ESC	ENGINEERING GRAPHICS AND DESIGN	L	T	P	C
		1	0	4	3

Prerequisite: Basic Mathematics

Course Objectives:

1. To provide the basic knowledge about Engineering Drawing.
2. Detailed concepts are given in projections, technical drawing, dimensioning and specifications

Course Outcome:

Upon completion of this course, the student will be able to

1. To prepare themselves to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
2. To prepare themselves to communicate effectively
3. To prepare themselves to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Module:1 Introduction to Engineering Drawing — **9 hours**

i. Principles of Engineering Graphics and their significance, usage of Drawing instruments
ii. Lettering - Single stroke letter – Vertical and inclined capital and small letter
iii. Scales – Plain, Diagonal and Vernier Scales
iv. Curves - Ellipse, parabola, hyperbola, different methods of construction of conic sections, tangents and normal to conics

Module:2 Orthographic Projections — **9 hours**

i. Principles of Orthographic Projections-Conventions
ii. Projections of Points and lines inclined to bothplanes
iii. Projection of lines (First angle only) : Line parallel to one or both planes, line perpendicular to a plane, line inclined to one plane and parallel to other, line inclined to both plane.
iv. Projections of planes (First angle only): Plane perpendicular to one plane and parallel to other, plane perpendicular to both plane, plane inclined to one plane and perpendicular to other.
v. Projection of solids (First angle only) : Axis perpendicular to one plane and parallel to other, axis parallel to both plane, axis inclined to one plane and parallel to other, axis inclined to both plane.

Module:3 Sections and Sectional Views of Right Angular Solids — **9 hours**

Section of solids: Section plane parallel to one plane and perpendicular to other, section plane inclined to one plane and perpendicular to other. Development of surfaces of Right Regular Solids- Prism, Pyramid, Cylinder and Cone

Module:4 Isometric Projections — **9 hours**

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;

Module:5 Introduction of Computer Graphics — **6 hours**

Listing the computer technologies that impact on graphical communication, Demonstratingknowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, ObjectProperties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, CoordinateSystem), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (whereapplicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.;Isometric Views of lines, Planes, Simple and compound Solids]

Module:6 Demonstration of simple team design (Students Project as group work) — **3 hours**

Geometry and topology of engineered components: creation of engineering models and their

BEL23101T	BASIC ELECTRICAL ENGINEERINGLABORATORY	L	T	P	C
		0	0	2	1

Pre-requisite:H.S Physics and Mathematics

Course Objectives: The students will try to learn

1. Implement different circuits and verify circuit concepts for DC and AC circuits.
2. Measure the parameters for RL, RC and RLC circuits.
3. Prove the various theorems used to reduce the complexity of electrical network.

Course Outcome:

After successful completion of the course, the students will be able learn

CO1: Practical implementation of Electrical fundamentals.
CO2: To demonstrate measurement and calibration using electrical instruments.
CO3: To implement various electrical theorems and study parameters ofelectrical and electronic circuits.

List of Experiments

1. Basic safety precautions, introduction and use of measuring instruments.
2. Calibration of a Milliammeter as a Voltmeter
3. Calibration of a Millivoltmeter as an Ammeter
4. Verification of Thevenins Theorem
5. Verification of Maximum Power Transfer Theorem
6. Study of R-L-C Series Circuit
7. Forward Characteristics of Semiconductor Diode
8. Measurement of power in a single phase AC circuit using Wattmeter.
9. Demonstration of layout of house wiring
10. Demonstration of measurement of insulation resistance

List of Equipments

1. AC, DC Voltmeter
2. AC, DC Ammeter
3. Wattmeter meter
4. Rheostat
5. DC supply

Text Book(s)

1	Basic Electrical Engineering: I J Nagrath and DP Kothari, McGraw Hill Education Pvt Ltd.
2	Basic Electrical Engineering: Mittle and Mittle, McGraw Hill Education (India) Pvt Ltd.
3	Electrical and Electronic Technology-Edward Hughes, Pearson Education India.

Reference Books

1.	Basic Electrical Engineering manual; available at the department of Electrical Engineering, GCU

BBI23101T	BIOLOGY FOR ENGINEERS	L	T	P	C
		2	0	0	2

Prerequisite: Biology in intermediate level

Course Outcome:

After studying the course, the student will be able to:

1. Understand the significance of 18th-century biological observations in driving major scientific discoveries.
2. Recognize that biological classification encompasses more than mere categorization, emphasizing morphological, biochemical, and ecological criteria.
3. Explain the concepts of dominance and recessiveness in genetic inheritance from parents to offspring.
4. Identify DNA as the genetic material, illustrating how all life shares common building blocks while exhibiting immense diversity.

Module:1 Introduction — **4 hours**

Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as an independent scientific discipline. Why we need to study biology? Discuss how biological observations of 18th Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor. These examples will highlight the fundamental importance of observations in any scientific inquiry.

Module:2 Classification — **3 hours**

The underlying criterion, such as morphological, biochemical or ecological be highlighted. Hierarchy of life forms at phenomenological level. A common thread weaves this hierarchy Classification. Discuss classification based on (a) cellularity- Unicellular or multicellular (b) ultrastructure- prokaryotes or eucaryotes. (c) energy and Carbon utilization -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricoteliec, ureotelic (e) Habitata- acquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life. A given organism can come under different category based on classification. Model organisms for the study of biology come from different groups. E.coli, S.cerevisiae, D. Melanogaster, C. elegance, A. Thaliana, M. musculus

Module:3 Genetics — **3 hours**

"Genetics is to biology what Newton's laws are to Physical Sciences" Mendel's laws, Concept of segregation and independent assortment. Concept of allele. Gene mapping, Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Emphasis to be give not to the mechanics of cell division nor the phases but how genetic material passes from parent to offspring. Concepts of recessiveness and dominance. Concept of mapping of phenotype to genes. Discuss about the single gene disorders in humans. Discuss the concept of complementation using human genetics.

Module:4 Biomolecules — **3 hours**

All forms of life has the same building blocks and yet the manifestations are as diverse as one can imagine Molecules of life. In this context discuss monomeric units and polymeric structures. Discuss about sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA. Two carbon units and lipids.

Module:5 Enzymes — **3 hours**

Without catalysis life would not have existed on earth Enzymology: How to monitor enzyme catalyzed reactions. How does an enzyme catalyze reactions. Enzyme classification. Mechanism of enzyme action. Discuss at least two examples. Enzyme kinetics and kinetic

parameters. Why should we know these parameters to understand biology? RNA catalysis.	
Module: 6 Information Transfer	**3 hours**
The molecular basis of coding and decoding genetic information is universal Molecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA structure- from single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination. DICOM Image formats, The DNA Technology (Use and Application) Regulation Bill, 2019	
Module: 7 Macromolecular Analysis	**3 hours**
How to analyses biological processes at the reductionistic level Proteins- structure and function. Hierarch in protein structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.	
Module: 8 Metabolism	**4 hours**
The fundamental principles of energy transactions are the same in physical and biological world. Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergoinc reactions. Concept of Keq and its relation to standard free energy. Spontaneity. ATP as an energy currency. This should include the breakdown of glucose to CO2 + H2O (Glycolysis and Krebs cycle) and synthesis of glucose from CO2 and H2O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge	
Module: 9 Microbiology	**4 hours**
Concept of single celled organisms. Concept of species and strains. Identification and classification of microorganisms. Microscopy. Ecological aspects of single celled organisms. Sterilization and media compositions. Growth kinetics.	
Total hours	**30 hours**
Text Book	
1. General Biology, Uma Devi Koduru, Khanna Book Publishing Company.	
Reference Books	
1. Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd	
2. Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H., John Wiley and Sons	
3. Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company	
4. Molecular Genetics (Second edition), Stent, G. S.; and Calender, R.W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher	
5. Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C. Brown Publishers	

BCH23111P	CHEMISTRY LABORATORY	L	T	P	C
		0	0	2	1

Pre-requisite: Basic Science

Course Objectives:

1. To make students familiar with different quantitative analysis.
2. To enable students carry out experiments using theoretical knowledge.
3. To provide knowledge of different properties of liquids by experimental methods.

Course Outcome:

After successful completion of the course, the students will be able

CO1: To conduct quantitative analysis of a given substance by using different types of volumetrictitrations.

CO2: To apply theoretical knowledge to carry out different experiments skillfully.

CO3: To learn the physical properties like surface tension and viscosity of liquids by conducting the experiments.

List of Experiments

1. Estimation of hardness of water by a standard solution of EDTA
2. Estimation of Fe^{2+} by a standard solution of $KMnO_4$
3. Estimation of Cu^{2+} by a standard solution of $Na_2S_2O_3$
4. Conductometric titration between strong acid and strong alkali
5. pH-metric titration between strong acid and strong alkali
6. Determination of surface tension of a liquid at room temperature w.r.t water by drop number method using stalagmometer
7. Determination of coefficient of viscosity of a given solution at room temperature by Ostwald's Viscometer.
8. Preparation of potash alum, $[K_2SO_4.Al_2(SO_4)_3.2H_2O]$

List of Equipments

1. Ostwald's viscometer
2. Stalagmometer
3. Conductivity meter
4. pH meter

Text Book(s)

1	Laboratory Manual on Engineering Chemistry by S. K. Bhasin and Sudha Rani.
2	Practical Engineering chemistry by Sunitha and Rathna.

Reference Books

1.	A Textbook of Practical Chemistry by Dr.SudarsanBarua

BCH23111T	CHEMISTRY	L	T	P	C
		3	0	0	3

Pre-requisite: Basic Science

Course Objectives:

1. To provide knowledge of molecular orbital theory along with electronic configuration on the basis of Schrodinger wave equation for simple homonuclear and heteronuclear diatomic molecules.
2. To analyze different compounds with the help of different spectroscopic techniques.
3. To make students aware of the relationships between different thermodynamics properties with reference to chemical systems.
4. To provide knowledge about different periodic properties and corrosion.
5. To provide an insight into different types of fuel and applications of various engineering materials.

Course Outcome:

After successful completion of the course, the students will be able

CO1: To analyse microscopic chemistry in terms of atomic and molecular orbitals.

CO 2: To apply the fundamental principles and applications ofdifferent spectroscopic techniques.

CO 3: To explain bulk properties and processes using thermodynamic considerations.

CO 4: To rationalize periodic properties such as ionization potential, electronegativity and oxidation states along with the study of corrosion in different materials.

CO 5: To explain the chemistry of different types of fuel and engineering materials.

Module 1:ATOMIC AND MOLECULAR STRUCTURE — **4 hours**

Wave property of matter, Schrodinger's wave equation, wave function, radial and angular wave functions, Eigen function, Eigen value, Particle in an one dimensional box and quantization of energy, Three dimensional potential box and degeneracy of energy states, Molecular Orbital Theory – Applications of MO Theory in diatomic molecules (N_2, O_2, NO and CO)

Module 2:SPECTROSCOPIC TECHNIQUES AND APPLICATIONS — **7 hours**

Principle of spectroscopy, principle and applications of UV – Visible spectroscopy, infra-red spectroscopy, applications of nuclear magnetic resonance spectroscopy, atomic absorption spectroscopy and flame photometry. Fluorescence and its applications in medicine.

Module 3:USE OF FREE ENERGY IN CHEMICAL EQUILIBRIA — **4 hours**

Entropy and randomness, Entropy change in reversible and irreversible processes, free energy, free energy as a criteria for spontaneity of a process, relationship between free energy change and entropy change,Dependence of Gibbs free energy on temperature and pressure, free energy and EMF, Cell potentials, the Nernst equation and applications.

Module 4:PERIODIC PROPERTIES — **5 hours**

Effective nuclear charge, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinities and electronegativity, polarizability, oxidation states, hard and soft acids and bases.

Module 5: CORROSION AND ITS PREVENTION — **5 hours**

Definition, causes, effects, Dry or chemical corrosion andwet or electrochemical corrosion - their mechanisms. Types of electrochemical corrosion (Differential aeration, Galvanic, Concentration cell), Typical electrochemical corrosion like Pitting, Waterline. Factors affecting corrosion, passivity, Protection against corrosion.

MODULE 6 : FUEL AND COMBUSTION — **7 hours**

Classification of fuel, calorific value, characteristics of a good fuel, determination of calorific value of fuel using the Bomb Calorimeter, calorific value from Dulong's formulae,

classification of coal, proximate and ultimate analysis of coal, fractional distillation of petroleum, cracking, thermal and catalytic cracking, Refining of gasoline, Reforming, knocking, octane rating of fuel, Chemical structure of knocking, Antiknocking agents, Diesel fuel, cetane number, additives for diesel fuel,	
MODULE 7 : ADVANCED ENGINEERING MATERIALS	**4 hours**
Cement - Cement and its classification, Portland cement, raw materials, manufacture, and its setting and hardening. Refractory materials - Definition, classification into acidic, basic and neutral refractories and their uses. Lubricants – Definition and function of lubricants, classification, additives for lubricants.	
Total Lecture hours	**36 hours**
Text Book(s)	
1. Engineering Chemistry - Jain &Jain , Dhanpat Rai & Company. 2. A Text Book of Engineering Chemistry – Dr. Sunita Rattan, . K. Kataria & Sons. 3. A Text Book of Engineering Chemistry - Dr. Rajashree Khare, S. K. Kataria & Sons.	
Reference Books	
1. Physical Chemistry, P. W. Atkins, Oxford. 2. Concise Inorganic Chemistry, J. D. Lee ,Blackwell Science 3. Fundamentals of Molecular Spectroscopy, C. N. Banwell, E. M. McCash, Tata McGraw – Hill. 4. Principles of Physical Chemistry, Puri, Sharma, Pathania, Shoban Lal Nagin Chand & Co. 5. Spectroscopy of Organic Compunds, P. S. Kalsi, Wiley Eastern.	

BME23103P	DESIGN THINKING AND IDEA LAB	L	T	P	C
		0	0	2	1

Pre-requisite: Mathematics-1, Physics-1, Engineering Graphics & Design

Course Objectives: The objectives of this course are to:

1. Learn all the skills associated with the tools and inventory associated with the IDEA Lab.
2. Learn useful mechanical and electronic fabrication processes.
3. Learn necessary skills to build useful and standalone system/ project with enclosures.
4. Learn necessary skills to create print and electronic documentation for the system/project.
5. To instill the core ideas of design thinking
6. To create, conceptualize, build and present ideas on the basis of prototypes

Course Outcome: After successful completion of this course, the students should be able to:

1. Understand various types of tools and its functions
2. Identify and solve problems using critical thinking skills and creative problem-solving techniques.
3. Use various technologies and tools to develop, implement and explore new plans testing their ideas
4. Understand the diverse methods employed in design thinking and establish a workable design thinking framework to use in their practices

Module 1: Introduction to Tools	**4 hours**

Introduction to basic hand tools - Tape measure, Vernier caliper, Hammers, Fasteners, Wrenches, Pliers, Saws, Tube cutter, Chisels, Vice and Clamps, Tapping and Threading, Adhesives. Introduction to Power tools - Power saws, Jigsaw, Angle grinder, Belt sander, Bench grinder, Rotary tools, Various types of drill bits.

Module 2: Mechanical Cutting/Joining Process	**4 hours**

Mechanical cutting processes - Basic operation in Lathe, Milling, Drilling, Grinding, Carpentry, Black Smithy operations, Wood Lathe, Basic welding, brazing and other joining techniques for assembly.

Module 3: Additive & Subtractive Manufacturing	**10 hours**

3D printing and prototyping technology, 3D printing using FDM, SLS and SLA, Basics of 3D scanning, point cloud data generation for reverse engineering, Prototyping using subtractive cutting processes. 2D and 3D Structures for prototype building using Laser cutter and CNC routers.

Module 4: PCB Design and Fabrication	**6 hours**

Familiarization to basic electronic components, Schematic design and board layout using Eagle software. Entire PCB fabrication process (printing, heat transfer, etching, drilling, component pasting, soldering, testing & verification).

Module 5: Design Thinking Approach in Stages	**6 hours**

Design process: Traditional design, Design thinking, Existing sample design projects, Study on designs around us, Compositions/structure of a design, Innovative design: Breaking of patterns, Reframe existing design problems, Principles of creativity Empathy: Customer needs. Conceptualization: Visual thinking, Drawing/sketching, New concept thinking, Concept Generation Methodologies, Concept Testing, Prototyping: Principles of prototyping, Prototyping technologies, Prototype using simple things	
Total Lecture hours	**30 hours**
Text Book(s)	
1.	Chapman W.A.J, "Workshop Technology", Volume I, II, III, CBS Publishers and distributors, 5th Edition,2002.
2.	3D Printing & Design, Dr. Sabrie Soloman, ISBN: 978-9386173768, Khanna Book Publishing Company, New Delhi.
3.	Ian Gibson, David W Rosen, Brent Stucker., "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing," Springer, 2010
4.	Venuvinod, PK., MA. W., Rapid Prototyping – Laser Based and Other Technologies, Kluwer, 2004.
5.	All-in-One Electronics Simplified, A.K. Maini; 2021. ISBN-13: 978-9386173393, Khanna Book Publishing Company, New Delhi.
6.	The Art of Electronics. 3rd edition. Paul Horowitz and Winfield Hill. Cambridge University Press. ISBN: 9780521809269
7.	Practical Electronics for Inventors. 4th edition. Paul Sherz and Simon Monk. McGraw Hill. ISBN-13: 978-1259587542
8.	Encyclopedia of Electronic Components (Volume 1, 2 and 3). Charles Platt. Shroff Publishers. ISBN-13: 978-9352131945, 978-9352131952, 978-9352133703
9.	Programming Arduino: Getting Started with Sketches. 2nd edition. Simon Monk. McGraw Hill. ISBN-13: 978-1259641633
10.	Make Your Own PCBs with EAGLE: From Schematic Designs to Finished Boards. Simon Monk and Duncan Amos. McGraw Hill Education. ISBN-13: 978-1260019193.
Reference Books	
1.	The Big Book of Maker Skills: Tools & Techniques for Building Great Tech Projects. Chris Hackett. Weldon Owen; 2018. ISBN-13: 978-1681884325.
2.	The Total Inventors Manual (Popular Science): Transform Your Idea into a Top-Selling Product. Sean Michael Ragan (Author). Weldon Owen; 2017. ISBN-13: 978-1681881584.
3.	Make: Tools: How They Work and How to Use Them. Platt, Charles. Shroff/Maker Media. 2018. ISBN-13: 978-9352137374
4.	Building Scientific Apparatus. 4th edition. John H. Moore, Christopher C. Davis, Michael A. Coplan and Sandra C. Greer. Cambridge University Press. ISBN-13: 978-0521878586
5.	Electronic Product Design, G. Kaduskar and V.B. Baru, Wiley India.

BEN23102T	ENGLISH FOR TECHNICAL COMMUNICATION	L	T	P	C
		2	0	2	3

Pre-requisite: English language competence of 10+2 level

Course Objectives: the objectives of this course are to:

1. provide learning environment to practice listening, speaking, reading and writing skills
2. assist the students to carry on the tasks and activities through guided instructions and materials
3. effectively integrate English language learning with employability skills and training
4. provide hands-on experience through case-studies, mini-projects, group and individual presentations

Course Outcome: After successful completion of this course, the students will be able to

1. develop their basic as well as domain specific vocabulary
2. apply the basic principles of effective writing in constructing meaningful sentences and paragraphs, and writing different styles of texts
3. produce various academic and professional texts like essays, reports, and letters
4. enhance their English language skills and employability skills through activities and training in a language laboratory

Module 1: Vocabulary Building — **8 hours**

The concept of Word Formation, root words, prefixes and suffixes, synonyms, antonyms, and standard abbreviations,
collocations, domain specific vocabulary used in real life contexts, vocabulary building exercises

Module 2: Basic Writing Skills — **8 hours**

Mechanisms of writing: importance of proper punctuation, English punctuation marks, capitalization, semantic markers
Sentence Structures: simple, complex, compound
Use of phrases and clauses in sentences
Paragraphs: parts of a paragraph, topic sentence, supporting sentences, concluding sentence
Organizing principles of paragraphs, Creating coherence and unity, techniques for writing precisely

Module 3: Nature and Style of sensible Writing — **6 hours**

Describing, defining classifying, providing examples or evidence, writing introduction and conclusion of a long text

Module 4: Identifying Common Errors in writing — **7 hours**

Subject-verb agreement, noun-pronoun agreement, misplaced modifiers, articles, prepositions, redundancies, clichés

Module 5: Writing Practices — **8 hours**

Comprehension, formal letter writing, essay writing,
report writing: features, types, format, structure, report writing process, sources of data collection, plagiarism

Module 6: Oral Communication (This Module involves interactive practice — **8 hours**

sessions in Language Lab)	
Listening Comprehension Pronunciation, Intonation, Stress and Rhythm Common Everyday Situations: Conversations and Dialogues Communication at Workplace Interviews Formal Presentations	
Total Lecture hours	**45 hours**
Text Book(s)	
1. **AICTE's Prescribed Textbook: English (with Lab Manual) ISBN: 978-93-91505-097**	
Reference Books	
1 Effective Communication Skills. Kul Bhushan Kumar, Khanna Book Publishing, 2022.	
2 Practical English Usage. Michael Swan. OUP. 1995.	
3 Remedial English Grammar. F.T. Wood. Macmillan.2007	
4 On Writing Well. William Zinsser. Harper Resource Book. 2001	
5 Study Writing. Liz Hamp- Lyons and Ben Heasly. Cambridge University Press. 2006.	
6 Communication Skills. Sanjay Kumar and Pushp Lata. Oxford University Press. 2011.	
7 Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press.	

BME23102P	MANUFACTURING PRACTICE WORKSHOP– II	L	T	P	C
		0	0	2	1

Pre-requisite: Manufacturing Practice Workshop – I

Course Objectives: The objectives of this course are:

1.To impart knowledge and skill to use tools and equipment used in welding.
2.To educate students onthe safe handling of welding machines and to develop hands-on practical skills.

Course Outcome: After successful completion of this course, the students will be able to

CO1: Understand and classify different types of welding processes, basic fitting techniques, machining processes and basic turning operations.
CO2: Illustrate and explain the various tools, equipment, and machines used in welding, fitting, machining and turning.
CO3: Apply the techniques and principles learned in welding, fitting, machining and turning to develop and produce precision components and joints.

PART-A: WELDING

Module 1: Introduction to Welding and Arc welding	**4 hours**

Importance of welding in industry. Introduction and definition of welding. Advantages of welding over other methods of joining metals.Identification of safety equipment and their uses. Various welding processes.Arc welding equipment and tool, Different types of arc welding machines, arc welding accessories, and its functions. Various welding processes.

Module 2: Gas Welding and Cutting	**8 hours**

Oxy-acetylene gas welding equipment and accessories,Features of oxygen and acetylene gas cylinders and regulators. Hose connectors used in oxygen and acetylene gas regulators. Function of hose protectors. Function of blow pipe and nozzles. Torch adjustments and flame control, Introduction and demonstration of MIG welding. Practice of welding and cutting techniques, Marking and performing radial cuts, cutting out holes using oxy-acetylene gas cutting.

Module 3: Welding practice	**8 hours**

Deposit straight line beading on M-S plate, Butt joint, T-joint, Corner joint, Lap joint and Edge joint, Pipe welding.

PART-B: FITTING

Module 1: Introduction to Fitting	**5 hours**

Introduction Safety Precautions, Types of Fitters, Familiarization and use of various Tools and Instruments, Marking, Measuring, Holding and Checking Tools, Identification of tools and equipment used.

Module 2: Drilling	**5 hours**

Introduction, necessity of drills, Type of drill used, parts of a twist drill. Drill angles, Drilling - Cutting speed, feed and rpm, drill holding devices, Counter boring, Counter sinking: purposes of countersinking.

Module 3: Fitting Practice	**10 hours**

Filing flat and square. Practice square fitting, drilling and tapping, radius, and angular fitting, counter sinking, key and keyway, practice tapping, counter sinking, chamfering, internal threading and external threading, external radius, nut and bolt.

PART-C: MACHINING

Module 1: Introduction to Machining	**6 hours**

Introduction to milling, Types and parts of milling machine. Demonstrate working principle of Milling Machine, Different types of milling attachments and their uses. Setting vice & job on the table of milling machine. Setting arbor on the spindle of milling machine. Setting the cutter on arbor, Demonstrate Up Milling and Down Milling Process. Safety protocols.

Introduction of shaper, types, classification, shaping parts, quick return mechanism ratio etc. Demonstrate working principle of shaper machine. Various tools of shaping machine. Various methods of holding jobs, use of clamps, nuts & bolts, V-blocks, angle plates shaping operations, their importance. Tool head - its parts and application. Speed, feed, depth of cut. Setting of vice, setting of block on vice. Shaping angular surfaces. Jigs and Fixtures– Introduction, principle, types, use, advantages and disadvantages, Indexing, Safety protocols.

Module 2:Machining Practice	**14 hours**

Different milling operations - plain, face milling. Concave milling, dovetail milling, Perform Step milling. Make spur gear. Making model in shaper machine. Produce flat or plane surface, grooves using shaper. Cutting of external keyway on shaper.

PART-D: TURNING

Module 1: Introduction to Turning	**6 hours**

Importance of turning, Types of lathe, Identification and function of different parts oflathe, merits, and demerits, List of tools &equipment used in lathe. Safety precautions: Introduction to safety equipment and their use. Marking & sawing,Measurement using a caliper, bevel protector, and scale. Setting lathe in different speed and feed. Mounting and dismounting of 3-jaw chuck and 4-jaw chuck. Grinding of cutting tool. Checking alignment of lathe centers.Adjustment of tool post. Mounting job between centers.

Module 2: Turning Practice	**14 hours**

Facing operation to correct length, center drilling on lathe, step drilling, boring, step boring, threading, grooving, and knurling. Parallel turning, Step turning, chamfering, Parting off operation. Making square block from round bar in lathe.

Text Book(s)

1. Hajra Choudhury S.K., Hajra Choudhury A.K., and Nirjhar Roy S.K., “Elements of Workshop Technology”, Media promoters and publishers private limited, Mumbai, Vol. I 2008 and Vol. II 2010.
2. Kalpakjian S, Steven S. Schmid, “Manufacturing Engineering and Technology”, Pearson Education India Edition, 4th Edition, 2002
3. Rao P.N., “Manufacturing Technology”, Vol. I and Vol. II, Tata McGraw-Hill House, 2017
4. A course in Workshop Technology, Vol-I &Vol-II, B. S. Raghuvanshi, Dhanpat Rai &

	Co., 2015
Reference Books	
1.	Workshop Practice – Singh S., S.K. Kataria & Sons. 2003
2.	A. Ghosh & A.K Mallik, Manufacturing Science, Publisher: 0AFF0 (1 January 2010), ISBN-10: 8176710636

BME23101P	MANUFACTURING PRACTICE WORKSHOP - I	L	T	P	C
		0	0	4	2

Pre-requisite: None

Course Objectives: The objectives of this course are to:

1. To impart knowledge and skill to use tools, machines, equipment, and measuring instruments.
2. To educate students of safe handling of machines and to develop the hands-on practical workshop skills.

Course Outcome: After successful completion of this course, the students will be able to

1. Select tools and machinery according to the job.
2. Use hand tools in different shops for performing different operations.
3. Prepare job according to the drawing.

Module 1: Welding: **5**

(a) Theoretical Instructions: Introduction to welding processes, Safety Precautions, Demonstration of different equipments, Types of welding-Gas, Arc and Resistance welding, tools used in welding, various fluxes & electrodes used in welding. Introduction of AC & DC welding and its applications.

(b) Practical Demonstrations: Demonstration of all basic tools & personal protective equipments. Demonstration of operations such as measuring, marking, punching and cutting. Demonstration of different types of joints by using arc welding, gas welding and flame brazing.

Module 2: Machine and Machine Tools **5**

(a) Theoretical Instructions: Introduction of machine and machine tools, Safety Precautions, Different equipments and tools used, basic study of constructional details of lathe, drilling, milling, shaper and surface grinder. Introduction of various types of cutting tools (Nomenclature) and their material

(b) Practical Demonstrations: Demonstration on Lathe & basic operations such as drilling, facing, turning, taper turning, step turning, knurling, chamfering, threading. Demonstration of basic measuring instruments

Module 3: Metal cutting operations **5**

(a) Theoretical Instructions: Demonstration of different tools and material used - different edges and angles, introduction to different attachment and accessories required in lathe, milling & shaper machine, Safety Precautions, Demonstration of basic measuring instruments used

(a) **Practical Demonstrations:** Lathe- centering, plain turning, step turning, taper turning, internal and external thread cutting, Milling- indexing, hexagonal/square headed bolt, gear cutting, Shaper- planing, slotting and grooving, Surface grinding

Module 4: Fitting **5**

(a) Theoretical Instructions: Introduction to fitting work, safety precautions, Demonstration of basic hand tools, holding devices and basic fitting operations such as measuring, marking, punching, filing, sawing, drilling, tapping and dieing.

(b) Practical Demonstrations: Demonstration of all basic hand tools, measuring tools & equipments. Demonstration of simple operations such as marking, measuring, punching, filing, sawing, drilling, tapping and dieing.

Module 5: Carpentry **5**

(a) Theoretical Instructions: Introduction to Carpentry, Safety Precautions, demonstration of different tools used in carpentry. Various types of joints. Brief description of wood cutting

machines. **(b) Practical Demonstrations:** Demonstration & practice of different carpentry operation like marking and measuring, cutting, planning, chiseling, filing and chamfering.	
Module 6: Blacksmithy	**5**
(a) Theoretical Instructions: Introduction, Safety precautions, Demonstration of basic hand tools and holding devices, Description of all forging operations such as heating, hammering, finishing, forge welding, normalizing and tempering. Comparison of hot & cold working. **(b) Practical Demonstrations:** Demonstration & practice of different smithy operations like cutting, hammering, punching, bending etc. Demonstration & practice of making a square dimension from a cylindrical bar and vice versa.	
Text Book(s)	
1.	Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Media promoters and publishers private limited, Mumbai, Vol. I 2008 and Vol. II 2010.
2.	Kalpakjian S, Steven S. Schmid, "Manufacturing Engineering and Technology", Pearson Education India Edition, 4th Edition, 2002
3.	Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGraw-Hill House, 2017
4.	A course in Workshop Technology, Vol-I &Vol-II, B. S. Raghuwanshi, Dhanpat Rai & Co., 2015
Reference Books	
1.	Workshop Practice – Singh S., S.K. Kataria & Sons. 2003.

BMA23111T	MATHEMATICS-I (Calculus and Linear Algebra)	L	T	P	C
		3	1	0	4

Pre-requisite: Knowledge of Mathematics at Class XI & XII

Course Objectives:

1. To equip the students with standard concepts and tools at an intermediate to advanced level
2. To familiarize the prospective engineers with techniques in calculus, multivariate differentiation and integrationand their applications
3. To make students capable of using matrix methods and linear algebra as tools to solve engineering problems

Course Outcome:

After successful completion of the course, the students will learn

CO1:to apply differential and integral calculus to notions of curvature and to improper integrals. Apart from some other applications they will have a basic understanding of Beta and Gamma functions.
CO 2: to apply the Mean Value Theorems that inEngineering problems.
CO 3: the tool of power series and infinite series for learning advanced Engineering Mathematics.
CO 4: to acquaint with mathematical tools needed in evaluating multiple integrals and their usage.
CO 5: to use the essential tool of matrices and linear algebra in a comprehensive manner.

Module 1: Basic Calculus	**8 hours**

Curvature, evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Module 2:Single-variable Calculus (Differentiation)	**8hours**

Rolle's Theorem, Mean value theorems and applications; Extreme values of functions; Linear approximation; Indeterminate forms and L' Hospital's rule;Taylor and Maclaurin theorem

Module 3: Sequences and series	**8 hours**

Limits of sequence of numbers, Calculation of limits, Infinite series; Tests for convergence; Power series, Convergence of Taylor series, Error estimates.

Module 4: Multivariable Calculus	**12hours**

Partial derivatives, Total derivative; Directional derivatives, Gradient,Divergence and Curl;Tangent plane and normal line; Center of mass and Gravity (constant and variable densities);Orthogonal curvilinear coordinates; Scalar line integrals, Vector line integrals, Scalar surface integrals, Vector surface integrals, Volume integrals, Theorems of Green, Stokes and Gauss.

Module 5:Linear Algebra	**12 hours**

Linear Systems of Equations; Linear Independence; Rank of a Matrix; Determinant, Inverse of a matrix, Rank-nullity theorem; System of linear equations; Symmetric, Skew-symmetric and Orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Orthogonal transformation; Diagonalization of matrices; Cayley-Hamilton Theorem.

Total Lecture hours	**48 hours**

Text Book

1.**AICTE's Prescribed Textbook: Mathematics-I (Calculus & Linear Algebra), Khanna Book Publishing Co.**

Reference Books

1. Reena Garg, Engineering Mathematics, Khanna Book Publishing Company, 2022.
2.. Reena Garg, Advanced Engineering Mathematics, Khanna Book Publishing Company, 2021.
3. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson

Reprint, 2002.
4. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
5. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
6. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
7. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
8. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010

BMA23112T	MATHEMATICS-II (ODE & Complex Variables)	L	T	P	C
		3	1	0	4

Pre-requisite:Knowledge of Mathematics at Class XI & XII

Course Objectives:

1. To familiarize the prospective engineers with techniques in ordinary differential equations and complex variables
2. To provide the basic tools of mathematics for the purpose of modelling the problems and obtaining solutions.

Course Outcome:

After successful completion of the course, the students will learn

CO 1: the effective mathematical tools for the solutions of differential equations that model physical processes.

CO 2: the tools of differentiation and integration of functions of a complex variable that are used in varioustechniques dealing engineering problems.

Module 1:First Order Ordinary Differential Equations — **10hours**

Exact, linear and Bernoulli's equations. Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Module 2:Ordinary Differential Equations of Higher Orders — **14 hours**

Second order linear differential equations with variable coefficients: Euler-Cauchy equations, Solution by variation of parameters; Power series solutions: Legendre's equations and Legendre polynomials, Frobenius method, Bessel's equation and Bessel's functions of the first kind and their properties.

Module 3: Complex Variable – Differentiation — **10 hours**

Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius transformations and their properties.

Module 4: Complex Variable – Integration — **14hours**

Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals using the Bromwich contour.

Total Lecture hours — **48 hours**

Text Book

1. **AICTE's Prescribed Textbook: Mathematics-II (Calculus, Ordinary Differential Equations and Complex Variable), Khanna Book Publishing Co.**

Reference Books

1. Reena Garg, Engineering Mathematics, Khanna Book Publishing Company, 2022.
2. Reena Garg, Advanced Engineering Mathematics, Khanna Book Publishing Company, 2021.
3. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons, 2006.
4. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
5. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edition, Wiley India, 2009
6. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005
7. S. L. Ross, Differential Equations, 3rd Edition, Wiley India, 1984
8. E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.
9. E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958
10. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., Mc-Graw Hill, 2004.
11. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008
12. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010

BPY23111P	PHYSICS LABORATORY	L	T	P	C
		0	0	2	1

Pre-requisite: Basics of 12 standard Physics lab

Course Objectives:

1) To develop the laboratory skill in handling equipments.
2) Provide the basic idea of various electromagnet theorems
3) To develop the technical skill & ideas through continuous interactions.
4) To understand the basic concepts for performing different experiment for further application

Course Outcome:

CO1: Learning basic concept of various measuring instruments
CO2: Learning the basic concept measuring various electrical components by using Digital multimeter
CO3: Understand the concept of focal length and power of lens
CO4: Understand the concept of measuring inductance of coils.
CO5: Learning the concept of resonant and anti-resonant frequency concept of LCR circuit.
C06: The course provides the basic idea focal length, refractive index of a material and diffraction of light.

List of Experiments

1. Measured the length, breadth and diameter of particular shapes by using slide calipers and screw gauge.
2. To measure the
   a) Resistance, Capacitance and Inductance
   b) AC & DC Voltage and current by using Digital Multimeter
3. To determine the inductance of a coil by Anderson's bridge
4. To study a series LCR circuit and determine it's
   a) Resonant frequency and b) Quality factor Q
5. To study a parallel LCR circuit and determine its
   a) Anti-resonant frequency and b) Quality factor Q.
6. Measure the self-inductance of a coil by Rayleig's method.
7. To determination of the power of (a) Convex lens (b) Concave lens
8. To find the radius of curvature of a Plano convex lens using Newton's ring apparatus
9. To find the refractive index of water using a convex lens and a plain mirror.
10. To find the refractive index of the material of the Prism with the help of spectrometer.

Text Book(s)

1	A text book on Practical Physics: K.G. Mazumdar &B.Ghosh
2	A text book on Practical Physics: Dr. Samir Kumar Ghosh
3	Bhattacharya & Nag. Engineering Physics.

Reference books

1.	B.Sc. Practical Physics by C.l. Arora.

BPY23111T	PHYSICS	L	T	P	C
		3	1	0	4

Prerequisite: Physics and Mathematics course of 12th standard.

Course Objectives:

1. To enhance the fundamental knowledge in mathematics to understand engineering courses.
2. To have a broader concept of electrostatics related to dielectrics.
3. To be aware of magnetic behavior of different substances by understanding basics of magnetism and electromagnetic theory.
4. To enhance the knowledge of wave propagation to be applied in engineering fields.
5. To have a wider perspective of wave theory.

Course Outcome:

After successful completion of the course, the students will be able to
CO1: to remember various laws related to Physics.
CO 2: to understand the concept of fundamentals of various topics in the field of Physics.
CO 3: to apply the basics laws in solving various physical problems.
CO 4: to differentiate different concepts involved in solving the physical problems.
CO 5: to evaluate various parameters related to different topics.

Module 1: Mathematical Physics	**12 hours**

Del operator, Laplacian operrtor gradient, divergenge and curl, problems related to these concepts, their physical significance (qualitative), Gauss's theorem, Stoke's Theorem

Module 2: Electrostatics in vacuum and other dielectric media	**12 hours**

Divergence and curl of electrostatic field; Laplace's and Poisson's equations for electrostatic potential, Electrostatic field and potential of a dipole. Bound charges due to electric polarization; Electric displacement; boundary conditions on displacement; Solving simple electrostatics problems in presence of dielectrics – Point charge at the center of a dielectric sphere, charge in front of a dielectric slab, dielectric slab and dielectric sphere in uniform electric field

Module 3: Magnetostatics and Electromagnetic theory	**12 hours**

Bio-Savart law, Ampere's law, Inconsistency of Amere's law, Displacement current, Faraday's law in terms of EMF produced by changing magnetic flux; equivalence of Faraday's law and motional EMF, magnetic substances, paramagnetic, diamagnetic, ferromagnetic, Maxwell's equations (qualitative)

Module 4: Harmonic motion , Non-dispersive transverse and longitudinal waves	**12 hours**

Mechanical and electrical simple harmonic oscillators, complex number notation and phasor representation of simple harmonic motion, damped harmonic oscillator – heavy, critical and light damping, energy decay in a damped harmonic oscillator, quality factor, forced mechanical and electrical oscillators, Transverse wave on a string, the wave equation on a string, Harmonic waves, longitudinal waves and the wave equation for them

Module 5: Optics	**12 hours**

Spherical and chromatic aberrations, Achromatism in different cases, interference of light in Newton's rings experiment, Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, , different types of lasers: gas lasers (He-Ne, CO2), solid-state lasers (ruby, Neodymium)

Total hours	**60 hours**

Text Book(s)

1. Introduction to Electrodynamics, D.J Griffiths, 3rd Edn., 1998, Benjamin Cummings.
2. Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-Hill

3.	Education Optics, Ajoy Ghatak, 2008, Tata McGraw Hill
4.	Concepts of Modern Physics, Arthur Beiser, 2002, McGraw-Hill
5.	Ian G. Main, Oscillations and waves in physics.
Reference Books	
1.	The Feynman Lectures on Physics, Vol I, II,III
2.	Bhattacharya & Nag, Engineering Physics
3.	O. Svelto, Principles of Lasers

BSC	PHYSICS LABORATORY	L	T	P	C
		0	0	2	1

Pre-requisite: Basics of 12 standard Physics lab

Course Objectives:

1) To develop the laboratory skill in handling equipments.
2) Provide the basic idea of various electromagnet theorems
3) To develop the technical skill & ideas through continuous interactions..
4) To understand the basic concepts for performing different experiment for further application

Course Outcomes:

CO1: Learning basic concept of various measuring instruments
CO2: Learning the basic concept measuring various electrical components by using Digital multimeter
CO3: Understand the concept of focal length and power of lens
CO4: Understand the concept of measuring inductance of coils.
CO5: Learning the concept of resonant and anti-resonant frequency concept of LCR circuit.
CO6: The basic idea focal length, refractive index of a material and diffraction of light.

List of Experiments

1. Measured the length, breadth and diameter of particular shapes by using slide calipers and screw gauge.
2. To measure the
   a) Resistance, Capacitance and Inductance
   b) AC & DC Voltage and current by using Digital Multimeter
3. To determine the inductance of a coil by Anderson's bridge
4. To study a series LCR circuit and determine it's
   a) Resonant frequency and b) Quality factor Q
5. To study a parallel LCR circuit and determine its
   a) Anti-resonant frequency and b) Quality factor Q.
6. Measure the self-inductance of a coil by Rayleig's method.
7. To determination of the power of (a) Convex lens (b) Concave lens
8. To find the radius of curvature of a Plano convex lens using Newton's ring apparatus
9. To find the refractive index of water using a convex lens and a plain mirror.
10. To find the refractive index of the material of the Prism with the help of spectrometer.

Total Hours **15 Hours**

Text Book(s)

1	A text book on Practical Physics: K.G. Mazumdar &B.Ghosh
2	A text book on Practical Physics: Dr. Samir Kumar Ghosh

Reference books

1.	B.Sc. Practical Physics by C.l. Arora.
2.	Bhattacharya & Nag. Engineering Physics.

Internal Member External Member/BoS

BSC	MATHEMATICS-I (Calculus and Linear Algebra)	L	T	P	C
		3	1	0	4

Pre-requisite: Knowledge of Mathematics at Class XI & XII

Course Objectives:

1. To equip the students with standard concepts and tools at an intermediate to advanced level
2. To familiarize the prospective engineers with techniques in calculus, multivariate differentiation and integration and their applications
3. To make students capable of using matrix methods and linear algebra as tools to solve engineering problems

Course Outcome:

After successful completion of the course, the students will learn
CO1: to apply differential and integral calculus to notions of curvature and to improper integrals. Apart from some other applications they will have a basic understanding of Beta and Gamma functions.
CO 2: to apply the Mean Value Theorems that in Engineering problems.
CO 3: the tool of power series and infinite series for learning advanced Engineering Mathematics.
CO 4: to acquaint with mathematical tools needed in evaluating multiple integrals and their usage.
CO 5: to use the essential tool of matrices and linear algebra in a comprehensive manner.

Module 1: Basic Calculus	**12 hours**
Curvature, evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.	
Module 2:Single-variable Calculus (Differentiation)	**12hours**
Rolle's Theorem, Mean value theorems and applications; Extreme values of functions; Linear approximation; Indeterminate forms and L' Hospital's rule;Taylor and Maclaurin theorem	
Module 3: Sequences and series	**12 hours**
Limits of sequence of numbers, Calculation of limits, Infinite series; Tests for convergence; Power series, Convergence of Taylor series, Error estimates.	
Module 4: Multivariable Calculus	**12hours**
Partial derivatives, Total derivative; Directional derivatives, Gradient,Divergence and Curl;Tangent plane and normal line; Center of mass and Gravity (constant and variable densities);Orthogonal curvilinear coordinates; Scalar line integrals, Vector line integrals, Scalar surface integrals, Vector surface integrals, Volume integrals, Theorems of Green, Stokes and Gauss.	
Module 5:Linear Algebra	**12 hours**
Linear Systems of Equations; Linear Independence; Rank of a Matrix; Determinant, Inverse of a matrix, Rank-nullity theorem; System of linear equations; Symmetric, Skew-symmetric and Orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Orthogonal transformation; Diagonalization of matrices; Cayley-Hamilton Theorem.	
Total hours	**60 hours**

Text Book

1.**AICTE's Prescribed Textbook: Mathematics-I (Calculus & Linear Algebra), Khanna Book Publishing Co.**

Reference Book(s)

1. Reena Garg, Engineering Mathematics, Khanna Book Publishing Company, 2022.
2.. Reena Garg, Advanced Engineering Mathematics, Khanna Book Publishing Company, 2021.
3. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
4. Erwin Kreyszig, Advanced Engineering Mathematics, 9thEdition, John Wiley & Sons, 2006.
5. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
6. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
7. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
8. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010

Internal Member

External Member/BoS

BSC	BIOLOGY FOR ENGINEERS	L	T	P	C
		2	0	0	2

Prerequisite: Biology in intermediate level

Course Outcome:

After studying the course, the student will be able to:

1. Describe how biological observations of 18th Century that lead to major discoveries.
2. Convey that classification per se is not what biology is all about but highlight the underlying criteria, such as morphological, biochemical and ecological
3. Highlight the concepts of recessiveness and dominance during the passage of genetic material from parent to offspring
4. Convey that all forms of life have the same building blocks and yet the manifestations are as diverse as one can imagine
5. Classify enzymes and distinguish between different mechanisms of enzyme action.
6. Identify DNA as a genetic material in the molecular basis of information transfer.
7. Analyse biological processes at the reductionistic level
8. Apply thermodynamic principles to biological systems.
9. Identify and classify microorganisms

Module:1 Introduction — **4 hours**

Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as an independent scientific discipline. Why we need to study biology? Discuss how biological observations of 18th Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor. These examples will highlight the fundamental importance of observations in any scientific inquiry.

Module:2 Classification — **3 hours**

The underlying criterion, such as morphological, biochemical or ecological be highlighted. Hierarchy of life forms at phenomenological level. A common thread weaves this hierarchy Classification. Discuss classification based on (a) cellularity- Unicellular or multicellular (b) ultrastructure- prokaryotes or eucaryotes. (c) energy and Carbon utilization -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricoteliec, ureotelic (e) Habitata- acquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life. A given organism can come under different category based on classification. Model organisms for the study of biology come from different groups. E.coli, S.cerevisiae, D. Melanogaster, C. elegance, A. Thaliana, M. musculus

Module:3 Genetics — **3 hours**

“Genetics is to biology what Newton’s laws are to Physical Sciences” Mendel’s laws, Concept of segregation and independent assortment. Concept of allele. Gene mapping, Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Emphasis to be give not to the mechanics of cell division nor the phases but how genetic material passes from parent to offspring. Concepts of recessiveness and dominance. Concept of mapping of phenotype to genes. Discuss about the single gene disorders in humans. Discuss the concept of complementation using human genetics.

Module:4 Biomolecules — **3 hours**

All forms of life has the same building blocks and yet the manifestations are as diverse as one can imagine Molecules of life. In this context discuss monomeric units and polymeric structures. Discuss about sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA. Two carbon units and lipids.

Module:5 Enzymes — **3 hours**

Without catalysis life would not have existed on earth Enzymology: How to monitor enzyme catalyzed reactions. How does an enzyme catalyze reactions. Enzyme classification. Mechanism of enzyme action. Discuss at least two examples. Enzyme kinetics and kinetic parameters. Why should we know these parameters to understand biology? RNA catalysis.	
Module: 6 Information Transfer	**3 hours**
The molecular basis of coding and decoding genetic information is universal Molecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA structure- from single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination. DICOM Image formats, The DNA Technology (Use and Application) Regulation Bill, 2019	
Module: 7 Macromolecular Analysis	**3 hours**
How to analyses biological processes at the reductionistic level Proteins- structure and function. Hierarch in protein structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.	
Module: 8 Metabolism	**4 hours**
The fundamental principles of energy transactions are the same in physical and biological world. Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergoinc reactions. Concept of Keq and its relation to standard free energy. Spontaneity. ATP as an energy currency. This should include the breakdown of glucose to CO2 + H2O (Glycolysis and Krebs cycle) and synthesis of glucose from CO2 and H2O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge	
Module: 9 Microbiology	**4 hours**
Concept of single celled organisms. Concept of species and strains. Identification and classification of microorganisms. Microscopy. Ecological aspects of single celled organisms. Sterilization and media compositions. Growth kinetics.	
Total hours	**30 hours**
Text Book	
1. General Biology, Uma Devi Koduru, Khanna Book Publishing Company.	
Reference Books	
1. Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd	
2. Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H., John Wiley and Sons	
3. Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company	
4. Molecular Genetics (Second edition), Stent, G. S.; and Calender, R.W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher	
5. Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C. Brown Publishers	

Internal Member

External Member/BoS

ESC	BASIC ELECTRICAL ENGINEERING	L	T	P	C
		3	1	0	4

Pre-requisite: Physics and Mathematics in intermediate level

Course Objectives:

1. The network reduction techniques such as source transformation, mesh analysis, nodal analysis and network theorems to solve different networks
2. The various configurations of electromagnetic induction used in magnetic circuits
3. The steady state response of complex electrical circuits with single phase AC supply
4. The three phase systems for star and delta connected systems and perform three phase power calculations for balanced and unbalanced loads.
5. The fundamentals of instrumentation in measurements and calibration of instruments.
6. The different parameters for characterizing different circuits like rectifiers, filters, voltage regulators etc. using p-n junction diodes, Zener diodes and BJTs.
7. The different cables, wiring systems, wiring circuits, earthing and its purpose, fuse, MCBs and their role in electrical installations.

Course Outcome: After successful completion of the course, the students will be able

1. Analyze DC networks and theorems using various solution techniques.
2. Apply fundamental concepts of magnetic circuits and AC networks to solve problems.
3. Explain different types of measuring instruments and their workings.
4. Demonstrate the operating principle and output characteristics of pn junction diodes, zener diode, BJT, rectifiers and different filter circuits.
5. Describe the components of low voltage electrical installations and perform elementary calculations for energy consumption.

Module 1: DC Networks — **10 hours**

Definitions of active, passive, linear non-linear circuit elements and networks; Kirchhoff's laws; Nodal and mesh analysis; Voltage and current sources; Network theorems: Superposition, Thevenin's, Norton's and Maximum power transfer.

Module 2: Magnetic Circuits — **10 hours**

Definitions of mmf, flux, flux-density and reluctance; comparison between electric and magnetic circuits; series, parallel and series-parallel circuits and their solutions; energy stored in a magnetic circuit; lifting power of a magnet; electromagnetic induction, self and mutual inductance, hysteresis and eddy current losses.

Module 3: AC Circuits — **10 hours**

Waveforms of alternating voltages and currents, instantaneous, average and RMS values, form factor & peak factor, forms of representation of alternating quantities, concept of phasor & phasor diagrams, Concept of lead & lag, reactances & impedances, AC circuits-resistive, inductive, capacitive, RL, RC & RLC series, parallel and series parallel combination, impedance triangle, admittance, active & reactive power & power factor, Concepts of 3-phase AC, connections, phase & line values in star & delta connections, solutions of simple 3-phase balanced circuits with resistive & reactive loads, 3-phase power, and phase sequence

Module 4: Instruments — **10 hours**

Classification of instruments; essentials of indicating type instruments-deflecting controlling and damping torque; types of indicating instruments; moving coil and moving iron ammeters and voltmeters; extension of range of instruments -use of shunts and multiplier

Module 5: Electronics — **10 hours**

Diode as a rectifier-half wave and full wave rectifier circuits; ripples in output waveform-ripple factor; introduction to filters; Zener diode and its application as voltage regulator; bipolar junction transistor and its classification, static characteristics.	
Module 6: Basics of Electrical Installations	**10 hours**
Basic knowledge of domestic wiring, types of cables, types of wiring; circuit layouts-single phase AC mains to DB; 3 phase connections; accessories-main switch, ceiling rose, fuse, MCB etc., Earthing-purpose & methods.	
Total hours	**60 hours**

Text Book(s)	
1.	Basic Electrical Engineering: I J Nagrath and DP Kothari, McGraw Hill Education Pvt Ltd.
2.	Basic Electrical Engineering: Mittle and Mittle, McGraw Hill Education (India) Pvt Ltd.
3.	Electro Technology: H Cotton, CBS Publishing.
4.	Electrical and Electronic Technology-Edward Hughes, Pearson Education India.
Reference Book(s)	
1.	Basic Electrical Engineering: Ravish R Singh, McGraw Hill Education (India) Pvt Ltd.
2.	Basic Electrical Engineering: K. Uma Rao, Pearson Education India.
3.	Basic Electrical and Electronics Engineering: R.K. Rajput, University Science Press.
4.	Basic Electrical and Electronics Engineering: J.B. Gupta, S.K. Kataria and Sons

Internal Member

External Member/BoS

ESC	BASIC ELECTRICAL ENGINEERINGLABORATORY	L	T	P	C
		0	0	2	1

Prerequisite: Physics and Mathematics in intermediate level

Course Objectives:

The students will try to learn

1. Implement different circuits and verify circuit concepts for DC and AC circuits.
2. Measure the parameters for RL, RC and RLC circuits.
3. Prove the various theorems used to reduce the complexity of electrical network.

Course Outcome:

After successful completion of the course, the students will be able learn

CO1: Practical implementation of Electrical fundamentals.

CO2: To demonstrate measurement and calibration using electrical instruments.

CO3: To implement various electrical theorems and study parameters ofelectrical and electronic circuits.

List of Experiments

1. Basic safety precautions, introduction and use of measuring instruments.
2. Calibration of a Milliammeter as a Voltmeter
3. Calibration of a Millivoltmeter as an Ammeter
4. Verification of Thevenins Theorem
5. Verification of Maximum Power Transfer Theorem
6. Study of R-L-C Series Circuit
7. Forward Characteristics of Semiconductor Diode
8. Measurement of power in a single phase AC circuit using Wattmeter.
9. Demonstration of layout of house wiring
10. Demonstration of measurement of insulation resistance

List of Equipments

- AC, DC Voltmeter
- AC, DC Ammeter
- Wattmeter meter
- Rheostat
- DC supply

Total Hours: 15

Text Book

1	Basic Electrical Engineering: I J Nagrath and DP Kothari, McGraw Hill Education Pvt Ltd.
2	Basic Electrical Engineering: Mittle and Mittle, McGraw Hill Education (India) Pvt Ltd.
3	Electrical and Electronic Technology-Edward Hughes, Pearson Education India.

Reference Books

1.	Basic Electrical Engineering manual; available at the department of Electrical Engineering, GCU

Internal Member

External Member/BoS

ESC	ENGINEERING GRAPHICS AND DESIGN	L	T	P	C
		1	0	4	3

Prerequisite: Basic Mathematics

Course Objectives:

1. To provide the basic knowledge about Engineering Drawing.
2. Detailed concepts are given in projections, technical drawing, dimensioning and specifications

Course Outcome:

Upon completion of this course, the student will be able to

1. To prepare themselves to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
2. To prepare themselves to communicate effectively
3. To prepare themselves to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Module:1 Introduction to Engineering Drawing — **9 hours**

i. Principles of Engineering Graphics and their significance, usage of Drawing instruments
ii. Lettering - Single stroke letter – Vertical and inclined capital and small letter
iii. Scales – Plain, Diagonal and Vernier Scales
iv. Curves - Ellipse, parabola, hyperbola, different methods of construction of conic sections, tangents and normal to conics

Module:2 Orthographic Projections — **9 hours**

i. Principles of Orthographic Projections-Conventions
ii. Projections of Points and lines inclined to bothplanes
iii. Projection of lines (First angle only) : Line parallel to one or both planes, line perpendicular to a plane, line inclined to one plane and parallel to other, line inclined to both plane.
iv. Projections of planes (First angle only): Plane perpendicular to one plane and parallel to other, plane perpendicular to both plane, plane inclined to one plane and perpendicular to other.
v. Projection of solids (First angle only) : Axis perpendicular to one plane and parallel to other, axis parallel to both plane, axis inclined to one plane and parallel to other, axis inclined to both plane.

Module:3 Sections and Sectional Views of Right Angular Solids — **9 hours**

Section of solids: Section plane parallel to one plane and perpendicular to other, section plane inclined to one plane and perpendicular to other. Development of surfaces of Right Regular Solids- Prism, Pyramid, Cylinder and Cone

Module:4 Isometric Projections — **9 hours**

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;

Module:5 Introduction of Computer Graphics — **6 hours**

Listing the computer technologies that impact on graphical communication, Demonstratingknowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, ObjectProperties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, CoordinateSystem), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (whereapplicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.;Isometric Views of lines, Planes, Simple and compound Solids]

Module:6 Demonstration of simple team design (Students Project as group work) — **3 hours**

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; mesh edtopologies for engineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerancing; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modeling (BIM).	
Total hours	**45 hours**
Text Book	
1.	AICTE's Prescribed Textbook: Engineering Graphics & Design (ISBN: 978-93-91505-066)
Reference Books	
1.	Jain, Maheshwari, Gautam (2021), Engineering Graphics & Design, Khanna Book Publishing.
2.	Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing.
3.	Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson.
4.	Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication.
5.	Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers.
6.	Corresponding set of CAD Software Theory and User Manuals.

Internal Member

External Member/BoS

ESC	DESIGN THINKING	L	T	P	C
		0	0	2	1

Prerequisite: NA

Course Objectives: The objectives of this course are to:

1. To instill the core ideas of design thinking
2. To educate students on the design process as a tool for innovation.
3. To create, conceptualize, build and present ideas on the basis of prototypes
4. To provide an authentic opportunity for students to develop teamwork and leadership skills.

Course Outcome: After successful completion of this course, the students will be able to

- Compare and classify the various learning styles and memory techniques and Apply them in their engineering education.
- Analyze emotional experience and produce great designs, be a more effective engineer, and communicate with high emotional and intellectual impact.
- Understand the diverse methods employed in design thinking and establish a workable design thinking framework to use in their practices.
- Perceive individual differences and its impact on everyday decisions and further Create a better customer experience.

Module 1: Design Thinking Overview	**2 hours**
Understanding the Process of Learning, Remembering and Emotions, Kolb's Learning Styles, Memory Retention and enhancement techniques, Assessment and Interpretation, Principles of Design Thinking	
Module 2: Design Thinking Approach in Stages	**5 hours**
Design process: Traditional design, Design thinking, Existing sample design projects, Study on designs around us, Compositions/structure of a design, Innovative design: Breaking of patterns, Reframe existing design problems, Principles of creativity Empathy: Customer Needs	
Module 3: Adopt and Adapt Design Thinking	**5 hours**
Design team-Team formation, Conceptualization: Visual thinking, Drawing/sketching, New concept thinking, Patents and Intellectual Property, Concept Generation Methodologies, Concept Selection, Concept Testing, Opportunity identification Prototyping: Principles of prototyping, Prototyping technologies, Prototype using simple things, 3D printing; Experimenting/testing.	
Module 4: Feedback, Re-Design & Re-Create	**3 hours**
Feedback loop, Focus on User Experience, Address "ergonomic challenges, User focused design, rapid prototyping & testing, final product, **Final Presentation – "Solving Practical Engineering Problem through Innovative Product Design & Creative Solution".**	
Total hours	**15 hours**

Text Book(s)

1.	E Balaguruswamy (2022), Developing Thinking Skills (The way to Success), Khanna Book Publishing Company.
2.	Tim Brown, Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation, HarperCollins Publishers Ltd.
3.	Idris Mootee, Design Thinking for Strategic Innovation,2013, John Wiley & Sons Inc

Reference Books

1.	Ulrich &Eppinger, Product Design and Development, 3rd Edition, McGraw Hill, 2004
2.	Kevin Henry, Drawing for Product designers, 2012, Laurence King Publishing Ltd

Internal Member

External Member/BoS

AU	IDEA Lab Workshop	L	T	P	C
		2	0	2	0

Prerequisite: Mathematics, Physics,

Course Objectives: The objectives of this course are to:

5. Learn all the skills associated with the tools and inventory associated with the IDEA Lab.
6. Learn useful mechanical and electronic fabrication processes.
7. Learn necessary skills to build useful and standalone system/ project with enclosures.
8. Learn necessary skills to create print and electronic documentation for the system/project.

Course Outcome: After successful completion of this course, the students should be able to

1. Think outside the box and generate new and innovative ideas.
2. Identify and solve problems using critical thinking skills and creative problem-solving techniques.
3. Work collaboratively in a team, motivate others and understand the importance of effective communication, cooperation and conflict resolution to achieve a common goal.
4. Use various technologies and tools to develop, implement and explore new plans testing their ideas.

Module 1: Introduction to Tools — **2 hours**

- Introduction to basic hand tools - Tape measure, Vernier caliper, Hammers, Fasteners, Wrenches, Pliers, Saws, Tube cutter, Chisels, Vice and Clamps, Tapping and Threading. Adhesives.
- Introduction to Power tools - Power saws, Jigsaw, Angle grinder, Belt sander, Bench grinder, Rotary tools. Various types of drill bits.

Module 2: Mechanical Cutting/Joining Process — **8 hours**

- Mechanical cutting processes - Basic Turning, Milling, Drilling, Grinding, Carpentry, Black Smithy operations, Wood Lathe.
- Basic welding, brazing and other joining techniques for assembly.

Module 3: Additive & Subtractive Manufacturing — **8 hours**

- 3D printing and prototyping technology, 3D printing using FDM, SLS and SLA.
- Basics of 3D scanning, point cloud data generation for reverse engineering.
- Prototyping using subtractive cutting processes. 2D and 3D Structures for prototype building using Laser cutter and CNC routers.

Module 4: Basic Electronic Components and Devices — **2 hours**

- Electronic component familiarization, familiarization & use of basic measurement instruments - DSO including various triggering modes, DSO probes, DMM, LCR bridge, Signal, and function generator. Understanding electronic system design flow.

Module 5: PCB Fabrication — **10 hours**

- Schematic design and PCB layout and Gerber creation using Eagle CAD, Circuit prototyping using (a) breadboard (b) custom PCB. Single and double-sided PCB prototype fabrication in the lab. Soldering using soldering iron/station. Soldering using a temperature controlled reflow oven.

Module 6: Sensors and Arduino Programming — **6 hours**

- Electronic circuit building blocks including common sensors. Arduino and Raspberry Pi programming and use. Power Supply design (Linear and Switching types), Wireless power supply, Solar panels, Battery types and charging.

Total hours — **36 hours**

Text Book(s)

1.	Chapman W.A.J, "Workshop Technology", Volume I, II, III, CBS Publishers and distributors, 5th Edition,2002.
2.	3D Printing & Design, Dr. Sabrie Soloman, ISBN: 978-9386173768, Khanna Book Publishing Company, New Delhi.
3.	Ian Gibson, David W Rosen, Brent Stucker., "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing," Springer, 2010
4.	Venuvinod, PK., MA. W., Rapid Prototyping – Laser Based and Other Technologies, Kluwer, 2004.
5.	All-in-One Electronics Simplified, A.K. Maini; 2021. ISBN-13: 978-9386173393, Khanna Book Publishing Company, New Delhi.
6.	The Art of Electronics. 3rd edition. Paul Horowitz and Winfield Hill. Cambridge University Press. ISBN: 9780521809269
7.	Practical Electronics for Inventors. 4th edition. Paul Sherz and Simon Monk. McGraw Hill. ISBN-13: 978-1259587542
8.	Encyclopedia of Electronic Components (Volume 1, 2 and 3). Charles Platt. Shroff Publishers. ISBN-13: 978-9352131945, 978-9352131952, 978-9352133703
9.	Programming Arduino: Getting Started with Sketches. 2nd edition. Simon Monk. McGraw Hill. ISBN-13: 978-1259641633
10.	Make Your Own PCBs with EAGLE: From Schematic Designs to Finished Boards. Simon Monk and Duncan Amos. McGraw Hill Education. ISBN-13: 978-1260019193.
Reference Books	
1.	The Big Book of Maker Skills: Tools & Techniques for Building Great Tech Projects. Chris Hackett. Weldon Owen; 2018. ISBN-13: 978-1681884325.
2.	The Total Inventors Manual (Popular Science): Transform Your Idea into a Top-Selling Product. Sean Michael Ragan (Author). Weldon Owen; 2017. ISBN-13: 978-1681881584.
3.	Make: Tools: How They Work and How to Use Them. Platt, Charles. Shroff/Maker Media. 2018. ISBN-13: 978-9352137374
4.	Building Scientific Apparatus. 4th edition. John H. Moore, Christopher C. Davis, Michael A. Coplan and Sandra C. Greer. Cambridge University Press. ISBN-13: 978-0521878586
5.	Electronic Product Design, G. Kaduskar and V.B. Baru, Wiley India.

Internal Member

External Member/BoS

BSC	CHEMISTRY	L	T	P	C
		3	0	0	3

Prerequisite: Basic Science

Course Objectives:

1. To provide knowledge of molecular orbital theory along with electronic configuration on the basis of Schrodinger wave equation for simple homonuclear and heteronuclear diatomic molecules.
2. To analyze different compounds with the help of different spectroscopic techniques.
3. To make students aware of the relationships between different thermodynamics properties with reference to chemical systems.
4. To provide knowledge about different periodic properties and corrosion.
5. To provide an insight into different types of fuel and applications of various engineering materials.

Course Outcome:

After successful completion of the course, the students will be able

CO1: To analyse microscopic chemistry in terms of atomic and molecular orbitals.

CO 2: To apply the fundamental principles and applications of different spectroscopic techniques.

CO 3: To explain bulk properties and processes using thermodynamic considerations.

CO 4: To rationalize periodic properties such as ionization potential, electro negativity and oxidation states along with the study of corrosion in different materials.

CO 5: To explain the chemistry of different types of fuel and engineering materials.

Module 1:ATOMIC AND MOLECULAR STRUCTURE	**6 hours**

Wave property of matter, Schrodinger's wave equation, wave function, radial and angular wave functions, Eigen function, Eigen value, Particle in an one dimensional box and quantization of energy, Three dimensional potential box and degeneracy of energy states, Molecular Orbital Theory – Applications of MO Theory in diatomic molecules (N_2, O_2, NO and CO)

Module 2:SPECTROSCOPIC TECHNIQUES AND APPLICATIONS	**7 hours**

Principle of spectroscopy, principle and applications of UV – Visible spectroscopy, infra-red spectroscopy, applications of nuclear magnetic resonance spectroscopy, atomic absorption spectroscopy and flame photometry. Fluorescence and its applications in medicine.

Module 3:USE OF FREE ENERGY IN CHEMICAL EQUILIBRIA	**6 hours**

Entropy and randomness, Entropy change in reversible and irreversible processes, free energy, free energy as a criteria for spontaneity of a process, relationship between free energy change and entropy change,Dependence of Gibbs free energy on temperature and pressure, free energy and EMF, Cell potentials, the Nernst equation and applications.

Module 4:PERIODIC PROPERTIES	**5 hours**

Effective nuclear charge, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinities and electronegativity, polarizability, oxidation states, hard and soft acids and bases.

Module 5: CORROSION AND ITS PREVENTION	**5 hours**

Definition, causes, effects, Dry or chemical corrosion andwet or electrochemical corrosion - their mechanisms. Types of electrochemical corrosion (Differential aeration, Galvanic, Concentration cell), Typical electrochemical corrosion like Pitting, Waterline. Factors affecting corrosion, passivity, Protection against corrosion.

MODULE 6 : FUEL AND COMBUSTION	**7 hours**

Classification of fuel, calorific value, characteristics of a good fuel, determination of calorific value of fuel using the Bomb Calorimeter, calorific value from Dulong's formulae, classification of coal, proximate and ultimate analysis of coal, fractional distillation of petroleum, cracking, thermal and catalytic cracking, Refining of gasoline, Reforming, knocking, octane rating of fuel, Chemical structure of knocking, Antiknocking agents, Diesel fuel, cetane number, additives for diesel fuel,

MODULE 7 : ADVANCED ENGINEERING MATERIALS	**9 hours**
Cement - Cement and its classification, Portland cement, raw materials, manufacture, and its setting and hardening. Refractory materials - Definition, classification into acidic, basic and neutral refractories and their uses. Lubricants – Definition and function of lubricants, classification, additives for lubricants.	
Total hours	**45 hours**
Text Book(s)	
1. Engineering Chemistry - Jain &Jain ,DhanpatRai& Company.	
2. A Text Book of Engineering Chemistry – Dr. Sunita Rattan, . K. Kataria& Sons.	
3. A Text Book of Engineering Chemistry - Dr. RajashreeKhare, S. K. Kataria& Sons.	
Reference Books	
1. Physical Chemistry, P. W. Atkins, Oxford.	
2. Concise Inorganic Chemistry, J. D. Lee ,Blackwell Science	
3. Fundamentals of Molecular Spectroscopy, C. N. Banwell, E. M. McCash,Tata McGraw – Hill.	
4. Principles of Physical Chemistry,Puri, Sharma, Pathania,ShobanLalNagin Chand & Co.	
5. Spectroscopy of Organic Compunds, P. S. Kalsi, Wiley Eastern.	

Internal Member

External Member/BoS

BSC	**CHEMISTRY LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**
Pre-requisite: Basic Science					

Course Objectives:

4. To make students familiar with different quantitative analysis.
5. To enable students carry out experiments using theoretical knowledge.
3. To provide knowledge of different properties of liquids by experimental methods.

Course Outcome:

After successful completion of the course, the students will be able
CO1: To conduct quantitative analysis of a given substance by using different types of volumetrictitrations.
CO2: To apply theoretical knowledge to carry out different experiments skillfully.
CO3: To learn the physical properties like surface tension and viscosity of liquids by conducting the experiments.

List of Experiments

1. Estimation of hardness of water by a standard solution of EDTA
2.Estimation of Fe^{2+} by a standard solution of $KMnO_4$
3.Estimation of Cu^{2+} by a standard solution of $Na_2S_2O_3$
4. Conductometric titration between strong acid and strong alkali
5. pH-metric titration between strong acid and strong alkali
6. Determination of surface tension of a liquid at room temperature w.r.t water by drop number method using stalagmometer
7. Determination of coefficient of viscosity of a given solution at room temperature by Ostwald's Viscometer.
8. Preparation of potash alum, $[K_2SO_4.Al_2(SO_4)_3.2H_2O]$

List of Equipments

- Ostwald's viscometer
- Stalagmometer
- Conductivity meter
- pH meter

Total hours: 15 hour

Text Book(s)

1	Laboratory Manual on Engineering Chemistry by S. K. Bhasin and Sudha Rani.
2	Practical Engineering chemistry by Sunitha and Rathna.

Reference Books

1.	A Textbook of Practical Chemistry by Dr.Sudarsan Barua

Internal Member

External Member/BoS

BSC	MATHEMATICS-II (ODE & Complex Variables)	L	T	P	C
		3	1	0	4

Pre-requisite: Knowledge of Mathematics at Class XI & XII

Course Objectives:

1. To familiarize the prospective engineers with techniques in ordinary differential equations and complex variables
2. To provide the basic tools of mathematics for the purpose of modelling the problems and obtaining solutions.

Course Outcome:

After successful completion of the course, the students will learn
CO 1: the effective mathematical tools for the solutions of differential equations that model physical processes.
CO 2: the tools of differentiation and integration of functions of a complex variable that are used in varioustechniques dealing engineering problems.

Module 1:First Order Ordinary Differential Equations	**15hours**

Exact, linear and Bernoulli's equations. Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Module 2:Ordinary Differential Equations of Higher Orders	**15 hours**

Second order linear differential equations with variable coefficients: Euler-Cauchy equations, Solution by variation of parameters; Power series solutions: Legendre's equations and Legendre polynomials, Frobenius method, Bessel's equation and Bessel's functions of the first kind and their properties.

Module 3: Complex Variable – Differentiation	**15 hours**

Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius transformations and their properties.

Module 4: Complex Variable – Integration	**15 hours**

Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals using the Bromwich contour.

Total Lecture hours	**60 hours**

Text Book

1. AICTE's Prescribed Textbook: Mathematics-II (Calculus, Ordinary Differential Equations and Complex Variable), Khanna Book Publishing Co.

Reference Books

1. ReenaGarg, Engineering Mathematics, Khanna Book Publishing Company, 2022.
2. ReenaGarg, Advanced Engineering Mathematics, Khanna Book Publishing Company, 2021.
3. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons, 2006.
4. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
5. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edition, Wiley India, 2009
6. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005
7. S. L. Ross, Differential Equations, 3rd Edition, Wiley India, 1984
8. E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.
9. E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958

Internal Member External Member/BoS

ESC	**PROGRAMMING FOR PROBLEM SOLVING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Prerequisite: Basic computer knowledge, basic mathematics

Course Objectives:

1. To learn the fundamentals of computers.
2. To understand the various steps in program development.
3. To learn the syntax and semantics of C programming language.
4. To learn the usage of structured programming approach in solving problems.
5. To understated and formulate algorithm for programming script
6. To analyze the output based on the given input variable

Course Outcome:

After successful completion of the course, the students will learn
CO1: Illustrate basic concepts of computer and C programming.
CO2: Apply the concepts of conditional and looping statements.
CO3: Demonstrate the ability to write C program using arrays, structures, pointers and files.
CO4: Develop modular programs using C language.

MODULE 1: Introduction to Programming	**6 hours**
Introduction to Programming; Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.) Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples. From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code.	
MODULE 2: Introduction to C	**6 hours**
Using Comments, Keywords, Identifiers, Tokens, Basic Data Types, Writing C Expressions using Operators, Precedence of Operators, I/O Statements in C	
MODULE 3: Conditional Branching and Loops	**6hours**
Conditional Branching Statements, Iterative Statements, Nested Loops, Break and Continue Statements, Goto Statements.	
MODULE 4: Arrays and Strings	**6 hours**
1-D Array-Declaration, Accessing Array Elements, Array Operations, 2-D Array-Matrix Addition, Subtraction, Multiplication, Character Arrays, Strings, String Manipulation Function.	
MODULE 5: Functions	**8 hours**
Function Declaration/Prototype, Function Definition, Function Call, Return Statement, Passing Parameters, Scope of Variables, Storage Classes, Recursive Function. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.	
MODULE 6: Structure	**7 hours**
Structures, Defining Structures, Accessing Members, Array of Structures.	
MODULE 7: Pointers and File handling	**6 hours**
Pointers, Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, File handling.	
Total hours	**45 hours**

Text Books

1.	Byron Gottfried, Schaum's Outline of Programming with C,McGraw-Hill
2.	YashavantKanetkar, Let us C, BPBPublication

Reference Book

Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India

Internal Member External Member/BoS

BSC	PROGRAMMING FOR PROBLEM SOLVING LABORATORY	L	T	P	C
		0	0	4	2

Prerequisite: Basic computer knowledge, Basic Mathematics

Course Objectives:

1. To translate given algorithms to a working and correct program.
2. To be able to correct syntax errors as reported by the compilers.
3. To be able to identify and correct logical errors encountered at run time.
4. To be able to write iterative as well as recursive programs.
5. To be able to represent data in arrays, strings and structures and manipulate them through a program.
6. To be able to declare pointers of different types and use them in defining self-referential structures.
7. To be able to create, read and write to and from simple text files.

Course Outcome: After successful completion of the course, the students will be able

1. CO1: Translate a given algorithm to C program and become familiarized with programming environments.
2. CO2: Build programs using modular programming and recursion.
3. CO3: Build programs using built-in and user defined data types for data processing.
4. CO4: Build programs for data processing using dynamic memory management.
5. CO5: Solve a computational problem through team work.
6. CO6: Exhibit self-learning by writing programs for solving problems in differentiation and integration by numerical methods.

List of Experiments

1. Familiarization with programming environment (editors, compilation, debugging etc.)
2. Simple computational problems using expressions and precedence
3. Problems involving using if-then-else and switch statements
4. Iterative problems e.g., sum of series, factorial, Fibonacci series etc.
5. 1D, 2D Array manipulation: summation, finding odd/even in a set, string handling etc.
6. Matrix problems (addition, multiplication etc.), String operations (finding length, concatenation, comparing etc.)
7. Simple function illustrating the concepts, call by value
8. Recursive functions for summation, Fibonacci series, and factorial
9. Pointers, call by reference, passing arrays to functions, passing address of structure to function, passing array of structure to function, pointers and arrays, function pointer, dynamic allocation of block of memory and accessing the elements
10. File operations on text files, binary files. Total Hours: 30 hours

Text Book(s)

1	Byron Gottfried, Schaum's Outline of Programming with C,McGraw-Hill
2	YashavantKanetkar, Let us C, BPBPublication
3	E. Balaguruswamy, Programming in ANSI C, TataMcGraw-Hill
4	YashavantKanetkar, Understanding Pointers in C, BPBPublication
5	Practical Engineering chemistry by Sunitha and Rathna.

Reference Book

1.	Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India

Internal Member External Member/BoS

HSMC	ENGLISH FOR TECHNICAL WRITING	L	T	P	C
		2	0	2	3

Prerequisite: English language competence of 10+2 level	
Course Objectives: the objectives of this course are to:	
1.Provide learning environment to practice listening, speaking, reading and writing skills 2.Assist the students to carry on the tasks and activities through guided instructions and materials 3.Effectively integrate English language learning with employability skills and training 4.Provide hands-on experience through case-studies, mini-projects, group and individual presentations.	
Course Outcome: After successful completion of this course, the students will be able to	
1. develop their basic as well as domain specific vocabulary 2. apply the basic principles of effective writing in constructing meaningful sentences and paragraphs, and writing different styles of texts 3. produce various academic and professional texts like essays, reports, and letters 4. enhance their English language skills and employability skills through activities and training in a language laboratory	
Module 1: Vocabulary Building	**8 hours**
The concept of Word Formation, root words, prefixes and suffixes, synonyms, antonyms, and standard abbreviations,collocations, domain specific vocabulary used in real life contexts, vocabulary building exercises	
Module 2: Basic Writing Skills	**8 hours**
Mechanisms of writing: importance of proper punctuation, English punctuation marks, capitalization, semantic markers.Sentence Structures: simple, complex, compound. Use of phrases and clauses in sentences.Paragraphs: parts of a paragraph, topic sentence, supporting sentences, concluding sentence.Organizing principles of paragraphs, Creating coherence and unity, techniques for writing precisely	
Module 3: Nature and Style of sensible Writing	**10 hours**
Describing, defining classifying, providing examples or evidence, writing introduction and conclusion of a long text.	
Module 4: Identifying Common Errors in writing	**4 hours**
Subject-verb agreement, noun-pronoun agreement, misplaced modifiers, articles, prepositions, redundancies, clichés	
Module 5: Writing Practices	**7 hours**
Comprehension, formal letter writing, essay writing, report writing: features, types, format, structure, report writing process, sources of data collection, plagiarism.	
Module 6: **Oral Communication** (This Module involves interactive practice sessions in Language Lab)	**8 hours**
Listening Comprehension Pronunciation, Intonation, Stress and Rhythm Common Everyday Situations: Conversations and Dialogues Communication at Workplace Interviews Formal Presentations	
Total hours	**45 hours**
Text Book	
1. AICTE's Prescribed Textbook: English (with Lab Manual) ISBN: 978-93-91505-097	
Reference Books	

1.	Effective Communication Skills. Kul Bhushan Kumar, Khanna Book Publishing, 2022.
2.	Practical English Usage. Michael Swan. OUP. 1995.
3.	Remedial English Grammar. F.T. Wood. Macmillan.2007
4.	On Writing Well. William Zinsser. Harper Resource Book. 2001
5.	Study Writing. Liz Hamp- Lyons and Ben Heasly. Cambridge University Press. 2006.
6.	Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.
7.	Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press.

Internal Member

External Member/BoS

HSMC	Universal Human Values-II: Understanding Harmony And Ethical Human Conduct	L	T	P	C
		2	1	0	3

Prerequisite: UHV 1 / SIP

Course Objectives:

This introductory course input is intended:

1. To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
2. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.

Course Outcome:

By the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature); they would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind. They would have better critical ability. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society). It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

Module:1 Introduction — **9 hours**

Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education) , Understanding Value Education ,Sharing about Oneself ,Self-exploration as the Process for Value Education , Continuous Happiness and Prosperity – the Basic Human Aspirations , Exploring Human Consciousness ,Happiness and Prosperity – Current Scenario , Method to Fulfill the Basic Human Aspirations ,Exploring Natural Acceptance

Module:2 Harmony in the Human Being — **9 hours**

Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, Exploring the difference of Needs of Self and Body. The Body as an Instrument of the Self. Understanding Harmony in the Self. Exploring Sources of Imagination in the Self. Harmony of the Self with the Body. Programme to ensure self-regulation and Health. Exploring Harmony of Self with the Body

Module:3 Harmony in the Family and Society — **9 hours**

Harmony in the Family – the Basic Unit of Human Interaction. Trust' – the Foundational Value in Relationship. Exploring the Feeling of Trust. 'Respect' – as the Right Evaluation.Exploring the Feeling of Respect.Other Feelings, Justice in Human-to-Human Relationship. Understanding Harmony in the Society. Vision for the Universal Human Order. Exploring Systems to fulfil Human Goal.

Module:4 Harmony in the Nature/Existence — **9 hours**

Understanding Harmony in the Nature. Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature. Exploring the Four Orders of Nature. Realizing Existence as Co-existence at All Levels. The Holistic Perception of Harmony in Existence Exploring Co-existence in Existence.

Module:5 Implications of the Holistic Understanding	**9 hours**
Natural Acceptance of Human Values. Definitiveness of (Ethical) Human Conduct. Exploring Ethical Human Conduct. A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order. Competence in Professional Ethics. Exploring Humanistic Models in Education. Holistic Technologies, Production Systems and Management Models-Typical Case Studies. Strategies for Transition towards Value-based Life and Profession. Exploring Steps of Transition towards Universal Human Order.	
Total hours	**45 hours**

Text Book	
1.	A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47
Reference Books	
1.	JeevanVidya: EkParichaya, A Nagaraj, JeevanVidyaPrakashan, Amarkantak, 1999.
2.	Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3.	The Story of Stuff (Book).
4.	The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi.

Internal Member

External Member/BoS

ESC	MANUFACTURING PRACTICE WORKSHOP	L	T	P	C
		0	0	4	2

Prerequisite: None

Course Objectives: The objectives of this course are to:

1. To impart knowledge and skill to use tools, machines, equipment, and measuring instruments.
2. To educate students of safe handling of machines and to develop the hands-on practical workshop skills.

Course Outcome: After successful completion of this course, the students will be able to

1. Select tools and machinery according to the job.
2. Use hand tools in different shops for performing different operations.
3. Prepare job according to the drawing.

Module 1: Welding — **5 hours**

(a) Theoretical Instructions: Introduction to welding processes, Safety Precautions, Demonstration of different equipments, tools used in welding, various fluxes & electrodes used in welding. Introduction of AC & DC welding and its applications.

(b) Practical Demonstrations: Demonstration of all basic tools & personal protective equipments. Demonstration of operations such as measuring, marking, punching and cutting. Demonstration of different types of joints by using arc welding, gas welding and flame brazing.

Module 2: Turning — **5 hours**

(a) Theoretical Instructions: Introduction of machine and machine tools, Safety Precautions, Different equipments and tools used, basic metal cutting operations. Introduction of various types of cutting tools (Nomenclature) and their material.

(b) Practical Demonstrations: Demonstration on Lathe & basic operations such as drilling, facing, turning, taper turning, step turning, knurling, chamfering, threading. Demonstration of basic measuring instruments.

Module 3: Machining — **5 hours**

(a) **Theoretical Instructions:** Introduction to machine tools such as milling, shaper and surface grinder. Safety Precautions. Demonstration of different tools and material used, Demonstration of basic measuring instruments used.

(b) **Practical Demonstrations:** Demonstration on basic operations such as gear cutting, hexagonal bolt, grinding, slot cutting and fitting.

Module 4: Fitting — **5 hours**

(a) Theoretical Instructions: Introduction to fitting work, safety precautions, Demonstration of basic hand tools, holding devices and basic fitting operations such as measuring, marking, punching, filing, sawing, drilling, tapping and dieing.

(b) Practical Demonstrations: Demonstration of all basic hand tools, measuring tools & equipments. Demonstration of simple operations such as marking, measuring, punching, filing, sawing, drilling, tapping and dieing.

Module 5: Carpentry — **5 hours**

(a) Theoretical Instructions: Introduction to Carpentry, Safety Precautions, demonstration of different tools used in carpentry. Various types of joints. Brief description of wood cutting machines.

(b) Practical Demonstrations: Demonstration & practice of different carpentry operation like marking and measuring, cutting, planning, chiseling, filing and chamfering.

Module 6: Blacksmithy — **5 hours**

(a) Theoretical Instructions: Introduction, Safety precautions, Demonstration of basic hand

	tools and holding devices, Description of all forging operations such as heating, hammering, finishing, forge welding, normalizing and tempering. Comparison of hot & cold working. **(b) Practical Demonstrations:** Demonstration & practice of different smithy operations like cutting, hammering, punching, bending etc. Demonstration & practice of making a square dimension from a cylindrical bar and vice versa. Total Hours : 30 hours
Text Book(s)	
1.	Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Media promoters and publishers private limited, Mumbai, Vol. I 2008 and Vol. II 2010.
2.	Kalpakjian S, Steven S. Schmid, "Manufacturing Engineering and Technology", Pearson Education India Edition, 4th Edition, 2002
3.	Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGraw-Hill House, 2017
Reference Book	
1.	Workshop Practice – Singh S., S.K. Kataria & Sons. 2003.

Internal Member

External Member/BoS

AU	Sports and Yoga	L	T	P	C
		2	0	0	0

Prerequisite: Nil

Course Objectives:

1. To make the students understand the importance of sound health and fitness principles as they relate to better health.
2. To expose the students to a variety of physical and yogic activities aimed at stimulating their continued inquiry about Yoga, physical education, health and fitness.
3. To create a safe, progressive, methodical and efficient activity based plan to enhance improvement and minimize risk of injury.
4. To develop among students an appreciation of physical activity as a lifetime pursuit and a means to better health.

Course Outcome:

On successful completion of the course the students will be able:

1. To practice Physical activities and Hatha Yoga focusing on yoga for strength, flexibility, and relaxation.
2. To learn techniques for increasing concentration and decreasing anxiety which leads to stronger academic performance.
3. To learn breathing exercises and healthy fitness activities
4. To understand basic skills associated with yoga and physical activities including strength and flexibility, balance and coordination.
5. To perform yoga movements in various combination and forms.
6. To assess current personal fitness levels.
7. To identify opportModuleies for participation in yoga and sports activities.
8. To develop understanding of health-related fitness components: cardiorespiratory endurance, flexibility and body composition etc.
9. To improve personal fitness through participation in sports and yogic activities.
10. To develop understanding of psychological problems associated with the age and lifestyle.
11. To demonstrate an understanding of sound nutritional practices as related to health and physical performance.
12. To assess yoga activities in terms of fitness value.
13. To identify and apply injury prevention principles related to yoga and physical fitness activities.
14. To understand and correctly apply biomechanical and physiological principles elated to exercise and training.

Module:1 Introduction to Physical Education

Meaning & definition of Physical Education
Aims & Objectives of Physical Education
Changing trends in Physical Education

Module:2 Olympic Movement

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.)

Module:3 Physical Fitness, Wellness & Lifestyle

Meaning & Importance of Physical Fitness & Wellness
Components of Physical fitness
Components of Health related fitness

Components of wellness o Preventing Health Threats through Lifestyle Change Concept of Positive Lifestyle
Module:4 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, Respiratory System, Neuro-Muscular System etc.)
Module:5 Kinesiology, Biomechanics & Sports
Meaning & Importance of Kinesiology & Biomechanics in Physical Edu. & Sports Newton's Law of Motion & its application in sports. Friction and its effects in Sports.
Module: 6 Postures
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, Kyphosis, Bow Legs and Scoliosis. Corrective Measures for Postural Deformities
Module: 7 Yoga
Meaning & Importance of Yoga Elements of Yoga o Introduction - Asanas, Pranayama, Meditation & Yogic Kriyas Yoga for concentration & related Asanas (Sukhasana; Tadasana; Padmasana & Shashankasana) Relaxation Techniques for improving concentration - Yog-nidra
Module: 8 Yoga & Lifestyle
Asanas as preventive measures. Hypertension: Tadasana, Vajrasana, Pavan Muktasana, 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.
Module: 9 Training and Planning in Sports
Meaning of Training Warming up and limbering down Skill, Technique & Style Meaning and Objectives of Planning. Tournament – Knock-Out, League/Round Robin & Combination.
Module:10 Psychology & Sports
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. Psychological benefits of exercise.

Anxiety & Fear and its effects on Sports Performance. Motivation, its type & techniques. Understanding Stress & Coping Strategies.
Module:11 Doping
Meaning and Concept of Doping Prohibited Substances & Methods Side Effects of Prohibited Substances
Module:12 Sports Medicine
First Aid – Definition, Aims & Objectives. Sports injuries: Classification, Causes & Prevention. Management of Injuries: Soft Tissue Injuries and Bone & Joint Injuries
Module:13 Sports / Games
Following subtopics related to any one Game/Sport of choice of student out of: Athletics, Badminton, Basketball, Chess, Cricket, Kabaddi, Lawn Tennis, Swimming, Table Tennis, Volleyball, Yoga etc. 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. Total Hours: 30 Hours

Text Book	
1.	Modern Trends and Physical Education by Prof. Ajmer Singh
Reference Books	
1.	Light On Yoga by B.K.S. Iyengar.
2.	Health and Physical Education – NCERT (11th and 12th Classes)

Internal Member External Member/BoS

BCS23101P	Programming for Problem Solving (Laboratory)	L	T	P	C
		0	0	4	2

Pre-requisite: Basic computer knowledge, Basic Mathematics

Course Objectives:

1. To translate given algorithms to a working and correct program.
2. To be able to correct syntax errors as reported by the compilers.
3. To be able to identify and correct logical errors encountered at run time.
4. To be able to write iterative as well as recursive programs.
5. To be able to represent data in arrays, strings and structures and manipulate them through a program.
6. To be able to declare pointers of different types and use them in defining self-referential structures.
7. To be able to create, read and write to and from simple text files.

Course Outcome: After successful completion of the course, the students will be able

1. CO1: Translate a given algorithm to C program and become familiarizedwith programming environments.
2. CO2: Build programs using modular programming and recursion.
3. CO3: Build programs using built-in and user defined data types for data processing.
4. CO4: Build programs for data processing using dynamic memory management.
5. CO5: Solve a computational problem through team work.
6. CO6: Exhibit self-learning by writing programs for solving problems in differentiation and integration by numerical methods.

List of Experiments

Lab1: Familiarization with programming environment (editors, compilation, debugging etc.)(2 hours)

Lab 2: Simple computational problems using expressions and precedence **(2hours)**

Lab 3: Problems involving using if-then-else and switch statements (**2 hours)**

Lab 4: Iterative problems e.g., sum of series, factorial, Fibonacci series etc. **(2 hours)**

Lab 5: 1D, 2D Array manipulation: summation, finding odd/even in a set, string handling etc. **(4hours)**

Lab 6: Matrix problems (addition, multiplication etc.), String operations (finding length, concatenation, comparing etc.)**(4 hours)**

Lab 7: Simple function illustrating the concepts, call by value **(2 hours)**

Lab 8: Recursive functions for summation, Fibonacci series, and factorial **(2 hours**)

Lab 9: Pointers, call by reference, passing arrays to functions, passing address of structure to function, passing array of structure to function, pointers and arrays, function pointer, dynamic allocation of block of memory and accessing the elements (**4 hours**)

Lab 10: File operations on text files, binary files (**2 hours)**

Text Book(s)

1	Byron Gottfried, Schaum's Outline of Programming with C,McGraw-Hill
2	Yashavant Kanetkar, Let us C, BPBPublication
3	E. Balaguruswamy, Programming in ANSI C, TataMcGraw-Hill

4	Yashavant Kanetkar, Understanding Pointers in C, BPBPublication
5	Practical Engineering chemistry by Sunitha and Rathna.
Reference Books	
1.	Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India

BCS23101T	PROGRAMMING FOR PROBLEM SOLVING	L	T	P	C
		3	0	0	3

Pre-requisite: Basic computer knowledge, basic mathematics

Course Objectives:

1. To learn the fundamentals of computers.
2. To understand the various steps in program development.
3. To learn the syntax and semantics of C programming language.
4. To learn the usage of structured programming approach in solving problems.
5. To understated and formulate algorithm for programming script
6. To analyze the output based on the given input variable

Course Outcome:

After successful completion of the course, the students will learn

CO1: Illustrate basic concepts of computer and C programming.
CO2: Apply the concepts of conditional and looping statements.
CO3: Demonstrate the ability to write C program using arrays, structures, pointers and files.
CO4: Develop modular programs using C language.

MODULE 1: Introduction to Programming — **4 hours**

Introduction to Programming; Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.) Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples. From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code.

MODULE 2: Introduction to C — **4 hours**

Using Comments, Keywords, Identifiers, Tokens, Basic Data Types, Writing C Expressions using Operators, Precedence of Operators, I/O Statements in C

MODULE 3: Conditional Branching and Loops — **4hours**

Conditional Branching Statements, Iterative Statements, Nested Loops, Break and Continue Statements, Goto Statements.

MODULE 4: Arrays and Strings — **6 hours**

1-D Array-Declaration, Accessing Array Elements, Array Operations, 2-D Array-Matrix Addition, Subtraction, Multiplication, Character Arrays, Strings, String Manipulation Function.

MODULE 5: Functions — **8 hours**

Function Declaration/Prototype, Function Definition, Function Call, Return Statement, Passing Parameters, Scope of Variables, Storage Classes, Recursive Function. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.	
MODULE 6: Structure	**4 hours**
Structures, Defining Structures, Accessing Members, Array of Structures.	
MODULE 7: Pointers and File handling	**6 hours**
Pointers, Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, File handling.	
Total Lecture hours	**36 hours**
Text Books	
1.	Byron Gottfried, Schaum's Outline of Programming with C,McGraw-Hill
2.	Yashavant Kanetkar, Let us C, BPBPublication
3.	Balaguruswamy, Programming in ANSI C, TataMcGraw-Hill
4.	Yashavant Kanetkar, Understanding Pointers in C, BPBPublication
Reference Books	
Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India	

UHV23001T	UNIVERSAL HUMAN VALUES-II: Understanding harmony and ethical human conduct	L	T	P	C
		2	1	0	3

Prerequisite: UHV-1 / SIP

Course Objectives:

1. To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
2. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.

3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.

Course Outcome: After successful completion of the course, the students will be able

1. To explain the significance of self-awareness and its impacts on understanding their surroundings (family, society, nature).

2. To understand the responsibility of life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.

3. To understand human values, human relationship and human society and have better critical thinking ability, sensitive to their commitment towards what they have understood.

4. To Apply what they have learnt to their own self in different day-to-day settings in real life, and in their profession

Module:1 Introduction — **9 hours**

Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education), Understanding Value Education, sharing about Oneself, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Exploring Human Consciousness, Happiness and Prosperity – Current Scenario, Method to Fulfill the Basic Human Aspirations, Exploring Natural Acceptance

Module:2 Harmony in the Human Being — **9 hours**

Understanding Human being as the Co-existence of the Self and the Body, distinguishing between the Needs of the Self and the Body, Exploring the difference of Needs of Self and Body. The Body as an Instrument of the Self. Understanding Harmony in the Self. Exploring Sources of Imagination in the Self. Harmony of the Self with the Body. Programme to ensure self-regulation and Health. Exploring Harmony of Self with the Body

Module:3 Harmony in the Family and Society — **9 hours**

Harmony in the Family – the Basic Unit of Human Interaction. Trust' – the Foundational Value in Relationship. Exploring the Feeling of Trust. 'Respect' – as the Right Evaluation. Exploring the Feeling of Respect. Other Feelings, Justice in Human-to-Human Relationship. Understanding Harmony in the Society. Vision for the Universal Human Order. Exploring Systems to fulfil Human Goal.

Module:4 Harmony in the Nature/Existence — **9 hours**

Understanding Harmony in the Nature. Interconnectedness, self-regulation and Mutual

Fulfilment among the Four Orders of Nature. Exploring the Four Orders of Nature. Realizing Existence as Co-existence at All Levels. The Holistic Perception of Harmony in Existence Exploring Co-existence in Existence.	
Module:5 Implications of the Holistic Understanding	**9 hours**
Natural Acceptance of Human Values. Definitiveness of (Ethical) Human Conduct. Exploring Ethical Human Conduct. A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order. Competence in Professional Ethics. Exploring Humanistic Models in Education. Holistic Technologies, Production Systems and Management Models-Typical Case Studies. Strategies for Transition towards Value-based Life and Profession. Exploring Steps of Transition towards Universal Human Order.	
Total hours	**45 hours**

Text Book

1.	A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47

Reference Books

1.	Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2.	Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3.	The Story of Stuff (Book).
4.	The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi.

BEL23101T	BASIC ELECTRICAL ENGINEERING	L	T	P	C
		3	1	0	4

Pre-requisite: H.S Physics and H.S Mathematics

Course Objectives:

1. The network reduction techniques such as source transformation, mesh analysis, nodal analysis and network theorems to solve different networks
2. The various configurations of electromagnetic induction used in magnetic circuits
3. The steady state response of complex electrical circuits with single phase AC supply
4. The three phase systems for star and delta connected systems and perform three phase power calculations for balanced and unbalanced loads.
5. The fundamentals of instrumentation in measurements and calibration of instruments.
6. The different parameters for characterizing different circuits like rectifiers, filters, voltage regulators etc. using p-n junction diodes, Zener diodes and BJTs.
7. The different cables, wiring systems, wiring circuits, earthing and its purpose, fuse, MCBs and their role in electrical installations.

Course Outcome: After successful completion of the course, the students will be able

1. Analyze DC networks and theorems using various solution techniques.
2. Apply fundamental concepts of magnetic circuits and AC networks to solve problems.
3. Explain different types of measuring instruments and their workings.
4. Demonstrate the operating principle and output characteristics of pn junction diodes, zener diode, BJT, rectifiers and different filter circuits.
5. Describe the components of low voltage electrical installations and perform elementary calculations for energy consumption.

Module 1: DC Networks — **6 hours**

Definitions of active, passive, linear non-linear circuit elements and networks; Kirchhoff's laws; Nodal and mesh analysis; Voltage and current sources; Network theorems: Superposition, Thevenin's, Norton's and Maximum power transfer.

Module 2: Magnetic Circuits — **8 hours**

Definitions of mmf, flux, flux-density and reluctance; comparison between electric and magnetic circuits; series, parallel and series-parallel circuits and their solutions; energy stored in a magnetic circuit; lifting power of a magnet; electromagnetic induction, self and mutual inductance, hysteresis and eddy current losses.

Module 3: AC Circuits — **10 hours**

Waveforms of alternating voltages and currents, instantaneous, average and RMS values, form factor & peak factor, forms of representation of alternating quantities, concept of phasor & phasor diagrams, Concept of lead & lag, reactances & impedances, AC circuits-resistive, inductive, capacitive, RL, RC & RLC series, parallel and series parallel combination, impedance triangle, admittance, active & reactive power & power factor, Concepts of 3-phase AC, connections, phase & line values in star & delta connections, solutions of simple 3-phase balanced circuits with resistive & reactive loads, 3-phase power, and phase sequence

Module 4: Instruments — **8 hours**

Classification of instruments; essentials of indicating type instruments-deflecting controlling and damping torque; types of indicating instruments; moving coil and moving iron ammeters and voltmeters; extension of range of instruments -use of shunts and multiplier

Module 5: Electronics	**8 hours**
Diode as a rectifier-half wave and full wave rectifier circuits; ripples in output waveform-ripple factor; introduction to filters; Zener diode and its application as voltage regulator; bipolar junction transistor and its classification, static characteristics.	
Module 6: Basics Of Electrical Installations	**8 hours**
Basic knowledge of domestic wiring, types of cables, types of wiring; circuit layouts-single phase AC mains to DB; 3 phase connections; accessories-main switch, ceiling rose, fuse, MCB etc., Earthing-purpose & methods.	
Total Lecture hours	**48 hours**

Text Book(s)	
1.	Basic Electrical Engineering: I J Nagrath and DP Kothari, McGraw Hill Education Pvt Ltd.
2	Basic Electrical Engineering: Mittle and Mittle, McGraw Hill Education (India) Pvt Ltd.
3	Electro Technology: H Cotton, CBS Publishing.
4	Electrical and Electronic Technology-Edward Hughes, Pearson Education India.
Reference Books	
1.	Basic Electrical Engineering: Ravish R Singh, McGraw Hill Education (India) Pvt Ltd.
2	Basic Electrical Engineering: K. Uma Rao, Pearson Education India.
3	Basic Electrical and Electronics Engineering: R.K. Rajput, University Science Press.
4	Basic Electrical and Electronics Engineering: J.B. Gupta, S.K. Kataria and Sons

BEC23111T	BASIC ELECTRONIC ENGINEERING	L	T	P	C
		2	1	0	3

Pre-requisite: Physics

Course Objectives: The objectives of this course are to:

1. To provide an overview of electronic device components to Mechanical engineering students
2. To provide some idea about different electronic circuits applicable to Mechanical Engg students

Course Outcome: After successful completion of this course, the students will be able to

CO1: Understand the principles of semiconductor devices and their applications.
CO2: Design an application using Operational amplifier.
CO3: Understand the working of timing circuits and oscillators.
CO4: Understand logic gates, flip flop as a building block of digital systems.
CO5: Learn the basics of Electronic communication system.

Module 1: Semiconductor Devices and Applications	**8 hours**

Introduction to P-N Junction Diode and V-I characteristics, Half wave and Full-wave rectifiers, capacitor filter. Zener diode and its characteristics, Zener diode as voltage regulator. Regulated power supply IC, Input- output characteristics of BJT, BJT as a single stage CE amplifier, frequency response and bandwidth.

Module 2: Operational amplifier and its applications	**8 hours**

Introduction to operational amplifiers, Op-amp in open loop configuration, op-amp with negative feedback, inverting and non-inverting amplifier applications: summing and difference amplifier, unity gain buffer, comparator, integrator and differentiator.

Module 3: Timing Circuits and Oscillators	**6 hours**

RC-timing circuits, IC 555 and its applications as a stable and mono-stable multi-vibrators, Barkhausen's criteria for oscillation, R-C phase shift and Wein bridge oscillator.

Module 4: Digital Electronics Fundamentals	**8 hours**

Difference between analog and digital signals, Boolean algebra, Basic and Universal Gates, Symbols, Truth tables, logic expressions, Logic simplification using K- map, Logic ICs.

Module 5: Digital Circuits	**7 hours**

Half and full adder/subtractor, multiplexers, de-multiplexers, flip-flops, shift registers, counters, Block diagram of microprocessor/microcontroller and their applications.

Module 6: Electronic Communication Systems	**8 hours**

The elements of communication system, IEEE frequency spectrum, Transmission media: wired and wireless, need of modulation, AM and FM modulation schemes, Mobile communication systems: cellular concept and block diagram of GSM system.

Total Lecture hours	**45 hours**

Text Book(s)

1. Floyd, Electronic Devices‖ Pearson Education 9th edition, 2012.
2. R.P. Jain, ―Modern Digital Electronics‖, Tata Mc Graw Hill, 3rd Edition, 2007.

Reference Book(s)

1. A.K. Maini & Nakul Maini - All-in-One Electronics Simplified, Khanna Book Publishing, 2021.
2. Frenzel, ―Communication Electronics: Principles and Applications‖, Tata Mc Graw Hill, 3rd Edition, 2001

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BME23202T	BASIC THERMODYNAMICS	L	T	P	C
		3	1	0	4

Pre-requisite: Physics, Chemistry, Mathematics

Course Objectives: The objectives of this course are to:

1. Impart knowledge on the basic thermodynamic properties
2. Understand the mechanism of different cycles and to develop the ability to analyze and solve problems related with thermodynamics
3. Recognize the differences between work producing and work consuming cycles.
4. Identify the change of state results in a process.

Course Outcome: After successful completion of this course, the students will be able to

CO1: Understand of the first and second laws of thermodynamics and their application to a wide range of systems working with pure substance and gaseous mixtures.

CO2: Explain the concepts of entropy and its presence in processes and cycles

CO3: Apply pressure-temperature diagrams, volume-temperature and pressure-volume phase diagrams and the steam tables for the analysis of engineering devices and systems.

CO4: Compare various air standard cycles applied in internal combustion engines.

Module 1: Thermodynamic System	**6 hours**
Macroscopic and Microscopic concepts, concept of continuum, Intensive and Extensive properties, Thermodynamic state, process and cycle, Thermodynamic equilibrium, pressure, energy, work and heat transfer	
Module 2: Laws of thermodynamics	**13 hours**
Zeroth law –Concept of equilibrium–Principles of therm. Fixed points. First law of thermodynamics and its application to open and closed systems, Concept of internal energy –Steady flow energy equation – Processes of closed systems. Second law of thermodynamics –Various statements –Carnot cycle – Irreversible and Irreversible processes –Thermodynamic efficiency and temperature scales –Concept of entropy –Entropy changes in various processes.	
Module 3: Properties of pure substances	**8 hours**
P-V, P-T, T-s and h-s diagrams of a pure substance, sensible heat, latent heat, saturation temperature, dryness fraction, Rankine cycles (use of steam table and Mollier diagram)	
Module 4: Thermodynamic cycles	**10 hours**
Air Standard cycles (Otto, Diesel and dual cycles). Principles of working of two and four stroke SI and CI engines –Representations of processes on T-sand p-v diagram and comparisons of efficiencies, vapour power cycles, refrigeration cycles.	
Module 5: Properties of ideal gases and their mixtures	**8 hours**
Properties of ideal gases and their mixtures: Gases-equation of state of an ideal gas, thermodynamic property relations, specific heats, internal energy, enthalpy change of ideal gases, equation of state of real gases, principle of corresponding state, compressibility factor.	
Total Lecture hours	**45 hours**

Text Book(s)

1	Nag, P.K, 1995, Engineering Thermodynamics, Tata McGraw-Hill Publishing Co. Ltd.
2	R. E. Sonntag, C Borgnakke, G. J. Van Wylen, Fundamentals of Thermodynamics, John Wiley, 2003.
3	Y. A. Cengel & M. A. Boles, Thermodynamics, An Engineering Approach, Tata McGraw Hill, 2003

Reference Book(s)

1	P. Howell and P. O. Buckius, Fundamentals of Engineering Thermodynamics, McGraw Hill, 1992.
2	G. F. Rogers & Y. R. Mayhew, Engineering Thermodynamics Work and Heat Transfer, Pearson 2003

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BEC23111T	BASIC ELECTRONIC ENGINEERING LAB	L	T	P	C
		0	0	2	1

Pre-requisite: Engineering Physics

Course Objectives: The objectives of this course are to:

1. Provide an overview of electronic device components to Mechanical engineering students
2. Provide some idea about different electronic circuits applicable to Mechanical Engineering students

Course Outcome: After successful completion of this course, the students will be able to

CO1: Design the circuits with basic semiconductor devices.
CO2: Design, test and evaluate single stage BJT amplifiers.
CO3: Design circuits using OP-AMP
CO4: Simplify, design and implement Boolean expression/half and full adders using basic/universal gates.
CO5: Experiment with modulation scheme, analyze the results and prepare a formal laboratory report.

LIST OF EXPERIMENTS

Experiment No. 1:	**2 hours**
To study the forward static characteristics of the P-N Junction diode.	
Experiment No. 2:	**4 hours**
a) To study a simple shunt type voltage regulator circuit using Zener diode. b) To find the voltage regulation of the above circuit.	
Experiment No. 3:	**4 hours**
To plot the static collector characteristics of a bipolar junction transistor in the common emitter configuration.	
Experiment No. 4:	**2 hours**
To study the operational Amplifier circuits as inverting and non-inverting amplifier.	
Experiment No. 5:	**2 hours**
To study the logic gates of Digital Integrated Circuits.	
Experiment No. 6:	**2 hours**
To implement a simple Boolean expression on TTL / CMOS Small Scale Integrated Circuit (SSI) devices.	
Experiment No. 7:	**2 hours**
To implement Half adder and Full adder.	
Experiment No. 8:	**2 hours**
To Study Amplitude Modulation (DSB-SC) and demodulation.	
Total Lecture hours	**20 hours**

Text Book(s)

1	Floyd, Electronic Devices‖ Pearson Education 9th edition, 2012.
2	R.P. Jain, —Modern Digital Electronics‖, Tata Mc Graw Hill, 3rd Edition, 2007.

Reference Book(s)

1	Frenzel, —Communication Electronics: Principles and Applications‖, Tata Mc Graw Hill, 3rd Edition, 2001

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BME23201P	ENGINEERING MECHANICS LAB	L	T	P	C
		0	0	2	1

Pre-requisite: Physics and Mathematics

CourseObjectives: Theobjectivesofthiscourseareto:

Understanding the basic engineering mechanisms (like equilibrium of forces, moment of forces, frictional force etc.)

CourseOutcome: Aftersuccessfulcompletionof thiscourse,thestudentswillbeableto

CO1: Understand various types of forces and its equilibrium, reactions, moment of inertia and center of gravity
CO2: Understand the concepts of friction on equilibrium and its application
CO3: Perform experiments and determine unknowns such as force, moment, center of gravity

List of Experiments:

Experiment-1	**4 hours**
Verification of polygon law of forces	
Experiment-2	**4 hours**
Verification of parallel law of forces	
Experiment-3	**4hours**
Study of sliding friction on plane and inclined surfaces	
Experiment-4	**4 hours**
Study of moment of inertia of a disc in the form of flywheel	
Experiment-5	**8 hours**
To find the center of gravity of various cross-sections (circular, square)	
Experiment-6	**6 hours**
Verification of principle of moment using Bell Crank Lever apparatus	
Total contact hours	**30 hours**

Text Book(s)

1	S. Timoshenko, D. H. Young, J.V. Rao, S. Pati: Engineering Mechanics: McGraw HillEducation; 5th edition
2	J. L. Meriam & L.G. Kraige: Engineering Mechanics -Statics: John Wiley & Sons, Inc

Reference Book(s)

1	A. Nelson: Engineering Mechanics Statics and Dynamics: McGraw Hill Education; 1st edition
2	K. L. Kumar, V. Kumar: Engineering Mechanics: McGraw Hill Education; 4th edition

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BME23201T	ENGINEERING MECHANICS	L	T	P	C
		3	1	0	4

Pre-requisite: Physics and Mathematics

CourseObjectives: Theobjectivesofthiscourseareto:

1. Understand the different laws of forces associated with different engineering elements.
2. Identify the application of different types of frictional forces.
3. Understand the practical problems of mechanics to determine the static forces with their magnitudes and directions

CourseOutcome: Aftersuccessfulcompletionof thiscourse,thestudentswillbeableto

CO1: Understand the basics of law of forces, friction, Centre of Gravity, Moment of Inertia and work doneon machine elements
CO2: Apply fundamental concepts of kinematics of rigid bodies to the analysis of simple, practical problems
CO3: Apply moment, force and frictional forcein solving problems related to rigid bodies and structures and also to determine the Centre of Gravity, Moment of Inertia of simple and composite bodies.

Module1: Equilibrium of Rigid Bodies	**10 hours**
Force, moment and couple, resultant of forces, forces in space equilibrium, free body diagram, general equations of equilibrium, analysis of forces in perfect frames, brief introduction to vector approach	
Module2: Analysis of Structures	**10 hours**
Method of joint, method of sections, graphical methods	
Module3: Friction	**12 hours**
Introduction to dry friction, laws of friction, friction of simple machines, inclined planes, Screw jacks	
Module4: Centre of Gravity and Moment of Inertia	**8 hours**
Centre of gravity of axes, volume and composite bodies, Area moment of inertia and mass moment of inertia for plane figures and bodies	
Module5:Work and Energy	**8 hours**
Work, Work done by varying force, Energy, Power, Work energy equation for translation, Motion of connected bodies Work done by spring	
Module6: Kinematics of Particles and Rigid Bodies	**12 hours**
Kinematics and Kinetics, Rectilinear motion of particles, determination of position velocity and acceleration under uniform rectilinear motion (uniform and non-uniform accelerated rectilinear motion), Relative motion, construction of x-t, v-t and a-t graphs (simple problems), Projectile motion, Normal and Tangential components, Radial and Transverse components, simple problems, Equation of motion, D. Alembert's principle.	
Total contact hours	**60 hours**

Text Book(s)

1	S. Timoshenko, D. H. Young, J.V. Rao, S. Pati: Engineering Mechanics: McGraw Hill Education; 5th edition
2	J. L. Meriam & L.G. Kraige: Engineering Mechanics -Statics: John Wiley & Sons, Inc
3	F. P. Beer, Jr., E. R. Johnston, E. R. Eisenberg, P. J. Cornwell, D. Mazurek: Vector Mechanics for Engineers- Statics & Dynamics: McGraw-Hill Higher Education; 9th edition
4	R.C. Hibbeler: Engineering Mechanics - Statics & Dynamics: Pearson Education, 14th edition.

Reference Books

1	A. Nelson: Engineering Mechanics Statics and Dynamics: McGraw Hill Education; 1st edition
2	K. L. Kumar, V. Kumar: Engineering Mechanics: McGraw Hill Education; 4th edition

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BCH23112T	ENVIRONMENTAL SCIENCE	L	T	P	C
		2	0	0	0

Pre-requisite: Biology, Sociology, Chemistry

Course Objectives: The objectives of this course are to:

1. To examine the concept of environment and ecosystem.
2. To understand the different types of natural resources and the concept of biodiversity and its importance for the environment.
3. To examine the concept of different types of environmental problems such as pollution, climate change, population growth and its causes, effects on environment and to find out the solution to control the environmental degradation.

Course Outcome: After successful completion of this course, the students will be able to

CO1: Understand the basic concept of environment and ecosystem.
CO2: Value the natural resources, conservation of biodiversity and its importance.
CO3: Evaluate the problems of environmental issues such as pollution, population growth, climate change and its impact on human and environment and the control measures.

Module1: Concepts of Environmental Science	**3 hours**

Definition of environment, scope and importance of environmental studies; Need for public awareness; Structure and functions in an ecosystem.

Module 2: Natural Resources	**6 hours**

Renewable and Non-renewable Resources; Forest, water, minerals, food and land resources (with example of one case study); Energy, growing energy needs, energy sources (conventional and alternative).

Module 3: Biodiversity And Its Conservation	**5 hours**

Biodiversity at global, national and local levels; India as a mega diversity nation; Threats to biodiversity (biotic, abiotic stresses), and strategies for conservation.

Module 4: Environmental Pollution	**8 hours**

Types of pollution-Air, water (including urban, rural, marine), soil, noise, thermal, nuclear; Pollution prevention; Management of pollution –Rural /Urban/Industrial waste management [with case study of any one type, e.g., power (thermal/nuclear), fertilizer, tannin, leather, chemical, sugar], Solid/Liquid waste management, disaster management.

Module 5: Social Issues and Environment	**8 hours**

From unsustainable to sustainable development; Problems relating to urban environment-Population pressure, water scarcity, industrialization, remedial measures; Climate change-Reasons, effects (global warming, ozone layer depletion, acid rain) with one case study; Legal Issues-Environmental legislation (Acts and issues involved), Environmental ethics.

Total Lecture hours	**30 hours**

Text Book(s)

1	S.C. Santra: Environmental Science, New Central Book Agency
2	S.E. Manahan: Environmental Chemistry
3	K.V. Krishnamurthy: Textbook of Biodiversity

Reference Book(s)

1	Agarwal, K.C., Environmental Biology, Nidi Publication Ltd., Bikaner, 2001.
2	Bharucha Erach, Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmadabad, 2002
3	Dr R J Ranjit Daniels and Dr Jagadish Krishnaswamy, Environmental studies-2010-Willey India

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BME23203P	MACHINE DRAWING	L	T	P	C
		0	0	4	2

Pre-requisites: Engineering Graphics and Design

Course Objectives: The objectives of this course are to:

1. Impart knowledge on various basic mechanical parts and its construction
2. Proffer knowledge on assembling of the parts of engine and valves
3. Impart a fundamental understanding of CAD system

Course outcomes: After successful completion of this course, the students will be able to

CO1: Understand and sketch various mechanical components (fasteners, couplings, and joints)
CO2: Develop machine parts and assembling of different mechanical components
CO3: Apply principles of technical drawing and prepare solid models

Module 1: Fasteners	**4 hours**
Screw Thread Nomenclature, Forms of Thread, Thread Profiles; Keys, Multistart Thread, lefthand thread, right hand thread, Locking devices for nuts, Different types of bolts and nuts.	
Module 2: Joints and Keys	**4 hours**
Saddle Key, Sunk Key, Cotter Joint with Sleeve, Cotter Joint with Socket and Spigot Ends, Cotter Joint with a Gib, Pin Joints-Knuckle joints, Flanged joint, Hydraulic Joint	
Module 3: Coupling	**6 hours**
Flanged Coupling, Sleeve or Muff Coupling, Bushed pin type Flanged Coupling	
Module 4: Assembly Drawing	**10 hours**
Engine Parts: Stuffing Box, Crosshead, Connecting Rod, Eccentric, Piston; Valves: Stop Valve, Feed Check Valve, Blow off Cock, Non-Return Valve	
Module 5: Introduction to CAD	**6 hours**
Basic concepts: Coordinate systems, Introduction to creating sketches, Creating basic features, Datum, Options aiding construction of parts, Orthographic and Isometric views	
Total contact hours	**30 hours**

Text book (s)

1.	Machine Drawing by N.D. Bhatt & V.M. Panchal, Charotar Publishing House (ISBN 9789380358468).
2.	Understanding Creo Parametric Through Examples by K. Kumar & A.K. Roy. Wiley (I) (ISBN 9789389583137).

Reference book (s)

1.	Computer Aided Design and Manufacturing Paperback – 1 by Narayan (Author), K Lalit, January 2008
2.	Sidheswar, N., Kanniah, P., Sastry, V. V. S., "Machine Drawing", Tata McGraw Hill, 2001, 1st Ed.

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BMA25212T	MATHEMATICS-III (ECE+ME+EE)	L	T	P	C
		3	1	0	4

Pre-requisite: Calculus, ODE theory and basic algebra

Course Objectives

- To introduce the solution methodologies for second order Partial Differential Equations with applications in engineering
- To provide an overview of probability and statistics to engineers
- To equip students with the knowledge of Laplace transforms, inverses, their properties and to apply these concepts in solving differential equations.

Course Outcome

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

CO1: solve field problems in engineering involving PDEs

CO2: formulate and solve problems involving random variables.

CO3: apply statistical methods for analyzing experimental data

CO4: apply the Laplace transform and the inverse Laplace transform of functions in solving differential equations and engineering problems

Module 1: Partial Differential Equations (PDE) — **20 hours**

Definition of Partial Differential Equations, First order partial differential equations, solutions of first order linear PDEs; Solution to homogenous and non-homogenous linear partial differential equations of second order by complimentary function and particular integral method. Second-order linear equations and their classification, Initial and boundary conditions, Separation of variables method to simple problems in Cartesian coordinates. D'Alembert's solution of the wave equation; One dimensional diffusion equation and its solution.

Module 2: Probability and Statistics — **20 hours**

Probability spaces, conditional probability, independence; Discrete random variables, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, Expectation of Discrete Random Variables, Variance of a sum, Continuous random variables and their properties, distribution functions, Bayes' rule

Basic Statistics, Measures of Central tendency: skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions. Test of significance: Large sample test for single proportion, difference of proportions, Tests for single mean, difference of means, and difference of standard deviations. Test for ratio of variances - Chi- square test for goodness of fit and independence of attributes

Module 3: Laplace Transforms and Applications — **20 hours**

Introduction, Definition of the Laplace transform, Useful properties of Laplace transform (without proof): Linearity, First shifting theorem, Multiplication and division by t, transforms of derivatives and integrals, Heaviside unit step function, Dirac's delta function, second shifting theorem, Laplace transform of Periodic function, Inverse Laplace transform using

partial fraction and Convolution theorem (without proof), Application to solve initial and boundary value problem involving ordinary differential equations with one dependent and constant coefficient.	
Total Lecture hours	**60 hours**
Text Book(s)	
1	Bali, N. P., Goyal M., A text book of engineering Mathematics, Laxmi Publications, Reprint, 2014
2	AICTE Prescribed Textbook: Mathematics – II (Probability and Statistics), ISBN: 978-93-91505- 41-7 2.
Reference Book(s)	
1	Kreyszig E, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2	Garg R., Engineering Mathematics, Khanna Book Publishing Company, 2022.
3	Reena Garg, Advanced Engineering Mathematics, Khanna Book Publishing Company, 2021
4	Hoel P. G., . Port S. C and Stone C. J., Introduction to Probability Theory, Universal Book Stall, 2003 (Reprint)

BME23302T	DESIGN OF MACHINE ELEMENTS	L	T	P	C
		3	0	0	3

Pre-requisite: Kinematics and Dynamics of Machines

Course Objectives: The objectives of this course are:

1. To impart a comprehensive understanding of mechanical design fundamentals.
2. To develop analytical and problem-solving skills in designing machine elements.

Course Outcome: After successful completion of this course, the students will be able to

CO1: Demonstrate a foundational understanding of mechanical design principles, including types of loads, stresses, material selection, joints, shaft design, power transmission, failure modes, and failure theories.

CO2: Apply knowledge of joint design, shaft, coupling, and power transmission elements to solve engineering problems effectively.

CO3: Evaluate the performance of various mechanical components by integrating design processes, material selection, under various operational loads.

CO4: Design machine elements such as joints, fasteners, shafts, couplings, and power transmission systems by applying relevant theories and using a design data handbook.

Module 1: Introduction to Design — **9 hours**

Introduction, General consideration and procedure in design, types of loads and stress, factor of safety, selection of materials, standards and codes in design, modes of failure, failure theories.

Module 2: Joints — **12 hours**

Detachable joints: Design of threaded fasteners, thread forms and threaded fastener types and materials, Power screws. Permanent Joints: Design of Riveted joints and welded joints – eccentric loading.

Module 3: Design of Shaft and Coupling — **12 hours**

Introduction, causes of failure and stresses in shaft, Design of shaft subjected to bending, torsion, axial and combined loading, Coupling: Classification, comparison of flange and flexible coupling, Design of Coupling.

Module 4: Power Transmission Elements — **12 hours**

Belt Drives: Introduction to flexible drive, types of belt, belt material, types of flat belt drives, Creep in belt, design of Flat and V-belts. Chain Drives : Types, Classification of chain, Design of Chain Drive.

Text Book(s)

1. Bhandari V B, Design of Machine Elements, Tata McGraw Hill, 4th Ed., 2016.
2. Norton L., Machine Design – an integrated approach, 5th edition, Pearson education Inc., 2014
3. Shigley, J.E., Charles, R.M. and Richard, G.B., Mechanical Engineering Design, 7th ed., McGraw-Hill, 2004.

Reference Books

1. M. F. Spotts, T. E. Shoup and L. E. Hornberger, Design of Machine Elements, 8th edition, Pearson education Inc., 2003.
2. Sharma, C.S. and Purohit Kamalesh, Design of Machine Elements, Prentice Hall of India, New Delhi, 2003
3. Khurmi, R.S. and Gupta J.K., Text book on Machine Design, Eurasia Publishing House, New Delhi.

Data Handbooks (allowed for reference during examinations)

1. K. Mahadevan and B. Reddy, Design Data Handbook for Mechanical Engineers, 4th ed. CBS Publishers and Distributors.

BEM24111T	ENGINEERING ECONOMICS	L	T	P	C
		3	0	0	3

Pre-requisite:

Course Objectives: The objectives of this course are to:

1. Understand the basic principles and terminology of engineering economic.
2. Apply various tools and techniques to engineering projects, including cash flow analysis, cost-benefit analysis.
3. Evaluate the ethical, social, and environmental factors affecting economic decisions in engineering.

Course Outcomes: On completion of this course, students will be able to

CO1: Understand the fundamental economic terms, principles, and concepts
CO2: Evaluate engineering projects, including benefit-cost analysis, payback period, and breakeven analysis.
CO3: Assess the impact of external economic factors, including inflation and taxes, on project viability and financial decision-making processes.

Module 1: Basic Economics: Basic concepts: definitions, scope and importance of economics, types of goods in economics, Managerial economics: Factors influencing managerial economics, Managerial economics and other disciplines.	**6 hours**
Module 2: Demand and Supply Analysis: Law of demand, determinants of demand, concept of elasticity of demand, Indifference curve analysis, law of supply, determinants of supply, utility –meaning, types, ordinal and cardinal utility	**8 hours**
Module 3: Production and cost: Cost and revenue functions; break –even point, Price-output determination under perfect competition, monopoly and monopolistic market.	**8 hours**
Module 4: Money and Banking: types and functions of money, Index numbers-types of index numbers, Functions of central bank and commercial bank, national income, measurement of national income	**8 hours**
Module 5: Basics of environmental Economics: Concept of environmental economic, social cost, private cost, social benefit, private benefit, market failure, externality-positive and negative externality	**8 hours**
Module 6: Basics of Public finance: Budget-meaning, types; revenue-sources of revenue- tax and non-tax revenue; GST.	**7 hours**
Total Lecture hours	**45 hrs**

Text book (s)

1.	A Koutsoyiannis: Modern Microeconomics
2.	Pravin Kumar, Fundamentals of Engineering Economics, New Delhi, John and Wiley, 2012
3.	Singh Seema, Economics for Engineering Students, I.K. International Publishing House Delhi, 2014, 2nd Edition

Reference book (s)

1.	Diwedi, D.N., Managerial Economics, New Delhi, Pearson Education India,2012.
2.	Park, S. Chan, Fundamentals of Engineering Economics, Pearson , New York, 2019, 4th Edition.
3.	Yates, J.K. Engineering Economics, CRC Press, Boca Raton, 2016, 1st Edition.

BME24111T	ENTREPRENEURSHIP AND START-UPS	L	T	P	C
		3	0	0	3

Pre-requisite: None

Course Objectives: The objectives of this course are to:

1. Introduce Mechanical Engineering students to entrepreneurship opportunities driven by technology and innovation in mechanical domains.
2. Develop competency in mechanical product innovation, design, prototyping, techno-economic evaluation, and business modelling.
3. Build student understanding of funding mechanisms, financial management, and regulatory frameworks relevant to mechanical start-ups.

Course Outcomes: On completion of this course, students will be able to

CO1: Identify and analyze entrepreneurial opportunities in mechanical engineering sectors
CO2: Apply mechanical design, prototyping, and innovation management principles to develop feasible products or services
CO3: Develop business models and conduct techno-economic feasibility studies for mechanical engineering ventures
CO4: Demonstrate financial literacy in budgeting, forecasting, funding acquisition, and regulatory compliance for technology-based start-ups

Module 1: Technology Entrepreneurship and Opportunity Identification	**9 hours**

Entrepreneurship in manufacturing, energy, mobility, and automation sectors; Design Thinking for mechanical engineering problem-solving; Opportunity identification: Market need vs. technology push, technology gap analysis; User-centric design thinking for engineers; Frugal innovation and Jugaad technologies in Indian context Case studies: Mechanical engineering start-ups (Ather Energy, Grey Orange Robotics, etc.)

Module 2: Product Development and Technology Commercialization	**9 hours**

Product development lifecycle for mechanical products; Rapid prototyping: CAD/CAM, 3D printing, CNC processes; Design for Manufacturability (DFM) and Design for Assembly (DFA); Technology Readiness Levels (TRL) for engineering products; Intellectual Property Rights (IPR): Patents and design protection

Module 3: Business Model Development and Techno-Economic Feasibility	**9 hours**

Business Model Canvas for engineering ventures; Market analysis, segmentation and customer identification for technical products; Cost estimation, pricing, break-even analysis; Techno-economic feasibility case studies; Minimum Viable Product (MVP) for engineering products; Quality assurance and reliability in product design

Module 4: Funding Strategies and Financial Literacy	**9 hours**

Funding options: Bootstrapping, Angel Investors, VC, MSME loans, Start-up India, SIDBI, TDB schemes; Preparing project proposals for funding agencies and banks (PMEGP, CGTMSE, AICTE Start-up Policy grants); Basics of financial management: budgeting, forecasting, financial statements for engineering start-ups; Regulatory requirements: business registration, GST, factory acts, environmental clearances, quality standards (ISO, BIS)

Module 5: Regulatory, Quality, and Ethical Aspects for Mechanical Start-ups	**9 hours**

Business registration procedures for technology start-ups; Regulatory clearances and certifications (ISO, CE marking, BIS, etc.); Environmental and safety regulations for engineered products; Start-up India and MSME schemes: legal and procedural overview;

Ethical considerations and professional responsibility for engineer-entrepreneurs		
Total Lecture hours		**45 hours**
Text book (s)		
1.	Byers, T., Dorf, R., & Nelson, A. (2014). Technology Ventures: From Idea to Enterprise. McGraw-Hill Education.	
2.	Ries, E. (2011). The Lean Startup. Crown Business.	
3.	Timmons, J.A., & Spinelli, S. (2019). New Venture Creation. McGraw-Hill.	
Reference book (s)		
1.	Saini, V., & Bhardwaj, R. (2020). Entrepreneurship Development for Engineers. I.K. International Publishing House.	
2.	Kuratko, D.F. (2016). Entrepreneurship: Theory, Process, and Practice. Cengage Learning	
3.	Hishamuddin, M.S., & Hasan, M.F. (2019). Engineering Entrepreneurship. CRC Press	

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BME23301T	HEAT TRANSFER	L	T	P	C
		3	1	0	4

Pre-requisite:

Course Objectives: The objectives of this course are to:

1. To provide a fundamental understanding of heat transfer principles including conduction, convection, and radiation.
2. To apply these principles in solving problems related to thermal systems and analyse heat exchanger performance.

Course Outcome: After successful completion of this course, the students will be able to

CO1: Understand and apply the fundamental concepts of conduction, convection, and radiation in solving heat transfer problems

CO2: Formulate and solve steady-state and transient heat conduction problems using analytical and numerical methods.

CO3: Analyze heat transfer through convection in external and internal flows, and apply the concept of boundary layer, boiling and condensation heat transfer in practical problems.

CO4: Design and evaluate the performance of heat exchangers using effectiveness-NTU and LMTD methods.

Module 1: Introduction to Heat Transfer	**3 hours**
Modes of Heat Transfer: Conduction, Convection, and Radiation, Basic Equations and Concepts in Heat Transfer, General Heat Conduction Equation (in Cartesian, cylindrical, and spherical coordinates)	
Module 2: Conduction	**12 hours**
Steady-state heat conduction: One-dimensional conduction in plane wall, cylinder and sphere, Thermal resistance and composite walls, Critical insulation thickness, Heat generation in solidsTransient heat conduction: Lumped system analysis, transient conduction in semi-infinite solids	
Module 3: Convection	**15 hours**
Introduction to convection: Forced and natural convection, Boundary layers, External and internal forced convection, Natural convection: Flow over plates, cylinders, and spheres, Use of empirical correlations in solving practical problems	
Module 4: Radiation	**10 hours**
Fundamentals of radiation, Blackbody radiation, emissivity, and absorptivity, Radiative exchange between surfaces, Radiation shields	
Module 5: Heat Exchangers	**10 hours**
Types of heat exchangers, Analysis of heat exchangers: Log Mean Temperature Difference (LMTD) method, Effectiveness-NTU method	
Module 6: Introduction to Boiling and Condensation	**10 hours**
Boiling heat transfer, Condensation heat transfer,Use of empirical correlations in solving practical problems	
Total Lecture hours	**60 hours**

Text Book(s)

1	Yunus A. Cengel, "Heat and Mass Transfer: A Practical Approach," McGraw-Hill Education
2	Frank P. Incropera and David P. DeWitt, "Fundamentals of Heat and Mass Transfer," Wiley.

Reference Book(s)

1	J.P. Holman, "Heat Transfer," McGraw-Hill Education.
2	S.P. Sukhatme, "A Textbook on Heat Transfer," Universities Press.

BME23301P	HEAT TRANSFER LABORATORY	L	T	P	C
		0	0	2	1

Pre-requisite: Physics, Basic Thermodynamics, Heat Transfer

Course Objectives: the objectives of this course are to:

1. Understand the modes of heat transfer for different heat transfer equipment.
2. Understand the concepts of conduction, convection and radiation practically in various thermal systems.

Course Outcome: After successful completion of this course, the students will be able to

CO1: Estimate physical properties like thermal conductivity of different liquids and solids and compare its variation.

CO2: Demonstrate the pin-fin apparatus and Experiment both free and forced convection to predict heat transfer coefficient.

CO3: Conduct experimental research in radiation heat transfer and determine various related parameters specifically Stefan-Boltzmann constant and Emissivity of solid surface.

Experiment No-1	**2 hours**
Determination of Thermal Conductivity of Composite Wall	
Experiment No-2	**2 hours**
Determination of Thermal Conductivity of Metal Bar (Brass)	
Experiment No-3	**2 hours**
Thermal conductivity of insulating powder	
Experiment No-4	**2 hours**
Thermal Conductivity of Liquids (Kerosene)	
Experiment No-5	**2 hours**
Study of heat transfer conduction from a pin fin.	
Experiment No-6	**2 hours**
Study of heat transfer by Natural convection.	
Experiment No-7	**2 hours**
Determination of Emissivity of a Grey Surface.	
Experiment No-8	**2 hours**
Determination of the Value of Stefan–Boltzmann Constant for Radiation Heat Transfer	
Total Practical hours	**16 hours**

Text Book(s)

1. Heat and Mass Transfer by P K Nag, Tata Mcgraw Hill
2. Heat Transfer by Y V C Rao, University Press
3. Fundamentals of Heat and Mass Transfer" by Theodore L. Bergman.
4. Fundamentals of Heat and Mass Transfer: Elements of Heat Transfer: By Ethirajan Rathakrishnan

Reference Book (s)

1. Heat Transfer by J P Holman, Souvik Bhattacharyya, Tata Mcgraw Hill
2. Heat and Mass Transfer by Yunus A. Cengel, Tata Mcgraw Hill

BME23305P	MEASUREMENT AND METROLOGY LABORATORY	L	T	P	C
		0	0	2	1

Pre-requisite: Engineering Mechanics, Measurement and Metrology.

Course Objectives: the objectives of this course are to:

1. The principle of linear and angular measurement.
2. To understand and use various measuring tools.
3. To understand calibration of various measuring devices.

Course Outcome: After successful completion of this course, the students will be able to

CO1: Illustrate the various metrological tools for taking measurements.
CO2: Compare the measurements obtained by various Metrological tools for the same parameter.
CO3: Evaluate the required parameters by the use of precision measurement instruments.
CO4: Estimate the profile of Engineering components with the aid of advance instruments.

Experiment No-1	**4 hours**
Study of various gauges for measurement	
Experiment No-2	**2 hours**
Measurement of bore of an Engine Cylinder	
Experiment No-3	**2 hours**
Measurement of tooth profile of a gear	
Experiment No-4	**2 hours**
Measurement of TPI, depth, pitch, diameter (major and minor diameter)	
Experiment No-5	**2 hours**
Measurement of pressure using dead weight pressure gauge tester	
Experiment No-6	**2 hours**
Measurement of taper angle	
Experiment No-7	**2 hours**
Measurement of speed of a rotating shaft	
Total Practical hours	**16 hours**

Text Book(s)

1. Engineering Metrology: A book by Er. R.K. Jain
2. Mechanical Measurements: A book by S.P. Venkateshan.
3. The Quality of Measurements: A Metrological Reference: A book by A.E. Fridman.
4. Engineering Metrology - Khanna Publishers.

Reference Books

1. Engineering Metrology and Measurements: By N.V. Raghavendra and L. Krishnamurthy.
2. A Textbook of Measurements & Metrology: By S.K. Kataria & Sons.

BME23304P	MACHINING AND MACHINE TOOLS LABORATORY	L	T	P	C
		0	0	2	1

Pre-requisite: Engineering Mechanics, Measurement and Metrology.

Course Objectives: the objectives of this course are to:

1. To provide fundamental knowledge of machining, fitting, and welding operations through hands-on experience and theoretical concepts.
2. To develop basic workshop skills required for shaping, assembling, and joining mechanical components using appropriate tools, machines, and safety protocols.

Course Outcome: After successful completion of this course, the students will be able to

CO1: Understand the basic principles, tools, and operations involved in machining, fitting, and welding processes.
CO2: Apply proper techniques and procedures to perform turning, threading, boring, drilling, filing, and welding operations safely and accurately.
CO3: Create simple mechanical components such as hexagonal nuts and bolts, shaft key slots, threaded fasteners, and welded joints using standard workshop practices.

MODULE 1: MACHINING OPERATIONS — **8 hours**

Theory: Overview of machining operations such as turning, facing, drilling, and boring. Identification and function of major components, types of lathes. Basics of single-point and multi-point cutting tool. Selection of speed, feed, and depth of cut. Safety precaution in machining

Practical
Experiment 1: Fabrication of a Hexagonal Nut and Bolt.
Experiment 2: Machining of a shaft key and key slot.
Experiment 3: Preparation of a spur gear using indexing on a milling machine.

MODULE 2: FITTING OPERATIONS — **4 hours**

Theory: Introduction to common fitting tools: files, hacksaws, taps, dies, punches, Marking methods and measuring instruments used in fitting work, Basics of fitting operations and safety precautions, Introduction to threads, tapping, and dieing processes.

Practical
Experiment 4: To prepare internal threading using taps for nut preparation.
Experiment 5: To prepare external threading using dies for bolt preparation.

MODULE 3: WELDING OPERATIONS — **4 hours**

Theory: Types of welding: Gas welding, MIG welding**,** Welding joints: Butt joint, lap joint, T-joint**,** Welding positions**,** Flame setting, filler material selection**,** Welding symbols and safety measures.

Practical
Experiment 6: To prepare a butt joint of given two metal strips using gas welding
Experiment 7: To Make a Pipe Joint by MIG Welding

Text Book(s)

1.	P N Rao. Manufacturing Technology Vol 2-Metal Cutting and Machine Tools. Tata McGraw Hill.
2.	A B Chattopadhyay. Machining and Machine Tools. Willey.
3.	G Boothroyd & W A Knight. Fundamentals of Machining and Machine Tools. CRC Press Taylor & Francis Group.

Reference Books

1.	H Gerling. All About Machine Tools. New Age Int. (P) Ltd.
2.	A. Ghosh & A. K. Mallik. Manufacturing Science. Affiliated East-West Press Pvt. Ltd
3.	S K Hajra Choudhury. Workshop Technology Vol II Machine Tools. Media Promoters & Publishers Pvt. Ltd.
4.	B S N Parashar. Elements of Manufacturing Processes. PHI.

BME23304T	MACHINING AND MACHINE TOOLS	L	T	P	C
		3	0	0	3

Pre-requisite: Manufacturing Practice Workshop Lab-I & II

Course Objectives: The objectives of this course are to:

1. Understand fundamental knowledge and principles in material removal processes.
2. Apply the fundamentals and principles of metal cutting to practical applications using lathes, milling machines, shaper and grinding machines.
3. Apply knowledge of basic mathematics to calculate the machining parameters for different machining processes.

Course Outcomes: On completion of this course, students will be able to

CO1: Understand different machine tools and their uses for practical applications

CO2: Select a measuring instrument to inspect the dimensional and geometric features of a given component.

CO2: Compare the machining parameters for estimation of machining time.

CO3: Apply knowledge of basic Mathematics to calculate the machining parameters for different machining processes

Module 1: Introduction	**10 hours**

Introduction to machine tools, types of machine tools, basic elements of machine tools, Geometry of single point cutting tool, mechanism of chip formation and types of chips, use of chip breaker, orthogonal and oblique cutting, machining forces and Merchant's Circle Diagram (MCD), tool wear and tool failure, tool life estimation

Module 2: Lathe	**8 hours**

Principle, classification, specifications, and operations performed on a lathe, estimation of machining time, machining parameters, and effects of process parameters on machining performance, lathe accessories, Capstan and Turret lathe, indexing mechanism

Module 3: Shaper	**8 hours**

Principle, classification, specifications, shaper mechanisms – crank and slotted lever quick return mechanism, feed mechanism, operations performed on shaper – machining horizontal, vertical, angular surfaces, cutting slots, grooves, key ways, machining irregular surfaces, splines and gears, calculation for machining time for shaping operations, effect of parameters on machining. Planer: Principle, classification, specifications, comparison between shaper and planer

Module 4: Milling machine	**8 hours**

Principle, classification, specifications, peripheral milling, up and down milling, face milling, end milling, different operations performed on milling machines, dividing heads, methods of indexing – direct, simple, compound and differential indexing, milling of spur gear, milling cutters

Module 5: Drilling machine	**6 hours**

Principle, classification, specifications, hole making operations performed on drilling machines, twist drill nomenclature.

Module 6: Grinding machines	**5 hours**
Principle, classification, specifications, different grinding processes, grinding wheel – components (wheel material), grit, grade and structure, specifications of grinding wheels. Glazing and loading in wheels, dressing, truing, balancing, and mounting of grinding wheels	
Total Lecture hours	**45 hours**

Text book (s)	
1.	P N Rao. Manufacturing Technology Vol 2-Metal Cutting and Machine Tools. Tata Mc Graw Hill.
2.	A B Chattopadhyay. Machining and Machine Tools. Willey.
3.	G Boothroyd & W A Knight. Fundamentals of Machining and Machine Tools. CRC Press Taylor & Francis Group.
Reference book (s)	
1.	H Gerling. All About Machine Tools. New Age Int. (P) Ltd.
2.	A. Ghosh & A. K. Mallik. Manufacturing Science. Affiliated East-West Press Pvt. Ltd
3.	S K Hajra Choudhury. Workshop Technology Vol II Machine Tools. Media Promoters & Publishers Pvt. Ltd.
4.	B S N Parashar. Elements of Manufacturing Processes. PHI.

BME23305T	MEASUREMENTS & METROLOGY	L	T	P	C
		3	0	0	3

Pre-requisite: Mathematics-1, Physics-1, Engineering Graphics & Design

Course Objectives: The objectives of this course are to:

1. Understand metrology, its advancements & measuring instruments.
2. Acquire knowledge on different standards of length, calibration of End Bars, linear and angular measurements, Screw thread and gear measurement & comparators.
3. Equip with knowledge of limits, fits, tolerances and gauging.

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

CO1: Understand the objectives of metrology, methods of measurement, standards of measurement & various measurement parameters.
CO2: Explain tolerance, limits of size, fits, geometric and position tolerances, gauges and their design.
CO3: Understand the working principle of different types of comparators.
CO4: Describe measurement of major & minor diameter, pitch, angle and effective diameter of screw threads.

Module 1: Introduction to Metrology: **3 hours**

- Definition, objectives and concept of metrology, Need of inspection, Sample Inspection and 100% Inspection, Methods of Measurement and its Classification for selection of measuring instruments, Precision and Accuracy, Process of Measurement, Errors in Measurement, Types of Errors, Standards of Measurement, Sub-Division of Standards, Line and End Standards.

Module 2: System of Limits, Fits, Tolerance and Gauging: **10 hours**

- Introduction to Tolerance, Interchangeability of Components, Terminologies, Classification of Tolerances, Economical aspects of Tolerance, Fits, Classification of Fit, Allowance, Systems for Obtaining Fits - Hole Basis System and Shaft Basis System, Fundamental Deviation, International Tolerance Grade, Gauges and its Classification, Types of Gauges (Plain Plug Gauge, Ring Gauge, Snap Gauge, Limit Gauge), Brief Concept of Design of Gauges (Taylor's Principles), Gauge Tolerance and Wear Allowance on Gauges.
- Numerical on Limits, Fits and Tolerances.

Module 3: Comparators: **4 hours**

- Introduction to Comparators, Need for Comparators, Characteristics of Good Comparators, Applications, Types of Comparators, Mechanical Comparators – Dial Indicator, Pneumatic Comparator – Back Pressure Bourdon Gauge, , Optical – Profile Projector

Module 4: Tool Room Linear & Angular Measuring Instruments: **10 hours**

- Linear Measurements, Vernier Instruments (Caliper, Depth Gauge, Height Gauge, Micrometer), V-Blocks, Straight Edges, Radius Gauges, Feeler Gauges, Wire Gauges, Screw Pitch Gauge, Surface Plate, Slip Gauges
- Angular Measurements, Bevel Protractor, Combination Set, Bore Gauge, Dial Indicator,

Sine Bar • Tool Maker's Microscope, Diameter Measuring Machine, Coordinate Measuring Machine	
Module 5: Surface Texture:	**6 hours**
• Introduction, Factors Affecting Surface Roughness, Controlling Surface Roughness, Orders of Geometric Irregularities, Elements of Surface Texture, Measuring Methods, Tomlinson Surface Meter, Taylor Hobson Talysurf, Related problems on Surface Roughness Measurement	
Module 6: Gear Measurements:	**6 hours**
• Gear Tooth Terminology (Review), Measurement and Testing of Spur Gears - Tooth Thickness Measurement, Pitch Measurement, Tooth Bearing Contact Testing, Composite Method of Gear Testing	
Module 7: Measurements of Screw Threads:	**6 hours**
• Terminology of Screw Thread (Review), Errors in Threads, Effects of Pitch Errors, Measurement of Major, Minor and Effective Diameters of Thread, Calculation of Best Wire Size, Measurement of Pitch, Measurement of Thread angle, Screw thread gauges	
Total Lecture hours	**45 hours**
Text Book(s)	
1.	E.O Doebelin and Dhanesh Manik, "Measurement Systems", McGraw Hill, 2017
2.	Bewoor & Kulkarni, "Metrology & Measurement" Tata McGraw Hill, 2009.
Reference Book (s)	
1.	D. James, and S, Meadow, "Geometric Dimensioning and Tolerancing", Marcel Dekker, 1995
2.	Madhav S. Phadke, Quality Engineering using Robust Design, Prentice Hall, 1989

BME23303T	MECHATRONICS, ROBOTICS AND CONTROL	L	T	P	C
		3	0	0	3

Pre-requisite: Engineering Mathematics

Course Objectives: The objectives of this course are to:

1. To acquire the knowledge on advanced algebraic tools for the description of motion.
2. To develop the ability to analyse and design the motion for articulated systems.
3. To develop an ability to use software tools for analysis and design of robotic systems.

Course Outcomes: On completion of this course, students will be able to

CO1: Explain the importance of robotics & illustrate robot configuration and its subsystems (Understanding)

CO2: Solve problems of robot kinematics (Applying)

CO3: Analyse robot dynamics using Lagrangian and Eulerian approach (Analysing)

CO4: Utilize the concepts of path planning and control & develop a program for the robot (Applying)

Module 1: Introduction	**4 hours**
History of robotics; Classification and usages of robot; Robot anatomy: Links, Grippers, Actuators, Sensors; Degrees of Freedom; Robot coordinates & reference frames; Workspace.	
Module 2: Kinematics	**7 hours**
Position Analysis: Matrix representations, Homogenous transformations; Representation of transformations; Forward and Inverse Kinematics; Differential Relationships; Jacobian; Denavit - Hartenberg Representation.	
Module 3: Dynamics of Robots	**10 hours**
Lagrange-Euler dynamic formulation; Effective Moments of Inertia; Dynamic equations; Static Analysis; Transformation of Forces and Moments; Dynamic analysis of the manipulator robot: Kinetic energy, Potential energy, Lagrangian, Equations of motion.	
Module 4: Trajectory Planning and Control	**10 hours**
Path vs Trajectory; Joint Space Trajectory Planning: Third order polynomial trajectory planning; Cartesian space trajectory planning; Continuous trajectory recording; Block Diagrams; System Dynamics; Laplace Transforms; Inverse Laplace Transforms; Transfer Functions; Root Locus Method; PID Controller.	
Module 5: Sensors and Actuators	**8 hours**
Encoders; Sensors: Position sensors, Acceleration sensors, Force & pressure sensors, Touch & tactile sensors, Proximity sensors, Range finders; Vision Systems; Hydraulic Actuation; Pneumatic Actuation; Electric Motors: AC & DC type motors, Brushless DC motors, Direct drive motors, Servomotors, Stepper motors	
Module 6: Programming and Actuation	**6 hours**
Programming of Robots and Vision System: overview of various programming languages.	
Total Lecture hours	**45 hours**
Text book (s)	

1.	Saeed B. Niku; Introduction to Robotics: Analysis, Control, Applications,3rd Edition Wiley
2.	J. J. Craig, Introduction to Robotics Mechanics and Control, Addison Wesley, 1999
3.	S. Mukherjee, "Essentials of Robotics Process Automation", Khanna Book Publishing, 2021.
Reference book (s)	
1.	M.P. Groover; Industrial Robotics–Technology, Programming and Applications: McGraw-Hill
2.	W. Bolton, "Mechatronics," Addison Wesley Longman, 2010.
3.	G.K. McMillan, "Process/Industrial Instruments and Controls Handbook," McGraw-Hill, 1999.

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BCM25101T	ACCOUNTING AND FINANCE	L	T	P	C
		3	0	0	3

Pre-requisite: Mathematics

Course Objectives: The objectives of this course are to:

1. Provide foundational knowledge of accounting principles and financial statements.
2. Enable students to record, classify, and summarize financial transactions.
3. Introduce core concepts of financial management, including cost of capital and financial decision-making.
4. To provide insights into various sources and methods of financing working capital.
5. To explore the core functions and principles of management.

Course Outcome: After successful completion of this course, the students will be able to

CO1: Explain fundamental accounting concepts and apply rules of double-entry bookkeeping**(Understanding)**
CO2: Prepare journal entries, ledgers, trial balances, and final accounts with adjustments**(Applying)**
CO3: Calculate cost of various sources of capital and interpret key financial decisions**(Applying)**
CO4: Evaluate the sources and methods of working capital financing**(Evaluate)**
CO5: Apply the principles of management in basic organizational settings**(Applying)**

Module 1:Introduction to Accounting	**9 hours**
Concept and classification of Accounts, Transaction, Double Entry system of Book Keeping, Golden rules of Debit and Credit, Journal: Definition, Procedure of Journalising, Ledger, Rules regarding Ledger posting, Balancing of Ledger accounts, Trial Balance: Definition, objectives, Procedure of preparation	
Module 2:Subsidiary Books and Final Accounts	**9 hours**
(i) Name of Subsidiary Books, Cash Book - Definition, advantages, objectives, types of Cash Book, preparation of different types of cash books, (ii) Final Account - Preparation of Trading Account, Profit and Loss Account with adjustments.	
Module 3: Introduction to Financial Management	**9hours**
Financial Management - Financial goals - Profit vs. Wealth Maximization; Finance Functions - Investment, Financing and Dividend Decisions - Cost of Capital - Significance of Cost of Capital - Calculation of Cost of Debt - Cost of Preference Capital - Cost of Equity Capital and Cost of Retained Earnings.	
Module 4:Working Capital	**9 hours**
Management of Working Capital - Significance and types of Working Capital - Estimation of Working Capital Requirements - Financing of Working Capital - Sources of Working capital - Factoring services- Finance - Dimensions of Working Capital Management.	
Module 5:Introduction to Management	**9 hours**
Definition and meaning of management, Characteristics of management, Importance of management, Functions of management - planning, organising, directing, staffing, coordination and controlling etc., Principles of management, Difference between administration and management	
Total Lecture hours	**45 hours**
Text Book(s)	

1.	R.L. Gupta & V.K. Gupta – *Financial Accounting,* Sultan Chand & Sons
2.	M.Y. Khan & P.K. Jain – *Financial Management,* McGraw Hill Education
3.	T.S. Grewal – *Double Entry Book Keeping – Accounting for Class XI & XII,* Sultan Chand & Sons
Reference Book(s)	
1.	S.N. Maheshwari & S.K. Maheshwari – *An Introduction to Accountancy,* Vikas Publishing House
2.	I.M. Pandey – *Financial Management,* Vikas Publishing House
3.	Koontz & O'Donnell – *Principles of Management,* McGraw Hill Education

BME23312T	COMPUTER AIDED DESIGN	L	T	P	C
		2	0	2	4

PRE-REQUISITES: Engineering Graphics, Machine Drawing, Machine Design

Course objectives: The objectives of this course are:

1. To provide foundational knowledge of CAD systems, geometric modeling, and coordinate representations.
2. To introduce CAD standards, data exchange formats, and the role of CAD in engineering applications.

Course outcomes: On completion of this course, students will be able to

CO No.	Course Outcome	Bloom's Level
CO1	Explain the structure and applications of CAD systems.	Understanding
CO2	Apply geometric modelling and transformation techniques.	Applying
CO3	Create 2D technical drawings and 3D models using CAD software.	Applying
CO4	Develop and interpret part, assembly, and detailed drawings with annotations.	Analysing
CO5	Integrate CAD with downstream CAE/CAM tools using industry-standard file formats.	Creating

MODULE 1: Introduction to CAD	**6 hours**
Product cycle- Design process- sequential and concurrent engineering, Computer aided design - CAD system architecture- co-ordinate systems - Types of CAD models: wireframe, surface, and solid; Introduction to computer graphics and CAD data structures	
MODULE 2: Geometric Modeling	**8 hours**
2D and 3D geometric transformations: translation, scaling, rotation; Homogeneous coordinates and matrix representation; Curve modeling: analytical curves (conics) and synthetic curves (Bezier, B-spline); Surface modeling and solid modeling techniques (CSG, B-rep)	
MODULE 3: 2D Drafting and Dimensioning	**6 hours**
CAD standards: ISO, BIS, ANSI; Drawing templates, layers, dimensioning, text styles; Orthographic projection, sectioning, and isometric views; Detailing conventions and plotting	
MODULE 4: 3D Part and Assembly Modeling	**6 hours**
Parametric and feature-based modeling concepts; Creating part models using extrude, revolve, sweep, loft; Assembly modeling: mating conditions and constraints; Generating exploded views and animations, tolerance.	
MODULE 4: CAD Standards	**4 hours**
Standards for computer graphics - Graphical Kernel System (GKS), Data exchange standard: IGES, STEP, STL, DXF; CAD in CAE: meshing and preprocessing (introductory); CAD in CAM: toolpath generation and 3D printing; Introduction to reverse engineering workflows	
Total contact hours	**30 hours**

Practical

Lab No.	Title of Practical Work
1	Introduction to CAD software interface and 2D drawing tools
2	Sketching with parametric constraints &3D part modeling: extrude, revolve, sweep, loft
3	Modeling mechanical components
4	Assembly of components with constraints
5	Generating detailed drawings with dimensioning
6	Exporting/importing files in IGES, STEP, and STL formats
7	Prototyping of generated mechanical components

Text book (s):	
1	Ibrahim Zeid, Mastering CAD/CAM, McGraw Hill
2	Understanding Creo Parametric Through Examples by K. Kumar & A.K. Roy. Wiley (I) (ISBN 9789389583137)
3	P.N. Rao, CAD/CAM Principles and Applications, McGraw Hill
Reference book (s)	
1	D.F. Rogers & J.A. Adams, Mathematical Elements for Computer Graphics
2	M.P. Groover & E.W. Zimmers, CAD/CAM: Computer-Aided Design and manufacturing
3	Donald Hearn, M. Pauline Baker: Computer Graphics, Prentice-Hall

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BME23313T	INTERNAL COMBUSTION ENGINES	L	T	P	C
		3	0	0	3

Pre-requisite: Basic Thermodynamics, Heat Transfer

Course Objectives: The objectives of this course are to:

1. To provide a fundamental understanding of the working of S.I. and C.I. engines and its important systems.
2. To familiarise with the latest technological developments in engine technology and provide insight into the harmful effects of engine pollutants and its control

Course Outcome: After successful completion of this course, the students will be able to

CO1: Analyze and compare the real cycles with ideal air standard cycles to estimate the losses occurring during the run of an I.C. Engine

CO2: Estimate the primary design parameters, namely, stroke, bore, compression ratio, air -fuel ratio and rated speed of components of internal combustion engines from required performanceparameters.

CO3: Critically examine the causes of unwanted exhaust emissions, their effects on the environment and measures to reduce such emissions from the study of chemistry of combustion and emission control technologies.

CO4: Assess the performance of internal combustion engines under diverse load situations and throttle locations using an appropriate test rig, and compare the outcomes for single-cylinder and multi-cylinder internal combustion engines, namely spark-ignition and compression-ignition engines.

Module 1:Fuel-Air cycle	**5 hours**
Effect of variation of specific heats, fuel-air ratio, compression ratio and dissociation. Actual cycle –losses in actual cycle.	
Module 2:IC Engine Fuels	**5 hours**
Petrol, Diesel, natural gases and some other alternative fuels and their characteristics and use in engines. Combustion process in S.I. And C.I. engines, abnormal combustion, detonation and fuel knock –additives. Rating of I.C. engine fuel.	
Module 3: Fuel Injection	**5 hours**
Carburetion –desirable characteristics –compensation for simple jet carburettor, calculation for air-fuel ratio. Injection processes –requirements and methods –mechanical, electronic and MPF injection system	
Module 4:Ignition and Combustion in IC Engines	**10 hours**
Battery, magneto & Electronic ignition systems,Ignition timing, spark advance mechanism. Stages of SI engine combustion, Effect ofengine variables on ignition lag flame front propagation. Abnormal combustion, pre-ignition & detonation, Theory of detonation, Effect of engine variables on detonation,Control of detonation. Requirement of good combustion chambers for SI engines. Stages of CI engine combustion. Effect of engine variables on delay periods. DieselKnock & methods of control in CI engine combustion chambers.	
Module 5:Testing and Performance	**10 hours**

Performance characteristics of petrol and Diesel engines. Part load and full load characteristics in respect to thermal efficiency, mechanical efficiency, fuel consumption, bmep and torque. I C engine ratings and volume capacity compression ratio and weight to power output ratio and its trends in power –weight characteristics. Supercharging of I C engines –effect of supercharging on Diesel and petrol engines –performance characteristics for supercharged engines	
Module 6:Lubrication and Cooling System	**5 hours**
Types of lubricants and their properties, SAE rating of lubricants, types of lubrication systems. Engine Cooling: Necessity of engine cooling, disadvantages of overcooling, Cooling systems and their comparison: Air cooling, Liquid cooling. Supercharging/Turbo-charging: Objectives, Limitations, Methods and Types,Different arrangements of turbochargers and superchargers	
Module 7: Basics of Electronic Engine Controls:	**5 hours**
Electronic Control module (ECM), Inputs required and output signals from ECM, Sensors: Throttle Position, Inlet Air Temperature, Coolant Temperature, Crankshaft Position, Camshaft Position, Mass Air flow and Exhaust Gas Oxygen sensors, their construction and importance in ECM. Electronic Spark control, Air Management system, Idle speed control	
Total Lecture hours	**45 hours**
Text Book(s)	
1	Internal Combustion Engines, V Ganesan, Tata McGraw Hill Publication, 2nd edn, 2003
2	A course in Internal Combustion engines, M. L. Mathur and R. P. Sarma, 5th edn, 2014
Reference Book(s)	
1	Internal Combustion Engine fundamentals, John B. Heywood, 5thedn, McGraw-Hill international edition, 1988
2	Engineering Fundamentals of Internal Combustion Engine, W W Pulkrabek, Pearson Education, 5thEdn. 2013.

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BME23313T	INTERNAL COMBUSTION ENGINES	L	T	P	C
		3	0	0	3

Pre-requisite: Basic Thermodynamics, Heat Transfer

Course Objectives: The objectives of this course are to:

1. To provide a fundamental understanding of the working of S.I. and C.I. engines and its important systems.
2. To familiarise with the latest technological developments in engine technology and provide insight into the harmful effects of engine pollutants and its control

Course Outcome: After successful completion of this course, the students will be able to

CO1: Analyze and compare the real cycles with ideal air standard cycles to estimate the losses occurring during the run of an I.C. Engine

CO2: Estimate the primary design parameters, namely, stroke, bore, compression ratio, air -fuel ratio and rated speed of components of internal combustion engines from required performanceparameters.

CO3: Critically examine the causes of unwanted exhaust emissions, their effects on the environment and measures to reduce such emissions from the study of chemistry of combustion and emission control technologies.

CO4: Assess the performance of internal combustion engines under diverse load situations and throttle locations using an appropriate test rig, and compare the outcomes for single-cylinder and multi-cylinder internal combustion engines, namely spark-ignition and compression-ignition engines.

Module 1:Fuel-Air cycle	**5 hours**
Effect of variation of specific heats, fuel-air ratio, compression ratio and dissociation. Actual cycle –losses in actual cycle.	
Module 2:IC Engine Fuels	**5 hours**
Petrol, Diesel, natural gases and some other alternative fuels and their characteristics and use in engines. Combustion process in S.I. And C.I. engines, abnormal combustion, detonation and fuel knock –additives. Rating of I.C. engine fuel.	
Module 3: Fuel Injection	**5 hours**
Carburetion –desirable characteristics –compensation for simple jet carburettor, calculation for air-fuel ratio. Injection processes –requirements and methods –mechanical, electronic and MPF injection system	
Module 4:Ignition and Combustion in IC Engines	**10 hours**
Battery, magneto & Electronic ignition systems,Ignition timing, spark advance mechanism. Stages of SI engine combustion, Effect ofengine variables on ignition lag flame front propagation. Abnormal combustion, pre-ignition & detonation, Theory of detonation, Effect of engine variables on detonation,Control of detonation. Requirement of good combustion chambers for SI engines. Stages of CI engine combustion. Effect of engine variables on delay periods. DieselKnock & methods of control in CI engine combustion chambers.	
Module 5:Testing and Performance	**10 hours**

Performance characteristics of petrol and Diesel engines. Part load and full load characteristics in respect to thermal efficiency, mechanical efficiency, fuel consumption, bmep and torque. I C engine ratings and volume capacity compression ratio and weight to power output ratio and its trends in power –weight characteristics. Supercharging of I C engines –effect of supercharging on Diesel and petrol engines –performance characteristics for supercharged engines	
Module 6:Lubrication and Cooling System	**5 hours**
Types of lubricants and their properties, SAE rating of lubricants, types of lubrication systems. Engine Cooling: Necessity of engine cooling, disadvantages of overcooling, Cooling systems and their comparison: Air cooling, Liquid cooling. Supercharging/Turbo-charging: Objectives, Limitations, Methods and Types,Different arrangements of turbochargers and superchargers	
Module 7: Basics of Electronic Engine Controls:	**5 hours**
Electronic Control module (ECM), Inputs required and output signals from ECM, Sensors: Throttle Position, Inlet Air Temperature, Coolant Temperature, Crankshaft Position, Camshaft Position, Mass Air flow and Exhaust Gas Oxygen sensors, their construction and importance in ECM. Electronic Spark control, Air Management system, Idle speed control	
Total Lecture hours	**45 hours**
Text Book(s)	
1	Internal Combustion Engines, V Ganesan, Tata McGraw Hill Publication, 2nd edn, 2003
2	A course in Internal Combustion engines, M. L. Mathur and R. P. Sarma, 5th edn, 2014
Reference Book(s)	
1	Internal Combustion Engine fundamentals, John B. Heywood, 5thedn, McGraw-Hill international edition, 1988
2	Engineering Fundamentals of Internal Combustion Engine, W W Pulkrabek, Pearson Education, 5thEdn. 2013.

BME23315T	MANUFACTURING PROCESS	L	T	P	C
		3	0	0	3

Pre-requisite: Mechanical Workshop, Machining & Machine Tools

Course Objectives: The objectives of this course are to:

1. Understand the concept of manufacturing technology with the help of various casting processes widely employed in industries and the underlying concept of welding and its classifications with the related details of equipment and applications.
2. Highlighting the Non-Conventional Machining Processes used for removing materials based on Subtractive Manufacturing
3. Articulate the various concepts of extrusion, forging processes, drawing, metal forming processes, powder metallurgy, its classification and their applications.
4. Apply the various concepts of CAD and design concept in additive manufacturing and its advance techniques along with their applications.

Course Outcome: After successful completion of this course, the students should be able to

CO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
CO2: Acquire knowledge and hands-on competence in applying the concepts of manufacturing science in the design and development of mechanical systems.
CO3: Competence to design a system, component or process to meet societal needs within realistic constraints.
CO4: Demonstrate creativeness in designing new systems components and processes in the field of engineering in general and mechanical engineering in particular.
CO5: Solve complex engineering problem using modern engineering and information Technology tools.

Module 1: Casting:	**6 hours**

Casting: Pattern, Pattern materials, Pattern making, allowances of pattern and Pattern types., Casting process, Types of casting: Continuous casting, Squeeze casting, vacuum mould casting, Evaporative pattern casting, ceramic shell casting, Casting defects., Molding process, Types of Molding process: Injection Molding, Blow molding.

Module 2: Welding:	**8 hours**

Introduction, Types of weld joints, Types of welding process: Gas welding, Arc welding, Electron beam Welding, Laser beam welding, Friction Stir Welding, Ultrasonic Welding, Thermite welding., Types of Arc welding process: Shielded metal arc welding, Submerged arc welding., Types of Gas welding process: GTAW, GMAW., Types of Resistance welding process: Spot welding,
Seam welding., welding defects – causes and remedies, Heat affected zones in welding.

Module 3: Extrusion & Forging:	**6 hours**

Basic Extrusion process and types, Forging operations and its classification., drawing: wire and tube drawing, Swaging, Blanking, Piercing, Punching and Trimming. Cutting of Metals: Oxy – Acetylene Gas cutting, Water Plasma Cutting, TIG cutting, MIG cutting, Soldering, Brazing.

Module 4: Metal Forming:	**8 hours**
Introduction, forming processes - Bending, Coining, embossing, rolling: types of Rolling and Roll mills, Strain Hardening, Recovery, Recrystallization and Grain growth Advanced Metal Forming Process: Details of High energy rate forming process, Electro Magnetic Forming, Explosive Forming, Electro-Hydraulic Forming, Contour Roll forming, Sheet Metal Working: Deep drawing process	
Module 5: Additive Manufacturing:	**7 hours**
Additive manufacturing: Introduction to Rapid Prototyping, material, applications, limitations., Techniques: Photo polymerization, Stereo lithography, Powder Bed Fusion, Selective Laser Sintering, 3D Printing, Laminated Object Manufacturing.	
Module 6: Powder Metallurgy:	**6 hours**
Introduction to powder metallurgy, Metal and alloy powder production, chemical, physical and mechanical methods of production, metal powder characterization introduction, chemical composition, particle size, surface area, density, compressibility, strength, Powder compaction, Sintering and Pre-Sintering.	
Module 7: Non-Conventional Machining:	**4 hours**
Abrasive Jet Machining, Electro Discharge Machining, Laser Beam Machining, Electron Beam Machining	
Total Lecture hours	**45 hours**

Text Book(s)

1.	P. N. Rao, Manufacturing Technology, Mc Graw Hill Education India Pvt Ltd., 2023
2.	Kalpakjain, Manufacturing Engineering &Technology, Pearson education, 7th Edn., 2018
3.	R. K. Jain, Production Technology, Khanna Publishers, 2021.
4.	R.K. Rajput, Manufacturing Technology, Laxmi Publication, 2029

Reference book (s)

1.	R. S. Parmar, Welding Process, Khanna Publishers, 1996
2.	Carl R. Loper, Philip C., Rosenthal, Richard W. Heine, Principles of Metal Casting, McGraw Hill Higher Education, 1976
3.	P. K. Mishra, Non-Conventional Machining, Narosa Publishing House, 1997.

BME23311T	PRODUCTION AND OPERATIONS MANAGEMENT	L	T	P	C
		3	0	0	3

Pre-requisite: Mathematics, Engineering Mechanics

Course Objectives: The objectives of this course are to:

1. Familiarize with the role of operations and its interaction with other activities of a firm and their integration in a highly competitive global environment.
2. Enable the understanding of production processes in quantitative analysis of problems arising in the management of operations.

Course Outcome: After successful completion of this course, the students should be able to

CO1: Explain the concept of Organization, functions of Management and Organization types.
CO2: Analyze the problems to related to Plant Location and Layout for optimal solutions.
CO3: Utilize the concept of Project Management to solve various problems related to time optimization of Projects.
CO4: Explain the concepts of Work Study, Product Design, Production Planning and Control and Inventory Management.
CO5: Explain the concepts of Maintenance and Quality Control Techniques practice in Organizations.

Module 1: Introduction to Organization:	4 hours

Definition of organization, organizational structure, types of organization, span of control, delegation of authority and responsibility.

Module 2: Plant Location and Layout:	4 hours

Objectives, Locational factors, Economics of plant location; Meaning, objectives and types of plant layout and their relevance to mass, batch and job-order production systems.

Module 3: Network Analysis:	8 hours

Objectives, Network development technique, Network computations – Critical Path and its significance, Earliest and Latest dates, calculation of float, Deterministic and probabilistic network models, Assumptions and computations related to PERT model, Crashing of jobs for minimum cost-time schedule for CPM models.

Module 4: Work Study:	10 hours

Meaning and scope, subdivisions of work study – Method/Motion study and Work Measurement; Method/Motion study- its meaning and scope, steps in method/motion study, Tools and techniques of method/motion study, Principles of motion economy; Micro-motion study – Meaning and scope, therbligs, use of motion camera in micro-motion study; Work measurement – concept of observed time, rating factor, average worker and standard time for jobs. Use of stop watch and work sampling techniques in the determination of standard time.

Module 5: Product Design and Development:	5 hours
Meaning of product, Product life cycle (PLC) and Product mix; Decisions to be taken during product development and design, Procedure for product development and design, Value of a product – its meaning, Value Analysis	
Module 6: Production Planning and Inventory Control:	8 hours
Meaning and Objectives, Effects of types of production, steps in Production Planning and Control, Use of Gantt chart, Machine Scheduling Problems, Make/Buy decision and Breakeven analysis and Inventory Control: EOQ Model, ABC, VED, FSN analysis.	
Module 7: Maintenance Management and Quality Control Engineering:	6 hours
Meaning and Types of maintenance, and their suitability, Standards of maintenance, Total Productive Maintenance (TPM), Meaning of Quality, Inspection, Quality Control, Process Control, Control Charts, Acceptance Sampling, Total Quality Management Philosophy	
Total Lecture hours	**45 hours**

Text Book(s) :	
1	O P Khanna, Industrial Engineering and Management, Dhanpat Rai & Co, 2021
2	Marland T. Telsang, Industrial Engineering and Production Management, S. Chand & Co. Ltd., 2018
3	Koontz O' Donnel, Essentials of Management, MCGRAW-HILL EDUCATION (INDIA) LTD., 2006
4	M Mahajan, Industrial Engineering and Production Management, Dhanpat Rai & Co, 2015
5	Panneerselvam,Production and Operations Management, PHI, 2012
Reference book(s):	
1	R M Barnes, Motion and Time study: Design and Measurement of Work,Wiley, 7th Edition, 2009
2	B C Punima and K. K. Khandelwal, Project Planning and Control, Laxmi Publications, 2024.
3	Besterfield et.al., Total Quality Management – Pearson, 3rd Edition, 2012

BME23420T	INDUSTRIAL SAFETY ENGINEERING	L	T	P	C
		3	0	0	3

Pre-requisite: None

Course Objectives: The objectives of this course are to:

1. Introduce students to the principles of industrial safety, accident causation, and risk management.
2. Develop competency in applying engineering methods to design safe processes, systems, and workplaces.
3. Expose students to safety standards, regulations, and emerging practices for industrial accident prevention.

Course Outcomes: On completion of this course, students will be able to

CO1: Explain the fundamentals of safety engineering, hazards, and accident prevention.
CO2: Apply risk analysis and engineering methods to control industrial hazards.
CO3: Analyse safety regulations, standards, and case studies to recommend preventive strategies.

Module 1: Introduction to Industrial Safety Engineering	**4 hours**

Principles of safety engineering; Accident causation models; Types of hazards (physical, chemical, mechanical, electrical, fire, explosion); Hazard identification techniques.

Module 2: Risk Assessment and Management	**6 hours**

Risk analysis methods: HAZOP, FMEA, Fault Tree Analysis (FTA), Event Tree Analysis (ETA); Quantitative Risk Assessment (QRA); Safety audits and inspections; Building a safety culture.

Module 3: Safety in Engineering Systems	**8 hours**

Safety in mechanical systems: pressure vessels, rotating equipment, lifting tools; Electrical safety and grounding; Fire prevention and protection systems; Personal Protective Equipment (PPE); Ergonomics and human factors in safety design

Module 4: Process Safety and Industrial Hygiene	**13 hours**

Process safety in chemical, thermal, and manufacturing plants; Safety in material handling and storage; Case studies of major accidents (Bhopal Gas Tragedy, Chernobyl, Piper Alpha, Vizag LG Polymers, etc.); Industrial hygiene: exposure limits, ventilation, noise and vibration control, occupational diseases.

Module 5: Safety Standards, Regulations, and Emerging Practices	**14 hours**

National and international standards (OSHA, ISO 45001, OHSAS 18001, Indian Factories Act); Safety management systems (SMS); Accident investigation and reporting; Ethical responsibilities of engineers; Digital safety tools: AI-enabled monitoring, IoT for workplace safety, digital twins for risk prediction.

Total Lecture hours	**45 hours**

Text book (s)

1. Dr. K.U. Mistry, Fundamentals of Industrial Safety and Health, Siddharth Prakashan, 1st edition,2008.

Reference book (s)

1. Charles D. Reese, Industrial Safety and Health for People-Oriented Services, CRC Press,
2. C. Ray Asfahl, David W. Rieske, Industrial Safety and Health Management, Pearson,

GIRIJINANDA CHOWDHURY UNIVERSITY

BME23406T	POWER PLANT ENGINNERING	L	T	P	C

		3	**0**	**0**	**3**

Pre-requisite: Basic Thermodynamics, Applied Thermodynamics

Course Objectives: *The objectives of this course are to:*

1.Analysis and preliminary design of the major systems of conventional fossil-fuel steam-cycle power plants.
2.A working knowledge of the basic design principles of nuclear, gas turbine, combined cycle, hydro, wind, geothermal, solar, and alternate power plants.
3.Awareness of the economic, environmental, and regulatory issues related to power generation

Course Outcome: *After successful completion of this course, the students will be able to*

CO1: Understand the energy resources and energy conversion methods
CO2: Determine the efficiency and output of a Rankine cycle, Brayton cycle etc.
CO3: Calculate the performance of steam and gas turbines with reheat and regeneration, and discuss the performance of combined cycle power plants.
CO4: Analyze the design of the major components of a conventional or alternate power plant

Module 1: Introduction	**5 hours**
Introduction of local and global Energy Scenario, history of power plant technology, key terminologies, various components and basic concepts of power plant, Resources and development. Concepts of captive power plant and co-generation, Types of power plants	
Module 2: Steam Power Plant	**10 hours**
Review of Rankine and Carnot cycles, Steam power plant appraisal, Deaeration,Typical layout of steam power plant, Efficiencies in steam power plant, Different types of fuel usedfor steam Generation, Draught system, Classification of boilers, Boiler accessories, Classification ofsteam turbines and their working, Fluidized bed	
Module 3: **Gas Turbine Power Plant**	**5 hours**
Classification of gas turbine power plants, components of gas turbineplants, Site selection, layout, fuels, materials, combined cycle	
Module 4: Diesel Electric Power Plant	**8 hours**
Application of diesel engines in power field, Plant layout, Advantages anddisadvantages of diesel engine power plant, General layout, Performance characteristics,Supercharging.	
Module 5:Hydro Electric and Nuclear Power Plant	**10 hours**
Classification of hydro-electric power plant, Site selection, Elements of hydro-electric power plant, Advantages of hydro-electric power plant, Classification of hydraulic turbines and its selection, Hydrographs, Flow duration curves Introduction to nuclear engineering, Types of nuclear reactors, fast breeder reactor, India‘s nuclear power Programme	
Module 6:Non- Conventional Power plants	**7 hours**
Prospect of renewable energy source, Types of non-conventionalpower plants, solar plants, Wind power plants, Bio-mass plants, Geo-thermal power plant, Tidal powerplant, Economics of power generation	
Total Lecture hours	**45 hours**

Text Book(s)

1	Nag, P. K. Power Plant Engineering. New Delhi: Tata McGraw-Hill Education, Latest Edition
2	*Arora, S. C., and Domkundwar, S. A Course in Power Plant Engineering. New Delhi: Dhanpat Rai Publications.*
3	*El-Wakil, M. M. Powerplant Technology. New York: McGraw-Hill, 1984.*
4	*R. K. Rajput, “Power Plant Engineering”, 4th edition Laxmi*

Reference Book(s)

1	*Woodruff, E. B., Lammers, H. B., and Lammers, T. F. Steam Plant Operation. McGraw-Hill Education*

2	*Haywood, R. W. Analysis of Engineering Cycles. Pergamon Press, 1991*

BME23415T	RENEWABLE ENERGY	L	T	P	C
		3	0	0	3

Pre-requisite: Applied Thermodynamics, Power Plant Engineering

Course Objectives: The objectives of this course are to:

1. Provide fundamental knowledge of various renewable and non-conventional energy sources, their characteristics, availability, and global/national energy scenario.
2. Develop an understanding of the working principles, components, and conversion technologies used in solar, wind, biomass, ocean, geothermal, and nuclear energy systems.
3. Explain bio-conversion and thermochemical processes used for biomass-based energy production and their applications.
4. Introduce direct energy conversion systems such as fuel cells, hydrogen energy, and Magneto-Hydro Dynamic (MHD) generation, along with associated technologies and limitations.
5. Build a foundation for evaluating and selecting appropriate renewable energy technologies for real-world applications to support sustainable development.

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

CO1: Explain the characteristics, availability, and environmental impacts of various renewable energy resources.

CO2: Describe the working principles, components, and conversion technologies of major renewable systems including solar, wind, biomass, ocean, geothermal, and nuclear energy.

CO3: Analyze various renewable energy conversion devices such as solar collectors, PV modules, wind turbines, biogas units, and OTEC plants for performance and applicability.

CO4: Evaluate feasibility, advantages, and limitations of different renewable energy systems, including direct conversion technologies such as fuel cells, MHD, and hydrogen energy.

Module 1: Introduction — **4 hours**

Present Fossil fuel-based systems and its impact, renewable energy – sources and features, seasonal variations and availability, importance, primary & secondary energy sources, limitations to primary sources, various sources of renewable energy, applications, Indian and international energy scenario of RE sources.

Module 2: Solar PV and Thermal System — **10 hours**

Solar Thermal Energy: Solar radiation, solar radiation angles, local solar time, solar radiation spectrum, radiation measurement, solar collector-flat plate collector & solar concentrator, solar heater-water heater & air heater, solar cooker, solar distillation, solar energy storage- sensible heat storage & latent heat storage.

Solar Photovoltaic Systems: Operating principle, photovoltaic cell concepts, Solar cell, panel, module, array, series and parallel connections, Maximum power point tracking (MPPT)

Module 3: Wind Energy — **4 hours**

Properties of wind, availability of wind energy in India, Wind turbine rotor -classification, characteristics, Analysis of ideal wind turbine rotor, Power coefficient, Types of wind mills, Site selection Characteristics of wind generators

Module 4: Biomass Energy — **6 hours**

Biomass resources and classification, thermochemical conversion: gasification, pyrolysis,

digestion, Biogas production, applications and limitations.	
Module 5: Ocean and Tidal Energy	**5 hours**
Tidal energy, wave energy, ocean thermal energy conversion (OTEC) introduction, types, plants & their specifications.	
Module: 6 Geo-Thermal Energy	**5 hours**
Sources and use of geo-thermal energy, classification of geo-thermal power plants, Heat transport in geothermal systems. Hot sprmgs and steam injections	
Module 7: Nuclear Energy	**5 hours**
Fission, fusion technology fundamentals. Thermal and fast reactors. State of art Breeder reactors, prospect and limitations, Fusion energy-controlled fusion of H_2, He etc. Energy release rate	
Module 8: Direct Conversion Methods	**6 hours**
Types of fuel cell & its components, polarization, hydrogen energy, hydrogen production technologies (electrolysis method only), hydrogen energy storage & applications, problem associated with hydrogen energy. Thermo-ions, electrochemical devices, Principles of MHD generation, MHD system	
Total Lecture hours	**45 hours**
Text Book(s)	
1.	Textbook of Renewable Energy, S. C. Bhatia, R. K. Gupta, Woodhead Publishing India PVT. Limited, 2018
2.	Fundamentals Of Renewable Energy, N.L. Panwar, N.S. Rathore, CRC Press, 2021, 1st Edition.
3.	Non-conventional Energy, B.H. Khan, 2024, McGrow Hills
Reference Book (s)	
1.	Solar Engineering and Thermal Processes, Duffie & Beckman- Wiley Int. Ltd., 2013
2.	Solar Energy, SP Sukhatme and JK Nayak, TMG, 4th Edition, 2017.

BME23416T	SOLID WASTE MANAGEMENT	L	T	P	C
		3	0	0	3

Pre-requisite: Basic knowledge of Environmental Science, Chemistry and Material Properties

Course Objectives: The objectives of this course are to:

1. Understand the sources, classification, and characteristics of solid waste.
2. Analyze different collection, transportation, and handling techniques.
3. Evaluate various processing, treatment, and disposal methods.

Course Outcome: After successful completion of this course, the students will be able to

CO1: Identify types and characteristics of various types of solid wastes
CO2: Understand the environmental problems relating to solid waste management
CO3: Apply modern techniques at different stages of waste processing
CO4: Design suitable processing system and evaluate disposal sites.

Module 1: Introduction to Solid Waste Management	**5hours**
Introduction to Solid Waste, 4-R Principle in waste minimization, Concept of Zero Waste, Types and Sources of Solid Waste, Characteristics & Quantification technique of Solid Waste, Legislation &Regulations	
Module 2: Collection Systems of Solid Waste	**8hours**
Refuse collection: Primary collection system, secondary collection system, transfer to disposal site, Commercial wastes, Transfer stations	
Module 3: **Processing of Municipal Solid Waste**	**7hours**
Storing, Conveying, Compacting, Shredding, Material separation, Trommel screens, magnets & electromechanical separators	
Module 4: Biochemical Processes	**8 hours**
Fundamentals of Composting, Different techniques of Composting, anaerobic digestion, Bio-gas production	
Module 5:Combustion andEnergy Recovery	**7hours**
Incineration, Waste to energy combustors, Pyrolysis, Plasma Gasification, Undesirable effects of combustion	
Module 6:Current Issues in Solid Waste Management	**10hours**
Life cycle analysis & management, social stigma associated with waste management, public or private ownership, financing solid waste facilities, role of solid waste engineer	
Total Lecture hours	**45hours**

Text Book(s)

1	P. Aarne Vesilind, William Worrell, Reinhart, Solid Waste Engineering, Thomson Publishing House
2	Prasad Modak, Waste Minimization-A Practical Guide to Cleaner Production & Enhanced Profitability, Centre for Environment Education, Ahmedabad
3	Tchobaanoglous, G., Theisen, H., and Samuel A Vigil, Integrated Solid Waste Management, McGraw-HillPublishers, 1993.
4	Bilitewski B., Hard He G., Marek K., Weissbach A., and Boeddicker H., Waste Management, Springer, 1994

Reference Book(s)

1	White, F. R., Franke P. R., & Hindle M., Integrated solid waste management: a life cycle inventory. Mc-Dougall,P. John Wiley & Sons. 2001
2	Nicholas, P., & Cheremisinoff, P. D., Handbook of solid waste management and waste minimization technologies, Imprint of Elsevier Science. 2005

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/105103205

- https://www.youtube.com/watch?v=k0ktJRoRcOA
- https://nptel.ac.in/courses/103/107/103107125/
- https://onlinecourses.nptel.ac.in/noc22_ce76/preview
- https://onlinecourses.swayam2.ac.in/cec20_ge13/preview

GIRIJANANDA CHOWDHURY UNIVERSITY, ASSAM

Hatkhowapara, Azara, Guwahati 781017, Assam

BME23401T	AUTOMOBILE ENGINEERING	L	T	P	C
		3	0	0	3

Pre-requisite: Basic Thermodynamics

Course Objectives: The objectives of this course are to:

1. To provide a fundamental understanding of the working of S.I. and C.I. engines and its important systems.
2. To familiarise with the latest technological developments in engine technology and provide insight into the harmful effects of engine pollutants and its control

Course Outcome: After successful completion of this course, the students will be able to

CO1. To apply the concept of internal combustion of a fuel-air mixture for energy production and subsequent controlled use.
CO2. To apply various types of engines and sub-systems with respect to the desired objective and performance.
CO3. To examine various disassembled components and assess their condition for replacement/repair.
CO4. To choose the primary and peripheral components of an automobile needed for control, safety,
comfort, economy, and efficiency.

Module 1:Introduction	**5 hours**
History of automotive systems and operations, components of an automobile, Basic Engine terminology, Classification of different types of engines.	
Module 2:Prime Mover	**5 hours**
Principles of Engine operation, Engine parts and their functions, Multiple cylinder Engines, Engine trouble and repairs. Hybrid and electric vehicles.	
Module 3: Fuel Systems	**5 hours**
Carburettor, fuel pump and injector, common rail system for diesel injection, CRDI, MPFI Engine.	
Module 4:Transmission System	**10 hours**
Manual and automatic transmission systems; meaning and functioning. The clutch construction and operation, mechanical versus hydraulic clutch. Gearbox:types, gear system and gearbox, process of speed changing and reversing. Propeller shaft:strength consideration and coupling used. Differential gearbox:need, construction and operation. Axle and Wheel assembly: solid/liquid lubrication in bearings, wheel alignment and balancing (castor/camber/toe/ offset). Tyre types, specification, and rotation of tyres	
Module 5:Chassis and Suspension system	**10 hours**
Springs (coil andleaf) and dashpots. Steel and rubber bushes and mountings for engine. Chassis construction and types.	
Module 6:Steering systems	**5 hours**
Rack and pinion system, tie rod and wheel pivot, turning radius & safety arrangement. Types: Mechanical system versus hydraulic systems (power steering), Electronic Power Steering (EPS)	
Module 7: Braking system	**5 hours**
Types of Brakes: drum and disc.Brake system: mechanical, pneumatic and hydraulic, and their operation. Components: shoe materials, size and replacement, drum/disc repair and replacement, Antilock Braking system (ABS)	
Total Lecture hours	**45 hours**

Text Book(s)	
1	Internal Combustion Engines, V Ganesan, Tata McGraw Hill Publication, 2ndedn, 2003
2	Understanding AutomotiveElectronics byWilliam B.Ribbens, Butterworth-Heinemann, 225 Wildwood Avenue, Woburn, MA 01801-2041
Reference Book(s)	
1	Internal Combustion Engine fundamentals, John B. Heywood, 5thedn, McGraw-Hill international edition, 1988
2	Engineering Fundamentals of Internal Combustion Engine, W W Pulkrabek, Pearson Education, 5thEdn. 2013.

BME23405T	BIOMEDICAL ENGINEERING	L	T	P	C
		3	0	0	3

Pre-requisite: Solid Mechanics, Materials Science, Theory of Machines

Course Objectives: The objectives of this course are to:

1. Introduce students to the fundamentals of biomedical engineering, human physiology, and the role of mechanics in biological systems.
2. Develop competency in applying mechanical engineering principles to biomedical devices, biomaterials, and prosthetics.
3. Expose students to medical imaging, rehabilitation technologies, and regulatory/ethical issues in biomedical product development.

Course Outcomes: On completion of this course, students will be able to

CO1: Explain the fundamentals of biomedical systems and biomechanics of human tissues and organs.

CO2: Apply mechanical design and materials knowledge to biomedical devices, implants, and prosthetics.

CO3: Analyse biomedical instrumentation, imaging technologies, and regulatory requirements for medical devices.

Module 1: Introduction to Biomedical Engineering	**4 hours**
Overview of biomedical engineering; Anatomy and physiology relevant to mechanical engineers (skeletal, muscular, cardiovascular systems); Role of mechanics in biological functions; Interdisciplinary nature of biomedical technologies.	
Module 2: Biomechanics and Human Motion Analysis	**6 hours**
Biomechanics of bones, muscles, and joints; Stress-strain behaviour of biological tissues; Gait analysis and motion capture systems; Fluid mechanics of blood flow; Respiratory mechanics.	
Module 3: Biomaterials and Prosthetic Design	**13 hours**
Engineering materials in biomedical applications (metals, ceramics, polymers, composites); Biocompatibility and degradation; Orthopaedic implants (hip, knee, dental); Prosthetic design and rehabilitation engineering; Case studies of mechanical design in biomedical devices.	
Module 4: Biomedical Instrumentation and Imaging	**11 hours**
Principles of biomedical instrumentation: sensors, transducers, and actuators; Bio-signal acquisition (ECG, EMG, EEG); Medical imaging technologies: X-ray, CT, MRI, ultrasound; Emerging trends: 3D printing in biomedicine, wearable health devices.	
Module 5: Regulations, Ethics, and Applications	**11 hours**
Regulatory aspects for medical devices (ISO, FDA, CE marking, Indian standards); Safety and reliability in biomedical devices; Ethical issues in biomedical engineering; Applications in rehabilitation, minimally invasive surgery, tissue engineering, and personalized medicine.	
Total Lecture hours	**45 hours**

Text book (s)

1. Bronzino, J.D., & Peterson, D.R. (2014). The Biomedical Engineering Handbook. CRC Press.
2. Khandpur, R.S. (2014). Handbook of Biomedical Instrumentation. McGraw-Hill.
3. Hall, S. J. (2022). Basic Biomechanics. McGraw-Hill.

Reference book (s)

1. Enderle, J., Blanchard, S., & Bronzino, J. (2012). Introduction to Biomedical Engineering. Elsevier

BME23404T	COMPUTATIONAL FLUID DYNAMICS (CFD)	L	T	P	C
		3	0	0	3

Pre-requisite: Fluid Mechanics (UG), Engineering Mathematics, Numerical Methods

Course Objectives: The objectives of this course are

1. To provide the student with a significant level of experience in the use of modern CFD software for the analysis of complex fluid-flow systems.
2. To improve the students' understanding of the basic principles of fluid mechanics.
3. To improve the students' research and communication skills using a self-directed, detailed study of a complex fluid-flow problem and to communicate the results.

Course Outcome: After successful completion of this course, the students will be able to

CO1: understand the basic knowledge of governing equations of Fluid flow applications.
CO2: recognize various solution methodologies to complex fluid dynamics problems.
CO3: apply appropriate solution strategy and estimate the accuracy of the results for a given flow case
CO4: select and formulate various CFD problems by considering appropriate boundary conditions.

Module 1: Introduction to CFD	**7 hours**
Computational approach to Fluid Dynamics and its comparison with experimental and analytical methods, Basics of PDE: Elliptic, Parabolic and Hyperbolic Equations.	
Module 2: Governing Equations	**7 hours**
Review of Navier-Stokes Equation and simplified forms, Solution Methodology: FDM and FVM, stability, Convergence and Accuracy.	
Module 3: Finite Volume Method	**8 hours**
Domain Discretization, types of mesh and quality of mesh, SIMPLE, pressure velocity coupling, checkboard pressure field and staggered grid approach.	
Module 4: Geometry Modeling and Grid Generation	**6 hours**
Practical aspects of computational modeling of flow domains, Grid Generation, Types of mesh and selection criteria, Mesh quality, Key parameters and their importance.	
Module 5: Methodology of CFDHT	**8 hours**
Objectives and Importance of CFDHT, CFDHT for Diffusion Equation, Convection Equation and Convection-Diffusion Equation.	
Module 6: Solution of N-S Equations for Incompressible Flows	**9 hours**
Semi-Explicit and Semi-Implicit Algorithms for staggered Grid System and Non-Staggered Grid System of N-S Equations for incompressible Flows.	
Total Lecture hours	**45 hours**

Text Book(s)

1. John A. Anderson, Jr., Computational Fluid Dynamics, McGraw Hill.
2. Muralidhar and Sundarrajan, Computaional Fluid Flow and Heat Transfer, Narosa Publication.

Reference Books

1. Suhas Patankar, Numerical Methods in Fluid Flow and Heat Transfer.
2. H. K.Versteeg, W. Malalasekera, An Introduction to Computational Fluid Flow (Finite Volume Method), Printice Hall.
3. Ferziger J.H. & Peric M. (1999) Computational Methods for Fluid Dynamics, Springer, Berlin, Germany.

BME23407T	REFRIGERATION AND AIR-CONDITIONING	L	T	P	C
		3	0	0	3

Pre-requisite: Basic Thermodynamics, Applied Thermodynamics.

Course Objectives: The objectives of this course are to:

1. Understand the fundamental principles and concepts of refrigeration and air-conditioning systems.
2. Develop an understanding of different refrigeration cycles and their performance characteristics.
3. Familiarize with various refrigeration components, equipment, and control systems.
4. Apply psychrometric principles to analyze air-conditioning processes for human comfort and industrial applications.
5. Enable to perform basic load estimation and design considerations for air-conditioning systems.

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

CO1: Explain the basic components and principles associated with refrigeration and air-conditioning systems.
CO2: Apply psychrometric principles to study the performance of various air-conditioning processes.
CO3: Evaluate the performance of various refrigeration cycles such as vapour compression, air, and vapour absorption systems.
CO4: Evaluate the performance cooling and heating loads considering ventilation, infiltration, and comfort conditions.

Module 1: Introduction — **2 hours**

- Introduction: Concepts of Refrigeration and Air-conditioning. Unit of refrigeration, Refrigerants– Desirable Properties, Nomenclature

Module 2: Vapour Compression Cycle — **6 hours**

- Simple Vapour Compression Refrigeration System(Simple VCRS): Vapour compression cycle on ph and T-s diagrams. Cycles with subcooling and superheating, their effects; Effect of changes in evaporator pressure and condenser pressure on the performance of a simple VCRS; dry compression and wet compression of refrigerant; actual Vapour Compression Cycle

Module 3: Air Refrigeration Cycle — **12 hours**

- Air Refrigeration System (ARS): Bell-Coleman refrigerator. COP determination, actual air-refrigeration cycle.

Module 4: Vapour Absorption Cycle — **4 hours**

- Vapour Absorption Refrigeration System (VARS): Advantages of VARS over VCRS. Working principle of simple VARS, practical VARS. Limitations of VARS, maximum COP of a VARS, Lithiumbromide-water System; Aqua-ammonia systems.

Module 5: Equipment and Control — **2 hours**

- Major Refrigeration Equipment - Compressors: Types; reciprocating, rotary & centrifugal, volumetric efficiency, Condensers: types used in refrigeration systems; Evaporators: expansion devices: capillary tubes and thermostatic expansion valves.

Module 6: Psychrometry	**10 hours**
• Basic definitions and principles related to Psychrometry ; Psychrometric Charts & Their Uses; Heating, Cooling, Heating & Humidification & Cooling & Dehumidification processes. Adiabatic Saturation, Cooling Coils, By-pass Factor. • Sensible Heat Factors. Heat Load estimation: Simple cases of Cooling and Dehumidification.	
Module 7: Load Estimation	**4 hours**
• Ventilation – Definition & Requirement, Natural & Mechanical Ventilation, Ventilation, Infiltration and Load Calculation	
Total Lecture hours	**45 hours**

Text Book(s)	
1.	C.P. Arora, Refrigeration and Air Conditioning, Tata McGraw Hill
2.	Arora, S.C. & Domkundwar, S., A Course in Refrigeration and Air Conditioning, Dhanpat Rai & Sons.
Reference Book (s)	
1.	P.L. Ballaney, Refrigeration and Air Conditioning, Khanna Publishers
2.	R.C.Arora, Refrigeration and Air Conditioning, Tata McGraw Hill.
3.	Stocker & Jones, Refrigeration and Air Conditioning, McGraw Hill.

BME23417T	ADDITIVE MANUFACTURING	L	T	P	C
		3	0	0	3

Pre-requisite: None

Course Objectives: The objectives of this course are to:

1. Introduce students to the fundamentals, processes, and materials used in Additive Manufacturing.
2. Develop the ability to design and evaluate components specifically for AM.
3. Expose students to industrial applications, economic aspects, and future trends in AM.

Course Outcomes: On completion of this course, students will be able to

CO1: Describe the principles, classifications, and working mechanisms of major AM processes.

CO2: Select appropriate materials and apply design rules for AM-based component development.

CO3: Analyze industrial applications, cost factors, and future trends in AM technologies.

Module 1: Introduction to Additive Manufacturing	**4 hours**

History and evolution of AM; Comparison with subtractive and formative manufacturing; AM process workflow (CAD → STL → Slicing → Printing → Post-processing); Classification of AM processes (ISO/ASTM standards).

Module 2: Additive Manufacturing Processes and Technologies	**4 hours**

Vat Photopolymerization (SLA, DLP); Material Extrusion (FDM/FFF); Powder Bed Fusion (SLS, SLM, EBM); Material Jetting, Binder Jetting; Directed Energy Deposition; Sheet Lamination; Hybrid manufacturing.

Module 3: Materials in Additive Manufacturing	**4 hours**

Polymers, composites, elastomers; Metals and alloys (Ti, Al, Ni, steels); Ceramics and biomaterials; Smart and functional materials; Challenges in AM material processing.

Module 4: Design for Additive Manufacturing (DfAM)	**17 hours**

CAD considerations for AM; Design rules (overhangs, supports, wall thickness, infill); Lattice structures and topology optimization; Generative design; Case studies on design-driven innovation.

Module 5: Post-Processing, Testing, and Applications	**16 hours**

Support removal, surface finishing, and heat treatment; Mechanical testing and quality assurance; Accuracy, tolerances, and standards; Applications in aerospace, automotive, biomedical, tooling, and consumer goods; Economics, sustainability, and emerging trends (4D printing, bioprinting, large-scale AM, multi-material printing).

Total Lecture hours	**45 hours**

Text book (s)

1. Gibson, I., Rosen, D., & Stucker, B. (2015). Additive Manufacturing Technologies. Springer.
2. Chua, C.K., & Leong, K.F. (2017). 3D Printing and Additive Manufacturing: Principles and Applications. World Scientific.
3. Gebhardt, A. (2018). Understanding Additive Manufacturing. Hanser Publishers.

Reference book (s)

1. Gu, D. (2015). Laser Additive Manufacturing: Materials, Design, Technologies, and Applications. Woodhead Publishing.
2. Frazier, W.E. (2014). "Metal Additive Manufacturing: A Review," Journal of Materials Engineering and Performance, ASM International.

	ELECTRIC VEHICLE POWERTRAIN: DRIVES & CONTROL	L	T	P	C
		3	0	0	3

Pre-requisite:

Course Objectives: The objectives of this course are:

1. To study the architecture and components of EV powertrains.
2. To understand the principles and characteristics of EV motors and their selection criteria.
3. To explore power electronics and control systems used in EV motor drives.
4. To analyze thermal management challenges and advanced techniques in EV powertrains.

Course Outcome: After successful completion of this course, the students will be able to

CO1: Explain the architecture and components of EV and HEV powertrains.

CO2: Analyze the motion profiles, motor selection criteria, and performance trade-offs for EV applications.

CO3: Design and control power electronic circuits for motor drives and charging systems in EVs.

CO4: Apply advanced techniques for motor control and thermal management to enhance EV performance.

Module 1: Overview of EV Powertrains — **8 hours**

Architecture of EV powertrains, Comparison of powertrain topologies. Components of Power Train: Components of conventional vehicle and propulsion load; power train of HEV and EV; efficiency considerations for conventional vehicle, HEV and EV; multi-motor in-wheel EVs; impact and benefits of EV on utility grid.

Module 2: EV Motors and Characteristics — **10 hours**

Requirement of EV motors; Review of motor principles, Motor load dynamics; Specifications of motors, Motor selection criteria for EV applications: Characteristic Curves of motors; Motion profile: acceleration, steady operation and deceleration profiles; Starting, braking, speed and torque control of motors; Constant-Torque Mode, Constant-Power Mode; Efficiency Map; Design variables of motors (introduction); Classification properties of PM material, Alnico, Ferrites, Rare-Earth PMs.

Module 3: Power Electronics in EVs — **10 hours**

Overview of inverters, converters, and rectifiers, PWM techniques and control of motor drives, Thermal management of power electronics. On-board Chargers: Review of semiconductor devices; turn-on and turn-off characteristics; loss computation in semiconductor devices; basics of nonisolated/isolated DC-DC and grid connected converters; classification of EV chargers; modelling and control of bi-directional DC-DC converters; discussions on V2X applications.

Module 4: Motor Drives and Control Systems — **12 hours**

Introduction to motor drives in electric vehicles, concept of motor drives and comparison of direct-drive and geared-drive systems, control of Induction Motor Drives (IMD) including vector control and direct torque control, control of Permanent Magnet Synchronous Motors (PMSM) with field-oriented control (FOC) and torque and speed control, control of Switched Reluctance Motors (SRM) covering current control and torque ripple minimization, drive configurations in EVs including front-wheel, rear-wheel, and all-wheel drive systems with performance trade-offs, principles and integration of regenerative braking with motor drives and its role in energy recovery and improving range, advanced motor control techniques such as sensorless control methods and adaptive control, application of machine learning in motor drives, and case studies featuring motor drives used in popular EVs like Tesla and Nissan Leaf.

Module 5: Thermal Management and Advanced Topics in EV Powertrains — **5 hours**

Introduction to the importance of thermal management in EV powertrains, discussing heat generation in electric motors and power electronics and the need for effective cooling techniques such as air cooling, liquid cooling, and phase change materials, etc.

Total Lecture hours — **45 hours**

Text/Reference Book(s)

1 | Electric Vehicle Technology Explained by James Larminie and John Lowry.(Publisher: Wiley)

2	Thermal Management of Electric Vehicle Battery Systems by Ibrahim Dincer, Halil S. Hamut, Nader Javani. (Publisher: Wiley)