Course Code: EEPE***	Contact:
Semester:	Credit: 3

Course Objectives:

The aim of this course is to help the student to attain the following industry-identified competency through various teaching-learning experiences:

- Maintain the efficient operation of various types of solar power technologies

Course Content

Unit No	Module Name	Content	Hrs
I	Solar Energy	Solar Map of India: Global solar power radiation Different types of Solar water heaters: Construction, working, specifications and installation, Solar Heating systems, Solar drying and different types of Solar cookers, Solar lighting. Preventive maintenance of all of the above.	
II	Concentrated Solar Power (CSP)	Concentrated Solar Power (CSP) plants or solar thermal electric systems. Parabolic Trough: Construction, working and specifications. Parabolic Dish: Construction, working and specifications. Power Tower, Fresnel Reflectors: Construction, working and specifications. Solar Stirling engines. Preventive maintenance of all of the above.	
III	Solar PV Systems	Solar PV cell: Types, construction, working, typical specifications of solar cells. Solar PV working principle: Series and parallel connections of solar modules. Solar Photovoltaic (PV) system: Components, layout and working. Solar modules, arrays and their standard specifications. Rooftop and streetlight solar PV systems and typical specifications. Maintenance of these systems.	
IV	Solar PV Electronics	Solar Charge controllers: Working and specifications, switchgear and cables. Batteries: Different types for solar PV systems, maintenance and specifications. Solar Inverters: Working and specifications. Signal conditioning systems: Working and specifications. Solar Power tracking: Construction, working, tilt angle, solar radiation, I-V, P-V characteristics, maximum power point tracking (MPPT). Maintenance of these systems.	
V	Solar PV Off-grid and Grid Tied Systems	Solar off-grid systems: Layout and specifications. Solar Grid-tied (on-grid) systems: Working principle of grid-tied DC-AC inverter, grid synchronization and active power export. Net metering: Main features and working. Solar-wind Hybrid systems: Layout and specifications.	

References:

1. Solanki, Chetan Singh - Solar Photovoltaics: Fundamentals, Technologies and Applications, PHI Learning, New Delhi, ISBN: 9788120351110
2. Solanki, Chetan Singh - Solar Photovoltaic Technology and Systems: A Manual For Technicians, Trainers and Engineers, PHI Learning, New Delhi, ISBN: 9788120347113
3. Kothari, D.P. et al - Renewable Energy Sources and Emerging Technologies, PHI
4. David M. Buchla, Thomas E. Kissell, Thomas L. Floyd - Renewable Energy Systems, Pearson Education New Delhi, ISBN: 9789332586826
5. Rachel, Sthuthi, Earnest, Joshua - Wind Power Technologies, PHI Learning
6. O.P. Gupta - Energy Technology, Khanna Publishing House, ISBN: 978-93-86173-683

Course Outcomes:

The theory, practical experiences, and relevant soft skills associated with this course are to be taught and implemented so that the student demonstrates the following industry-oriented COs associated with the above-mentioned competency:

- a) Maintain the solar non-electric equipment
- b) Maintain CSP plants
- c) Maintain solar PV systems
- d) Maintain solar PV electronics and MPPT systems
- e) Maintain off-grid and on-grid solar power plants

Course Name: Solar Power Technologies Laboratory	Duration: 6 months
Course Code: EEPE***	Contact:
Semester:	Credit: 1

Course Objectives:

The aim of this course is to help the student to attain the following industry-identified competency through various teaching-learning experiences:

- Maintain the efficient operation of various types of solar power technologies

Practical:

1. Dismantle solar power heaters
2. Assemble solar power heaters
3. Assemble the parabolic dish CSP plant
4. Dismantle the parabolic dish CSP plant
5. Troubleshoot a CSP plant
6. Assemble the solar PV system
7. Dismantle the solar PV system
8. Troubleshoot a solar PV system
9. Troubleshoot solar PV panels and arrays
10. Troubleshoot solar inverters
11. Troubleshoot solar signal conditioners
12. Troubleshoot solar PV MPPT systems
13. Troubleshoot solar off-grid systems
14. Troubleshoot solar net metering systems
15. Troubleshoot solar-wind hybrid systems

Course Outcomes:

The theory, practical experiences, and relevant soft skills associated with this course are to be taught and

implemented, so that the student demonstrates the following industry-oriented COs associated with the above-mentioned competency:

- Maintain the solar non-electric equipment
- Maintain CSP plants
- Maintain solar PV systems
- Maintain solar PV electronics and MPPT systems
- Maintain off-grid and on-grid solar power plants

Course Name: Wind Power Technologies	Duration: 6 months
Course Code: EEPE***	Contact:
Semester:	Credit: 3

Course Objectives:

The aim of this course is to help the student to attain the following industry-identified competency through various teaching-learning experiences:

- Maintain large wind power plants and small wind turbines.

Course Content

Unit No	Module Name	Content	Hrs
I	Wind Energy and Wind Power Plants	<p>Wind power scenario in the world and India.</p> <p>Characteristics of Wind Energy: Wind movement, wind profile, roughness, effects of obstacles in wind path.</p> <p>Types of Wind Power Plants (WPPs): Small and large wind turbines; Horizontal and Vertical axis; Upwind and Downwind; One, Two, and Three blades; constant and variable Speed; Geared, Direct-Drive and Semi-Geared (Hybrid) WPPs; WECS, WEGs, WTs, WPPs.</p> <p>WPP Tower Types: Lattice; tubular: steel, concrete, hybrid; ladders, cables.</p> <p>WPP substation: Switchgear, transformers, inside layouts of Electric electronic panels at block level.</p>	
II	Construction and Working of Large Wind Power Plants	<p>Wind Turbine Terminologies: Cut-in, cut-out and survival wind speeds, Threshold wind speeds, rated power, nominal power, Wind Power Curve.</p> <p>Major parts and Functions of WPP: Rotor blades, hub, nacelle, tower, electric sub-station, nacelle layouts of Geared, Direct-Drive and Semi-Geared WPPs, Main shaft, gearbox, electric generator, electronic control panels.</p>	

		<p>Rotation Principles: Drag and Lift principle, thrust and torque of wind turbine rotor.</p> <p>Different types of Sensors: Anemometer, wind vane, rpm sensors of main shaft and generator, temperature sensors of nacelle, gearbox and generator; cable untwisting and vibration sensors.</p> <p>Different types of Actuators: Electric and hydraulic pitching and yawing mechanisms, cable untwisting and braking mechanisms.</p>	
III	Aerodynamic Control, Electric Generators and Grid Connection	<p>Aerodynamic Control of WPPs: Stall Pitch and Active Stall. Braking mechanisms of large WPPs</p> <p>Electric Generator Types: Working of Squirrel-Cage rotor Induction Generator (SCIG), Wound-Rotor Induction Generator (WRIG), Doubly-Fed Induction Generator (DFIG), wound rotor and permanent magnet synchronous generators.</p> <p>Electric Grid Connection of WPPs: Local Impacts and system-wide impact.</p>	
IV	Maintenance of Large Wind Power Plants	<p>General maintenance of WPPs: Preventive maintenance schedule of actuators such as yaw control, pitch control, braking mechanisms and sensors; oiling and greasing; electric and electronic equipment related; tower related; minor repairs; some tips.</p> <p>Scheduled Maintenance: of Stall and Pitch and Active Pitch controlled WPPs.</p> <p>Unscheduled Maintenance: Operational factors, design faults, wear and tear of components, spurious trip, Major repairs.</p> <p>Software related, warranty and insurance related issues.</p>	
V	Construction and Working Small Wind Turbines	<p>Types and working of different types of small wind turbines (SWT): Classification: Horizontal and Vertical axis, Upwind and Downwind, One, Two and Three blades; Constant and Variable Speed; Direct-Drive and Geared; braking of SWTs.</p> <p>Parts of SWTs: Rotor, generator, gearbox, tower, electric control panel, tail vane, anemometer, wind vane, temperature and rpm sensors.</p> <p>Working SWTs: Direct-drive and Geared.</p> <p>Electrical Generators in SWTs: Permanent magnet synchronous generators, induction generators.</p> <p>SWT Towers: Lattice tubular type, hydraulic towers, ladders, cables.</p>	
VI	Maintenance of Small Wind Turbines	<p>Small wind turbine assembly.</p> <p>Installation of different types of small wind turbines (SWT): tubular and lattice types.</p> <p>SWT Routine Maintenance: Tips; Preventive maintenance schedule of: braking mechanisms,</p>	

		<p>sensors; oiling and greasing related; electric and electronic equipment related; tower related; software related; minor repairs.</p> <p>Power electronic devices and converters in different types of SWTs: Thyristors, power transistors.</p> <p>Common electrical and mechanical faults in SWTs.</p>	
--	--	---	--

References:

1. Hau, Erich: Wind Turbines, Springer-Verlag, Berlin Heidelberg, Germany, ISBN: 978-3-642-27150-2
2. Rachel, Sthuthi, Earnest, Joshua: Wind Power Technologies, PHI Learning, New Delhi, ISBN: 978-93-88028-49-3; E-book 978-93-88028-50-9
3. Gipe, Paul: Wind Energy Basics, Chelsea Green Publishing Co; ISBN: 978-1603580304
4. Wizelius, Tore, Earnest, Joshua: Wind Power Plants and Project Development, PHI Learning, New Delhi, ISBN: 978-8120351660
5. Bhadra, S.N., Kasta, D., Banerjee, S: Wind Electrical Systems Installation; Oxford University Press, New Delhi, ISBN: 978-0195670936
6. O.P. Gupta: Energy Technology, Khanna Publishing House, New Delhi, ISBN: 978-93-86173-683

Course Outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry-oriented COs associated with the above-mentioned competency:

- a) Identify the various types of wind power plants and their auxiliaries
- b) Maintain the normal working of large wind turbines
- c) Optimize the aerodynamic and electric control of large wind power plants
- d) Troubleshoot the common faults of large wind power plants
- e) Maintain the normal working of small wind turbines
- f) Troubleshoot small wind turbines

Course Name: Wind Power Technologies Laboratory	Duration: 6 months
Course Code: EEPE***	Contact:
Semester:	Credit: 1

Course Objectives:

The aim of this course is to help the student to attain the following industry-identified competency through various teaching and learning experiences:

- Maintain large wind power plants and small wind turbines.

Practical:

1. Identify the specified items of a wind farm after watching the video clip.

2. Identify the specified parts inside the nacelle of a large wind power plant after watching the video clips.
3. Check the performance of the temperature and vibration sensor used in 125/150 kW WPPs.
4. Check the performance of the SCIG.
5. Check the performance of the PMSG.
6. Check the performance of the hydraulic and electric pitch actuator and yaw actuator used in 125/150 kW WPPs.
7. Check the performance of the contactless RPM sensors used in WPPs.
8. Troubleshoot the anemometer and wind vane.
9. Check the generator performance of SWT s.
10. Identify the parts of a direct-drive SWT.
11. Identify the parts of a geared SWT.
12. Assemble/Dismantle a direct-drive SWT.
13. Assemble/Dismantle a geared SWT.
14. Check the performance of direct-drive SWT.
15. Check the performance of geared SWT.
16. Simulate faults in the small wind turbine trainer.
17. Troubleshoot direct-drive SWT.
18. Troubleshoot geared SWT.
19. Interpret the wiring of a SWT electric-electronic control panel.

Course Outcomes:

The theory, practical experiences, and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry-oriented COs associated with the above-mentioned competency:

- a) Identify the various types of wind power plants and their auxiliaries.
- b) Maintain the normal working of large wind turbines.
- c) Optimize the aerodynamic and electric control of large wind power plants.
- d) Troubleshoot the common faults of large wind power plants.
- e) Maintain the normal working of small wind turbines.
- f) Troubleshoot small wind turbines.

Course Name: Biomass And Micro-Hydro Power Plants	Duration: 6 months
Course Code: EEPE***	Contact:
Semester:	Credit: 3

Course Objectives:

The aim of this course is to help the student to attain the following industry-identified competency through various teaching-learning experiences:

- Maintain the efficient operation of various types of Biomass and Micro hydropower plants.

Course Content

Unit No	Module Name	Content	Hrs
I	Basics of Biomass-based Power Plants	Properties of solid fuel for biomass power plants: bagasse, wood chips, rice husk, municipal waste. Properties of liquid and gaseous fuel for biomass	

		<p>power plants: Jatropha, bio-diesel, gobar gas.</p> <p>Layout of a Bio-chemical based (e.g., biogas) power plant.</p> <p>Layout of a Thermo-chemical based (e.g., Municipal waste) power plant.</p> <p>Layout of an Agro-chemical based (e.g., bio-diesel) power plant.</p> <p>Selection of biomass power plants.</p>	
II	Biomass Gasification Power Plants	<p>The basic principle to convert agriculture and forestry products and wood processing remains (including rice husks, wood powder, branches, offcuts, corn straws, rice straws, wheat straws, cotton straws, fruit shells, coconut shells, palm shells, bagasse, corn cobs) into combustible gas.</p> <p>General construction and working of a typical gasifier.</p> <p>Power generating in gas engine.</p> <p>Strengths and limitations of agriculture and forestry products gasifier.</p> <p>Preventive maintenance steps of different types of biomass gasifiers.</p>	
III	Different Types of Gasifiers	<p>Construction and working of the following types of gasifiers:</p> <p>Rice Husk Gasification Power Plant and their specifications.</p> <p>Straw Gasification Power Plant and their specifications.</p> <p>Bamboo Waste, Bamboo Chips Gasification Power Plant and their specifications.</p> <p>Coconut shell, coconut peat, coconut husk Gasification Power Plant and their specifications.</p> <p>Bagasse/Sugar Cane Trash Gasification Power Plant and their specifications.</p> <p>Gobar gas plant and its specifications.</p> <p>Breakdown maintenance of biomass power plant at the module level.</p>	
IV	Micro-hydro Power Plants	<p>Locations of micro hydro power plant.</p> <p>Energy conversion process of hydro power plant.</p> <p>Classification of hydropower plant: High, medium, and low head.</p> <p>General layouts of typical micro-hydro power plant.</p> <p>Strengths and limitations of micro hydro power plants.</p>	
V	Different Types of Micro hydro Power Plants	<p>Construction and working of High head – Pelton turbine and their specifications.</p> <p>Construction and working of Medium head – Francis turbine and their specifications.</p> <p>Construction and working of Low head – Kaplan turbine and their specifications.</p>	

		Preventive and breakdown maintenance of micro hydro power plants. Safe practices for micro hydro power plants.	
--	--	---	--

References:

1. Khoiyangbam, R.S., Navindu, Gupta, and Sushil Kumar; Biogas Technology: Towards Sustainable Development; TERI, New Delhi; ISBN: 9788179934043
2. David M. Buchla; Thomas E. Kissell; Thomas L. Floyd; Renewable Energy Systems; Pearson Education New Delhi; ISBN: 9789332586826
3. Kothari, D.P. et al; Renewable Energy Sources and Emerging Technologies; PHI
4. Rachel, Sthuthi, Earnest, Joshua; Wind Power Technologies; PHI Learning
5. O.P. Gupta; Energy Technology; Khanna Publishing House; ISBN: 978-93-86173-683

Course Outcomes:

The theory, practical experiences, and relevant soft skills associated with this course are to be taught and implemented so that the student demonstrates the following industry-oriented COs associated with the above-mentioned competency:

- a) Select the relevant biomass power plant
- b) Undertake the preventive maintenance of different types of biomass gasifiers
- c) Undertake the breakdown maintenance of different types of biomass gasifiers
- d) Maintain the optimized working of large wind power plants
- e) Maintain the optimized working of small wind turbines
- f) Maintain the optimized working of micro hydropower plants

Course Name: Biomass And Micro-Hydro Power Plants Laboratory	Duration: 6 months
Course Code: EEPE***	Contact:
Semester:	Credit: 1

Course Objectives:

The aim of this course is to help the student to attain the following industry-identified competency through various teaching-learning experiences:

- Maintain the efficient operation of various types of Biomass and Micro hydropower plants.

Practical:

1. Identify different components of a typical Biomass power plant.
2. Identify different biomass resources and evaluate their energy potential.
3. Determine the carbon content of solid biomass.
4. Assemble the Biogas power plant.
5. Dismantle the Biogas power plant.
6. Identify the components of the high-head micro hydropower plant.
7. Identify the components of the medium-head micro hydropower plant.
8. Identify the components of the low-head micro hydropower plant.
9. Assemble a high-head micro hydropower plant.
10. Assemble a medium-head micro hydropower plant.
11. Assemble a low-head micro hydropower plant.
12. Undertake preventive maintenance of the high-head micro hydropower plant.
13. Undertake preventive maintenance of the medium-head micro hydropower plant.

14. Undertake preventive maintenance of the low-head micro hydropower plant.
15. Check the performance of the Pelton wheel micro hydropower plant.

Course Outcomes:

The theory, practical experiences, and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry-oriented COs associated with the above-mentioned competency:

- a) Select the relevant biomass power plant.
- b) Undertake the preventive maintenance of different types of biomass gasifiers.
- c) Undertake the breakdown maintenance of different types of biomass gasifiers.
- d) Maintain the optimized working of large wind power plants.
- e) Maintain the optimized working of small wind turbines.
- f) Maintain the optimized working of micro hydropower plants.

Course Name: Electric Vehicles	Duration: 6 months
Course Code: EEPE***	Contact:
Semester:	Credit: 3

Course Objectives:

The aim of this course is to help the student to attain the following industry-identified competency through various teaching and learning experiences:

- Maintain electric vehicles

Course Content

Unit No	Module Name	Content	Hrs
I	Introduction to Hybrid Electric Vehicles	Evolution of Electric Vehicles. Advanced Electric Drive Vehicle Technology Electric Vehicles (EV), Hybrid Electric Drive (HEV), Plug-in Electric Vehicle (PIEV), Components Used in Hybrid Electric Vehicles. Economic and Environmental Impacts of Electric Hybrid Vehicles. Parameters Affecting Environmental and Economic Analysis. Comparative Study of Vehicles for Economic and Environmental Aspects.	
II	Dynamics of Hybrid and Electric Vehicles	General Description of Vehicle Movement. Factors Affecting Vehicle Motion-Vehicle Resistance, Tyre Ground Adhesion, Rolling Resistance, Aerodynamic Drag, Equation of Grading Resistance, Dynamic Equation. Drivetrain Configuration, Automobile Powertrain, Classification of Vehicle Powerplant. Performance Characteristics of IC Engine and Electric Motor, Need for Gearbox.	

		<p>Classification of Motors Used in Electric Vehicles. Basic Architecture of Hybrid Drivetrains, Types of HEVs. Energy Saving Potential of Hybrid Drivetrains. HEV Configurations: Series, Parallel, Series-Parallel, Complex.</p>	
III	DC-DC Converters for EV and HEV Applications	<p>EV and HEV Configuration Based on Power Converters. Classification of Converters- Unidirectional and Bidirectional. Principle of Step-Down Operation. Boost and Buck-Boost Converters. Principle of Step-Up Operation. Two Quadrant Converters, Multi-Quadrant Converters.</p>	
IV	DC-AC Inverter & Motors for EV and HEVs	<p>DC-AC Converters. Principle of Operation of Half-Bridge DC-AC Inverter (R load, R-L load). Single-Phase Bridge DC-AC Inverter with Rload, R-L load. Electric Machines Used in EVs and HEVs, Principle of Operation, Working & Control, Permanent Magnet Motors, Their Drives, Switched Reluctance Motor. Characteristics and Applications of Above Motors.</p>	
V	Batteries	<p>Overview of Batteries Battery Parameters, Types of Batteries, Battery Charging, Alternative Novel Energy Sources, Solar Photovoltaic Cells, Fuel Cells, Super Capacitors, Flywheels. Control System for EVs and HEVs, Overview, Electronic Control Unit (ECU). Schematics of Hybrid Drive Train, Control Architecture. Regenerative Braking in EVs.</p>	

1. References:

2. A.K. Babu, Electric & Hybrid Vehicles, Khanna Publishing House, New Delhi (Ed. 2018)
3. Fuhs, A.E., Hybrid Vehicles and the Future of Personal Transportation, CRC Press
4. Gianfranco, Electric and Hybrid Vehicles: Power Sources, Models, Sustainability, Infrastructure and the Market, Pistoia Consultant, Rome, Italy
5. Ehsani, M., Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press
6. Husain, I., Electric and Hybrid Electric Vehicles, CRC Press
7. Chan, C.C., and K.T. Chau, Modern Electric Vehicle Technology, Oxford Science Publication
8. Lechner, G., and H. Naunheimer, Automotive Transmissions: Fundamentals, Selection, Design and Application, Springer
9. Rashid, M.H., Power Electronics: Circuits, Devices and Applications, 3rd edition, Pearson
10. Moorthi, V.R., Power Electronics: Devices, Circuits and Industrial Applications, Oxford University Press

11. Krishnan, R., Electric Motor Drives: Modeling, Analysis, and Control, Prentice Hall
12. Krause, O.P., C. Wasynczuk, S.D. Sudhoff, Analysis of Electric Machinery, IEEE Press

Course Outcomes:

The theory, practical experiences, and relevant soft skills associated with this course are to be taught and implemented so that the student demonstrates the following industry-oriented COs associated with the above-mentioned competency:

- a) Interpret the salient features of Hybrid Electric Vehicles.
- b) Interpret the Dynamics of Hybrid and Electric Vehicles.
- c) Maintain the DC-DC Converters in EV applications.
- d) Maintain the DC-AC Converters in EV applications.
- e) Select the Batteries for EV applications.

Course Name: Electric Vehicles Laboratory	Duration: 6 months
Course Code: EEPE***	Contact:
Semester:	Credit: 1

Course Objectives:

The aim of this course is to help the student to attain the following industry-identified competency through various teaching-learning experiences:

- Maintain electric vehicles.

Practical:

1. Develop block diagram of Electric vehicle and identify parts
2. Case study - Compare minimum four vehicles for economic and environmental analysis
3. Develop schematic diagram of hybrid electric vehicle and identify the components fluorescent lamp.
4. Prepare report on Plug-in Electric vehicle by visiting a charging station
5. Inspect and install inverter of given lead acid battery
6. Prepare a report on batteries used from market survey
7. Collect specifications of converters and inverters used for Electric vehicles a single lamp control by two switches
8. Diagnose, repair and maintain battery used in electric vehicle
9. Prepare test procedure for equipment used in Electric vehicle
10. List safety procedures and schedule for handling HEVs and EVs.

Course Outcomes:

The theory, practical experiences, and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry-oriented Cos associated with the above-mentioned competency:

- a) Interpret the salient features of Hybrid electric vehicles.
- b) Interpret the Dynamics of hybrid and Electric vehicles
- c) Maintain the DC-DC converters in EV applications.
- d) Maintain the DC-AC converters in EV applications
- e) Select the batteries for EV applications.

Course Name: Electric Traction	Duration: 6 months
---------------------------------------	---------------------------

Course Code: EEPE***	Contact:
Semester:	Credit: 3

Course Objectives:

The aim of this course is to help the student to attain the following industry-identified competency through various teaching learning experiences:

- Maintain electric traction systems.

Course Content

Unit No	Module Name	Content	Hrs
I	Basics of Traction	<p>General description of Electrical Traction system in India.</p> <p>Advantages and Disadvantages of Electric Drive, Diesel Electric Drive, Battery Drive.</p> <p>Problems associated with AC traction System and remedies for it.</p> <p>Voltage balance, current balance, production of harmonics, induction effects.</p> <p>Metro rail system, features.</p>	
II	Power Supply Arrangements	<p>Constituents of supply system:</p> <ul style="list-style-type: none"> ▪ Substation: layout, list of equipment and their functions. ▪ Feeding post: list of equipment and their functions ▪ Feeding and sectioning Arrangements ▪ Sectioning and paralleling post ▪ Sub sectioning and Paralleling post ▪ Sub sectioning post ▪ Elementary section <p>Major equipment at substation, Miscellaneous equipment at control post or Switching station.</p> <p>Protection system for traction transformer and 25 kV centenary construction.</p>	
III	Overhead Equipment	<p>Different types of overhead equipment.</p> <p>Pentagonal OHE Centenary Construction.</p> <p>Different Types of Centenary according to speed Limit.</p> <p>OHE Supporting Structure, Cantilever assembly diagram.</p> <p>Overhead system: Trolley collector, Bow collector, Pantograph Collector.</p> <p>Types and construction of pantograph.</p>	

IV	Electric Locomotive	Classification and Nomenclature of Electric Locomotive. Block diagram of AC locomotive. Power Circuit of AC Locomotive. Equipment (List and Function only) used in auxiliary circuit of AC Locomotive. Loco bogie classification according to wheel arrangements. Maintenance of AC systems.	
V	Traction Motors and Train Lighting	Desirable characteristics of traction motor. Types of motors used for traction with their characteristics and features. Control of motors used for traction and methods to control. Requirements of braking, types of braking, Electric braking, Regenerative braking. Systems of train lighting: Single battery, double battery parallel block system. SG, HOG, End on generation.	
VI	Signalling and Supervisory Control	Requirements of signaling systems. Types of signals, track circuits. Advantages of remote control. Systems of remote control, equipment and network. Metro rail-supply systems, advantages, schemes in India.	

References:

1. G.C. Garg, Utilization of Electric Power & Electric Traction, Khanna Book Publishing Co., New Delhi (ISBN: 978-93-86173-355) Revised Ed. 2018
2. Gupta J.B., S.K. Kataria and Son, Utilization of Electric Power and Traction
3. Partab H., Dhanpat Rai and Co., 'Art and Science of Utilization of Electrical Energy
4. Partab H., Dhanpat Rai and Co., Modern Electric Traction
5. Suryanarayana N.V., New Age International Publishers, Reprint 2010
6. Open Shaw Taylor, Orient Longman Ltd., Utilisation of Electrical Energy.

Course Outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry-oriented COs associated with the above mentioned competency:

- a) Interpret the traction layout and its systems
- b) Maintain the power supply arrangements.
- c) Maintain the function of the overhead equipment for electric traction
- d) Maintain the different components of the electric locomotive.
- e) Maintain the traction motor and train lighting system
- f) Maintain the signaling and supervisory control systems

Course Name: Electric Traction Laboratory	Duration: 6 months
Course Code: EEPE***	Contact:

Semester:	Credit: 1
------------------	------------------

Course Objectives:

The aim of this course is to help the student to attain the following industry-identified competency through various teaching learning experiences:

- Maintain electric traction systems

Practical:

1. Dismantle a traction motor
2. Assemble a traction motor
3. Troubleshoot a traction motor
4. Visit electric-traction train lighting system installation, identify components of system and prepare report
5. Visit electric-traction loco shed, investigate working of each section & prepare report
6. Visit to Traction Substation or feeding post (for layout and OHE) and write a report
7. Visit to Railway Station (for signalling and train lighting) and write a report on visit
8. Draw traction substation Layout on drawing sheet and prepare report
9. Draw Pentagonal OHE Catenary, different Catenaries according to speed limit, OHE supporting structure on drawing sheet and prepare report
10. Draw Power Circuit of AC Locomotive on drawing sheet and prepare report

Course Outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry-oriented COs associated with the above-mentioned competency:

- a) Interpret the traction layout and its systems
- b) Maintain the power supply arrangements
- c) Maintain the function of the overhead equipment for electric traction
- d) Maintain the different components of the electric locomotive
- e) Maintain the traction motor and train lighting system
- f) Maintain the signalling and supervisory control systems