Curriculum for Undergraduate Degree (B.Tech.) in Mechanical Engineering (w.e.f. AY: 2020-21)

Part III: Detailed Curriculum

Second Semester

Course Name:	**Physics**		
Course Code:	BS-PH201	**Category:**	Basic Science Courses
Semester:	Second	**Credit:**	4.0
L-T-P:	3-1-0	**Pre-Requisites:**	Mathematics course with vector calculus
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To understand the basic concepts of Electricity and Magnetism and comprehend their uses in real life situations.
2	To understand the formulations of Quantum Mechanics and its applications to modern technologies.
3	To describe the working principle of LASER and their applications to communication systems such as Optical Fiber.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Module-1: Foundations of Quantum Mechanics** ***Introduction to Quantum Physics:*** Brief idea about the historical development of Quantum Mechanics. ***Black Body Radiation:*** Planck's Hypothesis and derivation of Planck's Radiation formula, Limiting case of Planck's radiation law: Wien's Radiation Law & Rayleigh Jean's law, Stefan's Boltzmann law & Wien's Displacement law (no derivation), Numerical problems with applications of radiation laws. ***Compton Effect:*** Experimental observation of Compton effect, Derivation of the Compton shift, Modified and Unmodified lines, Estimation of the energy of the scattered radiation and energy of recoiled electron, Numerical problems.	8L

	Wave-Particle Duality: de Broglie hypothesis, Wave-particle duality, Calculation of de Broglie wavelength, Verification of matter waves by Davisson and Germer experiment, Concept of phase velocity and group velocity and their inter-relation. ***Uncertainty Principle:*** Heisenberg's uncertainty principles (no derivation) for motion of microscopic particles, Nonexistence of electrons within nucleus, Zero-point energy, Numerical problems.	
2	**Module-2: Schrödinger Wave Equation and Its Applications** ***Formulation of Quantum Mechanics:*** Postulates of Quantum Mechanics, Concept of operators and their Eigen values, Wave function and its physical significance, Expectation value of an observable quantity, Discussion of associated problems. ***Schrödinger Wave Equation:*** Time independent Schrödinger's equation from time dependent one by the separation of variable method. ***Applications of Quantum Mechanics:*** Solution of Schrödinger's time-independent equation for a free particle in an infinite potential well (1D & 3D box), Associated theoretical and numerical problems, Concept of degeneracy and non-degeneracy of a particle enclosed in a 3D box, Concept of quantum mechanical tunneling and quantum harmonic oscillator.	9L
3	**Module-3: Dielectric Materials and their Applications** ***Concept of Dielectric and Polarization:*** Electric field inside a dielectric, Electric dipole and dipole moment, Polar and non-polar dielectrics, Influence of electric field on non-polar and polar molecules, atomic polarizability and polarization vector. ***Inter Relationship among Dielectric Parameters:*** Concept of surface and volume bound charges, Gauss' law in presence of dielectric, Derivation of relation among electric field, polarization and displacement vector, Concept of susceptibility, permittivity and dielectric constant in linear dielectrics, Problems on relation among polarizability, susceptibility and dielectric constant. ***Types of Polarization:*** Electronic polarization and derivation of electronic polarizability, Concept of ionic and orientational polarization (no derivation). ***Applications of Dielectric:*** Dielectric breakdown and dielectric strength, Concept of dielectric loss, Few applications of dielectrics in different domains.	5L
4	**Module-4: Time Varying Fields** ***Electromagnetic Induction:*** Faraday's law of electromagnetic induction, Integral & differential form of Faraday's law, Application of Faraday's law in motors and generators, Calculation of induced EMF. ***Displacement Current:*** Ampere's law: integral & differential forms, Inconsistency of Ampere's law, Maxwell's modification, Concept and characteristics of displacement current.	3L

5	**Module-5: Electromagnetic Waves** ***Maxwell's Electromagnetic Field Equations:*** Maxwell's equations in differential & integral forms, Physical significances, Maxwell's equations under different conditions (free space, good conductor, perfect insulators *etc*.). ***Plane Electromagnetic Wave in Free Space:*** Wave equations in free space, Estimation of velocity of the EM wave in free space, Concept of transverse nature of electromagnetic waves. ***Plane Electromagnetic Wave in Medium:*** Wave equations in non-conducting and conducting media, Calculation of skin depth, Estimation of magnitude and direction of electric/magnetic field. ***Energy in an Electromagnetic Field:*** Flow of energy associated to electromagnetic field and Poynting vector.	6L
6	**Module-6: Laser and Fiber Optics** ***Introduction to Laser:*** Properties of light sources, Requirement of suitable light source in communication, Invention of laser, Characteristics and applications of laser. ***Interaction of Light with Matter:*** Stimulated absorption, spontaneous emission and stimulated emission of radiation, Transitions probabilities, Einstein's A and B coefficients and the inter-relationship among them. ***Components and Working of Laser Systems:*** Necessary conditions for lasing action, Metastable energy state, Population inversion, Amplification by optical cavity resonator, Design of resonator to ensure single longitudinal mode operation, Working principle of solid-state lasers (ruby laser and Nd:YAG laser) and gas lasers (He-Ne laser & CO_2 laser). ***Optical Communication:*** Introduction, Need for optical communication, Salient features of optical fibers, Analog and digital modulation, Estimation of number of speech signals to be sent simultaneously through specific bandwidth of analog/digital communication system. ***Light Guidance in Fibers:*** Ray theory of light guidance, Relative refractive index difference and numerical aperture, Concept of modes of a fiber, Single and multimode fibers, Step-index and graded-index fibers. ***Transmission characteristics of optical fibers:*** Attenuation, Rayleigh scattering, Pulse broadening mechanism, Estimation of intermodal dispersion, bit rate - length product, Minimization of intermodal dispersion.	9L
Total		**40L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Differentiate between different dielectric materials depending on their dielectric strength, breakdown voltage, losses and apply them to real life problems.
2	Apply the concepts of Faraday's law to analyze mechanisms of electromagnetic breaking and solve problems on induced EMF for motors, generators etc.
3	Solve for electric field, magnetic field & power flow using Maxwell's equations and analyze various media of propagations.
4	Explain the concept of black body radiation and predict its temperature from the spectrum, and comprehend the particle nature of light using Compton Effect, existence of matter waves.
5	Describe the basic formulations of Quantum Mechanics such as the concept of operators, wave function and their evolution using Schrödinger equation and apply them to understand the workings of devices like Tunnel Diode, Scanning Tunnelling Microscopy.
6	Explain the workings of various LASERs and their uses especially in optical fiber communication. Illustrate the concept of modes of an optical fiber and estimate the dispersion leading to calculation of bit rate of a communication channel.

Learning Resources:	
1	'Introduction to Quantum Mechanics' by David J. Griffiths.
2	'Quantum Mechanics' by Leonard I. Schiff.
3	'Quantum Physics' by A. N. Konar.
4	'Concepts of Modern Physics' by Arthur Beiser.
5	'Introduction to Electrodynamics' by David J. Griffiths.
6	'Electricity and Magnetism' by Chattopadhyay and Rakshit.
7	'Fundamentals of Optics' by F. Jenkins and H. White.
8	'Lasers: Theory and Applications' by K. Thyagarajan and A. Ghatak.
9	'Understanding Lasers' by Jeff Hecht.
10	'Introduction to Fiber Optics' by A. Ghatak and K. Thyagarajan.

Course Name:	**Mathematics-II**		
Course Code:	BS-M201	**Category:**	Basic Science Courses
Semester:	Second	**Credit:**	4.0
L-T-P:	3-1-0	**Pre-Requisites:**	High School Mathematics, BS-M101
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To learn how to solve different types of differential equation.
2	To solve different types of improper integrals.
3	To comprehend Laplace transform & inverse Laplace transform.
4	To understand basic concept of graph, digraph, walk, Hamiltonian graph, Euler circuit.
5	To understand basic concept of tree, binary tree and different algorithms.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Ordinary Differential Equations of First order:** ❖ Formation of ordinary differential equation, order and degree. ❖ Equations of first order and first degree (i) Method of separation of variables; Homogeneous equations (ii) Exact equations and their solution, Non-exact equations, Integrating Factors (iii) Linear and Bernoulli's equations ❖ Equations of first order and higher degree Equations solvable for $\boldsymbol{p}$, solvable for $\boldsymbol{x}$, solvable for $\boldsymbol{y}$; Clairaut's equations	8L
2	**Higher Order Ordinary Differential Equations:** (i) Equations with constant coefficients, D-operator, Complementary Function (CF) and Particular Integral (PI) (ii) Cauchy-Euler's homogeneous equations (iii) Method of variation of parameters (iv) Solution of simultaneous first order ordinary differential equations	8L
3	**Improper Integrals:** (i) Improper integrals, their types, convergence criterion of some standard improper integrals (ii) Gamma and Beta functions, their relation (no proof) and applications	3L
4	**Laplace Transforms and Inverse Laplace Transforms:** (i) Definition of LT, LT of some standard functions; Properties of LT: Linearity, Change of scale property, First and Second Shifting property; LT of a function multiplied by $\boldsymbol{t^n}$ and divided by $\boldsymbol{t}$; LT of unit step and periodic functions; LT of derivatives (ii) Inverse LT: Method of partial fractions, Convolution theorem (iii)Solutions of initial and boundary value problems by LT	8L

5	**Graph Theory:** (i) Introduction: Vertices, edges, loops, parallel edges, walk, trail, path, circuit; Euler and Hamiltonian circuits (ii) Connected and disconnected graph, directed and non-directed graph, simple graph, complete and bi-partite graph; Theorems on graph. (iii) Incidence and adjacency matrix; Graph isomorphism (iv) Shortest path: Dijkstra's algorithm	8L
6	**Tree:** (i) Definition of tree, binary tree; Theorems. (ii) Spanning tree: BFS and DFS algorithms (iii) Minimal spanning tree: Kruskal's and Prim's algorithms	5L
Total		**40L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand different techniques to solve first and second order ordinary differential equations with its formulation to address the modelling of systems and problems of engineering sciences.
2	Apply different types of transformations between two 2-dimensional planes for analysis of physical and engineering problems.
3	Utilize tree and graph algorithms for solving different physical and engineering problems.
4	Evaluate different types of improper integrals and apply into engineering problems.

Learning Resources:	
1	'Higher Engineering Mathematics' by B. S. Grewal, Khanna Publishers.
2	'Advanced Engineering Mathematics' by Erwin Kreyszig, , John Wiley & Sons.
3	'Mathematical Methods of Science and Engineering' by Kanti B. Dutta, Cengage Learning.
4	'An Introduction to Differential Equation' by Maity & Ghosh, NCBA.
5	'Advanced Engineering Mathematics' by Michael Greenberg, Pearson.
6	'Engineering Mathematics for First Year' by T. Veerarajan, Tata McGraw-Hill, New Delhi.
7	'An Introduction to Integral Calculus' by Maity and Ghosh, NCBA.
8	'Advanced Differential Equation' by M.D Raisinghania, S. Chand Publication.
9	'An Introduction to Engineering Mathematics-II' by G. P. Samanta, New Age Publication.
10	'Introduction to Graph Theory' by Dipak Kumar Ghosh, NCBA.
11	'Advanced Engineering Mathematics' by H. K. Dass, S. Chand Publication.

Course Name:	**Basic Electrical and Electronics Engineering**		
Course Code:	ES-EE201	**Category:**	Engineering Science Courses
Semester:	Second	**Credit:**	4.0
L-T-P:	3-1-0	**Pre-Requisites:**	Knowledge of Class XII level Physics & Mathematics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Group A: Basic Electrical Engineering

Course Objectives:	
1	To impart a comprehensive knowledge about AC and DC circuit analysis.
2	To impart knowledge about the working principle and applications of electrical machines.
3	To give idea about the components of low voltage electrical installations.
4	To convey concepts of the general structure of electrical power system.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**DC Circuits** Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton theorems, maximum power transfer theorem.	5L
2	**AC Circuits** Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel).	4L
3	**Three phase system** Generation of three-phase AC power, Three-phase balanced circuits, voltage and current relations in star and delta connections. Relationship between line and phase quantities.	2L
4	**DC Machines** Construction, EMF equation, Principle of operation of DC generator, Principle of operation of DC motor, speed-torque characteristics of shunt and series machine, starting of DC motor.	5L
5	**AC Machines Transformers** Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency	4L

	Three-phase Induction motor Generation of rotating magnetic fields, Construction and working of a three-phase induction motor.	
6	**Electrical Installations** Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries.	3L
7	**General Structure of Electrical Power System** Power generation to distribution through overhead lines and underground cables with single line diagram.	1L
Total		**24L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Apply the concepts of KVL/KCL and network theorems in solving DC circuits.
2	Analyze the steady state behavior of single phase and three phase AC circuits.
3	Illustrate the working principles of DC machines, transformer as well as induction motor and employ them in different area of applications.
4	Describe the components of low voltage electrical installations.
5	Describe the general structure of electrical power system.

Learning Resources:	
1	'Basic Electrical Engineering' by D. P. Kothari and I. J. Nagrath, Tata McGraw Hill, 2010.
2	'Basic Electrical Engineering' by C. L. Wadhwa, New Age, 2007.
3	'Basic Electrical and Electronics Engineering' by S. K. Bhattacharya, Pearson, 2011.
4	'Fundamentals of Electrical Engineering' by Ashfaq Husain and Haroon Ashfaq, Dhanpat Rai & Co., Delhi, 2007.
5	'Basic Electrical Engineering' by J. B. Gupta, Kataria & Sons, 2015.
6	'Fundamentals of Electrical Engineering' by L. S. Bobrow, Oxford University Press, 2011.
7	'Electrical and Electronics Technology' by E. Hughes, Pearson, 2010.

Group B: Basic Electronics Engineering

Course Objectives:	
1	To make the students understand about the semiconductor.
2	To make the students understand about diode and its circuit.
3	To make the students understand about different transistors.
4	To make the students understand about the basics of OPAMP and digital electronics.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	***Introduction to Semiconductors:*** Energy band theory, Fermi levels: Conductors, Semiconductors and Insulators: electrical properties, band diagrams, intrinsic and extrinsic, energy band diagram, electrical conduction phenomenon, P-type and N-type semiconductors, drift and diffusion carriers, mass action law.	5L
2	***Diode and Diode Circuits:*** Formation of PNP / NPN junctions, schematic symbols, current components in BJT, energy band diagram, transistor mechanism and principle of operation, CE, CB, CC configuration and characteristics, cut-off, active and saturation mode, early effect. Qualitative discussion on BJT as an amplifier. JFET (N channel only) structure, Drain and Transfer characteristics.	7L
3	***Introduction to Bipolar Junction Transistor (BJT) and Field Effect Transistor (FET):*** Formation of PNP / NPN junctions, schematic symbols, current components in BJT, energy band diagram, transistor mechanism and principle of operation, CE, CB, CC configuration and characteristics, cut-off, active and saturation mode, early effect. Qualitative discussion on BJT as an amplifier. JFET (N channel only) structure, Drain and Transfer characteristics.	6L
4	***Introduction to OPAMP and Digital Electronics:*** Introduction to Operational Amplifiers: Characteristics, Inverting and Non-Inverting mode of operation, summing amplifier, difference amplifier. Introduction to binary number; Basic Boolean algebra; Introduction to integrated circuits, Logic gates and truth tables for different logic operations and simple digital circuits using the basic gates.	6L
Total		**24L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Identify semiconductor materials, draw band-diagrams, distinguish between intrinsic and extrinsic semiconductors, n- and p- type semiconductors, calculate drift and diffusion current components
2	Explain the junction properties and the phenomenon of rectification, draw the I-V characteristics and identify operating points; Calculate ripple factors, efficiency of power supplies.
3	Draw and explain the I-V characteristics of BJTs and FET – both input and output;
4	Understand basics of OPAMP and learn the use of it as amplifier.
5	Explain binary numbers and identify different logic gates and circuit implementation.

Learning Resources:	
1	'Introduction to Electronics Principle' by Rakshit and Chattopadhyay.
2	'Electronic Principle' by Malvino.
3	'Integrated Electronics' by Millman & Halkias.
4	'Electronic Devices & Circuit Theory' by Boyelstad & Nashelsky.

Course Name:	**English**		
Course Code:	HM-HU201	**Category:**	Humanities and Social Sciences including Management Courses
Semester:	Second	**Credit:**	2.0
L-T-P:	2-0-0	**Pre-Requisites:**	Students must have basic knowledge of English Language.
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To develop technical communication skills (speaking, reading and writing).

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Technical Communication**: Theory of Communication - Definition, Scope & Barriers of Communication. Different Communication Models Effective Communication (Verbal / Non-verbal) Presentation / Public Speaking Skills.	1L

2	**Vocabulary Building**: Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives. Synonyms, antonyms, homonyms and standard abbreviations: Acronyms.	1L
3	**Basic Writing Skills:** Arranging paragraphs & Sentences in logical order Creating Cohesion. Organizing principles of paragraphs in documents. Techniques for writing precisely. Importance of proper punctuation. Creating coherence: Arranging paragraphs & Sentences in logical order.	1L
4	**Grammar**: Sentence Structures & Types: Simple, Compound, Complex. Use of phrases and clauses in sentences. Transformation of sentences. Articles, Prepositions, Tense, Voice, Narration. Identifying Common Errors in Writing. Subject-verb agreement. Noun-pronoun agreement. Misplaced modifiers. Redundancies. Clichés.	9L
5	**Writing Practices**: Teaching all varieties of Technical Reports, Précis Writing, Essay Writing, Business Letters, Cover Letter & CV; E-mail, Memo, Notice, Agenda, Minutes.	10L
6	**Reading Comprehension**: Strategies for Reading Comprehension, Practicing Technical & Non-Technical Texts, both Seen (3 texts) and Unseen.	2L
Total		**24L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Acquire basic proficiency in English including reading comprehension, writing and speaking skills. Write grammatically correct English.
2	Acquire basic language skills (listening, speaking, reading and writing) in order to communicate in English.
3	Acquire linguistic competence necessarily required in various life situations.
4	Develop intellectual, personal and professional abilities.

Learning Resources:	
1	'Practical English Usage' by Michael Swan, OUP, 1995.
2	'Remedial English Grammar' by F.T. Wood, Macmillan, 2007.
3	'On Writing Well' by William Zinsser, Harper Resource Book, 2001.
4	'Study Writing' by Liz Hamp-Lyons and Ben Heasly, Cambridge University Press, 2006.
5	'Universal English' by Prof. Prasad Kataria Publications, 2019.
6	'Communication Skills for Professionals' by Nira Konar, Prentice Hall of India, New Delhi, 2011
7	'Functional English' by Gajendra Singh Chauhan, Smita Kashiramka and L. Thimmesha. Cengage, 2019.

Course Name:	**Physics Laboratory**		
Course Code:	BS-PH291	**Category:**	Basic Science Courses
Semester:	Second	**Credit:**	1.5
L-T-P:	0-0-3	**Pre-Requisites:**	Concept of least count
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To apply the concepts of Physics in carrying out experiments on quantum physics, EMT, optics and general properties of matter and interpret the same for deduction of results.
2	To habituate with the perceptions of errors, significant digits and interpret experimental results through graphs using eye-estimation and linear regression as tools.

Course Contents: (Choose 10 experiments from the following)

Module No.	Description of Topic	Contact Hrs.
1	Determination of Hall Coefficient of a Semiconductor.	3P/ week
	Determination of Band Gap of a Semiconductor by Four Probe Method.	
2	Study of Current Voltage Characteristic, Load Response, Areal Characteristic and Spectral Response of a Photovoltaic Solar Cell.	
3	Verification of Bohr's Atomic Orbital Theory through Frank-Hertz Experiment.	
	Determination of Planck Constant using Photocell.	
	Determination of Rydberg Constant by Studying Hydrogen Spectrum.	
4	Determination of Thermo-electric Power of a given Thermocouple.	
	Determination of Unknown Resistance using Carey Foster's Bridge.	
	Determination of Specific Charge (e/m) of Electron by J. J. Thompson's Method.	
5	Determination of Young's Modulus of Elasticity of the Material of a Bar by the Method of Flexure.	
	Determination of Rigidity Modulus of the Material of a Wire by Dynamic Method.	
	Determination of Coefficient of Viscosity by Poiseulle's Capillary Flow Method.	

6	Determination of Wavelength of the Given LASER Light by Diffraction Method.	
	Determination of Wavelength of a Monochromatic Light by Newton's Ring.	
	Determination of Dispersive Power of the Material of a Prism.	
Total		**39P**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Examine various semiconductor properties (Hall coefficient, Band gap) and relate the same to the theoretical laws they have learnt.
2	Analyze various solar cell properties to get an idea of optimized performance.
3	Verify quantization of energy in atoms and calculate the least action.
4	Apply the concept of thermo-emf for thermometric calibration and calculate specific charge for charge characterization and unknown resistances using Wheatstone bridge principle.
5	Compute different fundamental elastic constants & general properties of matter.
6	Apply the concept of interference and diffraction to calculate wavelength of light sources and use lasers in fiber optic communications.

Learning Resources:	
1	'An Advanced Course in Practical Physics' by D. Chattopadhyay & P. C. Rakshit.
2	'A Manual of Practical Engineering Physics and Material Science' by A. S. Vasudeva.
3	'A Textbook of Engineering Physics Practical' by R. Das, R. Kumar, C. S. Robinson & P. K. Sahu.

Course Name:	**Basic Electrical and Electronics Engineering Lab**		
Course Code:	ES-EE291	**Category:**	Engineering Science Courses
Semester:	Second	**Credit:**	2.0
L-T-P:	0-0-4	**Pre-Requisites:**	Knowledge of Class XII level Physics & Mathematics
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Group A: Basic Electrical Engineering Laboratory

Course Objectives:	
1	Familiarization with the basic concepts of DC and AC circuit analysis.
2	Familiarization with three-phase power measurement
3	Familiarization with the working principle of Electrical machines.

Course Contents:		
Module No.	**Description of Topic/ Experiment**	**Contact Hrs.**
1	Verification of Circuit Theorem, (a) Thevenin's Theorem (with DC sources only) (b) Norton's Theorem (with DC sources only)	4P
2	Calibration of ammeter and Wattmeter.	4P
3	Measurement of current, voltage and power in RLC series circuit excited by (single-phase) AC supply.	4P
4	Measurement of power in a three phase unbalanced circuit by Two Wattmeter Method.	4P
5	(a) Open circuit and short circuit test of a single-phase transformer, (b) Load test of the transformer and determination of efficiency and regulation.	4P
6	Starting and reversing of DC shunt motor.	4P
Total		**24P**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Illustrate Thevenin's and Norton's theorems
2	Explain the concept of single phase and three phase AC supply.
3	Identify the parameters of a single phase transformer by open circuit and short circuit test.
4	Demonstrate the starting and reversing of DC motor.

Learning Resources:	
1	'Experiments in Basic Electrical Engineering' by S. K. Bhattacharya, K. M. Rastogi, New Age International (P) Ltd. Publishers.
2	'Laboratory Manual Basic Electrical Engineering' by Naveen Jain and Umesh Agarwal, Notion Press.
3	Laboratory Manual

Group B: Basic Electronics Engineering Laboratory

Course Objectives:	
1	To make the students familiarize with the electronic tools and components.
2	To make the students understand about p-n junction diode and zener diode characteristics and half wave and full wave rectifiers' performances.
3	To make the students understand about the characteristics of BJT and JFET in different modes of operation of it.
4	To make the students understand about the basics of OPAMP and logic gates.

Course Contents:		
Exp. No.	**Description of Topic**	**Contact Hrs.**
1	Familiarisation with passive and active electronic components such as Resistors, Inductors, Capacitors, Diodes, Transistors (BJT) and electronic equipment like DC power supplies, multimeters etc. Familiarisation with measuring and testing equipment like CRO, Signal generators etc.	4P
2	a) Study of I-V characteristics of Junction diodes, b) Study of I-V characteristics of Zener diodes.	4P
3	Study of Half and Full wave rectifiers with Regulation and Ripple factors.	4P
4	a) Study of I-V characteristics of BJTs. for CB configurations, b) Study of I-V characteristics of BJTs. for CE configurations.	4P
5	a) Study of drain characteristics of n-channel Junction Field Effect Transistors. b) Study of OPAMP as inverting and non-inverting amplifiers and determination of gain.	4P
6	Study of Logic Gates and realization of Boolean functions using Logic Gates.	4P
Total		**24P**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Identify different electronic components and can select appropriate tools and/or equipments for performing specific operation.
2	Realize the I-V characteristics of a p-n junction diode and a zener diode and will be able to understand the applicability of them in relation to their characteristics.
3	Implement half wave and full wave rectifier circuits and can analyze the performance of them.
4	Realize the I-V characteristics of BJT in CB and CE configurations and will be able to identify different operating regions of it.
5	Realize the I-V characteristics of JFET and will be able to identify different operating regions of it.
6	Use OPAMP as amplifier and verify the truth tables of different logic gates.

Learning Resources:	
1	'Basic Electronics: A Text - Lab Manual' by Paul Zbar, Albert Malvino, Michael Miller, Tata McGraw-Hill, 7th Edition, 2001.
2	'Practical Electronics: A Self-Teaching Guide (Wiley Self-Teaching Guides)' by Ralph Morrison, 2003.

Course Name:	**Engineering Graphics and Design**		
Course Code:	ES-ME291	**Category:**	Engineering Science Courses
Semester:	Second	**Credit:**	3.0
L-T-P:	1-0-4	**Pre-Requisites:**	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To make students aware of importance of engineering drawing and to familiarize with the drawing tools and standards.
2	To improve the technical communication skill in the form of communicative drawing for solution of science & engineering problems.
3	To develop ability to apply modern CAD tools in engineering practice.

Course Contents:

Module No.	Description of Topic/ Experiment	Contact Hrs.
1	**Introduction to Engineering Drawing**: Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Different types of lines and their use; Drawing standards and codes.	1L+4P
2	**Lettering, Dimensioning, Scales:** Plain scale, Diagonal scale and Vernier Scales.	1L+4P
3	**Geometrical Construction and Curves:** Construction of polygons, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid, Involute, Archimedean Spiral.	1L+4P
4	**Projection of Points, Lines, Surfaces**: Principles of Orthographic Projections-Conventions - 1st and 3rd angle projection, Projections of Points and lines inclined to both planes; Projections of planes (Rectangle, pentagon, Hexagon etc.) inclined Planes - Auxiliary Planes.	1L+4P
5	**Projection of Regular Solids:** Regular solids inclined to both the Planes- Auxiliary Views; Draw simple annotation, dimensioning and scale (Cube, Pyramid, Prism, Cylinder, Cone).	1L+4P
6	**Combination of Regular Solids, Floor Plans:** Regular solids in mutual contact with each other like Spheres in contact with cones standing on their base. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc.	1L+4P
7	**Isometric Projections:** Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions.	1L+4P

8	**Sections and Sectional Views of Right Angular Solids:** Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only).	1L+4P
9	**Overview of Computer Graphics, Customization & CAD Drawing:** Listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids]; Set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles.	1L+4P
10	**Annotations, Layering & Other Functions:** applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer- aided design (CAD) software modelling of parts and assemblies. Parametric and non-parametric solid, surface, and wireframe models. Part editing and two-dimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, multiview, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi views of dwelling.	2L+8P
11	**Demonstration of A Simple Team Design Project:** Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; meshed topologies for engineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerancing; Use of solid- modelling software for creating associative models at the component and assembly levels; floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc.	2L+8P

	Applying colour coding according to building drawing practice; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modelling (BIM).	
Total		**13L+52P**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand the basic concepts of Engineering Drawing for lines, geometric construction of curves and different scales.
2	Understand the concepts of orthographic projections and its applications.
3	Apply the principles of Isometric projection for conversion of orthographic to isometric views and vice versa.
4	Construct 2D geometries using AutoCAD software.

Learning Resources:	
1	'Engineering Graphics & Design' by Pradeep Jain, Ankita Maheswari, A.P. Gautam, Khanna Publishing House.
2	'Engineering Drawing' by N. D. Bhatt, V. M. Panchal & P. R. Ingle, Charotar Publishing House, 2014.
3	'Engineering Graphics' by B. Agrawal & C. M. Agrawal, TMH Publication, 2012.
4	'Engineering Drawing and Computer Graphics' by M. B. Shah & B. C. Rana, Pearson Education, 2008.
5	'Text book on Engineering Drawing' by K. L. Narayana & P. Kannaiah, Scitech Publishers, 2008.
6	Corresponding set of CAD Software Theory and User Manuals.